PROJECT MANUAL

CANADIAN MUSEUM OF IMMIGRATION AT PIER 21 – EXPANSION

Halifax, Nova Scotia
Project #: 13-005
July 2014

ARCHITECTURAL SPECIFICATIONS

MECHANICAL SPECIFICATIONS

ELECTRICAL SPECFICATIONS

ARCHITECTURAL SCHEUDLES
-Room Finish Schedule

APPENDIX

ISSUED FOR TENDER
JULY 11, 2014

CONTACT;
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INTRODUCTORY INFORMATION

25 00 00 - INTEGRATED AUTOMATION

26 00 00 - ELECTRICAL

END

1. GENERAL

.1 Cash allowances are designated for additional work and services deemed to be necessary by Owner, from time to time, throughout the execution of the Work. Where a cash allowance refers to an item or category of work already included in Contract Documents, it shall be assumed to cover work or services in addition to that indicated, unless specifically indicated otherwise.

.2 Contractor may be required from time to time to assist in tendering of certain items of work covered by allowance, as directed by Consultant.

2. AUTHORIZATION

.1 Expenditures from allowances included in the Contract must be authorized in writing by the Consultant.

.2 Work covered by allowances shall be performed for such amounts and by such persons as directed by the Consultant.

3. CASH ALLOWANCES

.1 Cash allowances include supply and installation unless specifically indicated otherwise.

.2 Supply only allowances shall include:

.1 Net cost of products
.2 Delivery to site
.3 Applicable taxes and duties (excluding VAT)

.3 Supply and install allowances shall include:

.1 Net cost of products
.2 Delivery to site
.3 Unloading, storing, handling of products on site
.4 Installation, finishing and commissioning of products
.5 Applicable taxes and duties (excluding VAT)

.4 Inspection and testing allowances shall include:

.1 Net costs of inspection / testing services
.2 Applicable taxes (excluding VAT)

.5 Other costs related to work covered by cash allowances are not covered by the allowance but shall be included separately in Contract.

.6 Include the following cash allowances in the Contract:

.1 Miscellaneous additional hardware (supply only) $3000.00

4. CONTINGENCY ALLOWANCE

.1 Include in the Contract a contingency allowance in the amount of 1,640,000.00 (one million six hundred forty thousand dollars) for Phase 2 work. Phase 2 work to be further defined and reviewed by both CMIP/MCIQ and the Contractor prior to Phase 2 start of construction. If the Owner and the contractor cannot come to an agreement on the value of the work identified in Phase 2 the Owner reserves the right to remove the value of the contingency allowance from the Contract and utilize those funds to proceed to an open tender/RFP for the Phase 2 work.

END

1. PRE-CONSTRUCTION MEETING

.1 Immediately prior to construction, upon notification attend at location of Owner's choice, pre--construction meeting, along with authoritative representatives of certain key subcontractors as specifically indicated in the conference notice.

.2 Purpose of meeting is as follows:

.1 Review project communications procedures.

.2 Review contract administration requirements including submittals, payment and change order procedures.

.3 Identify all critical points on construction schedule for positive action.

.4 Identify any product availability problems and substitution requests.

.5 Establish site arrangements and temporary facilities.

.6 Review Consultant’s inspection requirements.

.7 Review any points which, in Owner's, Consultant's and Contractor’s opinion, require clarification.

.3 The Consultant shall organize and chair the pre-construction meeting. Consultant shall record minutes of pre-construction meeting and distribute a copy to each participant within ten days of meeting.

2. SITE MEETINGS

.1 Prior to the commencement of the Work, the Contractor together with the Consultant shall mutually agree to a sequence for holding regular site meetings every 2 weeks.

.2 Organize and chair site meetings. Ensure that persons, whose presence is required, are present and that relative information is available to allow meetings to be conducted efficiently.

.3 Once a month or more often if directed by Consultant include review with Consultant and Owner of construction schedule and application for progress payment, during or immediately following site meeting.

.4 Record minutes of each meeting and promptly distribute copies to be received by all participants not later than seven days after meeting has been held. Distribute minutes of meetings to all Consultants, whether in attendance or not.

3. SUPERVISION

.1 Employ an experienced and qualified supervisor who shall be in complete charge of the Work from commencement to final completion of the Work and who shall be present at the site whenever work is being carried out. A working foreperson will not be acceptable. The supervisor shall not be changed after commencement of work without the Consultant's approval.

.2 Supervise, direct, manage and control the work of all forces carrying out the Work, including subcontractors and suppliers. Carry out daily inspections to ensure compliance with the Contract Documents and the maintenance of quality standards. Ensure that the supervisory staff includes personnel competent in supervising all Sections of Work required.

.3 Arrange for sufficient number of qualified assistants to the supervisor as required for the proper and efficient execution of the Work.

4. DOCUMENTS ON SITE

.1 Contractor's field office shall at all times contain a complete set of Contract Documents (Drawings and Specifications) with all addenda, site instructions, change orders, reviewed shop drawings and samples, colour schedule, paint materials schedules, hardware list, progress reports and meeting minutes.

5. INTERFERENCE AND COORDINATION DRAWINGS

.1 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the spaces provided.

.2 Prepare drawings to indicate coordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus, location of fixtures and connections are coordinated.

.3 Ensure that clearances required by jurisdictional authorities and clearances for proper maintenance are indicated on drawings.

.4 Within 4 weeks of contract award submit interference drawings to Consultant for review. Do not proceed with the work until interference drawings have been reviewed and approved by Owner and Consultant.

6. SLEEVING AND INSERT SETTING DRAWINGS

.1 Prepare sleeving drawings for work of Division 15 and 16, showing size and location of all penetrations through load bearing elements. Submit sleeving drawings to Consultant for review not less than 15 days prior to construction of affected elements.

.2 Prepare insert setting drawings for work to be cast into concrete and / or mortared into masonry elements. Submit insert setting drawings to Consultant for review not less than 15 days prior to construction of affected elements.

END

1. CONSTRUCTION SCHEDULE

.1 Comply with any additional requirements included in the RFP.

.2 Within 14 days of Contract award, submit in format acceptable to Consultant, minimum 3 copies of Contractor's critical path construction schedule using suitable computer scheduling software such as “MS Project” or “Primavera”.

.3 Schedule proposed by the Contractor shall be based on the following assumptions:

.1 Critical path base line is considered as reasonable and achievable.

.2 Schedule is based on resources which have been committed for this project and will be readily available when needed.

.3 Schedule is based on normal range of weather conditions, as documented by official weather records.

.4 Set up format to permit plotting of actual construction progress against scheduled progress.

.5 Schedule shall show:

.1 Commencement and completion dates of Contract.

.2 Commencement and completion dates of construction stages/phases, if any.

.3 Commencement and completion dates of each trade. Major trades shall be further broken down as directed by Consultant; generally follow Specification format.

.4 Order and delivery dates for major or critical equipment.

.5 Critical dates for shop drawing/sample submissions.

.6 Any other information relating to orderly progress of Contract, considered by Contractor or Consultant to be pertinent.

.6 Consultant, together with Contractor shall review construction progress once a month during or immediately following regular site meeting, or more often as directed by Consultant.

.7 Update construction schedule, whenever changes occur, in manner and at times acceptable to Consultant.

.8 Plot actual construction progress or schedule at least once a week.

.9 Submit copy of updated schedule to Consultant once a month, concurrently with application for payment.

2. CASH FLOW CHART

.1 Comply with requirements of the RFP.

.2 Within 14 days after award of Contract, submit, in form approved by Consultant, cash flow chart broken down on a monthly basis in an approved manner. Cash flow chart shall indicate anticipated Contractor’s monthly progress billings from commencement of work until completion.

.3 Update cash flow chart whenever changes occur to scheduling and in manner and at times satisfactory to Consultant.

.4 Cash flow and progress billings to follow the Schedule of Values given below:

Canadian Museum of Immigration at Pier 21

Schedule of Values

General Conditions (GC)

- Insurance
- Bonding
- On Site Requirements / Mobilization
- Site Super
- General Labour
- Training
- Security
- Demolition
- Shop Drawings
- Equipment/System Start-up, Testing, Performance Verification & Commissioning
- Fire Stopping
- Fire Watch (Roof, welding, etc)
- Project Close-out Documentation
  - Operatioins and Maintenance Manuals
  - As-built Drawings
  - Warranty Letters

Site Works

- Fencing

Concrete

- Concrete Supply
- Concrete Finishing

Masonry

- Concrete Masonry Units

Metals

- Structural Steel
- Steel Studs
- Miscellaneous Metals

Carpentry / Millwork

- Rough Carpentry
- Millwork

Roofing Waterproofing

- Roofing

Doors

- Metal Doors and Frames
- Wood Doors
- Specialty Doors (sliders, chair closet doors)
- Hardware

Interior Finishes

- Drywall
- Plywood
- Acousitic Wood Panels
- Acoustic Fabric Panels
- Tectum
- Paints
- Ceramic Tile
- Insulation
- Accoustic Sound Bats
- Altro Flooring
- Kitchen Wall Panels
- Rubber Base

Miscellaneous

- Lighting Grid
- Black-out Blinds
- Stage Curtains
- Stage Lighting Trusses

Washoom Accessories

- Toilet partitions
- Misc (mirrors, soap dispensers, garbage containers)

Mechanical

General

Bonding

Insurance

Mobilization and Office Administration

Shop Drawings

Fire Stopping

Training

Equipment/System Start-up, Testing, Performance Verification & Commissioning

Project Close-out Documentation

Operatioins and Maintenance Manuals

As-built Drawings

Warranty Letters

Plumbing

-Piping, Fittings and Valves (Materials)

-Piping, Fittings and Valves (Labour)

-Plumbing Fixtures & Trim (Materials)

-Plumbing Fixtures & Trim (Labour)

-Plumbing Specialties (Materials)

-Plumbing Specialties Labour

-Insulation (Materials and Labour)

HVAC

-Piping, Fittings and Valves (Materials)

-Piping, Fittings and Valves (Labour)

-Insulation - Piping (Materials and Labour)

-Insulation - Ductwork (Materials and Labour)

-Insulation - Equipment (Materials and Labour)

-Boiler

-Air-Cooled Chiller

-Air-Cooled Condenser Unit (serving AHU-12)

-AHU's

-Split A/C Systems

-Ductwork (Materials)

-Ductwork (Labour)

-Silencers

-Louvers and Louvered Penthouses

-VAV Terminal Units

-Humidifiers

-HUH's, FF's and Radiation

-Hydronic Specialties incl. Pumps, Heat Exchangers and Expansion Tanks

Controls

-Mobilization, Office Administration

-Materials

-Labour (including programming)

TAB

-Mobilization, Office Administration

-Water Balancing

-Air Balancing

Electrical

General

Bonding

Insurance

Mobilization and Office Administration

Shop Drawings

Fire Stopping

Training

Equipment/System Start-up, Testing, Performance Verification & Commissioning

Project Close-out Documentation

- Operatioins and Maintenance Manuals
- As-built Drawings
- Warranty Letters

Mobilization

Temporary Power

Lighting (general)

- Fixture Supply
- Fixture Instalation

Lighting (specialized - stage)

- Fixture Supply
- fixture Instalation

HV Switch Gear

Distribution Equipment

Distribution Installation

Conduits

Wiring

Fire Alarm Rough-In and Installation

HV Cabling

HV Cabling Installation

Devices Rough-In

Devices Installation

Mechanical Connections

Tel / Data Rough-In

Secuirty Rough-In

- Access Control
- Intrusion Alarm
- CCTV

Communication Cabling

3. PROGRESS RECORD

.1 Maintain on site, permanent written record of progress of work. Record shall be open to inspection by Consultant at all times and copy shall be furnished to Consultant upon request.

.2 This record shall show weather conditions, dates of commencement, progress and completion of various trades and items of work. Particulars pertaining to erection and removal of forms, pouring of concrete, installation of roofing and other critical or major components as well as number of employees of various trades and type and quantity of equipment employed daily, shall be noted.

.3 Display a copy of the construction schedule in the site office from start of construction to completion. Superimpose actual progress of work on schedule at least once each week.

4. AS-BUILT DRAWINGS

.1 Obtain and keep on site at all times a complete and separate set of black line white prints.

.2 Note clearly, neatly, accurately and promptly as the work progresses all architectural, structural mechanical and electrical changes, revisions and additions to the work and deviations from the Contract Documents.

.3 Accurate location, depth, position, size and type of concealed and underground services, both inside and outside shall be included as part of these as-built drawings.

.4 As-built drawings shall be available for review at each site meeting.

.5 Refer to Section 017719 for requirements on submission of as-built drawings.

5. PRODUCT DELIVERY CONTROL

.1 It is the responsibility of the Contractor to ensure that the supplier or distributor of materials specified or alternatives accepted, which he intends to use, has materials on the site when required. The Contractor shall obtain confirmed delivery dates from the supplier.

.2 Provide equipment delivery schedule, coordinated with construction and submittals' schedule, showing delivery dates for major and/or critical equipment.

.3 The Contractor shall contact the Consultant immediately upon receipt of information indicating that

any material or item, will not be available on time, in accordance with the original schedule, and similarly it shall be the responsibility of all subcontractors and suppliers to so inform the Contractor.

.4 The Consultant reserves the right to receive from the Contractor at any time, upon request, copies of actual purchase or work orders of any material or products to be supplied for the work.

.5 If materials and products have not been placed on order, the Consultant may instruct such items to be placed on order, if direct communication in writing from the manufacturer or prime suppliers is not available indicating that delivery of said material will be made in sufficient time for the orderly completion of the Work.

.6 The Consultant's review of purchase orders or other related documentation shall in no way release the Contractor, or his subcontractors and suppliers from their responsibility for ensuring the timely ordering of all materials and items required, including the necessary expediting, to complete the work as scheduled in accordance with the Contract Documents.

END

1. GENERAL

.1 Unless specified or directed otherwise, make all submissions to the Consultant at his office.

.2 Make all submissions required by the Contract Documents with reasonable promptness and in orderly sequence so as to cause no delay in the work.

2. RELATED REQUIREMENTS

.1 Make the following submissions in accordance with requirements specified elsewhere:

.1	Applications for payment:	Contract Conditions
.2	Insurance certificates:	Contract Conditions
.3	Bonds:	Contract Conditions
.4	Interference drawings:	Section 01310
.5	Sleeving and insert drawings:	Section 01310
.6	Construction schedule:	Section 01320
.7	Cash flow chart:	Section 01320
.8	Equipment delivery schedule:	Section 01320
.9	Purchase order documentation:	Section 01320
.10	Waste audit and reduction plans:	Section 01410
.11	Maintenance and operations data:	Section 01770
.12	As built drawings:	Section 01770
.13	Maintenance materials:	Section 01770

3. SCHEDULE OF SUBMITTALS

.1 Within 15 days of submission of construction schedule submit a schedule of submittals for shop drawings, samples, lists of materials and other documentation requiring Consultant's review.

.2 For each item requiring submission and review show anticipated date of submission and critical date for return of reviewed submission.

.3 Design sequence of submissions to reflect requirements of construction schedule.

.4 Allow up to 15 days for Consultant's review for each submission. Stagger submissions as much as possible to permit adequate review time for each item submitted. If several submissions are made at the same time or within a short time of each other, indicate order of priority in which submissions should be reviewed.

.5 Include sufficient time to permit corrections and resubmission, if necessary, without affecting construction schedule.

4. SHOP DRAWINGS

.1 Submit shop drawings required by Contract Documents.

.2 Unless otherwise directed by the Consultant, submit a digital file or the following number of prints for each shop drawing required:

.1 Architectural shop drawings: 3 prints

.2 Structural, mechanical, electrical shop drawings: 4 prints

.3 After review Consultant will return digital file or one print to the Contractor. Contractor shall obtain and distribute the necessary number of copies for each shop drawing.

.4 Shop drawings requiring seal and signature of a professional engineer, but submitted without it, will be returned “Not Reviewed”.

.5 Shop drawings which require the approval of a legally constituted authority having jurisdiction shall be submitted by Contractor to such authority for approval. Such shop drawings shall receive final approval of authority having jurisdiction before Consultant's final review.

.6 No work requiring a shop drawing submission shall be commenced until the submission has received Consultant's final review. Do not use any shop drawing, erection drawing or setting drawing which does not bear the stamp and signature of the Consultant.

.7 The Consultant's review is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and this review shall not relieve the Contractor of his responsibility for meeting the requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all subtrades.

.8 Allow five (5) business days for the Consultant’s review of each submission.

5. SAMPLES

.1 Submit samples required by Contract Documents and as directed by the Consultant.

.2 Unless indicated otherwise submit samples in duplicate.

.3 Where colour selection is required submit manufacturer's full colour range for specified product line.

.4 Submit samples with identifying labels bearing material or component description, manufacturer’s name and brand name, Contractor's name, project name, location in which material or component is to be used, and date.

.5 Prepay any shipping charges involved for delivering samples to destination point and returning to point of origin if required.

.6 No work requiring a sample submission shall be commenced until the submission has received Consultant's final review.

END

1. OPERATIONAL LIMITATIONS

.1 Contractor's access to and use of site is limited to areas indicated.

.2 At all times restrict access, parking, material deliveries, execution of work, operations and procedures to assigned locations and times and do not deviate from agreed procedures without prior approval by Consultant.

.3 Periodically review proposed construction operations with the Owner and Consultant and co-operate as required to ensure that the Owner's interests and requirements are not unduly compromised.

.4 Do not execute work adjacent and/or above unassigned areas except where it can be demonstrated that adequate protective devices are in place.

.5 Separate work and storage areas from unassigned areas in accordance with requirements specified in Section 01500 and 013513 and as indicated below. Where work is executed in stages, rearrange hoardings as required to suit each phase.

.1 Exterior locations: chain link or wire mesh fence.

.2 Interior location: fire rated, sound and dustproof partition.

.6 Take special care when operating delivery and construction vehicles near and on site; reduce speed and provide flag persons at points where construction traffic crosses public access routes.

.7 Prevent spread of dust and noxious fumes, odours to occupied areas.

.8 Workers are not permitted inside unassigned buildng areas except by prior arrangement with the approval of the Owner.

.9 Where work is permitted to be carried out within unassigned spaces take the following action upon completion of each authorized work period:

.1 Restore disturbed surfaces by patching, covering, painting, finishing as directed by Consultant.

.2 Remove construction materials, equipment and tools.

2. SCHEDULE / PHASING

.1 Meet scheduling and phasing requirements stated in the “Request for Proposal for General Contracting Services” (RFP) and Division 013513.

3. ALTERATIONS, MATERIALS AND WORKMANSHIP

.1 Cut, alter, relocate, modify existing work as required to accommodate new work.

.2 Materials used in patching, making good and refinishing of existing construction and/or components shall be of a standard equal to that specified for new construction and if not specified, equal to or exceeding that of original existing work.

.3 Quality of workmanship employed in alterations work shall be equal to that specified for new work if not specified, equal to or exceeding original existing work.

.4 Existing materials and equipment which are to be used in new work shall be repaired and refinished as necessary or additional new materials and components required shall be provided to facilitate reinstallation of such existing materials and equipment.

.5 As part of the work of this Section, remove and relocate, or temporarily remove and reinstall, existing materials and equipment as required to complete work of the Contract.

.6 Make good by restoring to original condition, existing construction, equipment, materials, finishes, features, not scheduled for alterations but damaged or disturbed due to work of this Contract.

.7 Prepare existing surfaces scheduled to receive new finish by grinding, filling, overcoating, washing, etching, shot blasting or other chemical or mechanical means, as required to ensure satisfactory installation of new finish.

.8 Unless otherwise detailed finish new surfaces flush with existing surfaces. Make junctions between existing and new work, or at replaced or remedial work visually undetectable. Make surfaces adjacent to one another of the same material, unit sizes, colour, and texture. If this is impossible, make a proposal of intended method of making good for approval, before proceeding.

.9 Where existing work, penetrating floors and/or roofs, has been removed, patch floors and/or ceilings to match existing construction.

4. CUTTING NEW OPENINGS

.1 Prior to cutting any new openings into/through existing reinforced concrete elements, conduct radar survey, or other type of non-destructive survey, of areas to be cut, to locate presence of reinforcing steel, conduits and other embedded items. Make adjustment in locations to be cut, to avoid embedded items. Surveys employing X-ray technique may only be carried out when building is unoccupied.

.2 Submit proposal to cut new openings to Owner and Consultant for review and approval prior to making any cuts.

5. EXISTING SERVICES

.1 Ensure that existing services (including but not limited to hot and cold water, drainage, power, heating, ventilation, cooling, life safety and security systems) required for unassigned areas are not damaged or interrupted. Reconfigure, relocate, extend, modify existing services as required, to maintain services.

.2 Should existing services be accidentally disrupted, make complete restoration immediately and ensure adequate protection to avoid future disruption.

.3 Give Owner minimum 72 hours notice for required disruption of services to unassigned areas and obtain permission to proceed. Schedule disruptions as directed by Owner.

6. DESIGNATED SUBSTANCES

.1 Designated substances (as defined by applicable legislation), except those identified by the Owner prior to submission of bids are not known to exist in Contractor's work area. Refer to requirements in Section 013513 and Appendix "Hazardous Materials Abatement".

.2 If, in the execution of the Work, any designated substances or PCB containing materials other than those previously identified, are encountered, cease work in area affected and inform Consultant immediately. Do not proceed with work in areas affected until receiving instructions from Consultant.

7. PROTECTION

.1 Keep area of work safe and secure at all times, denying access to unauthorized personnel.

.2 Protect existing work from damage. Make good any damage caused.

.3 Ensure that no part of the existing structure is overloaded due to work executed under this Contract.

.4 Take special measures when moving heavy loads or equipment. Protect floors, jambs and soffits of openings used as passageways or through which materials are moved. Use rubber tired conveyances only when moving materials and equipment inside building. Provide suitable coverings as required to protect existing work.

.5 Provide adequate guards, barricades and other temporary protection to prevent injury to persons.

.6 Protect existing building interiors from damage by weather, when executing work which affects integrity of exterior walls and roof. Schedule activities during dry periods and/or provide temporary weatherproof closures to protect openings made in exterior walls and roof. At no cost to the Owner, replace interior finishes damaged by weather as a result of the Work of this Contract.

8. ADDITIONAL REQUIREMENTS

.1 Refer to Additional Project Special Requirements Division 013513.

END

1. ADDITIONAL REQUIREMENTS

1) Hours of Work

Work will be permitted seven days a week, 24 hours/day in Shed 22, if required, with security requirements managed and paid for by the Contractor. Work in the Annex or Shed 21 must be arranged with the CMIP Building Team. Security in the Annex or Shed 21 will be the responsibility of CMIP/MCIQ. The Contractor is expected to perform noisy work, and work in the spaces outside of Shed 22, outside of the events scheduled. There is a portion of the systems work that will connect the equipment components in the Annex to work in Shed 21 and Shed 22. That work will be connected through the pedway bridge, through the existing mechanical mezzanine, and into the new mechanical mezzanine in Shed 22 (New Welcome Pavilion and New KCR Hall). This work can only be done when there are no events occurring in the existing KCR Hall. The Contractor will be expected to verify when this work is to occur in their Project Schedule. An event schedule will be provide prior to Construction. Acceptable hours of work during event days are 10pm-6am, provided it is pre-authorized.

To be incorporated with the above:

Work Restrictions – this section is missing – should in include all restrictive work hours and dates (below). Along with standard language you would use.

Event Schedule

The following 2014 days are unavailable for Noisy Work:

- Any day after 430 pm (except approved night shift work)
- August Weekends
- August 7th and 25th
- September 3rd, 4th, 5th, 12th, 13th, 16th, 18th, 23rd, 25th
- October 2nd, 5th, 7th, 8th, 15th, 21st, 24th, 25th, 28th, 29th
- November 3rd (6 am - noon), 21st, 27th

The GC will have the ability to work 10pm-6am in September and October, provided it is pre-authorized, understanding there may still be some event activity late night and early morning

2) Noisy Work

Any work or services that can be heard in an adjacent space to the work including but not limited to hammers, loud voices (shouting), scraping and/or shifting of materials/equipment. Noisy work is not permitted during CMIP/MCIQ events in the existing KCR Hall and the Contractor must perform work outside of the existing event schedule. CMIP/MCIQ will make best efforts to notify the Contractor 48 hours in advance should additional events be scheduled. Permission must be obtained 48 hours in advance from the Project Manager if deviation from the specified schedule is required by the Contractor.

3) Systems Shut Down

The Contractor must plan systems shut downs around the event schedule and service hours of the Museum, subject to approval by CMIP/MCIQ. Due to the requirement to maintain regular operations during construction of the new KCR Hall, there must be minimal shut down of M&E systems during construction which could cause event or audience disruption if not managed properly.

4) Work Stoppage due to Special Events

Some work stoppages could be required due to VIP visits, exhibitions opening events, special events, etc. Should such stoppage be required, CMIP/MCIQ would provide as much notice as possible.

5) Site Office

The Contractor will be expected to have a Site Office located within the designated interior project site and laydown area.

6) Communications b/w CMIP/MCIQ and the Contractor

Site supervisor(s) is/are to have on site the necessary equipment required for constant communication and be able to supply and receive various electronic instructions from CMIP/MCIQ and/or its representatives (consultants). Contractor/ Site supervisor(s) is responsible for a (1) hour response time during work hours.

7) Emergency On-site Response

The Contractor must provide emergency number(s) for CMIP/MCIQ to be able to call for site related emergencies, during off-hours, weekends and holidays. The Contractor and/or site supervisor(s) must provide a response and the ability to mobilize a crew within (3) hours.

8) Site Security

The Contractor is to assess the risk of the designated exterior construction staging areas and determine first-hand what security measures will be required to safeguard the Contractor's equipment, tools and material. All such security related costs are the responsibility of the Contractor. Should it be determined that security personnel will be hired to patrol the site, all arrangements to hire security personnel would have to be done through the security firm Securitas since they have exclusive rights to security on CMIP/MCIQ property.

9) Construction Signage

The Contractor must submit plans or samples of construction signage to CMIP/MCIQ Project Manager for approval prior to fabrication and installation. All public signage must be either bilingual, or in the form of pictograms. Where bilingual text appears, English must appear first.

10) Construction Waste, Garbage and Washrooms

The Contractor must place construction waste, garbage and washrooms within the designated construction staging area; actual placement to be done in consultation with CMIP/MCIQ Project Manager, for approval by CMIP/MCIQ and HPA.

11) Staging Space and Laydown Areas

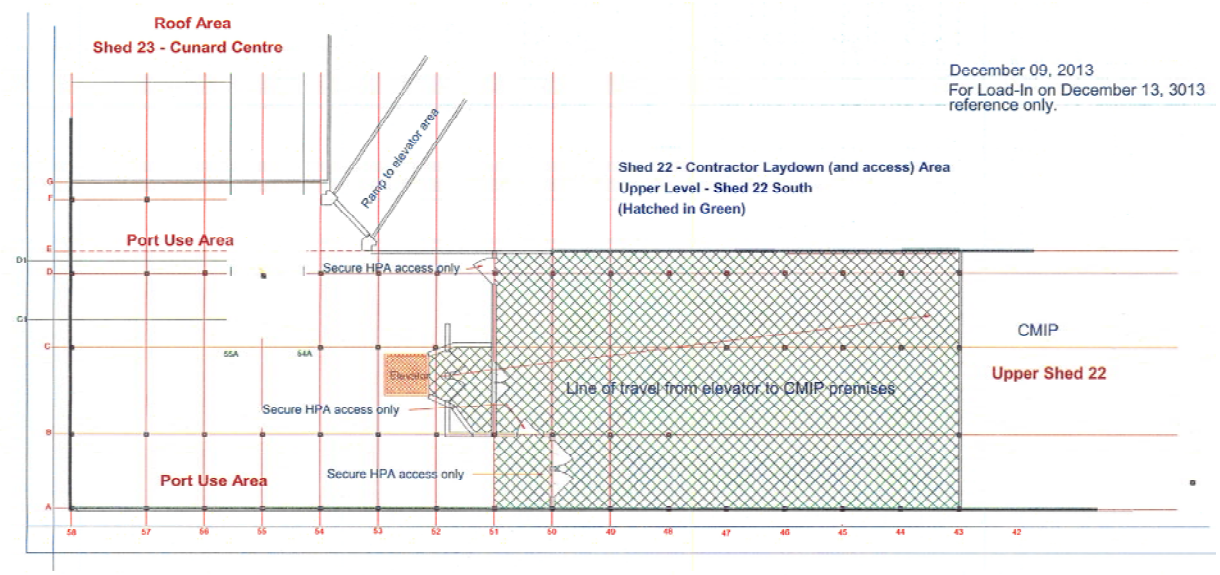
The Contractor is responsible to ensure that the staging space and any lay down areas are returned to pre-existing condition after the project has been turned over.

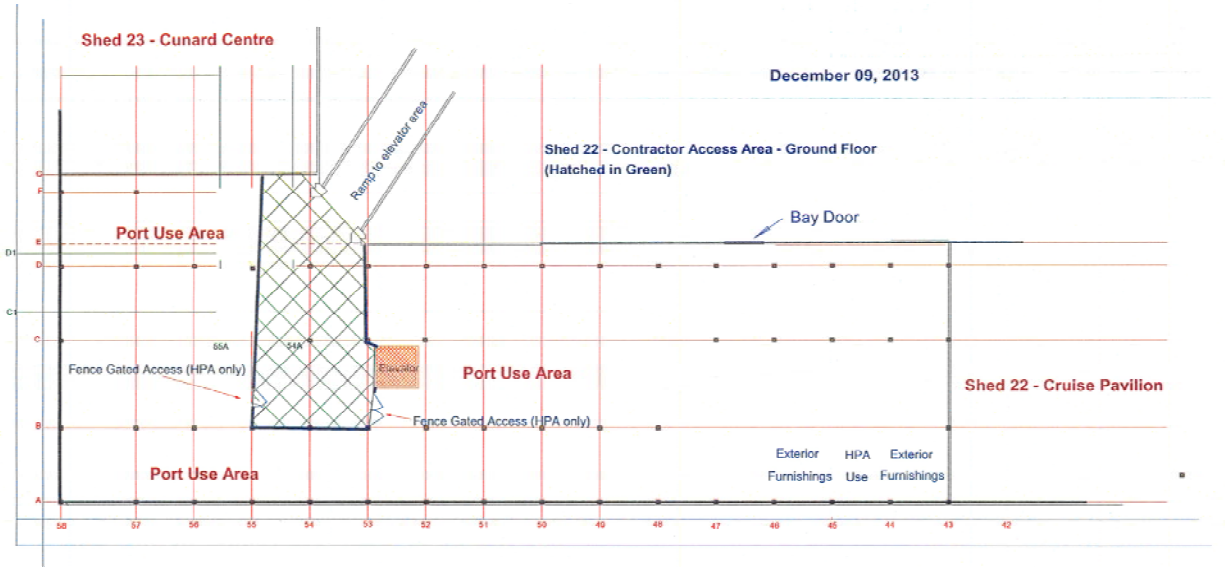
12) HPA Site Safety and Security Requirements

The Contractor will submit a Site Safety Plan, Fire Safety Plan, and Hazard Assessment Plan, in accordance with the Landlord's and CMIP/MCIQ requirements and submit those plans in advance of work on site commencing. HPA also requires that 24-hour fire watch be implemented during welding work. The Contractor will submit the Fire Safety Plan to the Fire Department prior to commencing construction.

13) Site Plan

The fencing has been put in place by Eastern Fence and reviewed and approved for use by HPA and Transport Canada. The Contractor is responsible for the cost of any damage to the fencing during the course of the work, and is responsible to contact Eastern Fence for repairs immediately upon identification of damage. There must be a formal incident report issued to the Project Manager, immediately upon identification of damage, so the Project Manager may notify HPA. HPA reserves the right to stop work should the security, provided by the fence, be compromised. Fencing plans are provided below:


Roof Area
Shed 23 - Cunard Centre
December 09, 2013
For Load-In on December 13, 3013
reference only.
Ramp to elevator area
Shed 22 - Contractor Laydown (and access) Area
Upper Level - Shed 22 South
(Hatched in Green)
Port Use Area
Secure HPA access only
CMIP
Upper Shed 22
Elevator
Line of travel from elevator to CMIP premises
Secure HPA access only
Port Use Area
Secure HPA access only


Shed 23 - Cunard Centre
December 09, 2013
Ramp to elevator area
Shed 22 - Contractor Access Area - Ground Floor
(Hatched in Green)
Bay Door
Port Use Area
Fence Gated Access (HPA only)
Elevator
Port Use Area
Shed 22 - Cruise Pavilion
Fence Gated Access (HPA only)
Exterior Furnishings
HPA Use
Exterior Furnishings
Port Use Area

14) Elevator Restrictions

The HPA Shed 22 elevator and the two external landside stairwells will be the sole access for vertical circulation to the second floor construction site. If the Contractor would like to propose an alternate access, it must be reviewed and approved by CMIP/MCIQ and HPA. The dimensions of the freight elevator are as follows:

DOOR
- Height: 84 inches
- Width: 53.75 inches

CAB
- Length: 102.5 inches
- Height: 107.5 inches
- Width: 72 inches

Note: The width of the elevator from handrail to handrail is 68 inches, not 72 inches.
CAPACITY
- The elevator load capacity is 5000lbs or 31 people maximum.

15) Incidents

The Contractor is required to provide same-day notification to the Project Manager, CMIP/MCIQ, and HPA of any incidents or damages to property defined as the worksite under the scope of this project.

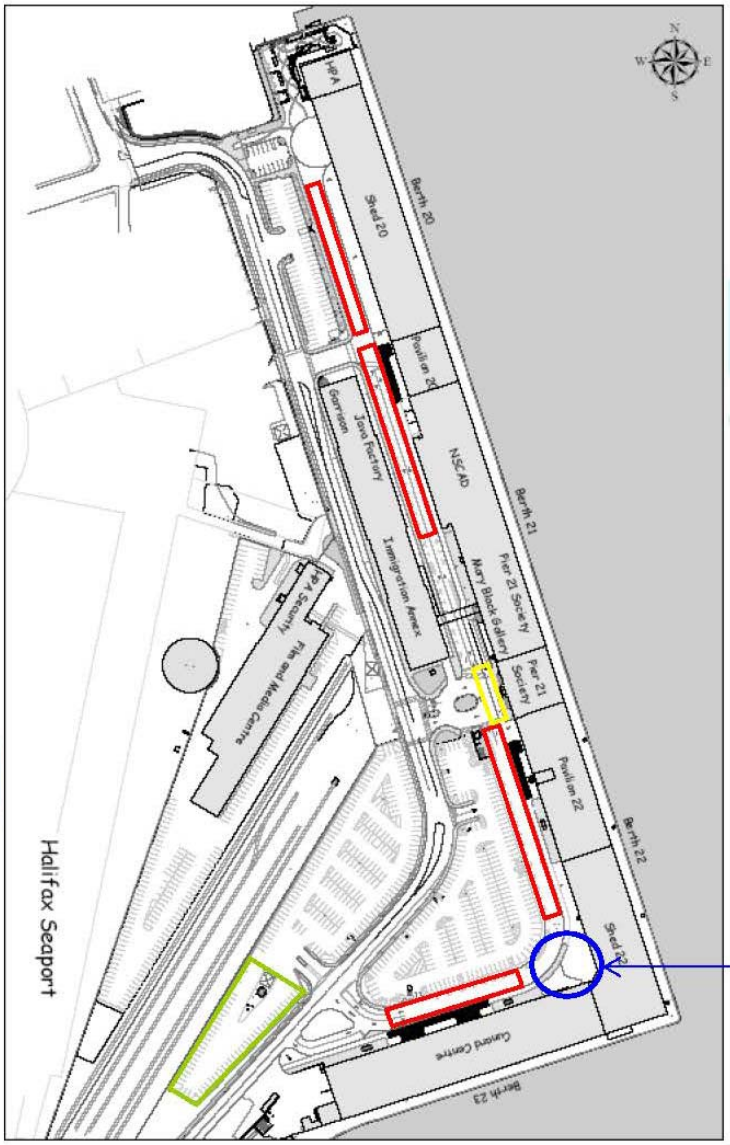
16) Delivery and Site Access Schedule

The Contractor will coordinate deliveries and access with the Landlord, HPA, as well as the protocol by which to execute that coordination. The Landlord reserves the right to take control of the site with one day's notice for unforeseen circumstances, such as emergency cruise vessel maintenance. The Landlord will also regularly use the same ramp as the Contractor to access Shed 22 for regular maintenance; hence, ramp activity must be coordinated. Regular cruise operations will have to be integrated into the Contractor's delivery schedule as there is reduced access to the property on cruise ship days. Receiving areas are shown in the diagram below. The Contractor will have to plan that delivery vehicles enter the Halifax Port Authority property immediately before and exit immediately after a delivery, so as not to block cruise ship pick up and drop off areas. The cruise ship schedule can be accessed on the Port of Halifax website, as per the link provided below. It is updated regularly and the Contractor is expected to remain updated on the schedule, as well as coordinate with Halifax Port Authority.

http://www.cruisehalifax.ca/our-visitors/index.html

Receiving Areas – Halifax Seaport

Areas outlined in red, yellow, and green are areas used for pick-up and drop-off of cruise ship passengers. These areas require free and clear access on cruise ship days. CMIP Expansion construction vehicles will still be permitted to drive through these areas to get in and out of the delivery area; however, construction vehicles that are queued for delivery would have to wait off-site for the loading bay to be clear.



CMIP Expansion delivery ramp, access to freight elevator

17) Loading Bay Capacity

The capacity of the loading bay that will be used by the Contractor to access the staging area and work site is outlined in documentation provided at the end of this section. The loading bay has a gravel ramp up to the secure area adjacent to the freight elevator; therefore a loading dock is not available. The Contractor will have to provide means to take materials/equipment off of their transport vehicles. A letter from Campbell Comeau Enginerring Limited describing Loading Bay Capacity is appended to the end of this section.

18) Power

Power will be fed from CMIP/MCIQ by the Contractor. Excessive power requirements should be fed from generators provided by the General Contractor. HPA has run empty conduit from CMIP/MCIQ's existing panel to the Shed 22 space for the Contractor to make the final connection for power source during construction.

19) Hazardous Materials

The Contractor will be responsible to keep chemicals and odors to a minimum while in or in close proximity to the Museum open hours and events scheduled. Area(s) for encapsulation of lead paint on overhead trusses to be completed in Phase 2. For minor work required in this area in Phase 1 (included herein), Contractor to review protocols for working in areas with lead paint outlined in Hazmat report provided in Division 2.

20) Hoarding

The Contractor will be responsible for hoarding on site to protect the existing CMIP/MCIQ and HPA premises from construction activity.

21) Lead Abatement

There has been extensive lead abatement work executed prior to this contract. There are some areas that were inaccessible at the time the work was executed and were left to be included with the current KCR Hall Phase 2 work - outside of the scope of this RFP. The areas for Phase 2 abatement include the structural steel above the stage in the existing KCR hall and the columns hidden within the walls of the existing KCR Hall, stage, and kitchen areas and the South Corridor on the landside of KCR Hall. For this phase (Phase 1) and work included in this RFP, the Contractor will be expected to follow safe work procedures should the Contractor need to work in those areas. All work must be in accordance with the Hazardous Materials Assessment in provided in the Appendix "Hazardous Materials Abatement".

22) Removal of Hazardous Light Bulbs

LVM/Maritime Testing Hazardous Materials Assessment has identified the risk that current light fixtures contain mercury and metal halides. Any removal of those fixtures must be in accordance with the standards for removal and disposal of hazardous materials. All work must be in accordance with the Hazardous Materials Assessment in Appendix "Hazardous Materials Abatement".

23) Sprinkler System

CMIP/MCIQ Insurer requires notification before any work on the sprinkler system occurs and once any work has finished. Any period of shutdown of the sprinkler system must be monitored by a 24 hour fire watch. The Contractor is responsible for all fire watch requirements for the site including additional security (if required). The Contractor is expected to show sprinkler work in their Project Schedule and where a fire watch is required. The Contractor will advise CMIP/MCIQ two (2) weeks in advance of needing the fire watch and confirm within 48 hours for CMIP/MCIQ to coordinate for any additional security that may be required for the occupied museum spaces and advise their insurer.

24) Provision of 'Clean Space'

In order to begin and complete the installation of exhibits and artifacts in the Museum, the GC must first provide a clean and secure space. The intent is to provide a discrete handover between the GC and Exhibit Design/Builder, the two contractors. In all spaces, a clean space is defined as a fully functional, completely commissioned, dust free environment. The GC and all sub-contractors are substantially complete (all mechanical, electrical, controls, fire protection, and lighting systems are installed and operating), and all known deficiencies have been completed, subject to approval by the Architect/Consultant. HVAC systems will have been in operation for at least 10 days and filters changed at least once. It is the responsibility of the Contractor to determine the time required to commission the building systems. At the clean space handover, the Exhibit Design/Builder will start utilizing the space to stage exhibit related materials (but not artifacts). It is expected that the HVAC and air pressure system will still be in the process of being balanced and commissioned.

25) Ceiling in Shed 22

HPA confirmed that the wood ceiling in Shed 22 was vacuumed but not washed. All the metal beams were sand blasted to remove Lead Paint and repainted. All metal beams are capable of being welded in Shed 22 North. The General Contractor will be responsible for washing the ceiling in the new space. The ceiling will need to be washed using controlled water cleaning, in a dusting and wet wipe fashion so that the excess water is controlled over the HPA space.

END

CAMPBELL COMEAU ENGINEERING LIMITED
• STRUCTURAL • CIVIL • MARINE •

112719 Gladstone Street
Suite 110
Halifax, NS B3K 4W6

t: 902.429.5454
cce@campbellcomeau.ns.ca

June 5, 2014

Ms. Alexis Cormier, B.Sc., B. Eng., LEED AP BD+C
Project Manager, Atlantic
MHPM Project Managers Inc.
1559 Brunswick Street, Suite 501
Halifax, NS B3J 2G1

Dear Ms. Cormier:

Re: ***Granular Access Ramp, Shed 22, Halifax Seaport***

We are pleased to provide this revised Letter of Opinion relative to the acceptable vehicle load carrying capabilities of the existing gravel access ramp located at the junction between Shed 21 and Shed 22 at the Halifax Seaport.

We visited the site on May 29 to view the ramp and overhead access doorway. It is clear that the gravel access ramp has been in service for some time and that the area is well travelled. It would appear that the area is well compacted although the type of fill material used to construct the ramp is not known.

We also note that the existing overhead door width is 16 ft with a vertical height of approximately 13 ft (which is less than the provincial highway standard). Therefore a restriction on vehicle height will be required and a cautionary sign should be installed.

There appears to be a ramp entrance throat width, from the terminal roadway, of approximately 30 ft tapering to the 16 ft wide doorway opening. (see photo next page).

Based on our observations, the conditions viewed during our visit, and based on the ramp as-is, we are of the opinion that the ramp would be suitable for the following truck loading:

- Single Steering axle weight: 6,500 kg
- Maximum tandem (Dual wheel): 9,100 kg/axle group for spread < 1.2 m
  18,000 kg/axle group for spread > 1.2 m

Additionally, as the material used to construct the existing ramp is not known, we recommend that the Spring Weight Regulations as well as the timeframe for these Regulations as issued by NSTIR be followed for vehicles accessing the ramp and this would generally restrict weights to the following:

- Single axle weight: 6,500 kg
- Maximum tandem (Dual wheel): 12,000 kg/axle grouping for spread > 1.2 m

- -

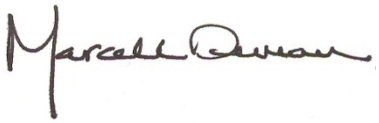
Please note that we did not assess manoeuvring space or other matters inside the shed.

- -

We trust that this is all that is required. Thank you.

Yours very truly,

CAMPBELL COMEAU ENGINEERING LIMITED



Marcel L. Deveau, P. Eng.

MLD/mpg
20414

1. PERMITS, LICENCES, FEES

.1 Where permits, licences and inspection fees are required by authorities having jurisdiction for specific trade functions, they shall be obtained by particular subtrade responsible for that work.

.2 Review building permit set with Consultant immediately following receipt of building permit and jointly determine whether or not changes to Contract are required.

.3 Be responsible for ensuring that no work is undertaken which is conditional on permits, approvals, reviews, licences, fees, until all applicable conditions are met. No time extension will be allowed for delay in obtaining necessary permits.

.4 Report to the Consultant in writing any condition which would prohibit granting of any permit or approval before work affecting such items is commenced.

.5 Give notice of completion of project prior to occupancy, as required by applicable legislation.

2. BUILDING CODE, BY-LAWS, REGULATIONS

.1 Carry out work in accordance with requirements of the National Building Code, latest issue, including all amendments and revisions.

.2 Comply with requirements, regulations and ordinances of other jurisdictional authorities.

.3 Where it is necessary to carry out work outside property lines, such as sidewalks, paving or concrete curbs, comply with applicable municipal requirements.

.4 Promptly submit written notice to Consultant, of observed variance of Contract Documents from requirements of Building Code and authorities having jurisdiction. Assume responsibility for work known to be contrary to such requirements and performed without notifying Consultant.

3. CONSTRUCTION SAFETY

.1 Be governed by pertinent safety requirements of Federal and Provincial Governments, the Halifax Port Authority and of municipal bodies having authority.

.2 Do not, in the performance of the work, in any manner endanger the safety or unlawfully interfere with the convenience of the public.

4. FIRE PROTECTION

.1 Refer to technical Sections of Specifications and Drawings for fire protection requirements.

.2 Comply with fire protection requirements of the Halifax Port Authority.

.3 Test methods used to determine fire hazard classification and fire endurance rating shall be as required by Building Code.

.4 Upon request, furnish Consultant with evidence of compliance with project fire protection requirements.

.5 Materials and components used to construct fire rated assemblies and materials requiring fire hazard classification shall be listed and labelled, or otherwise approved, by fire rating authority. Labelled materials and their packaging shall bear fire rating authorities label showing product classification.

.6 Fire rated door assemblies shall include doors, frame, anchors and hardware and shall bear label of fire rating authority showing opening classification and rating.

.7 Materials having a fire hazard classification shall be applied or installed in accordance with fire

rating authority's printed instructions.

.8 Fire rated assemblies shall be constructed in accordance with applicable fire test report information issued by fire rating authority. Deviation from fire test report will not be allowed.

.9 Construct fire separations as continuous, uninterrupted elements except for permitted openings. Extend fire rated walls and partitions from floor to underside of structural deck above.

.10 Fill and patch voids and gaps around openings and penetrations in and at perimeter of assemblies so as to maintain continuity and to produce a fire resistant smoke tight seal, acceptable to jurisdictional authorities and Consultant.

5. HAZARDOUS MATERIALS

.1 Comply with provisions of the governing authorities and with requirements included in RFP and Division 01 35 00 and Division 01 35 13, and Appendix "Hazardous Materials Abatement".

.2 Ensure that Material Safety Data Sheets (MSDS) are available on site prior to first delivery to site of any controlled material or substance.

.3 Maintain on site for duration of Contract a hazardous materials log containing all required MSDS.

.4 Log shall be open for inspection for Owner, Consultant and all personnel on site.

.5 Ensure that workers are instructed in the purpose and content of MSDS.

6. WASTE MANAGEMENT

.1 Comply with applicable regulations of the governing authorities.

.2 Prepare and submit waste audit and waste reduction plan in accordance with applicable requirements of jurisdictional authorities.

.3 Prepare and submit source separation plan in accordance with applicable requirements of jurisdictional authorities.

END

1. The abbreviations listed below, when used in the Contract Documents, shall have the meanings shown.

2. See Drawing Abbreviations and Room Finish Schedule for additional abbreviations.

ABBREVIATION	MEANING
AA	ALUMINUM ASSOCIATION
AAMA	ARCHITECTURAL ALUMINUM MANUFACTURERS` ASSOCIATION
AASHO	AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS
ACI	AMERICAN CONCRETE INSTITUTE
AGA	AMERICAN GAS ASSOCIATION
AIA	AMERICAN INSTITUTE OF ARCHITECTS
AIMA	ACOUSTICAL & INSULATING MATERIALS ASSOCIATION
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AISI	AMERICAN IRON AND STEEL INSTITUTE
AMCA	AIR MOVING AND CONDITIONING ASSOCIATION INC.
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
ASHRAE	AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIRCONDITIONING ENGINEERS
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWI	ARCHITECTURAL WOODWORK INSTITUTE (USA)
AWMAC	ARCHITECTURAL WOODWORK MANUFACTURERS ASSOCIATION OF CANADA
AWS	AMERICAN WELDING SOCIETY
CCA	CANADIAN CONSTRUCTION ASSOCIATION
CCRC	CANADIAN CODE FOR RESIDENTIAL CONSTRUCTION
CEC	CANADIAN ELECTRICAL CODE
CFUA	CANADIAN FIRE UNDERWRITERS ASSOCIATION
CGA	CANADIAN GAS ASSOCIATION
CGSB	CANADIAN GENERAL STANDARDS BOARD
CIQS	CANADIAN INSTITUTE OF QUANTITY SURVEYORS
CISC	CANADIAN INSTITUTE OF STEEL CONSTRUCTION
CITC	CANADIAN INSTITUTE OF TIMBER CONSTRUCTION
CLA	CANADIAN LUMBERMEN`S ASSOCIATION
CMHC	CANADA MORTGAGE & HOUSING CORPORATION
COFI	COUNCIL OF FOREST INDUSTRIES OF BRITISH COLUMBIA
CPCI	CANADIAN PRESTRESSED CONCRETE INSTITUTE
CRCA	CANADIAN ROOFING CONTRACTORS ASSOCIATION
CSA	CANADIAN STANDARDS ASSOCIATION
CSC	CONSTRUCTION SPECIFICATIONS CANADA
CSI	CONSTRUCTION SPECIFICATIONS INSTITUTE (USA)
CSPI	CORRUGATED STEEL PIPE INSTITUTE
CSSBI	CANADIAN SHEET STEEL BUILDING INSTITUTE
CUA	CANADIAN UNDERWRITERS` ASSOCIATION
CWB	CANADIAN WELDING BUREAU
CWC	CANADIAN WOOD COUNCIL
DND	DEPARTMENT OF NATIONAL DEFENCE, CANADA
FM	FACTORY MUTUAL ENGINEERING CORPORATION
FS	FEDERAL SPECIFICATION (USA)
IES	ILLUMINATING ENGINEERING SOCIETY
IGMAC	INSULATED GLASS MANUFACTURERS ASSOCIATION OF CANADA
LTIC	LAMINATED TIMBER INSTITUTE OF CANADA
MIA	MARBLE INSTITUTE OF AMERICA
MPI	MASTER PAINTERS INSTITUTE
MPMDD	MODIFIED PROCTOR MAXIMUM DRY DENSITY
NAAMM	NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (USA)
NBFU	NATIONAL BOARD OF FIRE UNDERWRITERS
NBC	NATIONAL BUILDING CODE OF CANADA

ABBREVIATION	MEANING
NBS	NATIONAL BUREAU OF STANDARDS (USDC)
NEMA	NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NHLA	NATIONAL HARDWOOD LUMBER ASSOCIATION (USA)
NLGA	NATIONAL LUMBER GRADES AUTHORITY
NRC	NATIONAL RESEARCH COUNCIL
OHSA	OCCUPATIONAL HEALTH AND SAFETY ACT
PCA	PORTLAND CEMENT ASSOCIATION
PCI	PRESTRESSED CONCRETE INSTITUTE
RAIC	ROYAL ARCHITECTURAL INSTITUTE OF CANADA
SDI	STEEL DECK INSTITUTE
SMACNA	SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION
SPMDD	STANDARD PROCTOR MAXIMUM DRY DENSITY
SSPC	STEEL STRUCTURES PAINTING COUNCIL
TTMAC	TERRAZZO, TILE & MARBLE ASSOCIATION OF CANADA
ULC	UNDERWRITERS' LABORATORIES OF CANADA
ULI	UNDERWRITERS' LABORATORIES, INC. (USA)
USAS	UNITED STATES OF AMERICA STANDARDS INSTITUTE

END

1. INDEPENDENT INSPECTION AND TESTING

.1 Requirements specified herein apply to independent inspection and testing specified under technical Specification Sections, Divisions 2 to 16. Owner will pay separately for independent inspection and testing services.

.2 Requirements specified herein do not apply to the following:

.1 Inspection and testing required by laws, ordinances, rules, regulations and orders of public authorities.

.2 Testing, adjustment and balancing of mechanical and electrical systems and equipment.

.3 Inspection and testing performed exclusively for Contractor`s convenience.

.4 Tests specified in Division 2 to 16 inclusive, to be included in Contract such as mill tests, certificates of compliance and testing to be carried out by Contractor under direction of Consultant.

.3 Failure by independent inspection and testing agency to detect defective work or materials shall not in any way prevent later rejection, when such defect is discovered, nor shall it obligate Consultant for final acceptance.

.4 Independent inspection and testing agency (hereinafter referred to as testing agency) is expected to do the following:

.1 Act on a professional and unprejudiced basis and carry out inspection and testing functions to establish compliance with requirements of Contract Documents.

.2 Check work as it progresses and prepare reports stating results of tests and conditions of work and state in each report whether specimens tested conform to requirements of Contract Documents, specifically noting deviations.

.3 Distribute reports as follows:

.1 Owner: 1 copy
.2 Consultant: 2 copies
.3 Subconsultants affected: 1 copy
.4 Contractor: 2 copies
.5 Building Department: 1 copy

.5 Testing agency is not authorized to amend or release any requirements of Contract Documents, nor to approve or accept any portion of work.

.6 Contractor shall do the following:

.1 Notify testing agency minimum 48 hours in advance of operations to allow for assignment of personnel and scheduling of tests without causing delay in work.

.2 Provide testing agency with access to work at all times.

.3 Supply material samples for testing.

.4 Supply casual labour and other incidental services required by testing agency.

.5 Provide facilities for site storage of samples.

.6 Make good work disturbed by testing agency.

.7 When initial inspection and testing indicates non-compliance with Contract Documents, any subsequent

reinspection and retesting occasioned by non-compliance shall be performed by same testing agency and cost thereof borne by Contractor.

2. MOCK UPS

.1 Where required by Contract Documents construct mock-ups of work on site, in size and at location directed by Consultant.

.2 Construct mock-ups prior to start of affected work. Allow sufficient time for Consultant's review. Work affected by mock-ups may not commence prior to acceptance of mock-up.

.3 Construct mock ups to include all related specified materials and workmanship. Make revisions as directed by Consultant, in accordance with intent of Contract Documents, until mock-ups are acceptable.

.4 Mock ups, reviewed and accepted by Consultant, shall become the standard of quality against which installed work will be measured.

.5 Mock ups, by prior arrangement, may be incorporated into finished work if approved by Consultant.

3. TOLERANCES

.1 Except where specific tolerances are required by a Section of the Specifications or a referenced standard, meet the following tolerances for installed work:

.1 "plumb" shall mean plumb within ±3 mm in 3 m of true plumb

.2 "level" shall mean level within ±3 mm in 3 m of true level

.3 "square" shall mean ±30 seconds from true 90°.

.4 "straight" shall mean within ±3 mm in 3 m under a 3 m straightedge.

END

1. GENERAL

.1 Provide all temporary facilities and controls required for the proper execution of the work.

.2 Provide and maintain temporary systems in accordance with applicable regulations and requirements. Arrange for, obtain and pay for any permits required.

.3 Refer to additional requirements in Section 013513.

2. TEMPORARY ELECTRICITY AND LIGHTING

.1 Provide temporary electrical lighting and power system for use by all Sections.

.2 Arrange, obtain and pay for service, including meter, of sufficient size to allow use of required tools and equipment and to ensure adequate lighting levels for the proper execution of work.

.3 Install and maintain temporary electrical systems in accordance with requirements of jurisdictional authorities.

3. TEMPORARY HEATING

.1 Furnish equipment, labour and fuel to provide temporary heat as required for proper execution of work.

.2 Heat enclosed building to minimum 15^{o}C at all times until taken over by Owner. Provide intermittent heating up to 21^{o}C as required for proper execution of work.

.3 Use propane or natural gas heaters of a type where the flame is not exposed. Open flame heaters are not permitted.

.4 Uniformly distribute heat to avoid hot and cold areas and to prevent excessive drying.

4. TEMPORARY VENTILATION

.1 Provide minimum 1 air change per hour for enclosed areas receiving architectural finishes.

.2 Prior to commencement of work where hazardous or volatile adhesives, coatings or substances are used, install adequate mechanical ventilation.

.3 Do not allow excessive build-up of moisture inside building.

5. TEMPORARY COMMUNICATIONS

.1 Provide site telephone service for duration of Contract until completion.

.2 Make provisions to send and receive e-mails on site for duration of Contract.

6. TEMPORARY WATER

.1 Provide temporary water supply, for use by all Sections.

.2 Water shall be clean and non-staining.

7. TEMPORARY SANITARY FACILITIES

.1 Provide temporary toilet facilities, including handwash facilities, for all personnel on site.

.2 Keep facilities clean and sanitary and provided with required supplies at all times.

.3 Except where temporary sanitary facilities are connected to municipal sewer system, periodically remove wastes from site.

8. TEMPORARY FIRST-AID FACILITIES

.1 Provide site equipment and medical facilities necessary to supply first-aid service to injured personnel in accordance with regulations of the Workplace Safety and Insurance Act. Maintain facilities for duration of Contract.

9. TEMPORARY FIRE PROTECTION

.1 Provide and maintain in proper working order at least two fire extinguishers on each floor, prominently placed, until completion of work.

.2 Fire extinguishers shall be minimum 9 kg 4A 60BC type.

.3 Remove fire extinguishers from site, upon completion of work or when directed by Consultant.

.4 Where gas welding or cutting is to be done within 3 m or above combustible material, or above space that may be occupied by persons, interpose shields of noncombustible material. Tanks supplying gases for welding or cutting shall be placed at no greater distance from the work than is necessary and shall be securely fastened in an upright position. Such tanks shall be free from exposure to the sun or high temperature.

.5 Refer to HPA requirements in Section 013513.

10. TEMPORARY USE OF NEW PERMANENT SERVICE AND EQUIPMENT

.1 Do not use any new permanent service or equipment without Owner's written approval.

.2 Where permission is granted to use permanent services and equipment provide competent persons to operate services and equipment; inspect frequently and maintain facilities in proper operating condition at all times.

.3 Permanent services and equipment shall be turned over to Owner in "as new" and perfect operating condition.

.4 Use of permanent systems and equipment as temporary facilities shall not affect the warranty conditions and warranty period for such systems and equipment. Make due allowance to ensure that Owner will receive full benefits of equipment manufacturers warranty after project takeover.

11. CONSTRUCTION AIDS

.1 Provide temporary stairs, ladders, ramps required for movement and placing of materials, equipment and personnel.

.2 Provide mechanical hoisting equipment and fully qualified operators as required during construction.

.3 Erect required scaffolding independent of walls, arranged to avoid interference with work of other Sections as much as possible.

.4 Provide and maintain required shoring and bracing in accordance with Occupational Health and Safety Act and other applicable regulations.

.5 Shoring and all false work over one tier in height shall be designed and shall bear the stamp of a registered professional engineer, having experience in this field.

.6 The use of explosive power tools will not be permitted under any circumstances unless equipped with a device which positively prevents free flight of the stud.

12. BARRIERS

.1 Protect public and workers from injury.

.2 Provide and maintain required hoardings, barricades, guardrails, and lights in accordance with applicable regulations.

.3 Provide around assigned staging and storage areas 6'0" high fencing, as follows:

.1 Steel pipe or tee posts driven into ground minimum 3'4" at maximum 8'0" o.c.
.2 2" hot dip galvanized chain link mesh wire tied to posts.
.3 Where required, for construction access, hinged, lockable chain link gates.

13. TEMPORARY CONTROLS

.1 Provide protective coverings to protect work against damage caused by weather, including but not necessarily limited to rain, snow, ice, wind, frost and excessive heat.

.2 Provide wind breaks and sun shades to allow proper setting and curing of cementitious materials.

.3 Protect building materials from freezing. Protect built components from freezing until fully cured.

.4 Prevent sprayed materials from contaminating air beyond application area, by providing temporary enclosures.

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

14. SIGNS

.1 Except as specified here do not erect any signs unless approved by the Consultant.

.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.

15. FIELD OFFICE AND SHEDS

.1 Maintain, until completion of Contract, for Contractor's use, a temporary office as required for work, large enough to accommodate site administrative activities and site meetings, complete with light, heating and cooling equipment to maintain 21^{o}C, ventilation, table and chairs. Do not store materials, tools, equipment in meeting area; keep clean and tidy.

.2 Provide temporary covers, sheds and platforms of weatherproof construction as may be required for protection and preservation of materials, small tools, equipment which may be susceptible to damage.

END

1. PRODUCT QUALITY

.1 Products supplied for work shall be new.

.2 Materials used for temporary facilities are not required to be new, provided they are structurally sound and in suitable and safe operating condition.

2. STANDARDS AND TERMINOLOGY

.1 Where a standard has been adopted by these Specifications, incorporate minimum requirements of such standard into the work. Where requirements of Specifications are more stringent than those of the standard, follow more stringent requirements.

.2 Reference to standards, specifications, handbooks and manufacturer's catalogues refer to latest edition thereof and all amendments or revisions applicable at bid closing date, unless date suffix is included with document number.

.3 Wherever words "acceptable", "approved", "satisfactory", "selected", "directed", "designated", "permitted", "inspected", "instructed", "required", "submit", or similar words or phrases are used in standards or elsewhere in Contract Documents, it shall be understood, that "by (to) the Consultant" follow, unless context provides otherwise.

.4 Where the word "provide" is used in these Contract Documents, it shall be taken to mean "supply and install" unless specifically noted otherwise.

3. CERTIFICATION

.1 Building materials, components and elements specified without the use of trade or proprietary names shall meet requirements specified.

.2 If requested by Consultant, submit evidence of meeting requirements specified. Evidence shall consist of certification based on tests carried out by an independent testing agency.

.3 Certification based on previous tests for same materials, components or elements is acceptable. Certification shall be in form of written test reports prepared by testing agency.

4. AVAILABILITY AND SUBSTITUTIONS

.1 Products which are specified by their proprietary names or by part or catalogue number form the basis for Contract. No substitutes for these may be used without Consultant's approval in writing.

.2 Where it is found that specified materials have become unavailable for incorporating into work, notify Consultant immediately of proposed substitution.

.3 Proposed substitution shall be any top quality product considered by Consultant to be of equal quality and value to that specified, and suitable for purpose intended.

.4 Products proposed as substitutions, and which are considered by Consultant to be suitable for purpose intended, but which are in his opinion of lesser value and quality than those specified shall only be accepted as substitution if reasonable credits are allowed for their use.

.5 In order to substantiate equivalency of proposed materials, products or processes, submit samples, printed product descriptions, test data, installation instructions, standards, certification, sample, - guarantee/warranty forms, list of successful projects incorporating such proposals, and similar information requested by Consultant.

.6 Whenever a substitute is proposed, any change to contract price as a result of acceptance of proposed product shall include any adjustments to adjacent structure or space in order to accept minor differences in size or weight between proposed items and corresponding specified items.

.7 Prevent any substitution or request for substitution from delaying construction progress in any way.

.8 Requests for substitution resulting from failure to place orders in time will not be entertained. Be responsible for ordering products in time to ensure their required delivery; bear all costs for failure to comply with these requirements.

5. PRODUCT HANDLING AND STORAGE

.1 Suitably pack, crate and protect products during transportation to site to preserve their quality and fitness for the purpose intended.

.2 Store products in original, undamaged condition with manufacturer's labels and seals intact until they are being incorporated into completed work.

.3 Handle and store materials in accordance with manufacturer's and supplier`s recommendations and so as to ensure preservation of their quality, appearance and fitness for work.

.4 Arrange materials so as to facilitate prompt inspection, and remove faulty, damaged or rejected materials immediately from site.

END

1. EXAMINATION

.1 Examine the site, existing premises and surrounding areas and be fully informed as to the conditions and limitations under which the work has to be executed. Claims for additional costs will not be entertained with respect to conditions which could reasonably have been ascertained by an inspection prior to bid closing.

.2 Prior to commencement of work, make careful examination of previously executed work, existing conditions, levels, dimensions and clearances. Promptly advise Consultant of unsatisfactory preparatory work and substrate conditions; commencement of work implies acceptance of conditions.

2. PROTECTION

1. Ensure that no damage is caused to existing structures, buildings, foundations, pavement, fences, curbs, grounds, plants, property, utilities, services, finishes during the progress of Work. Repair and make good any damage caused at no extra cost to Owner to the complete satisfaction of the respective property owners and authorities having jurisdiction. Do not proceed with repairs or remedial work without written permission of the Consultant. Only trades specifically capable of performing the work will be allowed to make remedial or repair work.

.2 Keep surfaces to receive finished flooring dry and free from oil and grease. Stockpiling of damp or wet building materials and use of mixing boxes or water buckets without protecting floors from moisture gain by approved means, is prohibited.

.3 Keep municipal roads clean of debris resulting from construction traffic.

.4 Prevent soiling of pavement due to spillage, mixing of material or any other cause. Make good any damage caused.

.5 Protect new work from damage with suitable protective coverings.

.6 Protect work during periods of suspension, regardless of reason for suspension.

3. SAFETY AND SECURITY

.1 Be responsible for security of all areas affected by work of this Contract until taken over by Owner. Take steps to prevent entry to the Work by unauthorized persons and guard against theft, fire and damage by any cause.

.2 Provide suitable surveillance equipment and/or employ guard services, as required to adequately protect the Work.

.3 Maintain fire protection for work. Store volatile substances in a separate and controlled location and inspect frequently. Inspect temporary wiring, drop cords, extension cables for defective insulation or connections frequently. Remove combustible wastes frequently. Prohibit smoking in areas where volatile and flammable substances are used.

.4 Do not cut, bore or sleeve through any loadbearing member, new or existing without Consultant's written authorization, unless specifically indicated.

4. SERVICES AND UTILITY SYSTEMS

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

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

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

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

.5 Operate and maintain all utility systems affected by work of this Contract, until the building or specific portions thereof have been accepted by the Owner.

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

5. SLEEVES, SUPPORTS, AND FASTENERS

.1 Unless specified in other Sections, furnish, set and secure inserts, hangers, sleeves, fasteners, adhesives, anchors and other supports and fittings required for proper installation of work.

.2 Use exposed metal fastenings and accessories of same texture, colour and finish as base metal on which they occur.

.3 Select appropriate type of anchoring and fastening devices and in sufficient quantity and in such manner as to provide positive permanent anchorage of unit to be anchored in position. Keep exposed fasteners to a minimum, evenly spaced and neatly laid out.

.4 Fasteners shall be of permanent type. Do not use wood plugs.

.5 Fasteners which cause spalling or cracking of material to which anchorage is being made shall not be used.

.6 Fasteners in contact with preservative pressure treated wood shall be stainless steel unless otherwise approved by Consultant.

6 CONCEALMENT

.1 Conceal ductwork, piping, conduit and wiring located in finished areas, in ceiling spaces and furred construction unless specifically noted to be exposed.

.2 If any doubt arises as to means of concealment, or intent of Contract Documents in this connection, request clarification from Consultant before proceeding with portion of work in question.

7. CUTTING AND PATCHING

.1 Regardless of which Section of work is responsible for any portion of cutting and patching, in each case tradesmen qualified in work being cut and patched shall be employed to ensure that it is correctly done.

.2 Any cost caused by omission or ill-timed work shall be borne by party responsible therefore.

.3 Do not endanger any work by cutting, digging or otherwise altering, and do not cut nor alter any loadbearing element without written authorization by Consultant. Provide bracing, shoring and temporary supports as required to keep construction safely supported at all times.

.4 Cut holes carefully and not larger than required after they are located by Sections requiring them, using suitable equipment and tools.

.5 Patching and making good work shall be undetectable in finished work.

8. WORKMANSHIP

.1 All work shall be carried out in accordance with the best trade practice, by workers skilled in the type of work concerned.

.2 Products, materials, systems and equipment shall be applied, installed, connected, erected, used cleaned and conditioned in accordance with the applicable manufacturer's printed directions.

.3 Where specified requirements are in conflict with manufacturer's written directions, follow manufacturer's directions, but inform Consultant in writing prior to proceeding with affected work. Where specified requirements are more stringent than manufacturer's directions, comply with specified requirements.

9. LINES AND LEVELS

.1 Verify all elevations, lines, levels and dimensions as indicated and report errors, any conflicts, or inconsistencies to the Consultant before commencing work or as soon as discovered.

.2 Accurately lay out work and establish lines and levels in accord with requirements of Contract Documents.

.3 Set up, maintain and protect permanent reference points and provide general dimensions and elevations for all Sections of Work.

10. DIMENSIONS

.1 Check and verify dimensions wherever referring to work. Dimensions, when pertaining to work of another Section, shall be verified with Section concerned. Details and measurements of work which is to fit or conform with work installed shall be taken at site.

.2 Do not scale Drawings. If there is ambiguity, lack of information or inconsistency, immediately consult Consultant for directions. Be responsible for extra costs involved through the disregarding of this notice.

.3 Walls, partitions and screens shall be considered as extending from floor to underside of structural deck unless specifically indicated otherwise.

11. LOCATION OF FIXTURES

.1 Location of fixtures, apparatus, equipment, fittings, outlets, conduits, pipes and ducts shown or specified, but not dimensioned, shall be considered approximate.

.2 Request direction from Consultant to establish exact location. Any relocation caused by Contractor's failure to request direction from Consultant shall be done by Contractor at no extra cost. Where job conditions require reasonable changes in indicated locations and arrangements, make changes at no additional cost.

.3 Conserve space and coordinate with work of other Sections to ensure that ducts, pipes, conduits and other items will fit into allocated wall and ceiling spaces, while ensuring adequate space for access and maintenance.

.4 Where ducts, piping and conduits are permitted to be exposed they shall be neatly and uniformly laid out parallel to adjacent building lines and parallel to each other where they run in the same direction. Review exposed installations with Consultant prior to start of work. At no cost to Owner make changes to exposed work as directed by the Consultant where such work is not installed in accordance with Consultant's prior review.

.5 Except where locations are specifically noted on Drawings, install exposed mechanical and electrical fixtures including outlets, switches, thermostats, panels and other items, located on walls, in orderly and neatly laid out manner, lining up with each other and grouped together where possible. Review installation with Consultant prior to start of rough-in work. Relocate at no cost to Owner any work which does not meet this requirement.

END

1. GENERAL

.1 Be responsible for cleanliness of assigned work areas to satisfaction of Consultant. Maintain work areas in neat and orderly condition at all times.

.2 Periodically, or when directed by the Consultant, remove from work areas rubbish and waste materials.

.3 Use only cleaning materials recommended by manufacturer of surface to be cleaned.

.4 Use cleaning material only on surfaces recommended by cleaning material manufacturer.

2. CLEANING DURING CONSTRUCTION

.1 Remove debris, packaging and waste materials frequently.

.2 Keep dust and dirt to an acceptable level, as directed.

.3 Remove oily rags, waste and other hazardous substances from premises at close of each day, or more often if required.

3. FINAL CLEANING

.1 Upon completion of work, or, where work is phased, upon completion of each phase, thoroughly clean all surfaces and components. Provide professional cleaning by a recognized, established cleaning company, to allow Owner to occupy without further cleaning.

.2 Remove stains, dirt and smudges from finished surfaces.

.3 Clean exposed finished surfaces in accordance with respective material manufacturer's recommendations.

.4 Clean mechanical and electrical fixtures and other fittings of labels, wrappings, paper and other foreign material.

.5 Replace heating, ventilation and air conditioning filters if units were operated during construction. Clean inside of ducts, blowers and coils.

.6 Remove from work areas all waste and surplus materials from all areas.

4. WASTE COLLECTION AND DISPOSAL

.1 All waste materials and debris resulting from the work of this Contract shall belong to the Contractor and shall be removed from the site and legally disposed.

.2 Periodically, or when directed by the Consultant remove waste material and debris.

.3 Separate and salvage materials suitable for recycling from general waste stream and transport to recognized recycling facility.

.4 Burying, burning, selling waste materials on site is prohibited.

.5 Disposal of liquid wastes into waterways, sewers is prohibited.

END

1. OPERATING AND MAINTENANCE MANUALS

.1 Provide operation and maintenance manuals. Data shall be contained in D-ring binders with soft vinyl covers. Binders shall have clear plastic pocket at back of spine identification containing label "Operation and Maintenance Manual" and project name and volume number, if applicable. Each manual shall contain a title sheet listing project name, date and volume number and names and addresses of Contractors and Subcontractors, Consultant and Subconsultants.

.2 Provide operating and maintenance data, prepared on 8 1/2" X 11" sheets in printed or typewritten form.

.3 Data shall be assembled in systematic order, generally following the specification format. Provide labelled, celluloid covered tabs fastened to hard paper dividers to identify different Sections.

.4 Provide the following material as applicable to work of this Contract:

.1 List of contents. If more than one volume is required, provide a cross-reference contents page at front of each volume.

.2 Complete list of subcontractors and suppliers, showing name, address, telephone/fax numbers, name of contact person and description of work done.

.3 Complete list of products used in the work showing product name, part number or code and manufacturer for each listing; follow specification format.

.4 Copy of finish hardware list, complete with all amendments and revisions.

.5 Schedule of paints and coatings. Include sufficient explanation to fully identify each surface with the applicable paint or coating used. Enclose copy of colour schedule.

.6 Maintenance instructions for all finished surfaces.

.7 Brochures, cuts of all equipment and fixtures.

.8 Operating and maintenance instructions for all equipment.

.9 Valve manual.

.10 Controls schematics.

.11 Extended warranties.

.12 Maintenance contracts.

.13 Other data required elsewhere in Contract Documents or deemed necessary by Consultant.

2. EXTENDED WARRANTIES

.1 Submit extended warranties as part of "Operating and Maintenance Manuals".

.2 Arrange extended warranties in systematic order matching Specification format. Include a table of contents listing warranties in same order.

.3 Each warranty must show:

.1 Name and address of Project
.2 Name of Owner
.3 Section Number and Title

3. MAINTENANCE MATERIALS

.1 Deliver to the location directed by Consultant maintenance materials as required elsewhere in these Specifications. Obtain receipt for delivered materials and submit copy of receipt to Consultant.

.2 Package materials so that they are protected from damage and loss of essential properties.

.3 Label packaged materials for proper identification of contents and project name.

4. AS-BUILT DRAWINGS

.1 Prior to final payment submit all as-built drawings.

.2 Clearly and prominently mark each drawing “AS-BUILT DRAWING prepared by _____ (name of Contractor)”.

5. OPERATING AND MAINTENANCE INSTRUCTIONS

.1 Prior to requesting Substantial Performance, at a time acceptable to Owner and Consultant, but not before operating and maintenance data has been reviewed and accepted by Consultant, instruct designated Owner's representatives in the operation and maintenance of all systems and equipment.

.2 Arrange training sessions for each type of operating system and equipment. Sessions shall be conducted by qualified instructors and shall be of sufficient duration and depth to adequately instruct participants.

.3 Throughout the training sessions make reference to reviewed operation and maintenance manuals to familiarize participants with the data provided.

.4 Prepare an attendance record for each training session, to be signed by each participant upon conclusion of session. Show date and time of session, subject of session and name, title and organization of each participant. Submit a copy of each record to Consultant.

.5 Subcontractor whose work is subject of training session and Contractor shall be represented during training session by qualified personnel.

6. INSPECTION AND ACCEPTANCE OF WORK

.1 Prior to requesting Substantial Performance submit the following:

.1 Three copies of operating and maintenance manuals (manuals must be submitted minimum 6 weeks prior to requesting Substantial Performance).

.2 Inspection and acceptance certificates required from regulatory agencies.

.2 Advise the Consultant in writing, when work has been substantially completed. If Consultant agrees that this stage has been reached, prepare a complete list of deficiencies and submit this list to Consultant.

.3 On receipt of the above deficiency list in a satisfactory form, the Consultant, accompanied by Subconsultants, the Contractor and the Owner, if deemed desirable, will carry out an inspection of the Project.

.4 Add to the deficiency list, in accordance with Consultant's directions, any additional deficiencies which are identified during inspection and reissue updated deficiency list.

.5 Upon completion, inspection and acceptance of work, Owner will take over and occupy completed work.

7. FINAL SUBMISSION

.1 Prior to claiming Final Payment do the following:

.1 Submit as-built drawings.

.2 Submit one complete set of reviewed shop drawings, folded to 8-1/2" x 11" size, contained in heavy duty manila envelopes, numbered and labelled. Follow specification format with no more than one Section per envelope.

.3 Submit maintenance materials.

.4 Submit a final accounting of all approved changes to the Contract Price, including adjustments to cash allowances.

8. WARRANTY INSPECTION

.1 The Contractor shall organize a warranty inspection to take place two weeks prior to the expiration of the standard one-year warranty. The Consultant, subconsultants, the Contractor, subcontractors and the Owner's representatives shall attend.

END

PART 1 - GENERAL

1.1 APPLICABILITY

.1 The work in this section lays out the responsibilities and the work required of the:

.1 General Contractor or Construction Manager

.2 Mechanical Contractor

.3 Electrical Contractor

.4 Controls Contractor

.5 Testing, Adjusting, and Balancing Contractor

.6 Other contractors providing services under the requirements of this contract as may be noted in this or other related parts of the specifications

1.2 DESCRIPTION

.1 Commissioning is a systematic process of ensuring that all building systems installed in accordance with the drawings and specifications, manufacturer's requirements and good industry practice. Commissioning also ensures that equipment operates and performs, in and of itself as well as in the system, as was intended by the designers in response to the owner's requirements. Finally commissioning ensures the owner has the documentation and training required to operate the equipment and systems in a safe, efficient and long lasting manner.

.1 During the construction phase, commissioning will include the following specific activities:

.1 Verify equipment is installed in accordance with the manufacturer's recommendations and industry accepted standards including review of completed manufacturers' start-up sheets, supplemented where required with commissioning installation verification checklists provided by the CxA. Contractor shall complete check sheets as required by the CxA

.2 Verify equipment is set-up, adjusted and balanced to perform as specified. This will include review of Testing, Adjusting, and Balancing (TAB) procedures, review of TAB reports and spot checking measurements on site. The TAB contractor shall cooperate with the CxA providing information requested and tools and manpower for spot checking measurements as required by the CxA.

.3 Functional Performance Testing (FPT) of mechanical and electrical equipment and systems to ensure proper, complete and efficient operation under the range of conditions they are expected to encounter. Contractors shall provide manpower, tools and other services as required by the CxA to perform the FPT

.2 Commissioning does not take away from, reduce responsibility of or in any way diminish the requirement for system designers and installing contractors to provide a complete, finished and fully functioning product.

1.3 COORDINATION

.1 Commissioning Team. The following contractors will be required to participate in commissioning and to assist the commissioning team with verification, testing and documentation preparation:

.1 General Contractor (GC or Contractor)

.2 Construction Manager (CM)

.3 Mechanical Contractor (MC)

.4 Electrical Contractor (EC)

.5 Testing, Adjusting and Balancing contractor (TAB)

.6 Controls Contractor (CC)

.7 Contractors installing insulation, windows and doors, air barrier or other building shell components.

.8 Any other installing Subcontractors or suppliers of equipment.

.2 Other members of the commissioning team include:

.1 Commissioning Agent (CxA)

.2 Owner's Project Manager (PM)

.3 Designated representative of the owner's Operations and Maintenance personnel (O&M)

.4 Architect and Design Engineers - particularly the mechanical and electrical engineers (A/M/E)

.2 Management: Contractors shall cooperate fully with the CxA who will be the Owner's representative for commissioning during all commissioning activities. Contractors shall work together and with the other members of the commissioning team as required to fulfil their contracted responsibilities and meet the objectives of commissioning.

.3 Scheduling: The GC/CM will work with the CxA to schedule the commissioning activities required of contractors and subcontractors. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

The CxA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. As construction progresses more detailed schedules may be developed by the GC/CM.

The GC/CM shall be responsible for ensuring that the mechanical, electrical, and controls sub-contractors will return to the building approximately 10 months after the start of the warrantee period to review system operation and to address operational issues.

1.4 RELATED SECTIONS

.1	Mechanical General Requirements	Section 21 05 01
.2	EMCS Startup, Verification and Commissioning	Section 25 01 11
.3	Testing, Adjusting and Balancing (TAB) for HVAC	Section 23 05 93
.4	Common Work Results – Electrical	Section 26 05 00

1.5 RESPONSIBILITIES

.1 Mechanical Contractor:

.1 Attend initial commissioning coordination meeting.

.2 Provide complete equipment and systems start-up including personnel and tools, as required for safe, proper and complete start-up of all mechanical equipment.

.3 Perform installation verification, start-up and complete required documentation as directed by CxA.

.4 Correct all deficiencies found during installation verification, start-up and TAB to ensure that all equipment and systems are fully functional and ready for functional performance testing.

.5 Notify CxA a minimum of two weeks in advance of equipment and system start-up and/or installation verification testing.

.6 Set-up and schedule vendors and contractors required to participate in the owner training sessions for all equipment and systems.

.2 TAB Contractor(s)

.1 Attend initial commissioning coordination meeting.

.2 Submit TAB procedures to CxA and Mechanical Consultant for review and acceptance.

.3 Provide a preliminary TAB report showing that the system is complete and capable of being balanced. Provide an additional copy of the preliminary report labelled “For CxA”.

.4 Attend TAB review meeting scheduled by the CxA. Be prepared to discuss procedures that shall be followed in TAB and findings of preliminary TAB.

.5 Submittal of final TAB report showing all flows, pressures, motor speeds, voltages and amperages etc., as required for a full and complete balancing report on all systems. Provide an additional copy of the TAB final report labelled “For CxA”, and include as-built distribution systems schematics.

.6 Participate in verification of the TAB report, which includes of repeating selected measurement contained in the TAB report where required by the CxA for verification or diagnostic purposes.

.3 Building Controls and Automation System Contractor(s)

.1 Attend initial commissioning coordination meeting.

.2 Attend Sequence of Operation and Graphics review meeting scheduled by the CxA. Be prepared to discuss all sequences including all changes, and provide a schematic for each proposed graphic.

.3 Provide the following submittals to the CxA at time of FPT. (Note: The following shall be updated to as-built conditions).

.1 Hardware and software submittals and shop drawings.

.2 Narrative description of each control sequence for each piece of equipment or system controlled.

.3 Point-to-point and sensor calibration verification checklists

.4 As-built diagrams showing all control points, sensor locations, point names, actuators, controllers and, where necessary, points of access, superimposed on diagrams of the physical equipment.

.5 Printout of panel layouts including all analog input, analog output, digital input, and digital output connections. Provide a separate list for each stand-alone control unit.

.6 Printout of final control programming algorithms, include current values of all parameters for each system point.

.7 Owner's operation and maintenance manuals.

.4 Provide complete training to operating personnel on hardware, operation and programming, and the application program for the system.

.5 Demonstrate system performance to CxA, including all modes of system operation. (e.g. normal, abnormal, emergency).

.6 Provide control system technician to operate systems as required by and under the direction of the CxA during system verification and functional performance testing.

.7 Provide support and coordination with TAB contractor on all interfaces between their scopes of work. Provide all devices, such as portable operators' terminals, for TAB use in completing TAB procedures.

.8 Provide any trend logs as may be required by the CxA.

.4 Electrical Contractor

.1 Attend commissioning meetings scheduled by the CxA.

.2 Correct all deficiencies found during Installation Verification Inspection (IVI), start-up, TAB and FPT to ensure all equipment and systems are fully functional and in complete and proper working order.

.3 Provide electrical system technicians to assist during system verification and functional performance testing as required by the CxA.

1.6 EQUIPMENT/SYSTEMS TO BE COMMISSIONED

.1 Systems to be commissioned under this part are primarily associated with HVAC for the building and central plant but do not include process or special purpose equipment such as:

.1 life safety systems such as fire alarm, sprinkler, fire pumps

.2 security systems such as card readers, automatic door locks, CC cameras

.3 Communication systems such as data, paging and telephone systems

.4 specialty equipment such as kitchen cooking and refrigeration equipment, medical gas, elevators, laboratory equipment, etc. but scope does include exhaust hoods and fans

.5 Plumbing piping systems such as drainage and storm water management but scope does include booster pumps, hot water generation, cistern pumping and control systems for these

.2 All major mechanical equipment and their controls will be commissioned using a series of installation verification and functional checks. Equipment to be commissioned during the course of this project includes but is not limited to:

.1 Air-Cooled Chiller (CHILLER.3)

.2 Boiler (B.3)

.3 Heat Exchanger (HX1)

.4 Building Automation System (Controls System)

.5 Domestic Electric Water Heater (HWT4)

.6 Split Type Air Conditioners (EVAP-1, COND-1)

.7 Air Handling Units (AHU-9, AHU-10, AHU-11, AHU-12)

.8 Humidifier (HU12)

.9 Pumps (P.1, P.2, P.3, P.4, P.6, PA.03A, PA.03B, PA.09A, PA.09B, PA.11A, PA.11B, PA.12, P-RC1, P-RC2)

.10 Exhaust Fans

.11 Radiation, Unit Heaters, Cabinet Unit Heaters, Force Flow Heaters

.12 VAV Boxes

.13 Fan Coil Units (Water Cooled Condensing Unit) (FC1)

.14 Range Hoods

.15 Heat Exchangers (HX1)

.16 Piping Systems

.17 Plumbing Fixtures

.18 Ducting Systems

.19 VFDs

.20 Lighting

.21 Lighting Control

.22 Transformers

.23 Panels

.24 Motor control centres

.25 Wiring devices

.26 Motor starters

.27 Unit equipment for emergency lighting

.28 Exit signs

Other major equipment as may be included in construction but may have been left off of this list will also be required to be included in commissioning.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

.1 All standard testing equipment required to perform start-up and installation verification and required functional performance testing shall be provided by the division contractor for the equipment being tested.

.2 Special test equipment, tools or instruments required by the contract documents shall be provided for commissioning and shall be left on site.

.3 All testing equipment shall have had a certified calibration, traceable to a national standard, performed within the past year. If not otherwise noted, temperature sensors and digital thermometers shall have an accuracy of ± 0.1°F, pressure sensors shall have an accuracy of ± 1.0% for each range available on the instrument (not the full range of the meter). All equipment shall be re-calibrated when dropped or damaged.

PART 3 - EXECUTION

3.1 MEETINGS

.1 Commissioning Meetings: Soon after construction commences, the CxA will conduct an initial commissioning scoping meeting with the entire commissioning team in attendance. Commissioning requirements, procedures, responsibilities and schedule will be reviewed.

Other commissioning meetings will be conducted as required throughout construction. These meetings will cover coordination, deficiency resolution and planning issues with particular Contractors and Subs.

3.2 SUBMITTALS

.1 Contractors and Subs shall comply with specific requests for submittal documentation from the CxA in a timely fashion to ensure commissioning work continues as scheduled. At a minimum, the request will include the manufacturer's printed installation and start-up procedures, O&M data and manuals, final shop drawings, power and control field wiring drawings, sequences of operation, and results of required tests.

.2 TAB contractor shall supply an extra copy of the preliminary and the final TAB report marked "for CxA" for review. The CxA will review and forward comments to the engineer of record for follow-up.

3.3 START-UP AND INSTALLATION VERIFICATION CHECKS

.1 The installing Contractor or Sub-contractor shall be responsible for performing and documenting start-up based on manufacturer's requirements and/or good industry practice. They shall perform all required procedures and checks and document the results. Start-up documents as requested by the CxA shall be provided.

.2 Controls and Sensor Point-to-Point Checks. Control system point-to-point checks and calibration checks for all sensors shall be included as part of installation verification. The results shall be documented and provided to CxA.

.3 Execution of Start-up and Installation Verification (IV/S-U).

.1 IV/S-U checklists shall be developed and provided by CxA. Where appropriate manufacturers checklists and procedures shall be combined or accepted in lieu of CxAs checklists.

.2 The contractor, sub-contractor, manufacturer's rep or supplier shall perform IV/S-U. They shall complete the checklist on each piece of equipment. IV/S-U shall be successfully completed prior to any FPT.

.3 At his sole discretion the CxA shall observe, recheck or verify the IV/S-U documentation of any or all equipment. The contractor shall cooperate with and provide support to the CxA as requested.

.4 Only individuals with direct knowledge of and who personally witnessed any IV/S-U shall sign off the checklists.

.5 It will be the responsibility of the contractor to remedy all deficiencies found. Retesting by the contractor may be required to demonstrate corrections have been made.

.4 Deficiencies, Non-Conformance and Approval of IV/S-U Checklists.

.1 Dates for remedy of deficiencies shall be provided to the CxA with the initial IV/S-U documents.

.2 The CxA will work with all parties as required to affect proper corrective measures, correct and retest deficiencies or uncompleted items.

.3 Items left incomplete or not properly corrected, causing delays or multiple call-backs for retest may result in back-charges to the party at fault.

3.4 TESTING, ADJUSTING, AND BALANCING (TAB)

.1 A preliminary TAB balancing shall be done prior to final balancing. System deficiencies requiring correction prior to final TAB shall be documented.

.2 All deficiencies shall be corrected by the contractor prior to final balancing.

.3 Participate in repeating selected measurement as required by the CxA for verification or diagnostic purposes.

3.5 FUNCTIONAL PERFORMANCE TESTING (FPT)

.1 In general, functional performance testing is conducted after IV/S-U have been satisfactorily completed, the control system is fully operational, and TAB is complete.

.2 The installing Contractor or Sub-contractor, under the direction of the CA, shall execute all FPT and shall maintain responsibility for all equipment tested.

.3 In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part-load, full-load). Proper responses to such modes and emergency conditions (e.g., power failure, freeze condition, no flow, equipment failure, etc.) shall be verified.

.4 FPT verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers. The CxA will determine which method is most appropriate.

.5 The CxA will schedule FPTs through the GC/CM and affected Contractors and Subs.

.6 Corrections of minor deficiencies identified during FPT may be made by the Contractor or Sub during the tests.

.7 Where a deficiency cannot be corrected immediately, the Contractor or Sub shall provide a reasonable timeline for correction. The CxA shall document the deficiency and reschedule the FPT.

.8 Where there is a dispute regarding whether a problem is a deficiency or who is responsible, the deficiency shall be documented and resolution attempted by parties in attendance. Final acceptance of proposed resolution lies with the Owner or designated representative.

.9 The burden of responsibility to solve and correct deficiencies lies with the A/M/E, manufacturers, vendors, GC/CM, Contractors, and Subs. The CxA may recommend solutions to problems in consultation with these parties.

.10 Cost of Retesting:

.1 If the Contractor or Sub is responsible for a deficiency then they shall carry the cost to rework the deficiency and complete the IV/S-U or FPT.

.2 The CxA will direct the first retesting of the equipment at no charge.

.3 If corrections of deficiencies have been reported to be successfully completed but are determined during testing to be faulty or otherwise incomplete, the time for the CxA to direct second or subsequent retests will be charged back.

3.6 TRAINING OF OWNER PERSONNEL

.1 The contractor supplying each piece of equipment shall be responsible for providing complete and satisfactory training on that piece of equipment. Training may be performed by the contractor, supplier, manufacturer or others as the contractor may decide best able to provide that training.

.2 Owner personnel shall be provided with completed O&M Manuals at least 1 week prior to training. In addition, up to five (5) copies of the related maintenance booklet and wiring as-builts shall be provided to owner personnel for the purpose of training.

.3 The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed. The CxA shall be responsible for overseeing and approving the content and adequacy of training for all commissioned equipment.

.4 Basic training for each piece of equipment shall include the following items at a minimum:

.1 General description of the system and its operation (Design Intent)

.2 Detailed itemization and identification of major components and access to same

.3 Detailed itemization and identification of operating controls and safeties including normal and abnormal sensor readings

.4 Review of the O&M manuals for identification of service requirements, procedures, wiring diagrams, parts identification, safety procedures, etc.

.5 Review of system drawings and schematics

.6 Review of control drawings and schematics

.7 Operational review for

.1 Start-up

.2 Normal operation

.3 Shut down

.4 Unoccupied operation

.5 Seasonal changeover

.6 Manual operation

.7 Controls set-up and programming

.8 Troubleshooting and alarms

.8 Interactions with other systems

.9 Adjustments and optimizing methods for energy conservation

.10 Health and safety issues

.11 Regular maintenance requirements including frequency, parts and equipment, and tools needed, replacement parts sources

.12 Special maintenance needs

.13 Tenant interaction issues

.14 Discussion of environmentally responsible system features

.15 Identification of contacts for service support and maintenance parts

3.7 DEFERRED TESTING

.1 If any check or test cannot be completed due to weather conditions, the building structure, required occupancy condition or other deficiency, execution of IV/S-U and/or FPT may be delayed upon approval of the Owner.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Disconnecting, removal of mechanical and electrical services: Divisions 21 to 26 incl.

1.3 REGULATORY REQUIREMENTS

.1 Obtain and pay for necessary permits for work of this Section. Give required notices, and make submissions required by regulatory agencies.

.2 Comply with applicable requirements of jurisdictional authorities and CSA S350-M1980 "Code of Practice for Safety in Demolition of Structures".

1.4 PROTECTION

.1 Prevent uncontrolled movement, settlement, or damage. Provide shoring and bracing required.

.2 Take steps to positively prevent uncontrolled falling of demolished materials.

.3 Ensure that no part of existing structure is overloaded due to work carried out under this Section.

.4 Prevent debris from blocking drainage systems.

.5 Ensure that temporary guards, hoardings are provided in accordance with applicable safety regulations.

1.5 EXAMINATION

.1 Visit the site and the existing building so as to fully understand all existing conditions, limitations and circumstances, and extent of work required. No increase in cost or extension of performance time will be considered for conditions, limitations and circumstances which could reasonably be determined prior to submission of bid.

1.6 COORDINATION

.1 Refer to Division 15 and 16 to determine demolition work covered by them and coordinate as required.

PART 2 - PRODUCTS Not Applicable

PART 3 - EXECUTION

3.1 PREPARATION

.1 Ensure that affected buildings are unoccupied and discontinued in use.

.2 Verify that existing services in areas affected by demolition work are disconnected, capped, removed or relocated, prior to start of work.

3.2 SALVAGE

.1 Prior to start of demolition carefully remove and salvage items designated accordingly.

3.3 DEMOLITION

.1 Demolish parts of existing building, including foundations, slabs on grade and underground services as shown and as required to accommodate new work.

.2 Demolish work in a safe and systematic manner, from top to bottom.

.3 Do not throw or drop demolished materials from heights. Use chutes, conveyors, or hoisting equipment to lower materials.

.4 Demolish in a manner to minimize dusting. Keep dusty materials wetted but prevent flooding or contaminated runoff.

.5 Demolish masonry and concrete elements in small sections.

.6 Carefully remove and lower in controlled manner structural framing members and other heavy or large objects.

.7 At all times leave work in safe condition, so that no part is in danger of uncontrolled toppling or falling.

3.4 DISPOSAL AND CLEAN-UP

.1 All materials, rubbish and debris resulting from demolition work shall become the Contractor's property and shall be removed from site and legally disposed of unless specifically indicated otherwise.

.2 Do not allow demolished materials to accumulate on site. Promptly, as work progresses, remove and legally dispose of materials away from site.

.3 Separate and salvage materials suitable for recycling from general waste stream and transport to recognized recycling facility.

.4 Selling, burning and burying of materials on site is not permitted.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Cast-in-place concrete: Division 3

1.3 SUBMITTALS

.1 Submit detailed and complete project data for each product required.

1.4 QUALITY ASSURANCE

.1 Installer Qualifications: Use an experienced installer and adequate number of skilled workers who are thoroughly trained and experienced in the work specified.

.2 Mock-up:

.1 At location directed by Consultant, provide mock-up of type of finish required to demonstrate typical joints, surface finish, colour variation (if any), and standard of workmanship.

.1 Build mock-up approximately 5 m² at location directed by Consultant.

.2 Notify Consultant seven days in advance of dates and times when mock-ups will be constructed.

.3 Obtain Consultant's approval of mock-ups before starting construction.

.4 Maintain mock-up during construction in an undisturbed condition as a standard for judging the completed work.

.5 Mock-up may become part of the completed work if approved by Consultant.

.3 Protection:

.1 Protect finished concrete floors from damage and staining. Take the following and other steps, as necessary, to ensure uninterrupted effective protection at all times.

.1 Provide plywood overlay when working or storing materials on top of polished concrete floor.

.2 Hydraulic powered equipment shall be diapered to avoid staining of the concrete.

.3 Do not park vehicles on slab. If unavoidable place drop cloths under vehicles.

.4 Pipe cutting machines shall not be placed on slab.

.5 Steel shall not be placed on slab.

.6 Acids and acidic detergents shall not come into contact with slab.

.7 Do not mix or otherwise handle liquids without adequate protection.

.8 Use rubber tired equipment only.

.2 Replace concrete slabs where finish has been discoloured or otherwise damaged due to improper procedures and/or inadequate protection.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in original containers, with seal's unbroken, bearing manufacturer labels indicated brand name and directions for storage.

1.6 PROJECT CONDITIONS

.1 Environmental limitations: Comply with manufacturers written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting application of finish.

.2 Close areas to traffic during floor application and after application, for time period recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Curing compound: Dissipating liquid membrane forming compound: KUREZ DR VOX by The Euclid Chemical Company.

.2 Concrete Floor Stripper: heavy duty concrete floor stripper: EUCO CLEAN & STRIP by The Euclid Chemical Company.

.3 Concrete Sealer: non-yellowing, low VOC cure and seal compound: SUPER DIAMOND CLEAR TB by The Euclid Chemical Company.

.4 Control joint filler: semi-rigid epoxy/polyurethane type as recommended by system manufacturer; colour selected by Consultant.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

.1 Examine substrate, with installer present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.

.2 Verify that base slab meets finish and surface profile requirements.

3.2 CURING COMPOUND

.1 Apply curing compound to new concrete surfaces at a uniform rate in accordance with manufacturer's directions.

.2 Apply curing compound as soon as possible after finishing and immediately after disappearance of surface moisture sheen.

3.3 CONTROL JOINTS

.1 Provide control joints 3 where shown or where directed by Consultant.

.2 Vacuum joint and overfill with control joint filler; shave excess filler after cure.

3.4 STRIPPER

.1 Apply stripper to floor using sprayers, automatic floor scrubbers, or other conventional methods.

Product shall remain on the floor for 30 minutes. Redistribute puddles during the soak time. Do not allow the product to dry. Add more product if necessary.

.2 After product has been on the floor for the appropriate amount of time, scrub with ride-on or walk behind mechanical scrubbers. After scrubbing, rinse the area with clean water or vacuum until there is no visible trace of product remaining on the floor. If necessary, repeat the process until the desired results are achieved.

3.5 SEALER

.1 Apply sealer by sprayer or roller in accordance with manufacturer's directions.

.2 Apply sealer in two coats, providing uniform coverage. Keep a wet edge while applying each coat. Allow the first coat to dry to the touch before applying the second coat.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Supply of loose steel lintels: Division 5

.2 Firestopping and smoke seals: Section 07 84 00

.3 Caulking of control & expansion joints: Section 07 92 00

.4 Supply of steel door frames: Section 08 11 00

1.3 WORK INSTALLED BUT SUPPLIED BY OTHERS

.1 Build into masonry elements inserts, anchors, bolts, sleeves and other items supplied by other Sections and which are required for installation and performance of work of other Sections.

.2 Install loose steel lintels required for support of masonry elements.

.3 Install steel door frames and access doors occurring in masonry elements.

.4 Install reinforcing steel and concrete fill into block lintels.

1.4 QUALITY ASSURANCE

.1 Meet requirements of CSA A370-04, CSA A371-04 and CSA S304.1-04.

.2 Masonry units used in partitions / walls designated to provide a fire separation shall be of thickness and material required to achieve required rating. Hollow masonry units used in fire separation shall have the necessary percentage of solid material to meet required rating. Concrete block used in fire separation shall be suitably identified to permit verification of fire resistance rating. Solidly fill around beams and joists penetrating fire rated walls/ partitions in accordance with requirements of Ontario Building Code.

1.5 SUBMITTALS

.1 Submit samples of each type masonry unit and accessory required

.

1.6 PRODUCT HANDLING & STORAGE

.1 Deliver and handle masonry units so as to prevent soiling and chipping.

.2 Store masonry units above and off ground on level platforms which permit air circulation under stacks.

.3 During storage, protect masonry units against moisture absorption, damage and staining.

1.7 PROTECTION

.1 Protect finished work at corners, sills, projections and other areas likely to be damaged, with suitable coverings until completion of building.

.3 Adequately brace masonry walls and partitions to resist effects of wind and other lateral forces.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Concrete Block:

.1 To requirements of CSA A165 Series-04; unless otherwise indicated:

.1 Lightweight block: H/15/C/M and S/15/C/M.

.2 Standard weight block: H/15/A/M and S/15/A/M.

.2 Units must be cured for at least 28 days before delivery and shall have a moisture content of not more than 30% of total absorption.

.3 Exposed concrete block units shall be uniform in size, free of perceptible warp or twist, without chipped, ragged or broken edges; have a uniform surface texture, free of cracks, blemishes or defects detrimental to appearance or performance.

.4 Provide special concrete block units as indicated and as follows:

.1 Lintel block

.2 Bullnose block

.3 Solid block

.2 Mortar:

.1 Quality standards: meet requirements of CSA A179-04.

.2 Water: Clean and non-staining.

.3 Sand: ASTM C144-11.

.4 Portland cement: CSA A3001-13.

.5 Masonry cement: CSA A3002-13.

.6 Provide the following mortar types:

.1 Foundations: Type M.

.2 Bearing walls: Type S.

.3 Non loadbearing walls: Type N.

.3 Metal Reinforcement and Anchors:

.1 Material: Steel wire, cold drawn high tensile strength to ASTM A82, with mill galvanized finish to ASTM A116, Class 3.

.2 Horizontal reinforcement, interior walls. Truss type with 9 ga diameter mill galvanized steel side and cross rods; side rods centred on concrete block face shells; prefabricated assemblies at corners and intersections: BLOK-TRUS BL30 by Blok-Lok or equivalent product by Dur-O-Wal.

.3 Anchors:

.1 Interior masonry to existing work: 3/16" diameter galvanized triangular wire tie with galvanized steel adjustable anchors: Flex-O-Lok BLT9 and Adjustable Flex-O-Lok Anchors by Blok-Lok.

.4 Lateral support angles and channels:

.1 Prime coated steel angles or channels, 3" high x 8" long x ¼" thick.

.2 Steel: CAN/CSA-G40.21-M92, minimum 260W.

.3 Primer: CAN/CGSB-1.40-M89.

.4 Fasteners: expansion type concrete anchors, two per angle.

.5 Premoulded joint filler:

.1 Interior walls, non-fire rated locations: mineral fibre insulation by Roxul or Fibrex.

PART 3 - EXECUTION

3.1 ERECTION - GENERAL

.1 Lay masonry work in uniform manner. No one portion of any section of work shall rise more than 30" above general level. Do not lay more than 5'0" in height of any wall in any working day.

.2 Unless otherwise noted, all walls and partitions shall extend to the underside of the structural deck.

.3 Cut exposed masonry units with power driven table model masonry saw only. Ragged or chipped edges will not be permitted.

.4 Consult with other Sections to avoid cutting and patching. Co-operate in setting and aligning built-in items. Build in conduit and piping so that they are not exposed. Do not break masonry bond to accommodate concealed built-in items.

.5 Grout solid with mortar all spaces around built-in items.

.6 Build in metal nailing plugs, grounds, inserts, anchor bolts, bearing plates, loose and miscellaneous items of steel and iron, isolated beams, lintels and shelf angles, sleeves, blocking and items furnished by other Sections.

.7 Do not shift or tap masonry units after mortar has taken its initial set.

.8 At masonry openings less than 18" wide, unless otherwise detailed, use mild steel plates, minimum ¼" thick, of width 1" less than supported masonry thickness and with minimum 4" end bearing each side.

.9 Construct structurally reinforced masonry elements in accordance with requirements indicated on structural drawings.

3.2 CHASES, OPENINGS AND HOLES

.1 Chases and openings shall be built in during erection of masonry work, and purpose-made chased units shall be built into proper position.

.2 Openings in masonry work exceeding 18" shall be provided with lintels in accordance with lintel schedule.

.3 Chasing of completed walls or formation of holes shall only be carried out with Consultant's prior

approval, and then only with a tool designed to cleanly cut masonry units.

.4 Chases shall be plumb and shall be minimum of one unit length from jambs of openings.

.5 No horizontal or diagonal chases will be permitted.

3.3 MASONRY BEARING

.1 Masonry bearing shall extend full thickness of wall, unless otherwise indicated.

.2 Unless otherwise indicated, provide at least 8” of bearing for lintels and beams.

.3 Bearings of block masonry walls: use minimum 2 courses of solid or grouted block units except where concrete bearing pads are required.

.4 Bearings in brick masonry walls: use solid face brick where exposed to view.

.5 Build masonry neatly around beam, and lintel bearings.

3.4 CONSTRUCTION JOINTS

.1 Where fresh masonry joins partially or totally set masonry, clean exposed surfaces of set masonry and remove loose mortar and foreign material prior to laying fresh masonry.

.2 If necessary to stop off a horizontal run of masonry, rack back one-half masonry unit length in each course. Toothing will not be permitted unless approved by the Consultant.

3.5 BLOCKWORK

.1 Blockwork shall be laid up in running bond except where shown otherwise. Unless otherwise indicated, blocks shall be of thickness required to produce total wythe thickness.

.2 Provide standard weight block, unless lightweight block is required. Provide lightweight block where shown.

.3 Do not wet blocks before laying.

.4 Units shall be laid with webs aligning one over the other in full bed of mortar over entire laying surface including webs.

.5 Exposed faces shall be full units laid out to minimize cutting with not less than 4” any at vertical edge or corner.

.6 Top course of block walls shall be laid with solid blocks at door and window sills, at wall changes to brick and where shown.

.7 Use solid block for at least two courses under all point bearing loads.

.8 Provide bullnose block at all exposed block corners, except where otherwise directed by Consultant.

.9 Provide minimum 16” solid or grouted block for jambs of openings and at ends of walls.

.10 Cut with power saw exposed units to accommodate flush mounted electrical outlets, grilles and other components. Leave maximum 3/16” clearance. Cover plates and flanges must cover cut edges.

.11 Blockwork scheduled to be left exposed or painted shall be laid and pointed with utmost care. Distribute units of varying colour and texture evenly to achieve homogeneous blend. Replace at no extra cost to Contract, block units which in the opinion of the Consultant are too contrasting in

appearance for satisfactory blending.

.12 Take special care to prevent mortar or other substances from staining exposed block faces. Replace stained blocks as directed by the Consultant at no extra cost to Contract.

3.6 BLOCK LINTELS

.1 Build block lintels; install reinforcement and concrete fill. Unless otherwise detailed make lintels 8" high.

.2 Lintels shall have minimum 8" bearing, with care taken in layout of wall to ensure that lintel jointing coincides with regular bond of wall.

.3 Provide building paper in joint at bearings and at vehicle joint at ends of block lintels to break bond.

3.7 JOINT WORK

.1 Make joints uniform and 3/8" thick unless otherwise shown.

.2 All joints including joints in walls above ceilings and areas behind wall mounted and built-in fixtures, shall be tooled when thumbprint hard with a 1" o.d. plastic tool to produce a concave joint.

.3 Joints in unparged masonry below grade shall be pointed tight with a trowel.

.4 Joints directly behind resilient base, rigid insulation, ceramic tile and gypsum board shall be struck flush.

3.8 ANCHORING, BONDING & REINFORCEMENT

.1 Anchor or bond walls and partitions at points where they intersect.

.2 Except where stack bond is required bond each wythe or masonry walls and partitions at corners by alternately bonding 50% of units of each wall and partition at corner intersection.

.3 Bond non-loadbearing walls and partitions to loadbearing walls with ties spaced at 16" o.c. vertically. Provide one tie for each 4" thickness, or part thereof, of wall or partition.

.4 Anchor masonry walls and partitions to concrete and steel elements with anchors spaced at 16" vertically.

.5 Unless otherwise indicated reinforce all walls and partitions with continuous horizontal metal reinforcement, installed at 16" o.c. vertically.

.6 At wall openings place continuous reinforcement in first and second mortar joints above and below openings. Additional reinforcement at openings shall extend 24" beyond both sides of openings.

.7 Install prefabricated corner assemblies at corners.

.8 Lap continuous reinforcement 6" at splices. Cut reinforcement at control joints.

.9 Tie masonry veneer to concrete back-up in accordance with requirements of CSA A370-04.

.10 Provide lateral support angles at top of non-loadbearing masonry walls/partitions. Anchor angles to structural deck or beam at 10x partition/wall thickness each side of partition and maximum 24" from ends from walls/partition.

3.9 CONTROL JOINTS

.1 Provide control joints in masonry walls supported by foundation walls at approximately 25'0" o.c. and in masonry walls supported on framed slabs at approximately 15'0" o.c., and where shown. Confirm actual locations of control joints with Consultant before starting work.

.2 Provide control joints at intersection of bearing and nonbearing walls.

.3 Construct control joints as shown. Unless otherwise shown make control joints 3/8" wide. Interrupt masonry reinforcement at control joints.

.4 Control joints must be constructed during erection of masonry, and may not be sawcut later.

3.10 STEEL DOOR FRAMES

.1 Install steel frames in masonry walls. Build in frames rigid, true and plumb. Fill voids between frames and masonry with mortar grout. Fill fixed door centre mullions with grout.

.2 Brace frames solidly in position while being built in. Provide temporary horizontal wood spreader at mid-height of frames to ensure maintenance of required frame width until masonry work is completed. For frames over 4'0" width provide temporary vertical support at centre of head.

.3 Comply with installation requirements specified under Section 08 11 00.

3.11 GROUTED MASONRY

.1 Provide grouted masonry at loadbearing walls in accordance with requirements shown on structural drawings.

.2 Meet requirements of CSA S304.1-04 and CSA A371-04, except where indicated otherwise.

3.12 MISCELLANEOUS

.1 Where non-loadbearing, non-fire rated partitions extend to underside of structural deck, terminate partitions as detailed. Where not detailed allow for structural deflection and fill space with premoulded joint filler. Recess joint filler to permit installation of caulking by Section 07 92 00. Refer to Section 07 84 00 for firestopping requirements at fire rated partitions.

.2 Provide paper backed galvanized steel lath as required for support of grout and mortar fill within masonry elements.

3.16 PATCHING AND CLEANING

.1 At completion of work, holes and other defects in masonry joints shall be repaired, and masonry surfaces shall be thoroughly cleaned.

.2 Holes in masonry joints shall be filled with mortar and suitably tooled. Cut out and repoint defective joints. Use coloured mortar to match existing.

.3 Dry brush masonry surfaces at end of each day's work and after all final pointing.

.4 Remove mortar smears and droppings from concrete block masonry surfaces after such smears and droppings have dried. When mortar joints are dry and hard, clean block masonry surfaces by rubbing down with abrasive blocks and stiff fibre brushes.

.5 Upon completion of work, clean blockwork by brushing and washing. In extreme cases a 5% solution of muriatic acid may be used preceded and followed by a copious bath of clean water. Clean blockwork to be painted to suit requirements of Section 09 91 00.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Rough carpentry: Section 06 10 00

.2 Finish carpentry: Section 06 20 00

.3 Painting: Section 09 91 00

.4 Corner guards: Section 10 26 13

1.3 DESCRIPTION

.1 Unless clearly shown to be part of the work of another Section, the work of this Section includes all metal work required including but not limited to:

.1 Stairs, railings and guards

.2 Ladders

.3 Door 133A header beam

.4 Steel channel raceways

1.4 WORK SUPPLIED BUT NOT INSTALLED

.1 Supply following items for installation under the Sections of work: anchor bolts, bearing plates, sleeves and other inserts to be built into concrete and masonry elements and required for anchorage and support of metal fabrications.

.2 Supply other Sections with instructions, and if required, templates, necessary for accurate setting of inserts and components.

1.5 QUALITY ASSURANCE

.1 Qualifications of Welders: welding shall be performed by fabricator certified under CSA W47.1-03, for appropriate class of work.

.2 Comply with applicable requirements of CSA S16-01.

1.6 SHOP DRAWINGS

.1 Submit detailed shop drawings of all metal fabrications required, showing profiles, members, fastenings, thicknesses, finishes and other pertinent data.

.2 Shop drawings for stairs, supporting framing for stairs, ladders, balustrades, railings, guards and door 133A header beam shall bear stamp and signature of a professional engineer registered in the province of Nova Scotia.

1.7 PRODUCT HANDLING

.1 Deliver, handle and store fabricated components to prevent permanent distortion, corrosion and damage.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Steel sections and plate: CAN/CSA-G40.21-04 minimum 260W Grade.

.2 Square steel tube: CAN/CSA-G40.21-04, Grade 350W.

.3 Steel pipe: ASTM A53, Type E, Grade A.

.4 Sheet steel: hot dip galvanized, cold rolled, with stretcher level degree of flatness to ASTM A653; zinc coating designation Z275.

.5 Metal gratings: hot dip galvanized welded or pressure locked steel gratings, type 19-4 by Dominion Bridge, Border, Armco, Fisher-Ludlow or other manufacturer approved by Consultant; stair treads with checkered nosing.

.6 Checkered steel plate: CAN/CSA-G.40-04, minimum 260W Grade.

.7 Welding materials: CSA W59-03.

.8 Shop primer: CAN/CGSB-1.40-97.

.9 Bituminous enamel: alkali resistant asphaltic coating.

.10 Non-shrink grout: Por-Rok by Hallemite Products Ltd., or SET 15 Minute Anchoring Cement by SET Products Ltd.

2.2 FABRICATION - GENERAL

.1 Fabricate components in the shop in largest size practicable to minimize field jointing.

.2 Fabricate components square, straight, true, free from warpage and other defects. Accurately cut, machine file and fit joints, corners, copes and mitres.

.3 Reinforce fabricated components to safely withstand expected loads.

.4 Make joints in built-up sections with hairline joints in least conspicuous locations and manner.

.5 Make allowance for thermal expansion and contraction when fabricating exterior work.

.6 Joints shall be welded unless otherwise indicated and unless details of construction do not permit welding. Exposed welds shall be continuous and shall be ground smooth.

.7 Close exposed open ends of tubular members with welded on steel plugs.

.8 Where work of other Sections is to be attached to work of this Section, prepare work by drilling and tapping holes, as required to facilitate installation of such other work.

.9 Work of this Section, supplied for installation under other Sections, shall be prepared as required ready for installation by: drilling, countersinking and tapping holes, forming shapes and cutting to required sizes.

.10 Grind off mill stampings and fill recessed markings on steel components left exposed to view.

2.3 METAL STAIRS

.1 Build stairs and landings to detail shown. Sizes of stringers and other structural members shown are minimum sizes.

.2 Construct stairs and landings to safely support minimum load of 150 psf evenly distributed over treads

and landings.

.3 Cope and crank stringers as necessary to line with floor steel members at framed openings for stairs. Apply continuous welds to cranked stringer joints.

.4 Fabricate tread pans and support brackets for metal pan stairs from minimum 1/8" sheet steel and continuously weld to support members. Grind exposed welds smooth.

.5 Where indicated provide checkered plate steps bolted or welded to stringers.

.6 Between stair stringers and wall provide minimum 1/8" thick steel trim.

2.4 RAILINGS

.1 Definition: the term "railing" shall be taken to mean balustrades guards, rails and railings of all types>

.2 Fabricate railings to conform to applicable building code requirements.

.3 Construction: unless otherwise indicated:

.1 Close open ends of tubular members with welded steel plugs.

.2 Turn exposed ends of wall rails into wall.

.3 Support railings at each end and at maximum 4'0" o.c. between.

.4 Tub wall thickness: minimum .1".

.5 At corners, angle sand intersections cope or mitre and weld and grind smooth.

.6 Pickets shall be solid bars.

2.5 FINISHES

.1 Thoroughly clean steel of loose scale, rust, oil, dirt and other foreign matter. Suitably prepare steel surfaces by power tool cleaning to receive specified finishes.

.2 Grind smooth sharp projections.

.3 Remove oil and grease by solvent cleaning.

.4 Apply coatings in the shop and before assembly. Where size permits, galvanize components after assembly.

.5 Interior components: shop apply coat of primer to interior components after fabrication except where other finish is required.

.6 Apply coat of bituminous enamel to contact surfaces of metal components in contact with cementitious materials and dissimilar metals.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install components plumb, square, straight and true to line. Drill, cut and fit as necessary to attach this work to adjoining work.

.2 Provide temporary supports and bracing required to position components until they are permanently anchored in place.

.3 Securely anchor components in place; unless otherwise indicated, anchor components as follows:

.1 To concrete and solid masonry with expansion type anchor bolts.

.2 To hollow construction with toggle bolts.

.3 To thin metal with screws or bolts.

.4 To thick metal with bolts or by welding.

.5 To wood with bolts or lag screws.

.6 Fill space between railing members and sleeves with non-shrink grout.

.4 Provide all components required for anchoring. Make anchoring in concealed manner wherever possible. Make exposed fastenings, where approved by Consultant, neatly and of same material, colour, texture and finish as base metal on which they occur. Keep exposed fastenings evenly spaced.

.5 Dissimilar metals and metals in contact with cementitious elements shall have contact surfaces coated with bituminous paint or be isolated by other means as approved by Consultant.

.6 After installation, clean and refinish injured finishes, welds, bolt heads and nuts. Refinish with zinc rich paint or primer to match original finish.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1	Metal fabrications:	Section 05 50 00
.2	Finish carpentry:	Section 06 20 00
.3	Steel doors and frames:	Section 08 11 00
.4	Wood doors:	Section 08 14 16
.5	Washroom accessories:	Section 10 28 13

1.3 QUALITY ASSURANCE

.1 Lumber shall bear the grading stamp of an agency certified by The Canadian Lumber Standards Administration Board.

.2 All lumber shall be sound, straight, dressed all sides and kiln dried, and moisture content at any time during shipment and storage shall not exceed 19%.

1.4 SUBMITTALS

.1 Submit erection drawing for stage flooring and supporting framing. Shop drawing shall bear seal and signature of a professional engineer licensed to practice in Nova Scotia.

1.5 WORK SUPPLIED BUT NOT INSTALLED

.1 Supply to other Sections anchors, bolts, rough hardware and other items required to be built into work of other Sections to receive, accommodate, secure work of this Section.

.2 Provide other Sections with instructions to ensure accurate setting of built-in items.

1.6 PRODUCT HANDLING

.1 Store materials on site to prevent deterioration, loss or impairment of their structural and other essential properties. Prevent excessive moisture gain of materials.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Lumber:

.1 Meet requirements of CSA-O86-09 Strength Group D (spruce-pine-fir) and CAN/CSA-O141-05 and National Lumber Grading Authority (NLGA) Standard Grading Rules.

.2 Blocking, Copings, Nailers, Curbs: NLGA 122c "Standard".

.2 Plywood:

.1 All locations except backboards: Douglas Fir to CSA O121-08 Unsanded Sheathing Grade.

.2 Backboards: Canadian Softwood Plywood to O151-09, Sanded grade, solid two sides, fire

retardant pressure treated.

.3 Fasteners and Connecting Hardware:

.1 Nails: to CSA B111-1974, hot dip galvanized steel for exterior work including components located in exterior walls and roofs; bright finish steel in all other locations. Unless otherwise indicated use common spiral flathead nails.

.2 Bolts, nuts, washers: ASTM A307, hot dip galvanized steel.

.3 Connectors, anchors, brackets, spikes: hot dip galvanized structural quality steel.

.4 Screws: zinc, cadmium or chrome plated.

.5 Fasteners in contact with preservative pressure treated wood shall be stainless steel unless otherwise approved by Consultant.

.6 Subfloor adhesive: Titebond All Weather Subfloor Adhesive or LePage PL400 Subfloor and Deck Adhesive.

2.2 WOOD TREATMENT

.1 Preservative pressure treated components: to CSA O80 Series-08 using copper and azole; standard of acceptance: Wolmanized “Natural Select” by ArchWood Protection Canada Corp.

.2 Fire retardant pressure treated components: to CAN/CSA-O80 Series-08 for maximum flame spread of 25 and labelled by ULC.

.3 Surface cut, bore and trim components to sizes required as much as possible prior to pressure treatment.

PART 3 - EXECUTION

3.1 GENERAL

.1 Erect work plumb, level, square and to required lines. Ensure that materials are rigidly and securely attached to each other and to adjacent building elements and will not be loosened by work of other Sections.

.2 Where other materials and components are to be applied directly over wood members recess heads of fastening devices below wood surfaces.

.3 Where work remains exposed to view, fasteners shall be uniformly and evenly spaced and neatly installed.

3.2 FRAMING

.1 Do framing, erection, fastening as indicted; and in accordance with building code requirements.

.2 Unless otherwise shown space framing members, studs at 16” o.c.

.3 Place spanning members with “crown” edge up.

.4 Install plywood sheathing/subflooring with end joints staggered, with grain of face plies running perpendicularly to wood framing members and with ends bearing on framing members.

.5 Leave 1/16” space between exterior sheathing panels.

.6 Provide subfloor adhesive on top of each floor joint, below subflooring and screw fasten subflooring with countersunk screws at maximum 12" o.c. along each support.

3.3 NAILERS, BLOCKING, COPINGS, GROUNDS, CURBS

.1 Provide wood nailers, blocking, copings, strapping, bucks, grounds and other rough carpentry components to sizes and in locations required for satisfactory support of fabricated items and other work. Provide wood blocking at steel stud framed gypsum board partitions for support of wall mounted components.

.2 Unless otherwise indicated, provide minimum 1 ½" thick materials. Grounds may be 7/8" thick material unless otherwise indicated.

.3 Provide built-up wood curbs for rooftop mounted equipment. Unless otherwise detailed, provide 3 5/8" thick curbs extending minimum 12" from top of roof membrane to top of curb.

3.3 ANCHORS AND FASTENERS

.1 Provide rough hardware including nails, screws, bolts, washers, brackets, hangers, and fastening devices of all types.

.2 Unless otherwise indicated, attach wood members at maximum 600 mm o.c. as follows:

.1 To concrete and solid masonry with expansion or friction type anchor bolts.

.2 To hollow masonry with toggle bolts.

.3 To heavy gauge metal with bolts.

.4 To light gauge metal with screws or bolts.

.5 To wood with nails, screws or bolts as required to ensure stability.

.3 Fasten wood copings to supporting masonry elements with ½" galvanized steel bolts minimum 12" long spaced maximum 24" o.c. Where width of coping plate exceeds 4", stagger bolts off centre.

3.4 BACKBOARDS

.1 Where required by Division 16 and by telephone system supplier, provide minimum 19 mm thick fire retardant treated plywood backboards mounted on strapping if required.

.2 Size backboards to adequately accommodate equipment to be mounted. Secure boards with countersunk fasteners to supporting walls in manner which will carry equipment load without damaging wall.

3.5 PRESERVATIVE PRESSURE TREATED COMPONENTS

.1 Use preservative pressure treated lumber and plywood within exterior wall and roof systems and at other locations indicated on drawings.

.2 Where it is necessary to cut, bore or otherwise alter pressure treated components in the field, treat cut surfaces with heavy coat of wood preservative.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1	Metal fabrications:	Section 05 50 00
.2	Rough carpentry:	Section 06 10 00
.3	Quartz surfacing fabrications:	Section 06 61 19
.4	Wood doors, except as specified herein:	Section 08 14 00
.5	Glass and glazing:	Section 08 81 13
.6	Stage wood flooring:	Section 09 64 26
.7	Acoustic perforated wood panels	Section 09 84 39
.8	Sinks, faucets:	Division 22
.9	Electrical outlets:	Division 26

1.3 DEFINITION

.1 "Exposed" when referred to in this Section shall mean all parts that can be viewed and shall include interiors of cupboards, cabinets and counters, backs of doors, shelving, gables, drawers.

1.4 QUALITY ASSURANCE

.1 Reference Standards: unless otherwise specified, carry out finish carpentry work in accordance with requirements of "Architectural Woodwork Quality Standards" (latest issue) of Architectural Woodwork Institute (AWI) and Architectural Woodwork Manufacturers' Association of Canada (AWMAC), Custom Grade.

1.5 SUBMITTALS

.1 Submit detailed shop drawings for wood panelling showing proposed assembly, connections, anchorage, materials, dimensions, thickness and finishes. Verify dimension on site prior to fabrication.

.2 Submit duplicate samples of each type of solid wood and plywood used in exposed work prior to fabrication. Include all types of finishes including plastic laminates, metals.

1.6 MOCK-UPS

.1 At location directed by Consultant, construct mock-up of wood panelling, minimum 8’ x 8’, incorporating edge details and junctions to each panel type and thickness.

.2 Mock-up may be incorporated into finished work, once approved by Consultant.

1.7 PRODUCT DELIVERY, HANDLING AND STORAGE

.1 Protect cabinetwork against damage, including damage by excessive changes in moisture content. Maintain minimum storage temperature of 16^{o}C, and relative humidity 25% to 55%.

.2 Cover plastic laminate faces at shop with heavy kraft paper.

.3 Do not deliver finish carpentry components to site before all wet trades are completed, the building is closed in and humidity conditions on site are acceptable. Do not deliver during rain or damp weather.

.4 From time of fabrication until installation, store handle and transport materials so as to prevent deterioration or loss or impairment of essential properties. Prevent moisture gain of kiln dried materials.

1.8 PROTECTION

.1 Provide coverings as necessary to protect finish carpentry components from damage of any kind during storage and after installation.

1.9 WARRANTY

.1 At no cost to Owner remedy any defects in work of this Section due to defects in materials and workmanship, including but not necessarily limited to delamination, warping, and other defects detrimental to appearance and/or performance for a period of 2 years from date of Substantial Performance.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Solid Wood:

.1 Unless otherwise indicated, provide AWI/AWMAC Premium Grade.

.2 All wood materials shall be new, straight and clean, free of sap, knots, pitch, and other defects, except as permitted by applicable grading rules.

.3 All wood shall be kiln dried to a maximum moisture content of 6% to 8%.

.4 Hardwood: White Ash Premium Grade.

.5 Softwood: to CSA O141-05, dressed all sides used in concealed locations only except where shown otherwise. Concealed framing: No. 1 Grade White Pine.

.2 Bumper rails: extruded 100% recycled plastic: Perma Deck Advantage+ by Cascades; sizes as shown; colours selected by Consultant.

.3 Panel Materials:

.1 Hardwood plywood: to CSA O115-1982, Type II, AWI/AMMAC AA Grade White Ash veneer.

.2 Softwood plywood: to CSA O151-09 Sanded Grade, solid two sides; use in concealed locations only.

.3 Particleboard: ANSI A208.1, minimum 700 kg/m³ density.

.4 Medium-density fibreboard: ANSI A208.1, minimum 700 kg/m³ density.

.5 Hardboard: CGSB 11-GP-3M, Type 2.

.6 Melamine faced panels: melamine resin impregnated sheet, thermally fused to particleboard; colours/textures selected by Consultant from full range of products by Uniboard Canada Inc., or Panolam by Flakeboard or other products approved by Consultant. Colours selected by Consultant.

.4 Plastic Laminated Components:

.1 Plastic laminate facing sheet: ANSI/NEMA LD3-2005, Grades HGS, VGS and HGP; colours, gloss and texture will be selected by Consultant from full rang eof products by Formica, Arborite, Nevamar, Wilsonart, Pionite. Colours selected by Consultant.

.2 Backing sheet: BKL Grade by manufacturer of facing sheet.

.3 Core: ANSI A208.1, minimum density 700 kg/m^3.

.4 Laminating adhesive: CSA-O112 Series M1977.

.5 Core sealer: clear water resistant synthetic resin sealer.

.5 Fasteners and Adhesive:

.1 Nails and staples: CSA B111-1974, galvanized.

.2 Screws: zinc, cadmium or chrome plated steel.

.3 Adhesive: CSA-O112 Series - M1977, waterproof type as approved by Consultant.

.6 Cabinet Hardware: Products listed below are a standard of acceptance. Products by other manufacturers, of equal quality and similar appearance may also be provided subject to review and approval by Consultant.

.1 Hinges for ¾" door Blum 91-650, 170^o with self-closing spring.

.2 Door and drawer pull: GSH 302 x 4", CTC 7.5 mm o.d. brushed stainless steel.

.3 Drawer slides: full extension for 100 lbs load @ 20", KV 1429 by K & V or Accuride.

.4 Drawer locks: Olympus 078 or CompX National C8702 or Corbin CCL 02066, keyed as directed by Consultant.

.5 Cabinet locks: Olympus 078 or CompX National C8702 or Corbin CCL 02067, keyed as directed by Consultant.

.6 Automatic door bolt per double doors: Hafele 245.58.754.

.7 Pilaster and clips: KV 255, 256.

.8 Hardware finish: unless otherwise indicated chrome or nickel plated.

2.2 FABRICATION

.1 General Requirements:

.1 Exposed surfaces:

.1 Provide wood members free from bruises, blemishes, mineral marks, knots, shakes and other defects, except as specifically permitted by grade rules.

.2 Select exposed surfaces in any one area for balanced overall appearance free of stark contrasts.

.3 Sand smooth all exposed surfaces to provide even and uniform finish free of defects detrimental to appearance.

.2 Exposed joints and edges:

.1 Uniformly space exposed joints unless otherwise indicated.

.2 No edge grain shall be visible; mitre external corners, house internal corners. Secure corners with corrugated metal fasteners. Glue mitred corners.

.3 All exposed edges of plywood and particle board shall have solid wood edging, pressure glued, unless required to be covered with plastic laminate, melamine or PVC edge banding.

.3 Mechanical fasteners:

.1 Inconspicuously locate mechanical fasteners. Wherever possible conceal fastenings.

.2 Countersink nail heads.

.3 Where exposed to view, countersink screw and bolt heads and fill holes with matching plugs.

.4 Cutting and fitting: make cutouts in work of this Section as required to accommodate work of other Sections.

.2 Standing and Running Trim:

.1 Fabricate trim of hardwood.

.2 Length: standing trim shall be in one piece. Running trim shall be in longest practicable lengths.

.3 Thickness: unless otherwise indicated, minimum ½".

.3 Bumper rails:

.1 Fabricate bumper rails to sizes and profiles shown. Slope cut rails at intermediate joints. Make provisions for anchorage to wall as shown.

.4 Plastic Laminate Components:

.1 Unless otherwise specified herein meet requirements of AWI/AWMAC "Quality Standards".

.2 Assembly: bond plastic laminate to core with adhesive using pressure. Bond plastic laminate to both faces of core using same adhesive and same pressure.

.3 Core: , unless otherwise indicated: ¾" thick plywood or particleboard.

.4 Balanced construction: plastic laminate covered components shall be of balanced construction, with plastic laminate on both faces of core. Seal core edges not covered with plastic laminate.

.5 Use largest practicable plastic laminate sheet size.

.6 Provide joints symmetrically; provide joints at corners and at changes in superficial areas; provide concealed draw bolt anchors at joints. All butt joints shall have a blind spline.

.7 Construct countertops with preformed front edge and square corner splashback. Chamfer edges uniformly at approximately 20^{o}; do not mitre.

.8 At L-shaped corners mitre plastic laminate to outside corner. Accurately fit members together to provide tight and flush butt joint.

.9 Apply self-edged minimum .06" thick plastic laminate to exposed ends of countertops.

.10 Construct splashbacks minimum 4" high or higher where indicated. Return splashback at ends except where indicated otherwise.

.11 Openings and cutouts:

.1 Radius internal corners at least 1/8" and chamfer edges.
.2 Where core edge is to remain exposed, cover with plastic laminate edging.
.3 Where core edge is to be concealed, seal with sealer.

.5 Wood Panelling:

.1 Fabricate wood panelling of hardwood plywood with solid ¼" hardwood edges matching panel veneer on all sides.

.2 Select hardwood plywood for each area where panelling is used, so as to produce a well blended appearance, free of starkly contrasting veneer colours within any one area. Run wood grain in direction shown on drawings. Replace components which in Consultant's opinion are not of a satisfactory appearance.

.3 Prepare panelling for mounting with concealed metal hangers.

.4 Factory finish all wood panelling with a stain and polymerizing two component catalytic conversion varnish system; colour and sheen to be selected by Consultant. All surfaces shall be carefully prepared and sanded before and between coats to provide final finish which shall be smooth, even and uniform free of machine marks, hammer marks, depressions and imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Examine existing conditions to ensure that they are satisfactory to receive the work of this Section.

.2 Start of installation shall imply acceptance of conditions.

3.2 INSTALLATION

.1 Install components plumb, true and level and securely fasten in place. Accurately scribe and closely fit components to irregularities of adjacent surfaces.

.2 Accurately fit joints in true plane, locate joints over bearing or supporting surfaces.

.3 Provide mechanical fastening devices such as nails, screws and bolts required for fastening wood components. Unless permitted provide concealed fastening of components.

.4 Where permitted, nail with small headed finishing nails. Countersink nail heads with nail setter.

.5 Install plastic laminate components using concealed fastening devices.

.6 Where components are fastened with screws or bolts, countersink screw and bolt heads and provide wood plugs matching surrounding wood.

.7 Where cabinetwork abuts other building elements provide wood trim matching cabinetwork except where otherwise detailed.

.8 Prepare work of this Section to receive services, fittings and fixtures provided by Division 22 and 26.

.9 Where access is required to valves and other mechanical and electrical components, located behind cabinetwork, provide removable plywood access panels of size required and secure with four brass screws.

.10 Check operation of all movable parts and, if necessary, adjust to ensure proper and smooth function.

.11 Upon completion of installation, inspect work of this Section and touch up, where required, minor or damaged surface finish to restore it to original condition. Replace damaged components which, in the opinion of the Consultant, cannot be satisfactorily repaired.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Metal support brackets: Section 05 50 00

.2 Rough carpentry: Section 06 10 00

.3 Cabinetwork: Section 06 20 00

.4 Sealants, except as specified herein: Section 07 92 00

.5 Plumbing fixtures: Division 22

1.3 QUALITY ASSURANCE

.1 Fabricator qualifications: fully trained and certified/licensed by material manufacturer.

.2 Installer qualifications: fully trained, with minimum 5 years experience in type of work specified.

1.4 SUBMITTALS

.1 Submit complete and detailed product data for each product required.

.2 Submit shop drawings showing materials, thickness, configurations, edge condition location of intermediate joints, location and dimensions of cutouts, location of support and blocking members.

.3 Submit duplicate minimum 12” x 12” samples of selected surfacing of each required colour and with required finish. Incorporate typical edge condition and intermediate seam.

.4 Submit duplicate cured sample of each colour and type adhesive and sealant required.

.5 Submit maintenance instructions for incorporation into operation and maintenance manual.

1.5 MOCK-UP

.1 Construct mock-up of type, size and at location directed by Consultant.

.2 Include backsplash, fascias, intermediate joint and plumbing fixtures and trim; coordinate with Division 22 as required.

.3 Approved mock-up may remain as part of the work.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Follow manufacturer’s recommendations and handle units in a manner to prevent breakage. Brace units if necessary. Transport in the near vertical position with finished face toward finished face. Do not allow finished surfaces to rub during shipping and handling.

.2 Store units in racks in near vertical position. Prevent warpage and breakage. Store inside away from direct exposure to sunlight. Store between 5°C and 35°C.

1.7 WARRANTY

.1 Provide manufacturer’s limited commercial 10 year warranty against product defects.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Quartz Surfacing: 90% plus crushed quartz aggregate combined with resins and pigments and formed into slabs using a vacuum vibro-compaction process:

.1 Acceptable product: Caesarstone Quartz Surfacing.

.2 Thickness: minimum ¾", unless shown otherwise.

.3 Colours: selected by Consultant from manufacturer's full colour range.

.3 Finish: honed.

.4 Flammability:

.1 Provide with the following Class A (Class 1) surface burning characteristics as evidenced by testing identical products against ASTM E84 (UL 723) or another testing and inspecting agency acceptable to authorities having jurisdiction.

.2 Flame Spread Index: 25 or less.

.3 Smoke Developed Index: 450 or less.

.5 Material shall be labelled in unexposed location with manufacturer's identification mark.

.2 Mounting adhesive: structural grade silicone or epoxy adhesive, by one of the following manufacturers:

.1 Acceptable Silicone Manufacturers:

.1 Dow Corning

.2 GE Sealants and Adhesives

.2 Acceptable Epoxy Manufacturers

.1 Akemi North America

.2 Bonstone Materials Corporation

.3 Tenax U.S.A.

.3 Stone joint adhesive: epoxy or polyester adhesive, recommended by surfacing manufacturer for particular application and conditions of use, colour tinted to match surfacing, where exposed, by one of the following:

.1 Akemi North America

.2 Bonstone Materials Corporation

.3 Tenax U.S.A.

.4 Solvent: as recommended by surfacing manufacturer.

.5 Cleaning agent: non-abrasive, low pH type.

2.2 FABRICATION

.1 Fabricate vanities and countertops in shop to sizes, profiles and thicknesses required.

.2 Fabricate tops in longest practicable sizes to minimize number of intermediate joints. Intermediate joints shall be hairline type, with concealed spline. Avoid L-shaped pieces.

.3 Inspect materials for defects prior to fabrication.

.4 Cut and polish with water cooled powered tools.

.5 Make cutouts for penetrating work. Cutouts shall have a minimum of 3/8" radius. Reinforce inside corners to prevent cracking.

.6 Where edges of cutouts will be exposed in finished work, polish edges.

.7 Laminate layers of surfacing with colour matching adhesive as required to create built up edges to profiles shown, following procedures recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verify dimensions by field measurements prior to installation.

.2 Verify that substrates supporting stone are plumb, level and flat to within 1/8" in 10' and that all necessary supports and blocking are in place.

.3 Base cabinets shall be secured to adjoining units and back wall.

.4 Inspect materials for defects prior to installation.

3.2 PREPARATION

.1 Clean surfaces prior to installation.

.2 Protect finished surfaces from scratches. Apply masking where necessary. Take necessary precautions to prevent dirt, grit, dust and debris from other trades from contacting the surface.

3.3 INSTALLATION

.1 Install materials in accordance with manufacturer's instructions and reviewed shop drawings.

.2 Position materials to verify the correct size.

.3 If size adjustments, or additional fabrication is necessary, use water cooled tools. Protect jobsite and surface from dust and water. Perform work away from installation site if possible.

.4 Allow gaps for expansion not less than 1/8" per 10' when installed between walls or other fixed structure.

.5 After verification of fit and finish, clean substrate; remove loose and foreign matter which may interfere with adhesion. Clean surfacing backside and joints with solvent.

.6 Horizontal surface: apply continuous bead of mounting adhesive around perimeter of structural substrate and supports.

.7 Vertical surface: apply continuous bead of mounting adhesive around perimeter. In addition, apply 6 mm mounting adhesive bead every 8" o.c. vertically.

.8 Install surfacing plumb, level, square and flat to within 1/8" in 10', non-cumulative.

.9 Align adjacent pieces in same plane.

.10 Joints between adjacent pieces of stone: joints shall be flush, tight fitting, level and neat; securely join adjacent pieces with adhesive; fill joints level to polished surface; and secure adjacent stone surfaces with vacuum clamps until adhesive hardens.

.11 Joints between stone surface and other surfaces: seal in accordance with requirements specified in Section 07 92 00.

.12 Repair minor surface damage as recommended by manufacturer. Replace units which in Consultant's opinion cannot be satisfactorily repaired.

.13 Remove masking, excess adhesive and sealant and clean exposed surfaces with denatured alcohol.

.14 Protect installed work from damage of any kind.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Masonry backing: Section 04 20 00

.2 Gypsum and cement board backing: Section 09 21 16

1.3 SUBMITTALS

.1 Submit duplicate minimum 4” x 8” samples of each type of panel required.

.4 Submit duplicate minimum 8” long, samples of each type of wall mouldings required. Submit mechanical fastener sample.

1.4 MOCK-UP

.1 Prior to start of work erect minimum 8’-0” x 8’-0” mock-up panel, at location directed by Consultant. Include corner condition and intermediate joint detail complete with moulding.

.2 Mock-up panel may be incorporated into finished work if approved by Consultant.

1.5 MATERIAL DELIVERY, STORAGE AND HANDLING

.1 Deliver components in original manufacturer’s packaging.

.2 Unpack panels upon arrival on site and restack in a protected indoor location, on a flat, dry surface. Do not place panels on a new concrete slab or any other surface that will emit moisture.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Wall Panels Type 1: .125” thick fibreglass reinforced plastic sheets with embossed surface finish and maximum flame spread of 25 when tested in accordance with CAN/ULC-S102; colour Bright White: one of the following products:

.1 Exeliner FRP by Graham Products Ltd.

.2 left blank

.3 Equivalent product by other manufacturer approved by Consultant.

.2 Wall Panels Type 2: reinforced plastic sheets as specified under wall panels type 1 laminated to 9.5 mm thick plywood; one of the following products:

.1 Exeliner FRP Laminated Panels by Graham Products Ltd.

.2 Equivalent products by Kemlite or other manufacturer approved by Consultant.

.3 Mouldings: extruded vinyl of one or two piece design, colour matched to panels.

.4 Mechanical fasteners: nylon drive rivets, colour matched to panels.

.5 Adhesive: FRP adhesive as recommended by panel manufacturer.

.6 Sealant: one part silicone, as recommended by panel manufacturer; colour selected by Consultant.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Before installation of panels, increase temperature in application areas above expected operating temperature.

.2 Store wall panels in area of application flat on clean, dry surface for at least 24 hours prior to installation.

.3 Clean and condition substrates as required to provide smooth and flush surfaces; remove high spots and fill low spots. Substrates shall be dry and clean, free of dust, grease and other contaminants. Start of installation shall imply acceptance of substrate conditions.

3.2 WALL PANELS

.1 Install wall panels with adhesive method in combination with mechanical fasteners, in accordance with panel manufacturer's directions.

.2 Provide type 1 panels at locations with gypsum board substrate and type 2 panels at locations with masonry substrate.

.3 Provide mechanically fastened mouldings at panel joints and terminations.

.4 Provide sealant at edges of panels (within moulding). Leave sufficient expansion space at all panel edges.

.5 Apply sufficient adhesive to ensure 100% coverage. Supplement panel securement with mechanical fasteners at spacing recommended by panel manufacturer. Arrange fasteners in orderly, aligned and uniformly spaced patterns acceptable to Consultant. Predrill fastener holes in panels 1/8" larger than fastener diameter. Do not overdrive fasteners.

.6 Make cutouts for penetrating work. Allow for minimum 1/8" clearance around penetrating elements and fill with sealant.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Firestopping and smoke seals: Section 07 84 00

.2 Acoustical insulation inside gypsum board elements: Section 09 21 16

.3 Duct and pipe insulation: Division 22

1.3 PRODUCT STORAGE AND HANDLING

.1 Deliver insulation to site in sealed wrappings bearing manufacturer's name, product name and RSI or KSI value.

.2 Store materials in a dry area protected from the elements.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Rigid fibrous insulation: glass fibre or mineral wool board: CAN/ULC-S702-10; density of 3 pcf; minimum R4.2 per 1” thickness: Fiberglas 700 Series by Owens Corning or RXL 40 by Roxul Inc.

.2 Batt or roll type: mineral or glass fibre CAN/ULC-S702-10.

.3 Impaling clips: zinc coated Stic-Klip with perforated base and cadmium plated speed washer by Eckel Industries of Canada Ltd., or Insul-Anchors "Spindle" by Continental Studwelding Ltd.; adhesive and mechanical fasteners as recommended by clip manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Substrates to receive rigid board insulation, shall be sound, dry and free of dirt, oil, grease and other foreign substances.

.2 Clean substrates as required. Remove concrete surface ridges and deposits.

3.2 INSTALLATION

.1 Provide under this Section all thermal insulation required except where it is specified to be part of other Sections.

.2 Provide continuous uniform thermal insulation over insulated areas.

.3 Where insulation is interrupted by construction elements, neatly fit insulation around such elements and pack spaces around elements with same insulation.

.4 Moderately butt insulation boards against each other so that there are no gaps.

.5 Stagger joints at multiple layer installations.

.6 Rigid insulation: secure insulation board to supporting work with adhesive bonded or mechanically fastened impale clips spaced at maximum 20” in each direction, unless otherwise indicated.

.7 Batt/roll insulation: completely fill spaces with insulation, leaving no gaps or voids. Do not pack insulation tighter than manufactured density of materials.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 SAMPLES

.1 Submit samples of vapour retarder and plastic pan.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Vapour retarder: 10 mil thick polyethylene to CAN/CGSB-51.34-M86.

.2 Plastic pans for electrical outlet and junction boxes: Air Vapour Barrier Box by Lessco.

.3 Sealant: Tremco Acoustical Sealant.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Ensure continuity of vapour retarder at all locations. Coordinate with other Sections as required.

.2 Provide vapour retarder on "warm" side of insulation.

.3 Place vapour retarder laps over solid backing and seal with sealant between sheets. Seal at terminations and penetrations.

.4 At electrical outlets / boxes provide plastic pans and seal vapour retarder to pan. Seal at wire penetrations.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Rough carpentry: Section 06 10 00

.2 Roof hatch: Section 07 72 83

.3 Mechanical and electrical penetrations: Division 21 to 28 incl.

1.3 DESCRIPTION

.1 This section covers patching, repairing, infilling at new penetrations through existing roof system.

.2 The existing roof system is assumed to be as follows:

Wood deck
½" gypsum board mechanically fastened
2 ply #15 felt vapour barrier
2 layer of 3" insulation mopped
1 layer of ½" fibreboard
1 layer of composite ply mopped in hot melt adhesive
2 layer of glass flet mopped in hot melt adhesive
Flood coat and gravel with hot melt adhesive.

1.4 QUALITY ASSURANCE

.1 Roofer qualifications: member in good standing of the CRCA and/or approved by the Consultant.

.2 Reference standards: where work required is not specified or shown in detail meet applicable requirements of CRCA Roofing Specification Manual, latest issue.

.3 Ensure compatibility between all roofing materials used.

1.5 PRODUCT HANDLING

.1 Store materials in dry location protected from inclement weather.

.2 Deliver and store materials in manufacturer's original and sealed containers or packaging.

1.6 JOB CONDITIONS

.1 Protect existing work from damage. When using equipment with open flame, maintain at work area a 9kg fire extinguisher, fully charged and operational.

.2 Do not apply roofing materials during precipitation nor over damp or otherwise unsuitable substrates.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Notwithstanding materials specified herein, in each case only use materials which are compatible with each other and with existing materials with which they are in contact.

.2 Felts:

.1 Base felt: Tremco Composite Ply

.2 Inorganic felt: ASTM D-2178 Type II

.3 Organic felt: #15 to CSA A123.3-05

.3 Asphalt CSA A123.4 M1979 Type 2 for slopes upt o 1:15, Type 3 for slopes greater than 1:15.

.4 Asphalt primer: CAN/CGSB-37.5-M89.

.5 Adhesive: Tremco Powerply Hot Melt Adhesive.

.6 Membrane flashings:

.1 Base sheet: self adhesive modified bitumen to CGSB 37-GP-56M, Type 2, Class C Grade 2.

.2 Cap sheet: torch grade modified bitumen to CGSB 37-GP-56M Type 1, Class A, B or C, Grade 2.

.7 Insulation: polyisocyanurate board.

.8 Fibreboard: CAN/CSA A247-M86, high density, asphalt coated.

.9 Cant strips: 100 x 100 mm rigid fibreglass or rigid fibreboard.

.10 Gravel: clean, water washed pea gravel 6 mm to 16 mm, no fines.

.11 Metal flashings: p repainted, galvanized sheet steel, minimum 24 ga thick: Baycoat Perspectra (Whites, Colours, Earth Tones) colour selected by Consultant.

.12 Falshing locking strips: galvanized sheet steel ASTM A653 (Z275), minimum 20 ga thick.

PART 3 - EXECUTION

3.1 ROOF ALTERATIONS

.1 Coordinate work of this Section with that of Section 06 10 00 and Division 21 to 28 incl. Repair, make good, tie into and extend existing roof system, where new work penetrates existing roof.

.2 Ensure compatibility of new materials with exisitng. Perform material tests where type of existing material is uncertain.

.3 Cut existing roof system to straight line, to facilitate tie-in of new materials.

.4 Protect and temporarily seal adjacent roofing against intrusion of water. Make good roofing as promptly as possible.

.5 Remove existing gravel from built-up membrane for a distance of minimum 24" beyond junction between new and existing membrane.

.6 Remove debris and waste materials, clean deck and provide new vapour retarder, insulation, fibreboard and roof membrane, attaching thickness and type of existing systems components, at disturbed areas. Provide can strip at intersections with vertical surfaces.

.7 Install built-up membrane lapping onto existing membrane 8", 12", 16" and 20". Ensure watertight junction between existing and new membrane.

.8 Make junctures at new or altered penetrations or added vertical surfaces, using modified bitumen sheet flashings, compatible with existing roof system, as follows:

.1 Base sheet: apply self adhesive membrane 3" over areas required, lapping laterally and 6" on ends. Extend base flashing 9" onto roof surface. Carry base sheet to the top of curb.

.2 Cap sheet: torch apply cap sheet to previously applied base sheet and install as per manufacturer's printed instructions. Extend cap flashing 12" onto the roof surface. Extend cap sheet over top of curb.

.3 Mechanically secure membrane flashings along top edge.

.9 Pour coat all altered, patched roof areas and cover with gravel matching existing.

.10 Provide metal flashings at new penetrations, secured with continuous locking strips. Provide flat locked seams at maximum 10' o.c.' double back exposed edges.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Roof repairs: Section 07 59 13

.2 Painting: Section 09 91 00

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

.1 Structural design: hatch cover shall safely support a minimum live load of 40 psf.

.2 Air and water control: closed hatch shall be weatherproof. Design hatch to prevent passage and leakage of water and air infiltration and exfiltration.

.3 Operation: hatch cover shall be hinged single leaf type. Operation shall be manual, with opening and closing mechanism operable from outside and inside.

1.4 SHOP DRAWINGS

.1 Prepare and submit detailed shop drawings showing fabrication and installation requirements.

PART 2 - PRODUCTS

2.1 MATERIALS AND FABRICATION

.1 Acceptable Products:

.1 Bilco Type E-20 with ladder safety post
.2 Lexcor R-105G with safety bar
.3 Acudor G4444 with safety ladder extension

.2 Material: galvanized sheet steel to ASTM A653 zinc coating designation Z275.

.3 Size (clear inside): 36” x 36”

.4 Fabrication:

.1 Weld and grind smooth all corners and connections.

.2 Provide angle shaped curb with predrilled holes for fastening to curb and continuous integral cap flashings. Fabricate curbs 18” high, unless otherwise indicated.

.3 Provide sandwich-construction hatch cover with continuous neoprene perimeter draft seal.

.4 Insulate curb and hatch cover with minimum 1” rigid fibre insulation.

.5 Provide heavy duty pintle hinges, compression spring type lifting mechanism enclosed in telescopic tubes, automatic hold open arms with vinyl covered handle, two point spring latch, inside and outside handles and padlock hasps. All hardware shall be zinc coated.

.5 Safety Device: provide one of the following:

.1 Ladder safety post: Ladder UP by Bilco; steel black enamel finish; telescoping tubular construction with automatic locking feature in fully extended position.

.2 Safety bar; externally mounted 1 3/8" diameter PVC coated safety bar by Lexcor.
.3 Safety ladder extension: hot dip galvanized steel: Acudor SLE.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Securely fasten roof hatch to roof deck.

.2 Install steel trim angle to cover junction between roof deck and roof hatch curb.

.3 Install safety device to ladder or to outside of roof hatch, as directed by manufacturer.

.4 After installation, adjust operable parts as required to ensure proper operation.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Sealants: Section 07 92 00

1.3 QUALITY CONTROLS

.1 Firestopping components shall be listed and labeled by ULC.

1.4 SUBMITTALS

.1 Prior to start of work submit list of proposed firestopping and smoke seal materials together with suitable documentation to verify that specified requirements will be met.

.2 Upon Consultant's request submit samples of materials.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Firestopping and smoke seal systems: in accordance with CAN/ULC-S115-11, asbestos free and capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of jurisdictional authorities; labeled by ULC. Fire resistance rating of installed systems shall equal to fire resistance rating of adjacent/surrounding building components.

.2 Firestopping materials: foamed in place insulation, mortar, gun grade sealant, mineral fibre felt or other materials bearing ULC label for required fire rating.

.3 Firestopping and smoke seals for vertical fire separation shall meet ULC designation PJ, JF and HW as required for respective location.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install firestopping and smoke seal materials in accordance with manufacturer's recommendations and ULC test requirements.

.2 Provide firestopping and smoke seal between fire rated walls/partitions and structural deck above, at control joints in fire rated walls/partitions, and at other locations, where required to maintain integrity of smoke and fire barriers.

.3 Firestopping and smoke seal in locations exposed to view shall be recessed to permit installation of sealant by Section 07920.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Acoustical sealants related to gypsum board: Section 09 21 16

1.3 DEFINITION

.1 Caulking = Sealant.

1.4 QUALITY ASSURANCE

.1 Use only sealants which are proven to be compatible with materials they are in contact with. Notify Consultant prior to start of work should any sealant specified be considered unsuitable for the purpose intended.

1.5 PRODUCT HANDLING

.1 Deliver sealants to site in sealed containers bearing manufacturer's name, brand name of sealant and reference standard to which sealant complies.

.2 Store materials in a dry area having an ambient temperature within limitations recommended by material manufacturer.

1.6 JOB CONDITIONS

.1 Unless otherwise specified, apply sealants when air temperature is between 10°C and 25°C. When air temperature is above 25°C or below 10°C follow sealant manufacturer's recommendations regarding application.

.2 Co-ordinate work of this Section with that of Section 09 91 00. Prior to start of work review installation procedures with Consultant, where caulking is located adjacent to painted surfaces.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Sealants

.1 Compatibility: provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as recommended by sealant manufacturer based on testing and field experience.

.2 Interior vertical joints: one part acrylic latex with joint movement capability of ± 7½%, paintable: ASTM 834; Standard of acceptance: Tremco Tremflex 834.

.3 Interior horizontal joints: multi-component, self-leveling, chemically curing polyurethane: ASTM C920, Type M, Grade P, Class 25; Standard of acceptance: Tremco THC-900.

.4 Interior wet locations: mildew-resistant silicone formulated with fungicide: ASTM C920, Type S, Grade NS, Class 25, Uses NT, G, A; Standard of acceptance: Dow Corning 786 Mildew Resistant Silicone Sealant.

.5 Sealant colours: selected by Consultant from manufacturer’s standard range, unless custom colour is required.

.2 Primers, thinners, cleaners: As recommended by sealant manufacturer, non-staining type.

.3 Premoulded backup for sealant: Non-gassing foam rope, compressed 25% when in joint: Sof-Rod by Tremco or Cera-Rod by W.R. Meadows.

.4 Bond breaker: Polyethylene tape, self-adhering one side.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Examine joints to be caulked and report in writing to the Consultant any defects in work of other Sections which would impair installation, performance and warranty of sealants.

.2 Do not commence installation of sealants until conditions are acceptable.

.3 Start of work implies acceptance of conditions.

3.2 PREPARATION

.1 Clean and prepare joints to be caulked to produce clean sound surfaces for sealant adhesion.

.2 Remove dust, oil, grease, water, frost, loose mortar and other foreign matter. Remove loose particles by blowing joint out with compressed air.

.3 Chemically clean non-pourous surfaces such as metal and glass, taking care to wipe solvents dry with a clean cloth. Use solvents recommended by sealant manufacturer.

.4 Clean porous surfaces such as masonry, concrete and stone by mechanical abrading.

.5 Surfaces adjacent to joints to be primed and which may be stained by primer shall be masked with tape before primer is applied.

.6 Prime joints in accordance with sealant manufacturer's recommendations. Apply primer before installing premoulded backup.

.7 Install premoulded backup in joints 6 mm and more in width. Roll rope type backup into joint, do not stretch or braid. Install bond breaker in joints less than 6 mm in width.

.8 Protect adjacent surfaces from stains and contamination. Make good any damage caused.

3.3 APPLICATION

.1 Apply sealants under pressure using suitable equipment. Gun nozzle shall be of proper size to fit, and seal joint.

.2 Force sealant into joints in full bead, making certain that void free contact is made with sides of joint. Tool joints to produce a slightly concave surface.

.3 Caulking must appear as a concave recessed joint, free of ridges, wrinkles and embedded foreign matter. Caulking shall not spread or bulge beyond surfaces on each side of joint.

.4 Apply sealants in accordance with following table:

Joint Width	Sealant Depth
5 mm	5 mm
10 mm	5 mm
15 mm	7 mm
20 mm	10 mm
25 mm	12 mm

3.4 CLEANING

.1 As work progresses, remove sealant smears and stains from adjacent surfaces. Use cleaning method recommended by sealant manufacturer.

.2 Leave adjacent surfaces in neat and clean condition.

3.5 SCHEDULE

.1 Apply sealant at the following locations:

.1 Between dissimilar materials in exposed locations except where specifically indicated otherwise.

.2 Perimeter of steel door and screen frames.

.3 Control joints in masonry elements, and joints between bearing and non-bearing masonry walls.

.4 Control joints in gypsum board components.

.5 Control joints in ceramic tile work.

.6 Perimeter of firehose cabinets, access panels, and control panels.

.7 Between countertops and sinks.

.8 Between floors and WC's.

.9 Between countertops and wall.

.10 Between plumbing fixtures and abutting surfaces.

.11 At base of walls.

.12 Where shown.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Firestopping: Section 07 84 00

.2 Sealants: Section 07 92 00

1.3 SUBMITTALS

.1 Submit detailed shop drawings of each component specified showing fabrication and installation requirements.

.2 Submit samples and accurate colour charts for selection of colour for resilient filler strip.

PART 2 - PRODUCTS

2.1 MATERIALS AND FABRICATION

.1 Expansion joint covers of the same materials and finishes, similar in function to those specified, manufactured by the following are considered equal subject to the approval of the Consultant.

.1 Construction Specialties Ltd.
.2 Migua by Emseal Corporation
.3 MM Systems Corporation by M.W. McGill & Associates Ltd.

.2 Fabricate components in longest practicable lengths.

.3 Prefabricate transition pieces.

.4 Resilient filler strip shall be keylocked or bonded to aluminum retainers.

.5 Select width of covers to suit joint size.

.6 System: Construction Specialties C/S Flush Thinline or equivalent system by other manufacturers listed:

.1 Floor to floor: Model GFT
.2 Floor to wall: Model GFTW
.3 Flat wall / ceiling: Model FWF
.4 Corner wall / ceiling: Model FWFC

2.2 FINISHES AND COLOURS

.1 Aluminum surfaces in contact with cementitious materials: apply shop coat of zinc chromate primer.

.2 Aluminum surfaces exposed to view: mill finish.

.3 Resilient filler strip colour: selected by Consultant from manufacturer's full range of standard colours.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install expansion joint covers in accordance with manufacturer's printed directions.

.2 Provide all items required for installation of joint covers and fire stops.

.3 Install floor joint covers flush with adjacent finished surfaces.

3.2 SCHEDULE

.1 Provide floor expansion joint covers where joints are exposed to traffic and/or view.

.2 Provide wall expansion joint covers where joints are exposed to view, except where detailed otherwise.

.3 Provide ceiling expansion joint covers where joints are exposed to view, except where detailed otherwise.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1	Rough carpentry:	Section 06 10 00
.2	Finish carpentry:	Section 06 20 00
.3	Caulking at frame perimeters:	Section 07 92 00
.4	Wood doors:	Section 08 14 00
.5	Sound control door assemblies:	Section 08 34 73
.6	Supply only of finish hardware:	Section 08 71 00
.7	Glazing:	Section 08 81 00
.8	Painting:	Section 09 91 00
.9	Electrical conduits and wiring for door access and security system:	Division 26

1.4 QUALITY ASSURANCE

.1 Acceptable manufacturers: one of the following:

.1 Artek
.2 Daybar
.3 Metal Door
.4 Fleming-Baron

.2 Reference standards: unless otherwise specified, meet requirements of "Canadian Manufacturing Specification for Steel Doors and Frames" and "Recommended Dimensional Standards for Commercial Steel Doors and Frames" published by the Canadian Steel Door Manufacturers' Association.

.3 Fire protection requirements: fire rated doors and frames shall bear ULC or WHI label for required rating and shall be installed with NFPA 80 - Fire Doors and Windows, current edition. Provide temperature rise rated assemblies where required.

1.5 WORK SUPPLIED BUT NOT INSTALLED

.1 Supply frames and anchors to other Sections where it is necessary to build frames into work of other Sections.

.2 Supply instructions required for accurate positioning and proper installation of components supplied to other Sections.

1.6 SHOP DRAWINGS

.1 Prepare and submit detailed shop drawings. Include door and frame schedules, materials and finishes, hardware preparations and frame anchorage details. Include adjacent construction and finishes as detailed on drawings. Provide engineered shop drawing for oversized door frame and track support.

1.7 PRODUCT HANDLING

.1 Tag doors and frames at shop with identification marks indicating proper location for installation.

.2 Deliver, store and handle components so as to prevent damage, distortion and corrosion. Store components off the ground and under cover in a dry protected area. Stack doors and frames to prevent twisting. Do not enclose components in plastic covers without venting.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Sheet Steel: hot dip galvanized (wipe coated) cold rolled steel with stretcher level degree of flatness, meeting requirements of ASTM A924 and A653; minimum zinc coating designation ZF120.

.2 Core Material:

.1 Fire rated doors: in accordance with fire test requirements.

.2 Interior doors, except fire rated doors: honeycomb core of rigid, pre-expanded resin impregnated paper with maximum 1" hexagonal shaped cells.

.3 Reinforcing steel: CAN/CSA-G40.21-04 Grade 300W, hot dip galvanized to CAN/CSA-G164-M92.

.4 Finishing Materials:

.1 Touch up paint: zinc rich paint CAN/CGSB-1.181-92.

.2 Metal filler: two component epoxy type.

2.2 HARDWARE PREPARATION

.1 Prepare for mortised and cylindrical hardware in accordance with ANSI A115 Series standards, except where specified otherwise. Provide mortise lock preparation to ANSI A115.1, including integral reinforcement channel, mounting tabs, and lock support. Provide cylindrical lock preparation to ANSI A115.2, including integral latch case support.

.2 Blank, reinforce, drill and tap doors and frames in shop for concealed and mortised hardware. Reinforce doors and frames for surface mounted hardware. Provide door closer reinforcement at all steel doors and frames whether closer is required by hardware list or not. Provide exterior doors and frames to receive alarm system contact switches.

.3 Coordinate with Section 08 71 00 and Division 26 to accommodate room access and security system components.

2.3 DOORS

.1 Construct fire rated doors in accordance with fire test requirements. Double doors shall be labelled without need for mullions, astragals or coordinating devices. Doors with transom panels shall be labelled with rebated interlocking head condition.

.2 Provide all doors of seamless construction with no visible seams or joints on faces.

.3 Exterior doors to be of hollow steel construction with all spaces filled with insulation; interior high traffic doors shall be of honeycomb core construction. Skins shall be 16 ga thick. Join door faces at vertical door edges by continuous weld, extending full height of door; grind, fill and dress smooth.

.4 Interior doors shall be of honeycomb core construction. Skins shall be minimum 18 ga thick. Join door faces at vertical door edges by tackwelding, filling and grinding smooth.

.5 Provide flush end closures made of steel at top edge of exterior doors and where required for attachment of hardware.

.6 Hardware reinforcements shall be minimum 10 ga thick exclusive of door skin thickness. Provide hardware reinforcement at all hardware fastening points.

.7 Surround openings in flush doors with minimum 18 ga thick steel edge channels, welded to both face sheets.

.8 Provide removable glazing stops of zinc coated steel channels mitred at corners, accurately fitted into position and fastened with oval head screws.

.9 Construct oversized doors to sizes indicated; frame and reinforce doors as required to maintain shape.

2.4 WELDED FRAMES

.1 Provide welded frames of 16 ga thick sheet steel to profiles shown, and as required to suit wall conditions. Form glass and door stops integrally with frame; do not add as a separate profile.

.2 Assemble components with accurately cut joints. Mitre outside corner joints of frames continuously. Weld joints on inside of profile; grind welds, flush and sand to smooth uniform surface; tabbed and spotwelded construction is not acceptable.

.3 Fit and assemble work in the shop wherever possible, eliminating field joints.

.4 Glazing stops shall be minimum 20 ga thick steel, mitred at corners, drilled and secured with oval head screws.

.5 Side light and transom framing shall be of same thickness metal as adjacent door frame.

.6 Drill interior door frames for rubber bumpers. Drill strike jamb of each single door frame for 3 bumpers. Drill head member of double door frames for 2 bumpers.

.7 Provide angle or channel door head reinforcement for doors wider than 36”.

.8 Tack weld two removable minimum 18 ga thick steel spreader channels to inside faces of door frames at base.

.9 Provide adjustable base clips for anchorage to floor at bottom of each door jamb.

.10 Protect hardware reinforcements at frames located in masonry elements with 0.9 mm thick guard boxes.

.11 Hardware reinforcements shall be minimum 10 ga thick exclusive of frame thickness. Provide hardware reinforcement at all hardware fastening points.

.12 Where indicated provide removable mullions.

.13 Make provisions to accommodate automatic door openers where required. Coordinate with Division 26.

.14 Provide welded on metal drip at head of exterior doors.

2.5 FINISHES

.1 Fill seams, corner joints and other depressions with filler and sand smooth.

.2 Clean and remove all traces of oil, grease and other foreign substances to ensure proper bond of touch up after fabrication.

.3 Touch up damaged zinc coating with zinc rich paint.

.4 Insulate, where necessary to prevent electrolysis, metal surfaces in contact with dissimilar metals or cementitious materials.

PART 3 - EXECUTION

3.1 FRAME AND SCREEN INSTALLATION

.1 Allowable limit of distortion shall be 1/16” out of plumb at each jamb, measured on face of frame, resulting in maximum twist of frame of 1/8” measured from upper corner to lower diagonal corner.

.2 Generally, anchorage of frames shall be by means of standard anchors. Where standard anchors cannot be used, provide special anchors to ensure proper installation. Method of anchorage shall not be visible when frames are installed.

.3 Provide minimum 3 anchors at each jamb. At frames exceeding 7’0” in height provide one additional anchor for each additional 24”, or part thereof.

.4 Anchor intermediate vertical frame members to structure above as required to ensure stability. Where required, provide steel frame extensions. Provide flexible connection at structure to allow for deflection.

.5 Remove steel shipping spreaders at welded frames; install wood installation spreaders at sill and at third points of frame rabbet height to maintain constant frame width. Remove wood spreaders only after frames are securely anchored in place.

3.2 DOORS

.1 Install steel doors and panels.

.2 Install hardware in accordance with hardware supplier's instructions.

.3 Adjust operable parts to ensure proper operation.

3.3 TOUCH-UP

.1 Patch damaged shop primer. Remove rust, sand damaged and abraded surfaces and touch-up with zinc rich paint.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1	Cabinet doors:	Section 06 20 00
.2	Steel door frames:	Section 08 11 00
.3	Sound control door assemblies:	Section 08 34 73
.4	Supply of door hardware:	Section 08 71 00
.5	Miscellaneous glazing:	Section 08 81 00
.6	Painting:	Section 09 91 00

1.3 QUALITY ASSURANCE

.1 Acceptable wood door manufacturers:

- .1 Algoma
- .2 Baillargeon
- .3 Lambton
- .4 V.T. Industries

.2 Meet requirements of CAN/CSA-0132.2 Series-90 and AWMAC Quality Standards for Architectural Woodwork except where specified.

.3 Fire rated doors shall bear ULC label.

1.4 SUBMITTALS

.1 Submit product data indicating door core materials and construction.

.2 Submit detailed shop drawings. Illustrate doo opening criteria, elevations, sizes, types, swings, undercuts required, special blocking and preparation for hardware, cut outs for louvers, glazing and other openings.

.3 Submit duplicate, minimum 12” x 12” samples of selected factory finished wood door facing.

.4 Submit minimum 8” long sample of each type of glazing stop.

1.5 PRODUCT DELIVERY, STORAGE & HANDLING

.1 Protect doors from dampness. Arrange for delivery after work causing high humidity has been completed.

.2 Protect doors from scratches, handling marks and other damage. Individually package doors in scuff and water resistant wrappings.

.3 Label each door with manufacturer’s name, product identification, door size and type.

1.6 WARRANTY

.1 At no cost to Owner remedy any defects in work, including work of this and other Sections, due to defects in doors provided under this Section, appearing within a period of 3 years from the date of Substantial Performance.

.2 Defects covered under warranty shall include warp exceeding ¼".

.3 Warranty shall cover all costs for replacement of defective doors including hanging, fitting, finishing, changing of hardware and removal of defective door.

PART 2 - PRODUCTS

2.1 SOLID CORE DOORS

.1 Flush doors: 5 ply, solid core, 1 ¾" thick.

.2 Construct fire rated doors in accordance with fire test requirements.

.3 Core: solid particleboard, to ANSI A208.1. For fire rated doors, provide core in accordance with fire test requirements.

.4 Crossbanding, both faces of core: 1/16" thick hardwood or composite veneer.

.5 Door facing: Wood veneer for transparent finish: minimum .05" thick White Ash, AWI/AWMAC Grade AA, factory finished with clear satin catalyzed lacquer, meeting AWI Quality Standard Section 1500, System #3, stain colour and sheen selected by Consultant.

.6 Edge bands: Laminated to core with adhesive:

.1 Stiles: laminated softwood and 5/8" thick hardwood edge; total width minimum approximately 1 5/8".

.2 Rails: approximately 1 5/8" softwood.

.7 Glazed openings: prepare openings where indicated to receive glazing. Provide hardwood glazing stops as per details, installed to project slightly over door face, mitred at corners. Provide glazing stops for fire rated doors, in accordance with fire test requirements.

.8 Factory prepare doors for finish hardware in accordance with directions by Section 08 71 10.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Accurately fit doors into frames to ensure smooth operation without binding. Doors shall have 1/16" clearance at head and jambs and 6 mm over finished floor surfaces unless otherwise indicated.

.2 Undercut doors where shown.

.3 Prepare doors and install door grilles where required.

.4 Install hardware in accordance with hardware supplier's instructions

.5 Adjust operable parts to ensure proper door operation.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Steel doors and frames, except as specified herein: Section 08 11 00

.2 Wood doors: Section 08 14 16

.3 Supply of door hardware: Section 08 71 00

.4 Miscellaneous glazing, except as specified herein: Section 08 81 00

.5 Painting: Section 09 91 00

1.3 DESCRIPTION

.1 The work of this section includes sound control door assemblies, each consisting of:

.1 Steel door

.2 Steel door frame

.3 Perimeter acoustic seals

.4 Bottom seal and threshold

.5 Glass and glazing stops for glazed doors

1.4 PERFORMANCE REQUIREMENTS

.1 Acoustic performance of installed doors and frame assemblies: minimum sound transmission class (STC) of 42, tested to ASTM E90.

1.5 QUALITY ASSURANCE

.1 Acceptable manufacturers:

.1 Ambico Ltd.

.2 Fleming Door Products

.2 Steel doors and frames: CSDMA “Recommended Dimensional Standards for Commercial Steel Doors and Frames”, “Recommended Specifications for Commercial Steel Door and Frame Products” and “Sound Retardant Steel Door and Frame Assemblies”.

.3 Installed fire rated door and frame assemblies shall conform to NFPA 80 fire rating as required. Fire rated door and frame assemblies shall bear ULC label for required rating.

1.6 SUBMITTALS

.1 Submit detailed product data for each product required.

.2 Submit detailed shop drawings. Show door opening criteria, elevations, sizes, types, swings, acoustic gasketing, special blocking and preparation for hardware, cut outs for thresholds, glazing.

.3 Submit minimum 8” long sample of glazing stop.

1.7 PRODUCT DELIVERY, STORAGE & HANDLING

.1 Protect doors and frames from dampness. Arrange for delivery after work causing high humidity has been completed.

.2 Protect doors and frames from scratches, handling marks and other damage. Individually package doors in scuff and water resistant wrappings.

.3 Label each door and frame with manufacturer's name, product identification, door size and type.

.4 Weld minimum two temporary jamb spreaders per frame prior to shipment.

.5 Remove frames from wrappings or coverings upon receipt on site and inspect for damage. Leave doors covered for protection until hung.

.6 Store doors in horizontal position, frames in vertical position, spaced with blocking to permit air circulation between components.

1.8 WARRANTY

.1 At no cost to Owner, remedy any defects in work, including work of this and other Sections, due to defects in doors provided under this Section appearing within a period of 5 years from the date of Substantial Performance.

.2 Warranty shall cover all costs for replacement of defective doors including hanging, fitting, finishing, changing of hardware and removal of defective door.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Steel:

.1 Sheet steel: galvanized steel to ASTM A653, ZF180.

.2 Reinforcement [Channel]: To CSA G40.20/G40.21, coating designation to ASTM A653, ZF75.

.2 Accessories:

.1 Glazing stops for frames: Formed galvanized steel channel, butted corners; prepared for countersunk tamperproof screws for side lite and borrowed lite frames.

.2 Glazing stops for doors: Formed galvanized steel stops, mitred corners; prepared for countersink tamperproof screws.

.3 Glass: Type as tested to achieve STC and fire ratings. Glazing shall be factory installed.

.4 Primer: Rust inhibitive zinc chromate on frames.

.5 Threshold: Manufacturer’s standard.

.6 Astragal: Manufacturer’s standard.

.7 Perimeter and bottom acoustic seals: Manufacturer’s standard.

.8 Removable mullion: Manufacturer’s standard.

2.2 FABRICATION

.1 Steel Doors:

.1 Sheet steel faces, thickness, design and core suitable to achieve specified STC performance.

.2 Acoustic core construction, longitudinal edges, mechanically inter-locked with visible edge seams.

.3 Reinforce doors where surface-mounted hardware is required.

.4 Drill and tap for mortised, template hardware.

.5 Top and bottom channels: inverted, recessed, welded steel channels.

.6 Astragals: metal acoustic astragals with integral acoustic seals for double doors.

.2 Steel Frames:

.1 Sheet steel, metal thickness and appropriate to maintain door STC and fire ratings, mitred corners, fully welded seams.

.2 Factory assemble and weld frames.

.3 Mullions for double doors: Fixed type except where shown to be removable.

.3 Factory install glazing.

.4 Affix permanent metal nameplates to door and frame, indicating manufacturer's name, and STC rating.

2.3 FINISHES

.1 Metal finish: Factory applied zinc chromate primer.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install components in accordance with manufacturers written instructions.

.2 Coordinate with Sections providing surrounding wall construction for anchor placement.

.3 Set frames plumb, square, level and at correct elevation.

.4 Allow for deflection to ensure that structural loads are not transmitted to frame.

.5 Adjust operable parts for correct clearances and function.

.6 Install and adjust perimeter and bottom acoustic seals.

3.2 ERECTION TOLERANCES

.1 Frames: Installation tolerances of installed frame for squareness, alignment, twist and plumbness shall not be more than ± 1/16".

.2 Doors: Accurately fit doors into frames to ensure smooth operation without binding and tightfitting acoustic seal at all locations.

END

PART 1 – GENERAL

1.1 RELATED WORK

.1	Steel Doors & Frames:	**Section 08 11 14**
.2	Wood Doors:	**Section 08 14 10**
.3	Aluminum Doors & Frames:	**Section 08 41 13**
.4	Electrical wiring for and hook-up of all electrical hardware specified in this section by:	**Sections 26 – 28**

1.2 REFERENCE STANDARDS

.1 Standard hardware location dimensions in accordance with the Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers Association.

.2 ANSI/BHMA A156.2-2011 - Bored and Preassembled Locks and Latches.

.3 ANSI/BHMA A156.1-2006 - Butts and Hinges.

.4 ANSI/BHMA A156.3-2008 - Exit Devices.

.5 ANSI/BHMA A156.4-2008, Door Controls (Closers).

.6 ANSI/BHMA A156.5-2010, Auxiliary Locks and Associated Products.

.7 ANSI/BHMA A156.6-2010, Architectural Door Trim.

.8 ANSI/BHMA A156.7-2009, Template Hinge Dimensions.

.9 ANSI/BHMA A156.8-2010, Door Controls – Overhead Stops and Holders.

.10 ANSI/BHMA A156.13-2005, Mortise Locks and Latches.

.11 ANSI/BHMA A156.15-2006, Closer/Holder Release Devices.

.12 ANSI/BHMA A156.16-2008, Auxiliary Hardware.

.13 ANSI/BHMA A156.18-2006, Materials and Finishes

.14 ANSI/BHMA A156.19-2007, Power Assist and Low Energy Power Operated Doors.

.15 ANSI/BHMA A156.26-2006, Continuous Hinges.

.16 ANSI/BHMA A156.21-2009, Thresholds.

.17 ANSI/BHMA A156.22-2012, Door Gasketing and Edge Seal Systems.

.18 ANSI/BHMA A156.25-2007, Electrified Locking Devices.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

.1 Hardware for doors in fire separations and exit doors to be certified by ULI / ULC, a Canadian Certification Organization accredited by Standards Council of Canada.

1.4 SAMPLES

.1 When requested, submit samples of hardware items in accordance with **Section 01 33 00** - Shop Drawings, Product Data, Samples and Mock-ups.
.2 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
.3 After approval, samples will be returned for incorporation in the Work.

1.5 HARDWARE SCHEDULE

.1 Submit finish hardware schedule using the standard DHI format for finish hardware schedules in accordance with **Section 01 33 00** – Shop Drawings, Product Data, Samples and Mock-ups.
.2 Clearly indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.

1.6 MAINTENANCE DATA

.1 Provide operation and maintenance data for door closers, locksets, door holders and fire exit devices for incorporation into manual specified in **Section 01 77 00 –** Operation and Maintenance Manual.
.2 Brief maintenance staff regarding proper care, cleaning and general maintenance of door hardware items.

1.7 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with **Section 01 77 00.**
.2 Supply two sets of wrenches for door closers, locksets and fire exit hardware.
.3 Supply one L-Series Maintenance Kit Schlage # 40-054 for mortise locksets.

1.8 DELIVERY AND STORAGE

.1 Store finishing hardware in locked, clean and dry area.
.2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

PART 2 – PRODUCTS

2.1 HARDWARE ITEMS

.1 Use one manufacturer's products only for all similar product groups.
.2 The product numbers listed in the finish hardware schedule are to be used as the standard of acceptance for all items and are from the following group of manufacturers:

Full Mortise Hinges	Ives
Continuous Hinges	Ives
Locksets, Deadlocks, Latchsets	Schlage
Exit Devices, Trims,	Von Duprin
Electric Strikes, Power Transfers	Von Duprin
Door Closers	LCN

Overhead Door Stops	Glynn-Johnson
Flush Bolts, Coat Hooks	Ives
Door Stops, Push Plates, Kickplates	Ives
Thresholds, Sound Seal, Door Bottoms & Sweeps, Astragals & Weatherstripping	Draft Seal
Power Supplies	Schlage
Sliding Door Hardware	K N Crowder

.3 Other manufacturer's products will be considered provided they meet or exceed the performance, grade, quality, function, weight, design and finish of the specified product, and requests for approval are approved by the consultant in writing through issued addenda seven (7) days prior to tender closing.

.4 Extended Warranty: Ensure manufacturer's warranty is provided which guarantees all door hardware for a minimum period of two (2) years extended beyond the expiration of the performance assurance requirements specified in the General Conditions.

2.2 DOOR HARDWARE

.1 Butts and hinges:

.1 Butts and continuous hinges: designated by letter and numeral identifiers, followed by size and finish, as listed in Hardware Schedule.

.2 Self-closing hinges and pivots: designated by letter and numeral identifiers as listed in Hardware Schedule.

.3 Butt hinges on exterior doors and locked doors opening out shall have non removable pins (NRP) and doors equipped with door closers or in high traffic areas shall have ball bearing (BB) hinges.

.4 Continuous hinges shall be Grade 1, heavy duty, geared-type, single section, full mortise, and UL 10C listed and approved. Hinges shall provide full height door support with 2" knuckles and nylon bearings (32) at each separation for quiet, smooth and self-lubricating operation. Hinge material to be 6063-T6 Clear Anodized Aluminum, and support door weight up to 450 lbs. Hinges shall have symmetrical hole pattern and minimum of 21 fasteners on each leaf, and be non-handed. Finish to be Clear Aluminum - 628.

.5 Specified product - butt hinges: Ives
Specified product - continuous hinges: Ives

.2 Locks and latches: Mortise

.1 Mortise locks and latches: to ANSI/BHMA A156.13-1994, Series 1000 mortise lock, Grade 1 operational and Grade 1 security, ULC Listed for A label doors, with all functions available in one size case;

.2 Mortise locks shall have a full ¾" throw two-piece mechanical anti-friction latchbolt, a one-piece stainless steel 1" throw deadbolt, and handing of locks shall be reversible without disassembly of the lockcase.

.3 Lever Handles: Schlage # 17 Design, Solid curved design, forged, complete with return to door; trims to be vandal-proof where specified.

.4 Roses: Round design "A" as listed in schedule.

.5 Normal strikes: box type, lip projection not to exceed ¼" beyond jam.

.6 Cylinders: LFIC, key into existing Schlage Everest Restricted Master Key system.

.7 Finish to be Satin Chrome Plated - 626.

.8 Specified products: Locksets - Schlage Lock.

.2a Locks and latches: Cylindrical

.1 Locksets and latchsets are to be heavy duty cylindrical, lever type, and meet ANSI Grade 1, A156.2-2011, A117.1 Accessibility, and ULC requirements, with Large Format I/C cores, keyed into Schlage Everest Restricted Master Key system.

.2 Lever handle trim must have concealed through bolt mounting, and the levers are to be solid cast with a return to the door face. All locks are to have heavy duty cast mounting plates, threaded hub and locking nut, and stainless steel interlocking spindle. Lever design to be Schlage ND-RHO.

.3 Provide ¾" latch throw for pairs of labeled doors.

.4 Roses or Escutcheons: Round design 3 7/16" O.D., as listed in schedule.

.5 Normal strikes: box type, lip projection not to exceed ¼" beyond jam.

.6 Cylinders: key LFIC cores into existing Schlage Everest Restricted Master Key system for CMI – Pier 21 as directed.

.7 Finish to be Satin Chrome Plated - 626.

.8 Specified products: Locksets - Schlage Lock.

.3 Exit Devices:

.1 To be heavy duty, grade 1, modern design push bar style, wide stile, to meet ANSI, ULC, NFPA and ADA certification, to have thru-bolted trim, heavy-duty steel I-beam bar, and heavy gauge latch head with reinforced bracket. All lever trims to be free-wheeling, vandal-resistant, and all devices are to have deadlocking latchbolts.

.2 Finish to be Satin Chrome 626 for complete devices as listed. Functions, trims, and options (QEL, HD-QEL) to be as listed in Hardware Schedule.

.3 Specified product: Von Duprin

.4 Door Closers and Accessories:

.1 Door controls (closers): to meet or exceed ANSI A156.4 Grade 1 requirements; to be heavy duty cast iron bodies with adjustable spring power and have separate valves for latching, closing and backcheck control. All closer arms to be forged steel, with power adjustment arm bracket.

.2 All closers are to be non-sized to suit door and opening, and to have full covers with finish 689. Brackets, shoes, and plates are to be included for proper mounting of closers. All closers shall have minimum 25-year warranty.

.3 Specified product: LCN

.5 Overhead stops/holders:

.1 Door controls (overhead stops/holders): to meet or exceed ANSI A156.8 Grade 1 requirements; to be heavy duty slide track type with heavy duty shock absorber spring and non-metal slide block and shock block, non-handed.

.2 To be Type 304 stainless steel material with stainless steel 630 finish.

.3 Specified product: Glynn-Johnson

.6 Auxiliary locks:

.1 To meet ANSI A156.16 requirements, to be heavy-duty and finished in 626.

.2 Cylinders: rim or mortise type, finished to 626, for installation in exit devices or deadlocks provided with special doors as listed in Hardware Schedule.

.3 Specified product: Schlage

.7 Architectural door trim:

.1 To meet ANSI A156.6 requirements, type 304 stainless steel, finished 630.

.2 Door protection plates: kick plate type 304 stainless steel, 1.27 mm thick stainless steel, finished to 630.

.3 Push plates: type 304 stainless steel, 1.27 mm thick stainless steel, finished to 630.

.4 Door Pulls: type 304 stainless steel, 1" thick stainless steel, finished to 630.
.5 Specified product: Gallery Specialty Hardware

.8 Auxiliary hardware; electric strikes:
.1 To meet ANSI A156.5 Grade 1 requirements; to meet ULC, Burglary-Resistant and Fire Door and Frame certifications. Finish to be 630.
.2 Electric Strikes shall be all stainless steel construction, non-handed, and be fail secure or fail-safe, as listed, with adjustable strike box and two-piece plug connectors.
.3 Specified product: Von Duprin

.9 Door Operators:
.1 Power-operated pedestrian doors: to meet ANSI A156.19 Grade 1, ADA , and UL10C requirements; to be heavy duty with power boost, adjustable spring size, multi-function, with valve adjustable sweep and latch closing speeds, and backcheck cushioning.
.2 Operator to include digital control suite, and programming mode with adjustable delay time, opening time/opening force, safety slow/stop, auto reverse/closing, and electric lock delay, and be finished in 689.
.3 Specified product: LCN

.10 Door bottom seal:
.1 Heavy duty, door seal of extruded aluminum frame and solid closed cell neoprene seal, surface mounted, adjustable, automatic retract mechanism when door is open, clear anodized finish.
.2 Specified product: DraftSeal

.11 Thresholds:
.1 100/127mm wide x full width of door opening, extruded aluminum, serrated surface, with thermal break of rigid PVC, clear anodized finish.
.2 Specified product: DraftSeal

.12 Weatherstripping:
.1 Head and jamb seal:
.1 Extruded aluminum frame and solid closed cell neoprene insert, clear anodized finish.
.2 Adhesive backed santoprene material.

.2 Door bottom seal:
.1 Extruded aluminum frame and closed cell neoprene, one inch drop, automatic closing mechanism, clear anodized finish.
.3 Specified product: DraftSeal

2.3 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 one 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.
.4 Use fasteners compatible with material through which they pass.

2.4 KEYING
.1 All cylindrical and mortise locksets, deadlocks, and exit device trims to have LFIC 6-pin cylinders to suit, and be keyed to the existing factory registered Schlage Everest Restricted Masterkey system, File # C934299 - Kwy. "D145". Doors to be keyed differently, keyed alike, keyed alike in groups,

master keyed or grandmaster keyed as directed. Prepare detailed keying schedule in conjunction with owner's representative.

.2 Provide three (3) change keys for every lock in this Contract.

.3 Provide six (6) master keys for each MK or GMK group, CMK, Control.

.4 Stamp keying code numbers on keys.

.5 Provide one (1) Wall Mounted Key Cabinet and Dual key control system, 150 key capacity, to suit number of locks and cylinders on project.

PART 3 – EXECUTION

3.1 INSTALLATION INSTRUCTIONS

.1 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.2 Furnish manufacturer's instructions for proper installation of all hardware components.

.3 Install hardware to standard hardware location dimensions in accordance with Canadian Imperial Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.

.4 Where door stop contacts door pulls, mount stop to strike bottom of pull.

3.2 SCHEDULE – PHASE ONE

Hardware Set # H-1 - Single Doors, 127, 128; Each to have:

4 Hinges Ives 5BB1 4 ½" x 4 ½" - 630
1 Deadlock Schlage B663R x GMK'D - 626
1 Push Plate Ives 8200-6 x 16 - C32D
1 Door Pull Ives 8302-0-10" - 4 x 16 - C32D
1 Door Closer LCN 4011 H-90 deg FMS - 689
1 Kick Plate Ives 8400 10" x 34 ½" - C32D
1 Wall Stop Ives WS 406CVX - C32D

Hardware Set # H-2 - Single Doors, 128A, 129; Each to have:

4 Hinges Ives 5BB1 4 ½" x 4 ½" - 652
1 Lockset Schlage ND80 RD - SPA x GMK'D - 626
1 Door Closer LCN 4011 H-90 deg FMS - 689
1 Kick Plate Ives 8400 10" x 34 ½" - C32D
1 Wall Stop Ives WS 406CVX - C32D
1 Set Door Seal Draftseal DS130C x 19ft - AL

Hardware Set # H-3 - Pair Doors, 130-A; Each to have:

8 Hinges Ives 5BB1 4 ½" x 4 ½" - 652
2 Push Plates Ives 8200-6 x 16 - C32D
2 Door Pulls Ives 8302-0-10" - 4 x 16 - C32D
2 Door Closers LCN 4040XP REG FMS - 689
2 Kick Plates Ives 8400 10" x 34 ½" - C32D
2 Wall Stops Ives WS 406CVX - C32D
1 Set Door Seal Draftseal DS132C x 22ft - AL
2 Door Bottom Sweeps Draftseal DS344AS x 3ft - AL

Hardware Set # H-4 - Pair Doors, 130-B; Each to have:

8 Hinges Ives 5BB1 4 ½" x 4 ½" - 652
1 Conc V/R D/E Exit Device Von Duprin CX9949L-F x 996L-17-RHR – 8 ft. dr. - 626
1 Conc V/R D/E Exit Device Von Duprin CX9949EO-F-LHR – 8 f.t dr. - 626
1 Rim Cylinder Schlage 20-057 x I/C core x GMK'd - 626
2 Mortise Cylinders Schlage 26-091 x I/C core x GMK'd - 626
2 Door Closers LCN 4040XP EDA FMS - 689
1 Set Door Seal Draftseal DS132C x 22ft - AL
2 Door Sweeps Draftseal DS135C x 3ft - AL
1 Power Supply Von Duprin PS914 x 900-2RS-FA x 900-BBK x 900-KL
2 Electric Power Transfers Von Duprin EPT10 x UL - SP28
Door Contacts & Wiring – by Electrical

Hardware Set # H-5 - Pair Doors, 131; Each to have:

8 Hinges Ives 5BB1 4 ½" x 4" - 652
1 Set C/L Flush Bolts Ives FB51P (LH Dr) - 32D
1 Lockset Schlage ND80 RD - SPA x 14-042 L/B x GMK'D (RH Dr) - 626
1 Door Closer LCN 4011 REG (RH Dr) - 689
1 O/H Door Stop Glynn-Johnson 454S (LH Dr) - 626
1 Wall Stop Ives WS 406CVX - C32D

Hardware Set # H-6 - Pair Sliding Doosr, 133-A; Each to have:

2 Sets Sliding Door Hardware Crowder C-207-8 x 108" x C-204 track c/w 3 hangers - Kit
1 Sliding Door Lock A-R MS1850SN-050MS x 1 ½" BS - 628
1 Mortise Cylinder Schlage 26-091 x I/C core x GMK'd - 626
1 Mortise Cylinder Thumb Turn Schlage 09-900 x 1 1/8" - 626
1 Flush Bottom Bolt Ives FB358 x DP1 Strike - 626
4 Door Pulls Ives 9266-72" x 56" c. to c. x #5 Conc. Mtg. - 626
2 Sliding Door Edge Pulls Ives 230 – 626
2 Kickplates Ives 8400 6" x 102" x #403 Stainless Steel - 630

Hardware Set # H-7 - Pair Doors, 133-B; Each to have:

8 Hinges Ives 5BB1 4 ½" x 4 ½" - 652
1 Conc V/R Exit Device Von Duprin CD9949L-996L-17-RHR-LBL-8 ft. dr. - 626
1 Conc V/R Exit Device Von Duprin CD9949EO x 996L-DT-17-LHR-LBL-8 ft. dr. - 626
1 Rim Cylinder Schlage 20-057 x I/C core x GMK'd - 626
2 Mortise Cylinders Schlage 26-091 x I/C core x GMK'd - 626
2 Door Closers LCN 4040XP EDA FMS - 689
1 Set Door Seal Draftseal DS132C x 22ft – AL
2 Door Sweeps Draftseal DS135C x 3ft - AL

Hardware Set # H-8 - Pairs Doors, 133-C, 133-D, 140; Each to have:

8 Hinges Ives 5BB1 4 ½" x 4 ½" - 652
1 Conc V/R Exit Device Von Duprin 9949L-F x 996L-17-RHR – 8 ft. dr. - 626
1 Conc V/R Exit Device Von Duprin 9949EO-F-LHR – 8 f.t dr. - 626

1 Rim Cylinder Schlage 20-057 x I/C core x GMK'd - 626
2 Door Closers LCN 4040XP EDA FMS - 689
2 Kick Plates Ives 8400 10" x 34 ½" - C32D
1 Set Door Seal Draftseal DS132C x 22ft - AL
2 Door Sweeps Draftseal DS135C x 3ft - AL
Door Contacts & Wiring – by Electrical

Hardware Set # H-9 - Single Door, 133-E; Each to have:

4 Hinges Ives 5BB1 4 ½" x 4 ½" – 652
1 Lockset Schlage ND70 RD - SPA x GMK'D - 626
1 Door Closer LCN 4011 H-90 deg FMS - 689
1 Kick Plate Ives 8400 10" x 34 ½" - C32D
1 Wall Stop Ives WS 406CVX - C32D
1 Set Door Seal Draftseal DS130C x 19ft - AL

Hardware Set # H-10 - Pair Doors, 133A-1; Each to have:

2 Sets Offset Pivots Ives 7226 x ¾" offset - 626
2 Intermediate Pivots 7226 INT x ¾" offset - 626
2 Flush Bolts Ives FB458 x 1@12" / 1@24" FWS - 626
1 Deadlock Schlage L463R x GMK'D - 626
1 Door Pull Ives 8102-6 x 6" x T/B - 630
2 O/H Door Stops Glynn-Johnson 904S FWS - 652

Hardware Set # H-11 - Single Doors, 133B-1, 133B-2, 133B-3, 133B-4; 133F Each to have:

1 Set Offset Pivots Ives 7226 x ¾" offset - 626
1 Intermediate Pivot 7226 INT x ¾" offset – 626
1 Deadlock Schlage L463R x GMK'D – 626
1 Door Pull Ives 8102-6 x 6" x T/B - 630
1 O/H Door Stop Glynn-Johnson 906S FWS - 652

Hardware Set # H-12 - Pair Doors, 134 (Existing); Each to have:

2 Electromagnetic Locks Schlage M490DEP x 12/24V – 628
1 Power Supply Schlage PS904 x 900-8F x 900-KL x 900-BBK
Door Contacts & Wiring – by Electrical

Hardware Set # H-13 - Single Door, 135; Each to have:

4 Hinges Ives 5BB1 4 ½" x 4 ½" – 652
1 Lockset Schlage ND53 RD - SPA x GMK'D - 626
1 Door Closer LCN 4011 REG ½ MS - 689
1 Kick Plate Ives 8400 10" x 34 ½" - C32D
1 Wall Stop Ives WS 406CVX - C32D
1 Set Door Seal Draftseal DS132C x 19ft - AL

Hardware Set # H-14 - Single Door, 135A; Each to have:

4 Hinges Ives 5BB1 4 ½" x 4 ½" – 652
1 Exit Device Von Duprin 99L-F x 996L - 17 x 36" Dr. - 626
1 Rim Cylinder Schlage 20-057 x I/C core x GMK'd - 626
1 Door Closer LCN 4040XP EDA FMS - 689
1 Kick Plate Ives 8400 10" x 34 ½" - C32D
1 Wall Stop Ives WS 406CVX - C32D
1 Set Door Seal Draftseal DS132C x 19ft - AL
1 Door Bottom Sweep Draftseal DS344AS x 3ft - AL
Door Contacts & Wiring – by Electrical

Hardware Set # H-15 - Single Doors, 136, 137; Each to have:

4 Hinges Ives 5BB1 4 ½" x 4" - 652
1 Privacy Lockset Schlage ND40S - SPA x E/K - 626
1 Door Closer LCN 4011 REG ½ MS - 689
1 Kick Plate Ives 8400 10" x 34 ½" - C32D
1 Wall Stop Ives WS406CCV - 626
1 Set Door Seal Draftseal DS130C x 19ft - AL

Hardware Set # H-16 - Single Door, 139; Each to have:

4 Hinges Ives 5BB1 4 ½" x 4 ½" – 652
1 Lockset Schlage ND80 RD - SPA x GMK'D - 626
1 Door Closer LCN 4111 SCUSH ½ MS - 689
1 Kick Plate Ives 8400 10" x 34 ½" - C32D
1 Set Door Seal Draftseal DS132C x 19ft - AL
1 Door Sweep Draftseal DS135C x 3ft - AL

Hardware Set # H-17 – Single Sliding Door, 141; Each to have:

1 Set Sliding Door Hardware Crowder C-207-8 x 72" x C-204 track - 1 Dr. Kit
1 Sliding Door Lock A-R MS1850SN-050MS x 1 ½" BS - 628
1 Mortise Cylinder Schlage 26-091 x I/C core x GMK'd - 626
1 Mortise Cylinder Thumb Turn Schlage 09-900 x 1 1/8" - 626
2 Door Pulls Ives 8190-18 x 18" c. to c. - 630
1 Sliding Door Edge Pull Ives 230 - 626
1 Kickplate Ives 8400 6" x 64" x #403 Stainless Steel - 630

Hardware Set # H-18 - Pairs Exterior Stair Doors, 142, 143; Each to have:

8 Hinges Ives 5BB1 4 ½" x 4 ½" NRP - 630
1 Conc V/R Exit Device Von Duprin 9949L x 996L-17-RHR – 8 ft. dr. - 626
1 Conc V/R Exit Device Von Duprin 9949EO - LHR – 8 f.t dr. - 626
1 Rim Cylinder Schlage 20-057 x I/C core x GMK'd - 626
2 Door Closers LCN 4040XP TJ FMS - 689
2 Mounting Plates LCN 4040-18G – 689
2 O/H Door Stops Glynn-Johnson 904S FMS – 630
1 Threshold DraftSeal DS177X5TBN x 72" - Alum

1 Set Door Seal Draftseal DS132C x 22ft - AL
2 Door Sweeps Draftseal DS138C x 3ft - AL

Hardware Set # H-19 - Single Door, 145; Each to have:

4 Hinges Ives 5BB1 4 ½" x 4 ½" - 652
1 Passage Set Schlage ND10S - SPA - 626
1 Door Closer LCN 4111 EDA ½ MS - 689
1 Kick Plate Ives 8400 10" x 34 ½" - C32D
1 Wall Stop Ives WS 406CVX - C32D
1 Set Door Seal Draftseal DS132C x 19ft - AL
1 Door Sweep Draftseal DS135C x 3ft - AL

Hardware Set # H-20 - Single Door, 145-B; Each to have:

4 Hinges Ives 5BB1 4 ½" x 4 - 652
1 Lockset Schlage ND80 RD - SPA x GMK'D - 626
1 Wall Stop Ives WS 406CVX - C32D

Hardware Set # H-21 - Single Door, 147; Each to have:

4 Hinges Ives 5BB1 4 ½" x 4 ½" - 652
1 Lockset Schlage ND80 RD - SPA x GMK'D - 626
1 Door Closer LCN 4111 EDA ½ MS - 689
1 Kick Plate Ives 8400 10" x 34 ½" - C32D
1 Wall Stop Ives WS 406CVX - C32D
1 Set Door Seal Draftseal DS132C x 19ft - AL

Hardware Set # H-22 - Single Door, 203; Each to have:

4 Hinges Ives 5BB1 4 ½" x 4 ½" - 652
1 Passage Set Schlage ND10S - SPA - 626
1 Door Closer LCN 4111 EDA ½ MS - 689
1 Kick Plate Ives 8400 10" x 34 ½" - C32D
1 Wall Stop Ives WS 406CVX - C32D
1 Set Door Seal Draftseal DS132C x 19ft - AL

Hardware Set # H-23 - Single Door, 207; Each to have:

4 Hinges Ives 5BB1 4 ½" x 4 ½" – 652
1 Lockset Schlage ND80 RD - SPA x GMK'D - 626
1 Door Closer LCN 4111 EDA ½ MS - 689
1 Kick Plate Ives 8400 10" x 34 ½" - C32D
1 Set Door Seal Draftseal DS132C x 19ft - AL
1 Door Sweep Draftseal DS135C x 3ft - AL

Hardware Set # H-24 – Single Sliding Door, 133F; Each to have:

1 Set Sliding Door Hardware Crowder C-207-8 x 48” x C-204 track - 1 Dr. Kit
1 Sliding Door Lock A-R MS1850SN-050MS x 1 ½” BS - 628
1 Mortise Cylinder Schlage 26-091 x I/C core x GMK’d - 626
1 Mortise Cylinder Thumb Turn Schlage 09-900 x 1 1/8” - 626
2 Door Pulls Ives 8190-18 x 18” c. to c. - 630
1 Sliding Door Edge Pull Ives 230 - 626
1 Kickplate Ives 8400 6” x 40” x #403 Stainless Steel - 630

Hardware Set # H-25 - Single Doors, 202, 206; Each to have:

4 Hinges Ives 5BB1 4 ½” x 4 ½” - 652
1 Lockset Schlage ND80 RD - SPA x GMK’D - 626
1 Door Closer LCN 4111 EDA ½ MS - 689
1 Kick Plate Ives 8400 10” x 34 ½” TAPE - C32D
1 Wall Stop Ives WS 406CVX - C32D
1 Set Door Seal Draftseal DS132C x 19ft - AL

END OF SECTION 08 71 00

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements.

1.2 RELATED WORK

.1 Steel doors and frames: Section 08 11 00

.2 Wood doors: Section 08 14 00

.3 Framed washroom mirrors: Section 10 28 13

1.3 QUALITY ASSURANCE

.1 Follow recommendations of the Flat Glass Marketing Association (USA) "Glazing Manual" latest edition.

.2 Every pane of glass shall be factory labelled and label shall remain in place until final cleaning. Safety glass shall have permanent identification.

1.4 WARRANTY

.1 At no cost to Owner, replace mirrors should defects in silvering occur within a period of 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Setting blocks: neoprene, Shore 'A' durometer hardness of 70 to 90 points; spacer shims, 40 to 50 points, as recommended by glass manufacturer.

.2 Glazing sealant: ASTM C940: one part polysulphide or one part silicone.

.3 Glazing tape: polyisobutylene tape; acceptable product: Tremco 440 tape.

.4 Glazing gasket: Tremco Vision Strip; colour selected by Consultant.

.5 Tempered glass: minimum ¼” thick fully tempered float glass to CAN/CGSB-12.1-M90. Tempered glass identification must be sandblasted into glass and shall be visible after installation.

.6 Wired glass: ¼” thick polished, clear glass with square mesh to CAN/CGSB-12.11-M90.

.7 Float glass: CAN/CGSB-12.3-M91 Glazing Quality, clear, minimum ¼” thick.

.8 Mirror glass: minimum ¼” thick, clear float glass (tempered where shown), silvered, mirror quality to CAN/CGSB-12.5-M86.

.9 Mirror adhesive and protective coating as recommended by mirror manufacturer.

PART 3 - EXECUTION

3.1 GLASS INSTALLATION GENERAL

.1 Do not glaze when ambient or surface temperature is less than 5^{o}C. Ensure that glazing rabbets, stops and glass are dry, free of frost, grease, oil, dust, rust and other substances detrimental to adhesion of compounds and sealants.

.2 Provide clearance at perimeter edge of glass on all four sides, minimum equal to glass thickness. Accurately cut glass to fit openings, allowing for expansion in accordance with glass manufacturer's recommendations.

.3 Provide sealer space between face of glass and glazing stops of minimum 1/8”.

.4 Clean sealing surfaces at perimeter of glass and sealing surfaces of rabbets and stop beads before applying glazing tapes, gaskets and compounds. Use solvents and cleaning agents recommended by manufacturer of sealing materials.

.5 Install glazing tapes uniformly with accurately formed corners and bevels. Ensure that proper contact is made with glass and rabbet interfaces.

.6 Set glass on setting blocks, spaced as recommended by glass manufacturer. Provide at least one setting block at quarter points from each corner.

.7 Centre glass in glazing rabbet to maintain specified clearances at perimeter on all four sides. Maintain centred position of glass in rabbet and provide the required sealer thickness on both sides of glass.

.8 Use spacers and shims in accordance with glass manufacturer's recommendations.

.9 Carefully remove glazing stops and reinstall after glazing.

.10 Mark each pane of glass with a white cross of flour paste or other approved means to indicate presence of glass.

3.2 EXTERIOR GLAZING

.1 Unless otherwise indicated glaze exterior openings as follows:

.1 Apply glazing tape to permanent stop; butt tape joints and weld together; do not overlap joints; daub tape corners with sealant.

.2 Set glass on setting blocks, align edges and press home to ensure adhesion oat all points.

.3 Apply heel bead of sealant around perimeter of glass, maintaining 5 mm bite to glass and positive bond to frame. Completely seal void around glass edges. Sealant shall partially fill channel between glass and removable stop.

.4 Install removable stops; insert spacer shims between glass and stops at approximately 610 mm o.c. not less than 6 mm below sight lines. Fill remaining void with glazing compound or sealant to sight line and trim to clean line leaving no voids or depressions.

.5 Glazing gaskets may be installed in lieu of backfilling with sealant or glazing compound after setting removable stops.

3.3 INTERIOR GLAZING

.1 Unless otherwise indicated glaze interior openings as follows:

.1 Apply glazing tape to permanent stop; centre glass in opening and set on setting blocks; apply glass and press against tape.

.2 Apply glazing tape to removable stops and install stops. Trim tape for neat appearance.

3.4 MIRRORS

.1 Install mirrors at locations indicated.

.2 Bond mirrors to substrate with spot adhesive method in accordance with material manufacturer’s

recommendations, or use chrome plated mirror clips.

.3 Prior to applying adhesive, coat back of mirror with protective coating and allow to dry.

.4 Where mirror cannot be produced in one piece, provide two or more panels. Accurately cut, fit and polish panels at joints.

3.5 CLEANING

.1 Remove dirt, scum, plaster, paint spatter, and other harmful and deleterious matter from glass promptly and completely, before they establish tight adhesion.

.2 Avoid using abrasives, steel wool, razor blades, solvents, alkaline or other harsh cleaning agents.

.3 Remove glazing compound droppings promptly from all surfaces as the work progresses.

.4 Replace scratched or otherwise damaged glass.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1	Board and batt thermal insulation:	Section 07 20 00
.2	Firestopping and smoke seals:	Section 07 84 00
.3	Caulking:	Section 07 92 00
.4	Supply of steel door frames:	Section 08 11 00
.5	Acoustic wood fibre panel ceilings:	Section 09 51 56
.6	Painting:	Section 09 91 00
.7	Supply of access doors:	Divisions 21 to 28 incl.

1.3 DEFINITION

.1 Drywall = gypsum board.

1.4 QUALITY ASSURANCE

.1 Interior metal framing and furring: comply with applicable requirements of ASTM C754 and ASTM C840 unless otherwise shown.

.2 Gypsum board application and finishing: comply with requirements of ASTM C840, unless otherwise shown.

.3 Gypsum board surfaces exposed to view shall meet Gypsum Association GA 214-10 Recommended Levels of Gypsum Board Finish “Level 5”.

.4 Gypsum board elements that are permanently attached to building structure, and their support attachments, shall be designed and constructed to resist the effects of seismic motions in accordance to local jurisdiction with applicable regulatory requirements.

.5 Studs used in partitions with a height in excess of 12’0” shall be considered “structural studs” and shall be designed by a professional engineer licensed to practice in Nova Scotia in accordance with the following requirements:

.1 Maximum deflection of studs under design load: L/360.

.2 Design sliding track connections to accommodate expected deflection of building structural frame, without transferring axial loads onto metal stud system.

.3 Meet applicable requirements of CSSBI 51-06 “Lightweight Steel Framing Manual” Second Edition.

.6 Do welding to CSA W59-03. Welders shall be certified by the Canadian Welding Bureau to CSA W47.1-09 for appropriate class of work.

1.5 FIRE PROTECTION REQUIREMENTS

.1 Provide fire rated gypsum and cement board components and assemblies as indicated.

.2 Comply with requirements of Section 01 41 00.

.3 Where firehose cabinets, electrical panels or other fixtures or equipment are recessed into fire rated partitions, provide fire rated backing to maintain required fire rating.

.4 Protect recessed fixtures in fire rated ceilings in accordance with fire rated assembly design report and/or as indicated.

.5 Bulkheads / partitions in ceiling spaces above fire rated glazed screens, doors or other elements shall have same fire rating as screens/doors over which they occur.

.6 Fire rated bulkheads are required in first floor ceiling spaces where construction changes from fire rated floor assembly to non-fire rated roof assembly. Carefully examine Drawings to determine locations.

1.6 SUBMITTALS

.1 Submit detailed and complete product data for each product required.

.2 Submit shop drawings showing provisions and details to accommodate seismic motions in accordance with applicable regulatory requirements. Shop drawings shall bear seal and signature of a professional engineer licensed to practice in Nova Scotia. Show materials, sizes of framing members, thicknesses, spacings, connections and anchorages and other pertinent details.

.3 Submit detailed shop drawings for structural stud framing bearing seal and signature of a professional engineer licensed to practice in location of project. Show design loads, materials, thicknesses, coatings, spacing o members, anchorage to building structure, fastening of members to each other, bracing, sliding track connections and other pertinent details.

1.7 PRODUCT HANDLING AND STORAGE

.1 Handle gypsum board panels to prevent damaged and broken edges.

.2 Store materials in dry place so as to preserve their quality and fitness for work.

1.8 JOB CONDITIONS

.1 Install and finish gypsum board when ambient temperature is between 14 and 22^{o}C. Maintain this temperature range in areas to receive gypsum board for 24 hours before and during application and until joint cement and adhesives are fully cured.

.2 Apply gypsum board after building has been completely enclosed. Ensure that work to be concealed by gypsum board has been installed, tested, inspected and approved before starting work.

PART 2 - PRODUCTS

2.1 FRAMING, FURRING AND TRIM

.1 Unless otherwise specified provide: framing, furring, trim (beads, control joints): minimum 0.5 mm thick core steel, hot dip galvanized (wipe coat) to ASTM A653.

.2 Studs, interior locations: channel shaped screw-on type: depth as indicated; with knurled supporting flanges at least 1 3/8" wide; with service pass-through holes at 610 mm o.c. in web. Provide minimum 20 ga thick studs where stud depth exceeds 3 5/8" and/or where cementitious board and abuse resistant gypsum board is required.

.3 Top and bottom runners: channel sections, 1 3/8" legs. Depth to suit studs. Provide oversized top runner where required to accommodate deflection of structure.

.4 Rough framing members: 1 ½" x ¾" x 18 ga and ¾" x ½" x 18 ga galvanized steel channels.

.5 Furring and strapping members to receive gypsum board: ¾" deep channel shaped section with outstanding flanges and 1 3/8" wide knurled supporting face.

.6 Resilient furring channel: RC-1 by CGC.

.7 Corner beads: beaded angle with perforated flanges.

.8 Casing beads: channel shaped; beaded corners.

.9 Hangers: minimum 1/8" galvanized steel wire.

.10 Tie wire: minimum 16 ga soft annealed galvanized steel.

.11 Metal control joint section: bellows shaped section with perforated flanges.

.12 Reveal mouldings: extruded aluminum, profiles as indicated, by Fry, Reglet, Gordon or Pittcon Softforms.

.1 Edge trim: Fry DMET-50.

2.2 GYPSUM BOARD

.1 Exposed gypsum board for interior use: tapered edge: ASTM C1396.

.2 Unexposed gypsum board for interior use: backing board: ASTM C1396.

.3 Fire rated gypsum board: Type 'X' board: ASTM C1396.

.4 Moisture resistant gypsum board: ASTM C1396: Pro Roc M2 Tech by CertainTeed or equivalent product by CGC.

.5 Tile backer board: ASTM C1178: Diamondback Glas Roc Tile Backer by CetainTeed.

.6 Abuse resistant gypsum board: 5/8" thick ASTM C1278: Fiberock VH1 by CGC or equivalent product by CertainTeed.

2.3 SHAFT WALL ASSEMBLIES

.1 Vertical

.1 Metal framed, ULC labelled Gypsum Board Shaftwall System by CGC or equivalent product by other manufacturer approved by Consultant.

.2 Horizontal:

.1 Canadian Gypsum Co. (CGC) Horiztonal Shaft Wall Assembly, consisting of 1" thick CGC Shaft wall liner and three layers of ½" thick Sheetrock Firecode "C" panels, fitted and fastened with metal studs, channels, runners, screws, anchors, trim and sealants as recommended by manufacturer.

.2 Fire resistance rating: 2 hours, unless indicated otherwise.

2.4 CEMENTITIOUS BOARD

.1 Board for paint finish:

.1 Board: polymer modified, fibreglass mesh reinforced concrte board, ½" thick, tapered edges: PermaBoard by Unifix.

.2 Joint tape: 3" wide alkali resistant fibreglass mesh tape: Unitape by Unifix.

.3 Joint compound: acrylic based: Acryjoint by Unifix.

.4 Fill coat: Acrybase by Unifix.

.2 Board for textured finish or backing for ceramic tile: Durock by CGC ½" thick, or equivalent product by other manufacturer approved by Consultant.

2.5 FASTENING AND FINISHING MATERIALS

.1 Drywall screws: self-drilling, self-tapping, case hardened.

.2 Laminating adhesive: CGC Durabond 90 compound by CGC, or equivalent product by CertainTeed.

.3 Joint tape: 2" perforated type.

.4 Joint filler and topping cement: casein, vinyl or latex base, slow setting.

2.6 ACOUSTICAL MATERIALS

.1 Acoustic Insulation: Acoustical Fire Batt by Roxul or equivalent product by Fibrex.

.2 Caulking: to CAN/CGSB-19.21-M87: Acoustical Sealant by Tremco, or CGC Acoustical Sealant.
.3 Steel deck closures: Emseal 25V Expanding Foam Sealant, sized and shaped to fit flutes.

PART 3 - EXECUTION

3.1 METAL FRAMING

.1 General:

.1 Framing and furring indicated is schematic and shall not be considered exact or complete. Location and spacing of members, bracing, supports and securement shall be in accordance with referenced standards as required to provide complete and finished work.

.2 Make provision for supporting recessed and surface mounted fixtures and equipment. Provide additional framing, supports and stiffeners as required.

.3 Neatly frame around recessed fixtures and openings.

.4 Examine mechanical and electrical drawings and coordinate with Divisions 21 to 28 incl. to determine openings required.

.5 Construct gypsum board assemblies which are permanently attached to building structure to resist seismic motions in accordance with reviewed shop drawings.

.2 Partitions:

.1 Unless specified or shown otherwise, extend steel studs to underside of structural slab above. Make provisions to accommodate structural creep and deflection.

.2 All steel studs shall be spaced at 16" maximum, except where indicated otherwise. At curved walls/partitions space studs closer so as to maintain uniform curvature.

.3 Install runner channels at top and bottom of partition and secure to supporting building elements at maximum 24" o.c.

.4 At partition corners extend one runner channel to end of corner and butt other runner channel; allow clearance for gypsum board thickness; do not mitre runner channels.

.5 Install steel studs vertically; fix studs to runner channels by crimping or screwing on both sides of stud.

.6 Install additional studs as detailed and required at partition intersections, openings and terminations at dissimilar materials. Place studs not more than 2" from abutting walls, openings and each side of corners.

.7 Stiffen partitions over 10' in height at mid-height with at least one ¾" horizontal bracing channel extending full length of partition.

.8 Install structural stud framing in accordance with reviewed shop drawings.

.3 Ceilings and Soffits:

.1 Erect suspension and furring system level with a maximum tolerance of 1/8" over a 10' length.

.2 Suspension system shall support ceiling assemblies, with maximum deflection of L/360, L being span between supports.

.3 Hangers for suspended ceilings shall support grillage independent of walls, columns, pipe and ducts. Space hangers at maximum 4'0" o.c. along rough furring members and not more than 6" from ends.

.4 Space rough furring members at maximum 3'0" and not more than 6" from perimeter walls.

.5 Space furring channels transverse to runner channels at maximum 24" o.c. except at exterior soffits, and secure to each support with clip or saddle tie with 2 loops of tie wire. Install furring channels so as not to contact perimeter walls.

.6 Where ductwork, piping and other elements within ceiling spaces interfere with direct suspension of ceiling from structure, install additional framing securely fastened to main structure to accommodate proper hanging of ceiling.

.7 Provide metal suspension system for acoustic wood fibre panel ceilings specified in Section 09 51 56. Provide supports at max 24" o.c. and at all terminations and penetrations. Coordinate with Section 09 51 56 as required.

.4 Bulkheads, Coves, Furring:

.1 Frame to profiles shown, rigid, square, true to line and securely fastened to supporting building elements.

.2 Space furring members to receive gypsum board at maximum 24" o.c.

.3 Provide rough framing and bracing members as required to ensure stability and accuracy of work.

3.2 GYPSUM BOARD INSTALLATION

.1 Unless otherwise specified, erect gypsum board vertically or horizontally, whichever results in fewer end joints.

.2 Locate board end joints over supporting members.

.3 Cut and fit gypsum board as required to accommodate other work.

.4 Unless otherwise shown or specified, extend gypsum board on both sides of partitions to underside of structural deck above. Fasten gypsum board to studs, not to top channel. Allow for deflection.

.5 Do not install gypsum board until wood blocking or other back-up components are installed. Remove and reinstall gypsum board at no extra cost to Contract where this requirements is not complied with.

.6 Provide corner beads at external corners.

.7 Provide casing beads around openings and where gypsum board abutts dissimilar material and construction.

.8 Fasten gypsum board to supports with screws spaced at maximum 12" o.c.

.9 Install gypsum sheathing horizontally at outside of exterior wall steel studs. Fasten each board at each stud with minimum 3 screws.

.10 Adhesive bonded gypsum board; apply ½" x ½" ribbons of laminating adhesive to back side of board, parallel to long dimension; space adhesive ribbons at max.6" o.c. temporarily brace boards until complete adhesive bond develops.

.11 Where double layer gypsum board is required, screw fasten second layer through first, into framing; offset joints in second layer.

3.3 CEMENTITIOUS BOARD

.1 Screw fasten board to each supporting member at maximum 12" o.c.

.2 Finish cementitious board joints at locations scheduled to be painted with 3-step joint finishing system as recommended by board manufacturer. Apply fill coat over entire board surface to achieve smooth, uniform surface, ready for painting. Provide corner and casing beads similar to gypsum board installation.

3.4 SHAFTWALL ASSEMBLIES

.1 Install shaft wall assemblies in locations indicated and where necessary to maintain required fire separation.

.2 Install assemblies in accordance with manufacturer's directions, meeting required fire resistance rating.

3.5 GYPSUM BOARD FINISHING

.1 Tape and fill exposed joints, fastener heads, edges, corners, to produce an acceptable surface ready for decoration.

.2 Conceal exposed flanges of corner beads, casing beads and other trim sections with at least 3 coats of cement, feathered out minimum 8".

.3 Fill depressions at fastener head with cement, then apply 2 additional coats of cement to produce smooth, level surface.

.4 Treat joints using 3 coat method as follows:

.1 Apply thin uniform layer of cement and embed joint tape.

.2 Immediately apply thin skim coat of cement over tape and allow to dry.

.3 Apply 2 additional coats of cement. Allow first coat to dry before applying second coat.

.5 Sand each coat of topping cement with fine sandpaper as required to produce smooth surface. Do not sand paper face of gypsum board.

.6 Finish concealed fastener heads at fire rated gypsum board elements in manner specified for exposed work.

.7 Finish concealed joints at fire rated and at acoustically insulated gypsum board elements in manner specified for exposed work.

3.6 CONTROL AND RELIEF JOINTS

.1 Control Joints:

.1 Provide control joints where shown and at maximum 25' o.c.

.2 Break continuity of gypsum board and framing system at control joints; install continuous metal control joint section.

.2 Relief Joints:

.1 Provide relief joints where shown and where gypsum board assemblies abutt dissimilar construction.

.2 Stop gypsum board ¼" from abutting construction at dissimilar building elements, unless otherwise indicated.

.3 Where gypsum board comes into contact with window frames or exterior door/screen frames install thermal break. Adhere self-sticking tape to casing bead and compress during installation of gypsum board.

.4 Where indicated, install reveal mouldings.

3.7 SOUND CONTROL

.1 Acoustical Insulation: Provide acoustical insulation in gypsum board partitions and ceilings as indicated. Unless otherwise noted provide 2" thick insulation. Extend acoustical insulation over full height of partition, including portions located above ceiling.

.2 Acoustical Caulking:

.1 Provide acoustical caulking at all partitions, bulkheads and ceilings scheduled to receive acoustical insulation as follows:

.1 At perimeter of gypsum board partitions and ceilings.
.2 Around objects penetrating gypsum board elements.

.2 Provide 2 bead caulking system around horizontal and vertical perimeters of partitions. Apply continuous sealant beads at each side of horizontal runner tracks and vertical end studs, between gypsum board and adjacent construction.

.3 Caulk around objects such as electrical outlets, light switches, electrical and mechanical panels and boxes, grilles, and other objects penetrating. Caulk behind metal control joint sections.

.3 Where acoustically insulated partitions meet steel deck running perpendicularly to partition, provide steel deck closures.

3.8 DOOR FRAMES / ACCESS DOORS

.1 Install access doors supplied by Divisions 21 to 28 incl. Build doors into gypsum board elements flush and parallel to walls and securely fastened.

.2 Install steel door frames occurring in gypsum board partitions. Follow installation requirements specified in Section 08 11 00.

3.9 GYPSUM BOARD SCHEDULE

.1 Use Type 'X' gypsum board at fire rated elements.

.2 Use tile backer board behind tile finish.

.3 Use moisture resistant gypsum board in wet areas and where indicated.

.4 Provide cementitious board where indicated.

.5 Unless otherwise specified or shown, provide 5/8” thick gypsum board.

.6 Use abuse resistant gypsum board where indicated.

.7 Provide shaft wall systems where indicated.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Caulking: Section 07 92 00

1.3 QUALITY ASSURANCE

.1 Installer Qualifications: Member of Terrazzo, Tile and Marble Association of Canada (TTMAC) or approved by the Consultant.

1.4 SUBMITTALS

.1 Of each type of tile required, submit sample consisting of minimum 4 tiles bonded to rigid board back-up and joints filled with grout. Select tiles to show full range of tile to be used. Resubmit sample if required until tile range and group colour is approved by the Consultant.

.2 Submit list of mortar mixes and grouts to be used. In each case products proposed must be suitable for the purpose intended and they shall be capable to produce top quality work. Upon Consultant's request submit evidence of material manufacturer's endorsement of products proposed.

.3 Upon Consultant's request submit samples of bases, trim and fittings.

.4 Submit manufacturer’s recommended maintenance procedures and materials for inclusion into operation and maintenance manual.

1.5 JOB CONDITIONS

.1 Maintain minimum air temperature of 10^{o}C during installation and curing period.

.2 Exclude construction traffic from areas to receive tile during installation and curing period.

.3 Protect tile flooring subjected to construction traffic with non-staining protective covers.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Products by Laticrete listed herein are specified to establish a standard of acceptance. Equivalent products, subject to Consultant's review, by Mapei and H.B. Fuller are also acceptable.

.2 Water: clean and non-staining.

.3 Portland cement: CSA A3001-13.

.4 Sand: ASTM C114-11.

.5 Waterproof membrane: liquid rubber with reinforcing fabric: Laticrete 9235

.6 Thin set mortar: latex-portland cement mix: Laticrete 211/4237.

.7 High strength mortar: 100% solids epoxy adhesive: Latapoxy 300.

.8 Organic adhesive: latex adhesive to ANSI A136.1: Laticrete 15 Multi-Mastic.

.9 Floor grout: presanded, coloured latex grout: Laticrete 1500 Series/1776; colours selected by Consultant.

.10 Wall grout: unsanded dry set, coloured: Laticrete 1600 Series/1776; colours selected by Consultant.

.11 Edge trim: stainless steel angle profile: Schlüter Schiene-E, height to suit tile thickness or slab depression.

.12 Control joints: Schlüter DILEXL-BWB, height to suit tile thickness, colour selected by Consultant.

.13 Tile:

.1 Type 1 tile: unglazed porcelain tile 8" x 20" tiles Centura Tile, Design Positive, Blanc O. (to be confirmed by consultant)
.2 Type 2 tile: glazed porcelain tile 8" x 20" tiles, Centura Tile Design, Positive Blue 5. (to be confirmed by consultant)
.3 Type 3 tile: 12" x 24" Centura Basaltina Gris Lappato. (to be confirmed by consultant

.14 Cleaning, sealing and top coating compounds: as recommended by TTMAC and acceptable to the tile manufacturer.

2.2 MIXES

.1 Mortar and grout: mix using suitable mechanical mixers in accordance with material manufacturer's directions.

.2 Place liquid into mixer, start mixer and add dry material. Mix only long enough to wet out batch; do not overmix. Dump mixed material from mixer promptly and clean out mixer with water after each batch.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Substrates shall be structurally sound and clean and free of foreign matter and minimum 10°C. Fill rough and uneven surfaces with patching mortar.

.2 Clean substrates as required to produce acceptable surface. Dampen and sweep dusty and dry surfaces.

3.2 WATERPROOFING MEMBRANE

.1 At floors with floor drains and where indicated at other areas, provide waterproofing membrane below ceramic tile. Follow manufacturer's directions.

.2 Reinforce cracks in substrates and junctions of horizontal and vertical surfaces with 8" wide strip of waterproofing reinforced with 6" wide reinforcing fabric.

.3 Apply waterproofing liquid with roller or brush and, while still wet, place reinforcing fabric onto it. Use brush to embed fabric and to smooth out wrinkles. Lap fabric 2" at seams. Apply second coat to cover fabric and let dry to touch. Apply final coat to completely seal membrane.

.4 Carry waterproofing membrane up and over curbs and up surrounding walls, minimum 6" high, but in no case shall membrane be visible in finished work.
.5 Place liquid into mixer, start mixer and add dry material. Mix only long enough to wet out batch; do not overmix. Dump mixed material from mixer promptly and clean out mixer with water after each batch.

3.3 TILE INSTALLATION GENERAL

.1 Unless otherwise specified, meet applicable requirements of TTMAC Tile Installation Manual 2012-2014.

.2 At interior floors with floor drains, at ground floor areas and where required to meet level of adjacent floors, provide mortar bed to slopes and thickness required.

.3 Bond porcelain tile to all substrates with high strength mortar. Bond all other tiles to substrates in accordance with mortar/adhesive manufacturer's directions and as follows:

.1 All locations except where indicated otherwise: thin set mortar.

.2 Gypsum board substrate: organic adhesive.

.4 Finished work shall be level, plumb, or sloped as shown, true, square and free of defective, chipped, broken, discoloured or blemished tiles. Maximum allowable finished surface variation shall be 1/8” in 10’ when measured, in any direction, with a 10’ straightedge.

.5 Lay out tile patterns symmetrically within each area and to patterns shown. Unless otherwise indicated or directed provide stacked pattern.

.6 Joints shall be parallel, uniform, neat, straight, square and completely filled. Provide joint width as directed by Consultant.

.7 Fit tile neatly against and around interruptions, penetrations and abutting dissimilar surfaces. Wherever possible, drill holes for penetrating elements to ensure neat fitting.

.8 Provide accent patterns as shown, or if not shown, as directed by Consultant.

.9 Provide tile manufacturer's standard trim pieces at changes in direction and at terminations. Unless otherwise indicated provide the following corner and edge conditions:

.1 Internal horizontal corners: coved.

.2 External vertical and horizontal corners and edges: bullnose.

.3 Internal vertical corners and unexposed edges: square butt joint.

.10 Provide metal edge trim at junction of floor tiles with other flooring materials.

.11 After setting, sound tiles and replace hollow backed tiles.

3.4 GROUTING

.1 Commence grouting not earlier than 24 hours after setting tiles unless otherwise directed by grout manufacturer.

.2 Force grout into joint so as to fill them flush, leaving no voids.

.3 Promptly as work progresses remove excess grout from adjacent tile surfaces before grout establishes tight permanent adhesion.

.4 Cure grout in accordance with manufacturer's directions.

3.5 CLEANING

.1 Thoroughly clean tile surfaces in accordance with material manufacturer's recommendations.

.2 Polish after cleaning with clean, dry cloths.

.3 Seal and top coat unglazed tiles in accordance with TTMAC recommendations, as directed by Consultant, except where tile manufacturer recommends against it.

.4 Remove grout haze from tile surfaces. Use acid wash method if required.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Gypsum board: Section 09 21 16

.2 Mechanical fixtures: Division 21 to 25

.3 Electrical fixtures: Division 26 to 28

1.3 DESCRIPTION

.1 Work of this Section includes acoustic wood fibre panel ceilings secured to metal suspension system provided by Section 09 21 16.

1.4 SUBMITTALS

.1 Submit detailed and complete product data for each product required.

.2 Submit detailed installation drawings showing panel layout, fastening details and joint treatment.

.3 Submit duplicate 8” x 8” wood fibre panel with required paint finish/colour and incorporating the required edge profile.

1.5 MOCK UP

.1 At location directed by Consultant provide mock-up of acoustical wood fibre panels, minimum 8’ x 8’ showing required materials, installation method, finishes/colours, edge conditions.

.2 Mock-up may be incorporated into finished work, once approved by Consultant.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

.2 Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

.3 Prevent soiling, physical damage or wetting.

.4 Store cartons open at each end to stabilize moisture content and temperature.

1.7 JOB CONDITIONS

.1 Do not install ceiling panels until building is closed in and HVAC system is operational.

.2 Locate materials onsite at least 24 hours before beginning installation to allow materials to reach temperature and moisture content equilibrium.

.3 Maintain the following conditions in areas where acoustical materials are to be installed 24 hours before, during and after installation:

.1 Relative humidity: 65 – 75%

.2 Uniform temperature: 13 - 21ºC.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Ceiling Panels: 1" thick cementitious wood fibre panels consisting of Aspen wood fibres bonded with inorganic cement by Tectum Inc.

.1 Panel sizes: 4' x 8" nominal; (cut to fit where required)

.2 Panel edge: bevelled ¼"

.2 Fasteners: self drilling, self tapping countersunk plated screws.

.3 Panel finish paint: alkali resistant latex paint (white): spray paint exposed panel surfaces prior to installation.

.4 Touch up paint: matching panel finish paint.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Examine existing conditions, particularly the metal suspension system provided by Section 09 21 16, to ensure that they are acceptable for the installation of the acoustic wood fibre panel ceiling.

.2 Start of installation shall imply acceptance of conditions.

3.2 INSTALLATION

.1 Install panels in accordance with reviewed shop drawings and with manufacturer's printed directions, level, square and true to line.

.2 Where panel width required is less than the fabricated width, cut panels to suit. Cut edges shall be clean, straight and unbroken' bevel cut edges.

.3 Fasten panels to supporting framing with screws spaced at maximum 300 mm o.c. along each support member and not less than 20 mm, not more than 60 mm from panel edge. Countersink screws.

.4 Make cut-outs in panels to accommodate penetrating work of other Sections.

.5 Field paint cut edges and fastener heads to match surface colour and sheen.

3.3 CLEANING AND TOUCH UP

.1 Keep panels clean. Remove blemishes promptly as work progresses.

.2 Touch up any minor finish damage.

.3 Replace panels which in the opinion of the Consultant cannot be satisfactorily repaired.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Stage floor framing: Section 06 10 00

1.3 DELIVERY AND STORAGE

.1 Do not deliver wood flooring materials to site until work involving cementitious materials is complete and cured, and moisture conditions approximate those that will exist when building is complete.

.2 Store materials in area of installation for minimum 72 hours prior to commencing of work.

.3 Moisture content of lumber used for this project may be checked at any time by the Consultant prior to its incorporation into the work. Lumber found to be in excess of the allowable moisture content limit, will be rejected.

1.4 ENVIRONMENTAL CONDITIONS

.1 Maintain ambient temperature of not less than 10°C, not more than 21°C from 72 hours before installation to at least 48 hours after completion of work, and maintain 40% relative humidity during same period.

1.5 PROTECTION

.1 Be responsible for care and protection of finished floors until takeover of building by Owner.

PART 2 – PRODUCTS

2.1 MATERIALS

.1 Plywood: Douglas Fir to CSA 0121-08 Select-Tight Face, 3/4” thick square edges unless otherwise required.

.2 Hardboard: 6 mm thick tempered, high density hardboard to CAN/CGSB-11.3-M87.

.3 Hardboard finish: Tough Prime, (colour chosen by consultant) by Rosco.

.4 Base: 100 x 75 mm heavy duty, moulded vented rubber cove base by Connor AGA or Robbins or Johnsonite with premoulded outside corners; colour selected by Consultant.

.5 Thresholds: KNC CT-65, extruded aluminium 6.4 mm high x 127 mm wide, unless otherwise shown.

.6 Fasteners/Adhesives:

.1 Screws: flathead, zinc, cadmium or chrome plated steel.
.2 Nails/Staples: CSA B111-1974.
.4 Subflooring adhesive

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Prior to start of work of this Section examine all conditions affecting installation including but not necessarily limited to:

.1 Subfloor levels, finish, and tolerances.
.2 Temperature and humidity levels.
.3 Ensure overhead work which would damage finished floor, is complete.

.2 Report any deficiencies to Consultant in writing prior to proceeding. Start of work shall imply acceptance of conditions.

3.2 INSTALLATION

.1 Do not commence work until building is completely enclosed. Maintain an ambient temperature of not more than 21ºC and not less than 10ºC for duration of work.

.2 Allow for expansion of wood flooring system at perimeter of floor, and at penetrations through floor.

.3 Place plywood on top of subfloor offsetting joints from those in subfloor and mechanically secure to subfloor at maximum 300 mm o.c. in each direction and so as to prevent any movement underfoot and to ensure accurate alignment at intermediate joints.

.4 Install hardboard flooring with adhesive and countersunk screws at maximum 150 mm along panel edge and maximum 200 mm in panel field. Apply two coats of hardboard floor finish, in accordance with manufacturer's directions.

3.3 BASE AND THRESHOLDS

.1 Install base at perimeter walls; return base against door frames. Mitre corners.

.2 Install thresholds at door openings, interior and exterior.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Resilient sheet flooring: Section 09 65 19

1.3 SUBMITTALS

.1 Submit manufacturer's full range of colour samples of each type of base material specified.

.2 Submit maintenance instructions with recommended maintenance methods and procedures for inclusion into maintenance manual.

1.4 PRODUCT STORAGE

.1 Store flooring materials in areas of application for at least 48 hours prior to installation.

1.5 JOB CONDITIONS

.1 Maintain minimum 21^{o} C air temperature installation area for 3 days prior to, during and for 24 hours after installation.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Resilient base (B): 3 mm thick, nominally 150 mm high, coloured coved rubber base: Tightlock Wall Base by Johnsonite; colours:

.1 B1: Vapour Grey

.2 B2: Black

.2 Stair nosing: top set 2” x 3” with 2” co-extruded photoluminescent strip: VITSN-XX, colour: 40 Black, by Johnsonite.

.3 Transition: ½” material to subfloor, 4” wide: CTA-XX-Q by Johnsonite, Colour 21 Platinum.

.4 Primers, fillers, adhesives: as recommended by flooring material manufacturer.

PART 3 - EXECUTION

3.1 CONDITION OF SUBSTRATES

.1 Surfaces to receive resilient base shall be dry, true, even and smooth, and free of paint, grease and oil.

3.2 PREPARATION

.1 Level depressions, cracks and joints in substrates with non-shrinking type filler compatible with bonding adhesive.

.2 If recommended by adhesive or tile manufacturer, prime substrates. Apply primer in accordance with manufacturer's directions.

3.3 RESILIENT BASE INSTALLATION

.1 Adhesive apply cove base to vertical surfaces so that gaps do not occur behind base, so that front lip of base cove bears firmly and uniformly on floor surfaces and so that good and permanent bond is produced between base and surface to which it is applied.

.2 Use full length pieces where practicable; accumulated short lengths not permitted. Provide preformed external corners, mitre inside corners; butt intermediate joints flush without gaps.

3.4 TRIM INSTALLATION

.1 Provide stair nosings at Green Room stair.

.2 Provide transition at stage ramp.

.3 Install trim into full bed of adhesive in accordance with manufacturer's directions.

.4 Install trim in longest practicable lengths to minimize intermediate joints. Where unavoidable locate intermediate joints as directed by Consultant.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Steel trowel finish of concrete slabs: Division 3

1.3 SUBMITTALS

.1 Submit manufacturer's full range of colours of each type of flooring and base material specified.

.2 Submit seam layout for sheet vinyl floors for Consultant's review.

.3 Submit maintenance instructions for inclusion into maintenance manual.

.4 Maintenance materials: provide extra 2% of sheet flooring, each colour in one piece, from same production run as installed materials. Obtain receipt.

1.4 PRODUCT STORAGE

.1 Store flooring materials in areas of application for at least 48 hours prior to installation.

1.5 JOB CONDITIONS

.1 Maintain minimum 21°C air temperature at flooring installation area for 3 days prior to, during and for 24 hours after installation.

.2 Protect installed flooring against damage with heavy paper or plastic coverings. Do not place static loads on newly installed flooring until minimum 7 days after installation.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Anti-slip safety flooring: sheet vinyl flooring, 2.5 mm thick vinyl flooring with aluminium oxide non-slip aggregate, silicone carbide grains in surface layer and non-woven reinforcement: Altro Stronghold 30, colour: Midnight K30421.

.2 Transition strip: Altro Whitrock.

.3 Cove former: Altro 20R.

.4 Vinyl reducing strips tapered, to suit thickness of flooring, colours selected by Consultant: Johnsonite RRS.

.5 Primers, fillers, adhesives: those recommended by flooring manufacturer which will produce good and permanent bond between subfloor and flooring.

.6 Cementitious underlayment: polymer modified quick-setting cement based: Floor Patch by Flextile or equivalent product by other manufacturer approved by Consultant.

.7 Cleaning and finishing materials: as recommended by flooring material manufacturer.

PART 3 - EXECUTION

3.1 CONDITION OF SUBSTRATES

.1 Surfaces to receive resilient flooring shall be dry, true, even and smooth, and free of paint, grease and oil.

.2 Perform moisture tests on concrete substrates where moisture content is uncertain. Perform tests in minimum ambient temperature of 18^{o}C. Do not install materials until test results are satisfactory.

.3 Concrete slabs shall be at least 28 days old before installation of resilient flooring.

.4 Inspect condition of concrete slabs scheduled to receive resilient flooring as soon as possible after completion and record in writing any deficiencies discovered or state, if no deficiencies are found, acceptance of floor conditions.

3.2 PREPARATION

.1 Level depressions, cracks and joints in subfloor with non-shrinking type filler compatible with bonding adhesive.

.2 If recommended by adhesive or tile manufacturer, prime substrates. Apply primer in accordance with manufacturer's directions.

3.3 UNDERLAYMENT

.1 Where resilient flooring abuts other flooring of different thickness, provide cementitious underlayment allowing for smooth and level transition between finished floor surfaces.

.2 Mix, apply and finish underlayment in accord with latex admixture manufacturer's recommendations.

3.4 FLOORING INSTALLATION - GENERAL

.1 Install resilient flooring materials in accordance with material manufacturer's current printed directions. Keep a copy of manufacturer's installation manual on site during execution of work.

.2 Scribe flooring to walls, columns, cabinets, floor outlets and other appurtenances to produce tight joints. Extend flooring into recesses and closets.

.3 Locate change to different floor finish or colour centred under doors.

.4 Provide reducing strip adhesive bonded to floor where floor covering terminates, exposing edge of floor. Install transition strip at junction with other types of flooring.

3.5 SHEET FLOORING

.1 Run sheets in direction determined by Consultant.

.2 Tightly butt joints or double cut, groove out and weld with colour matching welding rod and suitable welding equipment.

.3 Form integral base unless otherwise indicated. Install fillet strips at inside corners. Carry flooring up walls, curbs 6” and bond to substrate with adhesive. Weld corners. Seal exposed edges at terminations with colour matching sealant. Install base cap.

.4 Make watertight connection at floor drains.

3.6 CLEANING

.1 Promptly remove adhesive from surface of resilient materials as work progresses.

.2 Immediately after installation, broom clean and wash resilient floors in accordance with material manufacturer's recommendations.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Wood trim: Section 06 20 00

.2 Steel support framing: Section 09 21 16

1.3 SUBMITTALS

.1 Submit detailed shop drawings for each type of acoustical treatment required. Show layout and panel sizes. Verify dimensions in field prior to submission of shop drawings.

.2 Submit duplicate 12” x 12” samples of each type acoustical unit.

1.4 JOB CONDITIONS

.1 Commence installation after building enclosed and dust generating activities are completed.

.2 Permit wet work to dry prior to commencement of installation.

1.5 ALTERNATIVE PRICE

.1 In lieu of acoustic wall panels specified herein provide Avanti Hardfaced Wall Panels (P2); fabric: Anchorage, colour: Graphite.

PART 2 - PRODUCTS

2.1 ACOUSTIC PANELS

.1 Acceptable product: Avanti Wall Panel (P1) by Sound Solutions, or equivalent product by other manufacturers approved by Consultant.

.2 Panels: fabric faced fiberglass core with a high impact control component; sizes indicated; bevelled edges; square corners, fabric wrapped around edges, corners tailored; maximum flame spread of 25 (ASTM E84).

.3 Panel Core: unless otherwise indicated 1” thick, resin edge hardened, 272 kg/m^3 density, glass fibre board.

.4 Fabric: Anchorage, colour Graphite.

.5 Mounting: Concealed metal clip system consisting of levelling angles, vertical and horizontal panel clips and wall brackets.

.1 Wall, panel and levelling clips: minimum 0.9 mm thick galvanized steel.
.2 Screws: zinc or cadmium plated.
.3 Plugs: plastic type.

.6 Panel metal trim: Preformed metal profiles, covered on exposed surfaces with fabric, matching panel; the following profiles by Decoustics or equivalent products by other manufacturers listed:

.1 Outside corners: C-trim.
.2 Exposed ends: J-trim.

.7 Reveal trim: extruded aluminum:

.1 Closed trim: 19 x 25 mm tubular section.

.2 Recessed trim: 19 x 25 mm channel section.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Examine existing conditions affecting the work of this Section to ensure they are satisfactory to receive the work specified herein.

.2 Start of work shall imply acceptance of Conditions.

3.2 INSTALLATION

.1 Install panels in accordance with manufacturer's current printed directions. Lay-out panels within each area, uniformly spaced with edges plumb and level. Make cut-outs in panels to accommodate penetrating work of other Sections.

.2 Mark bottom line of panels and install levelling angles.

.3 Attach vertical panel clips to back of panels, bend clips away from panel back and apply marking ink to lower end of each clip. Place panels on levelling angles in desired location and transfer marking ink to wall by pressing panels against wall.

.4 Fasten wall brackets to wall, approximately 3/16” below ink marks.

.5 Place panels on wall by engaging each vertical panel clip into its corresponding wall bracket. Ensure that panels are resting on levelling clips.

.6 Wherever possible fasten levelling angles and wall brackets to wall framing members or masonry, where not possible use suitable gypsum board screw anchors (toggle or plug type).

.7 Where panels are mounted in series, install intermediate panels by sliding horizontal panel clips under adjacent panel. Butt panels tightly, aligned with adjacent panels and screw fasten clips to wall.

.8 Install reveal trim where indicated.

3.3 CLEANING

.1 Keep panels clean. Remove blemishes promptly as work progresses.

.2 Replace panels which in the opinion of the Consultant cannot be satisfactorily repaired.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Unperforated wood wall panelling: Section 06 20 00

.2 Fabric covered acoustic wall panels: Section 09 84 14

1.3 SUBMITTALS

.1 Submit detailed and complete product data for each product required.

.2 Submit detailed shop drawings showing panel layout, sizes, materials, finishes, supports and securement details. Verify dimension in field prior to submission of shop drawings.

.3 Submit duplicate, minimum 12” x 12” samples of perforated wood panels with required finish and concealed panel hangers.

1.4 MOCK-UP

.1 At location directed by Consultant provide mock-up, minimum 8’ x 8’, of perforated acoustic wall panelling, complete with perimeter condition.

.2 Mock-up may be incorporated into finished work, once approved by Consultant.

1.5 JOB CONDITIONS

.1 Do not commence installation until building is fully enclosed, wet work has dried and dust generating activities have been completed.

1.6 PRODUCT DELIVERY, HANDLING AND STORAGE

.1 Deliver panels to site in original packaging with identifying labels intact and legible.

.2 Store panels in a fully enclosed space, protected from moisture, direct sunlight, surface contamination and any other damage.

.3 Handle panels carefully to avoid chipping of edges or damaging exposed surfaces in any way.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Acoustic panels: Plank style, grooved, veneered wood panels, 7 9/16” wide, 4’-0” and 8’-0” long, with Ash veneer matching unperforated panels specified in Section 06 20 00: 9 Wood Acoustic Wall Panels, Product 3000S, Style 3100 by Sound Solutions.

.2 Panel hangers: plated metal concealed z-type wall hangers; manufacturer’s standard.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Examine existing conditions to ensure that they are satisfactory to receive the work of this Section.

.2 Start of installation shall imply acceptance of conditions.

3.2 PREPARATION

.1 Place wood panels in area of installation and permit them to acclimatize for minimum 72 hours prior to installation.

.2 Ensure that environmental conditions in application area represent actual space design conditions.

3.3 INSTALLATION

.1 Install acoustic wall panels where required, with concealed wall hangers, in accordance with reviewed shop drawings and in compliance with manufacturer's directions.

.2 Install panels level, plumb and square, fully supported and accurately aligned with adjacent panels.

.3 Select panel veneer for balanced appearance overall. Avoid use of panels with starkly contrasting wood grain and/or colour in any area.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Finish carpentry and cabinetwork: Section 06 20 00

1.3 ACCEPTABLE MANUFACTURERS

.1 Unless otherwise specified, materials shall be manufactured and supplied by one of the following:

.1 Benjamin-Moore
.2 Canadian Industries
.3 Dulux Paints
.4 Para Paints
.5 Pratt & Lambert
.6 Sherwin-Williams

1.4 LIST OF MATERIALS, SAMPLES

.1 List of Materials:

.1 Before ordering materials, submit written request in form acceptable to Consultant, for approval of paint materials. List each of the materials proposed and surfaces to be covered. State manufacturer's name and brand name of materials.

.2 List of materials shall be endorsed by manufacturer as being the best material for the applicable condition.

.3 Do not order material or commence work until list of materials is approved by Consultant.

.2 Samples:

.1 Submit two 8” x 10” draw downs of each paint colour coated with manufacturer's paint system to confirm colour match with colours selected by Consultant.

.2 Submit sample of natural and stained finishes on each species and grade of wood to receive such finishes.

.3 Prepare full size samples showing each type of door finish.

.4 Prepare sample panels of each wall and ceiling paint system specified, as directed by Consultant.

.3 Maintenance Materials:

.1 Upon completion of work provide one sealed and properly identified 1 gallon can of each type and colour paint used on this project.

.2 Only top coating paints used in building interior are required.

1.5 PRODUCT HANDLING

.1 Deliver paint materials to site in sealed original labelled containers bearing manufacturer's name, brand name, type of paint and colour designation.

.2 Store materials in strict accordance with manufacturer's recommendations.

.3 Store paints, stains, varnishes, equipment in designated area only. Maintain separate workshop/storage area for duration of work by this Section.

1.6 JOB CONDITIONS

.1 Environmental Conditions:

.1 Maintain temperature in interior areas to receive coatings between 15°C and 25°C for at least 24 hours before, during application and until coatings have cured after application. Apply exterior coatings only when temperature is above 10°C.

.2 Adequately ventilate areas where coatings are being applied. Maintain a reasonably dust-free atmosphere for duration of work.

.2 Protection:

.1 Protect adjacent surfaces not scheduled to receive coatings from damage.

.2 Remove electrical plates, surface hardware, fittings and fastenings prior to painting operations. These items shall be carefully stored, cleaned and replaced on completion of work in each area. No solvent shall be used to clean hardware that will remove permanent lacquer finish on these items.

.3 Mask labels and specification plates occurring on equipment to be painted.

.4 Post "wet coating" signs and "no smoking" signs while work is in progress and while coatings are curing.

.5 Keep oily rags, wastes and other combustible materials in closed metal containers and remove at end of each work day. Take every precaution to avoid spontaneous combustion.

.3 Work Schedule:

.1 Unless otherwise permitted, apply coatings only after all other Sections have completed their work.

.2 Co-ordinate work of this Section with that of Section 07 92 00 and review order of installation with Consultant where sealants are installed adjacent to painted surfaces.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Materials shall be "top line quality" products and shall be supplied by a single manufacturer except for specialty products not available from paint manufacturer.

.2 Materials wherever possible shall be low odour products, free or low in VOC content.

.3 Paints shall be factory mixed unless otherwise specified, except any coating in paste or powder form, or to be field-catalyzed shall be field-mixed in accordance with manufacturer's directions.

.4 Primers shall be as specified by manufacturer and fully compatible with finish coats.

.5 Stains shall be of the rapid dry, alkyd base type or pigment oil type.

.6 Varnishes shall be synthetic type.

.7 Shellac shall be pure white gum in pure grain alcohol.

.8 Thinners, cleaners: as recommended by paint manufacturer.

.9 Epoxy paint: two part epoxy polyamide system: Glidden 5461 / 5242 primer and 5240 / 5242 top coat or equivalent system by other manufacturers listed.

.10 Concrete floor sealer: clear penetrating, 100% Silane: Chem-Trete Dynasylan BH-N by Degussa.

.11 Zinc rich primer: reinforced inorganic zinc coating: CathaCoat 302 by Devoe.

.12 Paint for structural steel: aliphatic polyurethane.

2.2 FINISHES

.1 Paint colours and other finishes will be selected by Consultant. Do not start work until after receiving colour schedule.

.2 Colours selected by the Consultant will not necessarily be from manufacturer's standard colours.

.3 A variety of colours may be used. Consultant may select different colours for different elements such as ductwork, bulkheads, exposed decks, slabs and structural steel. Some colours may be deep tones.

.4 Confirm gloss levels for all surfaces with Consultant before starting work. Unless otherwise indicated, allow:

.1 Walls: eggshell

.2 Ceilings: flat

.3 Frames, doors, trim: semi-gloss.

.5 Paint exposed piping, ductwork and conduits in mechanical and boiler rooms in colours directed by Consultant.

PART 3 - EXECUTION

3.1 CONDITIONS OF SUBSTRATES

.1 Sound, non-dusting, and free of grease, oil, dirt, and other matter detrimental to adhesion and appearance of coatings.

.2 Temperature: minimum 13°C.

.3 Moisture content: maximum 12%. Test for moisture content using moisture meter.

.4 Alkalinity: test cementitious substrates for alkalinity. Use method recommended by coating manufacturer.

3.2 PREPARATION OF SUBSTRATES

.1 All substrates: clean as required to produce an acceptable surface. If wood, metal or any other surface to be finished cannot be put in proper condition for finishing by cleaning, sanding and filling as specified, notify Consultant in writing or assume responsibility for an rectify any unsatisfactory finish resulting.

.2 Wood generally: clean soiled surfaces; sand smooth and dust off; putty nail holes, splits, scratches, after prime coat has been applied and dried; colour putty to match finish; putty stained wood after stain application.

.3 Wood for paint: clean knots, pitch streaks and sappy sections of residue and seal with sealer before applying prime coat.

.4 Wood for transparent finish: clean knots, pitch streaks and sappy sections of residue and seal with white shellac; seal after applying stain. Apply filler to open grained woods, prior to application of stain unless directed otherwise by Consultant. Do not apply satin varnish coat until Consultant has inspected and approved gloss varnish coat.

.5 Bare ferrous metal: remove rust and scale; wash with solvent; chemically clean; apply coat of metal primer.

.6 Previously primed metal: remove rust, oil, grease and loose shop paint by washing or wire brushing; make good shop coat; feather out edges of touch-up.

.7 Zinc coated metal: wash and etch to dull paint receptive surface using an approved crystalline zinc phosphate or vinyl pretreatment.

.8 Hot dip galvanized steel: light brush blast.

.9 Unit masonry & concrete: fill minor cracks, holes and fissures with Polyfilla and smooth to a flush surface. Texture filled areas to match surrounding surface.

.10 Plaster: fill minor cracks, holes and fissures with patching plaster, allow to dry, smooth to a flush surface and texture filled area to match surrounding surface.

.11 Gypsum board: fill minor cracks, holes and imperfections with patching plaster; allow to dry and sand smooth; sand taped joints and remove dust.

.12 Alkaline surfaces: wash and neutralize using proper type of solution compatible with paint to be used.

3.3 BACK PRIMING

.1 Back prime wood schedule for paint or enamel finish immediately on arrival at site with interior or exterior primer as applicable.

.2 Back prime wood scheduled for stain, varnish or natural finish immediately on arrival at site,with gloss varnish reduce 25% with mineral spirits.

3.4 APPLICATION OF COATINGS

.1 Apply paint by brush or roller, except on wood and metal surfaces where paint shall be applied by brush only.

.2 Spray painting may be permitted where deemed advantageous and shall be subject to Consultant's approval. When spray painting is permitted, use only airless spray guns. Consultant may prohibit use of spray painting at any time for such reasons as carelessness, poor masking or protective measures, drifting paint fog, disturbance to other trades or failure to obtain a uniform satisfactory finish.

.3 Applied and cured coatings shall be uniform in thickness, sheen, colour and texture and free of brush or roller marks, sags, crawls and other defects detrimental to appearance and performance.

.4 Regardless of the number of coats specified for any surface, apply sufficient paint to completely cover and hide substrate and to produce a solid uniform appearance.

.5 Thoroughly mix materials before application. Use same brand of paint for primer, intermediate and finish coats.

.6 Where two or more coats of same paint are to be applied, undercoats shall be tinted in lighter shades of final coat to differentiate from final coat.

.7 Touch up suction spots after application of first coat. Sand lightly between coats with fine sandpaper.

.8 Each coat of finish shall be dry and hard before succeeding coats are applied with a minimum of 24

hours between coats, unless manufacturer's instructions state otherwise. Do not proceed with any coat until the last preceding coat is approved by the Consultant.

.9 Stained woodwork shall be covered with a uniform coat of stain and wiped off if required. Wood shall have uniform shade. Match stain so that dissimilar woods have uniform finished appearance.

.10 Apply epoxy paint in accordance with manufacturer's directions.

3.5 PATCHING/TOUCH-UP

.1 Prior to takeover of project by Owner, inspect work of this Section and touch-up or refinish damaged finishes and finishes unsatisfactory to Consultant.

3.6 SCHEDULE OF FINISHES

.1 General Requirements:

.1 Paint exposed surfaces of building materials, services and equipment, except those which are prefinished in factory and except those which are located in areas designed as not requiring painting.

.2 Comply with the following requirements except in areas designated as not requiring painting.

.1 Paint behind surface mounted fixtures on walls and ceilings with full coats of paint.

.2 Paint walls behind wall mounted heating units with full coats of paint.

.3 Paint inside surfaces of light coves white.

.4 Finish tops of doors, trim, projections and other work as specified for surrounding work whether above site lines or not.

.5 Finish edges of doors to match face of door. Refinish edges of doors after fitting.

.6 Paint tops, bottoms and edges of shelves with full specified coats, whether exposed to view or not.

.7 Paint interior of ducts at grilles and diffusers with two coats of flat black paint, so that duct interior is not visible when grilles and diffusers are installed.

.8 Paint piping, ducts and conduits in colours matching background wall or ceiling colours, unless otherwise directed by the Consultant. Ducts in mechanical rooms require only one finish coat in addition to primer. Other exposed ductwork to receive two finish coats.

.9 Paint all gas piping whether exposed to view or not, with high-visibility yellow-orange paint meeting CGSB Colour Code #1-GP-12, Code 505-101 or equal.

.10 Unless specifically indicated to be painted, all finish carpentry work shall receive transparent finish.

.11 Unless specifically indicated otherwise paint all rooftop equipment and components, regardless of material and finish, including but not necessarily limited to mechanical rooftop equipment, vent stack flashings, sleeve flashings window washing anchors, but not including prefinished sheet steel flashings.

.12 Use abuse resistant paint in areas shown to require “high traffic paint”.

.3 Where finishing formula for surfaces requiring painting is not included hereunder, follow recommendations of MPI Architectural Painting Specification Manual, latest issue.

.2 Interior Finishing:

.1 Concrete and concrete block:
Block filler
1 coat primer, latex or PVA based (Vapour barrier primer at pool area)
2 coats alkyd enamel

.2 Metal, prime painted:
spot prime with alkyd metal primer
2 coats alkyd metal enamel

.3 Metal, zinc coated:
1 coat galvanized primer
2 coats alkyd metal enamel

.4 Woodwork, painted:
1 coat alkyd enamel undercoat
2 coats alkyd enamel

.5 Woodwork, stained and varnished (transparent finish):
1 coat stain
1 coat sanding sealer, sand lightly
1 coat alkyd or polyurethane varnish, gloss
1 coat alkyd or polyurethane varnish, satin

.6 Gypsum board (walls):
1 coat drywall primer
2 coats alkyd enamel

.7 Gypsum board (ceilings and bulkheads):
1 coat drywall primer
2 coats acrylic latex

.8 Exposed piping, wrapped:
1 coat block filler
2 coats acrylic latex

.9 Exposed piping and conduit, unwrapped:
1 coat alkyd metal primer
2 coats acrylic latex

.10 Exposed ductwork, insulated:
1 coat block filler and primer
2 coats acrylic latex

.11 Steel handrails:

1 coat epoxy paint reduced with solvent thinner
2 coats epoxy paint, high gloss

.12 Concrete floors and stair treads:

2 coats sealer

.3 Exterior Finishing:

.1 Metal, zinc coated (hot dip galvanized):

1 coat epoxy primer
2 coats aliphatic polyurethane

.2 Metal, zinc coated (inorganic zinc rich primer):

1 coat epoxy primer
2 coats aliphatic polyurethane

3.7 EXISTING SURFACES

.1 Repaint existing surfaces where they are scheduled to be painted or where finish is damaged by alteration work. Extend new paint finish over full height and/or width of area affected, to a straight line in location determined by Consultant.

.2 All existing surfaces to be repainted shall receive as many coats of new paint, as required to hide existing finish.

.3 Materials used for repainting shall be of equivalent quality to those specified for new work, but in each case shall be compatible with finishes to which they are applied.

.4 Where compatibility of new coating with existing surface is uncertain, apply test patch of approximately 5 sf and check for results.

.5 Prepare existing surfaces to be repainted as follows:

.1 Clean as required to remove dirt, dust, oil, grease, lose paint, rust and any other foreign matter which would prevent proper bonding of new finish.

.2 Peeled, chipped, scratched and otherwise damaged surfaces shall be filled, sanded and repaired as required to provide consistent surface with texture matching that of adjacent area.

.3 Sand glossy surfaces to uniform dull texture.

.4 Treat bare areas as specified for new work.

.6 Blast clean existing structural steel scheduled to be repainted to “Near White Grade” (SSPC-SP-10) and spray apply a coat of zinc rich paint maximum 3 mils thick. Top coat with minimum 2 coats of aliphatic polyurethane.

END

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Washroom accessories: Section 10 28 13

1.3 SUBMITTALS

.1 Submit detailed shop drawings. Clearly indicate fabrication details, plans, elevations, hardware, and installation details. Verify dimension on site prior to fabrication.

.2 Upon Consultant's request, submit duplicate 12” x 12” samples of panel showing finish on both sides, two finished edges and core construction.

.3 Submit duplicate representative samples of each hardware item, including brackets, fastenings and trim.

.4 Submit duplicate minimum 4” x 4” melamine samples of colour selected.

1.4 PROTECTION

.1 Protect finished surfaces during shipment and installation by approved means. Do not remove until immediately prior to final inspections.

1.5 WARRANTY

.1 At no cost to Owner, remedy any defects in work of this Section due to delamination and warping of components for a period of 2 years from date of Substantial Performance.

.2 Provide manufacturer’s standard extended material warranty.

PART 2 - PRODUCTS

2.1 SYSTEM

.1 Partition System: Floor mounted overhead braced partitions.

.2 Acceptable Manufacturers:

.1 DuraLine 1082 Series by Bobrick

.2 Equivalent product by Ampco, Decolam, Global, Trespa

2.2 MATERIALS

.1 Melamine surface sheets: to ANSI/NEMA LD3-2005 high pressure type with solid colour, satin finish; colour: DuraLine Graphite Grafix 515-58..

.2 Core material: solid phenolic core, ¾” thick.

.3 Wall and connection brackets: stainless steel.

.4 Stainless steel sheet metal: to ASTM A666, type 302 or 304 with satin finish.

.5 Fasteners: stainless steel tamperproof type screws and bolts.

.6 Pilaster shoes: stainless steel.

.7 Hardware for toilet partitions:

.1 Hinges: heavy duty stainless steel, self-closing type, adjustable to hold door open at any angle up to 90°.

.2 Slide bolt and keeper: stainless steel, equipped for emergency access.

.3 Door stop/coat hook: stainless steel with rubber insert.

.4 Wall and connecting brackets: stainless steel.

.5 Door pull: stainless steel, type suited for outswinging doors.

.8 Overhead brace: extruded aluminum channel with satin anodized finish; anti grip profile.

2.3 FABRICATION

.1 Fabricate panels of doors and pilasters of solid phenolic core with melamine surface sheets fused to core under high temperature and pressure.

.2 Fabricate panels and doors 5'0" high; fabricate pilasters 7'0" high.

.3 Panel and pilaster edges shall be black.

.4 Fabricate pilaster shoes of formed stainless steel sheet 3" high, with concealed fastening.

.5 Fabricate floor anchorage devices consisting of threaded rods and levelling bar assembly, to manufacturer's standards.

.6 Urinal screens:

.1 Fabricate urinal screen panels 18" deep x 3'6" high, unless otherwise shown.

.2 Secure urinal screens to wall with continuous wall bracket.

PART 3 - EXECUTION

3.1 PARTITION ERECTION

.1 Install partitions secure, plumb and square.

.2 Attach pilasters to floor with pilaster supports, and level installation with levelling device. Secure pilaster shoes in position.

.3 Leave max 3/16" space between wall and panel or end pilaster.

.4 Attach fixing brackets securely to solid masonry and concrete walls using friction or expansion type screw anchors and to hollow walls using bolts and toggle type anchors.

.5 Attach panel and pilaster to brackets with through type sleeve bolt and nut.

.6 Set doors in closed partition level with panels.

.7 Equip each door with hinges, latch set, and door stop. Adjust and align hardware for easy, proper function. Set door open position at 30° to front.

.8 Equip outswinging doors with door pulls inside and outside. Provide door stop outside. Provide coat hook inside.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Supply of padlocks: N.I.C.

1.3 SUBMITTALS

.1 Submit detailed shop drawings.

.2 Indicate partition panel modules and types, materials, gauges, finishes, door and other openings, hardware, fastening methods to adjacent structure and assembly methods.

1.4 QUALITY ASSURANCE

.1 Acceptable manufacturers:

.1 Cogan Wire & Metal Products Ltd.
.2 Morningstar Industries Ltd.
.3 Redirack Industries Ltd.
.4 Spinnaker Industries
.5 Triple-A Manufacturing Company Ltd.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Wire mesh: 10 ga diameter medium-hard, drawn steel wire, electrically welded 2” x 2” mesh.

.2 Steel sections and plates: CAN/CSA-G40.21-M92 type 300W.

.1 Posts: 2” x 2” hollow steel tubing, minimum wall thickness 2 mm.
.2 Angle frame: 1 ¼” x 1 ¼” x 1/8”.

2.2 FABRICATION

.1 Panels: fabricate panels to sizes and layouts shown consisting of wire mesh welded at 100 mm o.c. to angle frame. Mitre and weld frame corners. Provide ¾” x ¼” flat bars across panels at third points of height of panel or maximum 3’4”, whichever is less.

.2 Posts: extending from floor to underside of structure, with floor plate for fixing; provide slotted angle connector for fastening at top. Include corner, wall, door and other special posts to manufacturer's standard.

.3 Doors: unless otherwise shown provide standard swing doors approximately 2’8” x 7’0”. Construct doors and transom above of angle frame and wire mesh, same as panels. Reinforce door with 1 ½ x 3/16”or equivalent flat bar centre rail and ¾” x ¼” or equivalent flat bar bracing from centre rail to opposite corners on hinge side.

.4 Door hardware:

.1 Swing doors: equip each door with manufacturer's standard stops, hasp and keeper for padlocks and 1-1/2 pair of butts.

2.3 SHOP FINISHING

.1 After fabrication, clean and paint all components with thermosetting powder coat of colour selected by Consultant.

PART 3 - EXECUTION

3.1 ERECTION

.1 Install mesh partitions and doors in accordance with manufacturer's instructions at locations required. Partitions shall extend from floor to underside of structural slab above.

.2 Unless otherwise indicated space posts at maximum 4’0” o.c.

.3 Erect partitions plumb, level, straight, rigidly supported and securely fastened to abutting surfaces, free from superimposed loads.

.4 Anchor to steel supports with bolts in threaded holes or spot welds. Anchor to concrete with expansion type concrete anchors. Locate fasteners on interior side where possible for maximum security.

.5 Provide additional bracing and reinforcing as required to suit partition heights.

.6 Provide 75 mm sweeping clearance.

.7 Provide clips, bolts and other ancillaries required to complete the installation.

.8 Touch-up damaged areas during transportation and installation.

.9 Install doors and adjust for proper closing, locking and smooth operation.

END

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 SUBMITTALS

.1 Submit detailed and complete product data for each product required.

.2 Submit detailed shop drawings showing locations, materials, profiles, anchorage details.

.3 Upon Consultant's request, submit sample of corner guard.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Deliver products to site in unopened original factory packaging, with identifying labels legible and intact.

.2 Store products flat in protected, dry, off ground, under cover location until required for installation.

.3 Handle products in manner preventing damage of any kind.

PART 2 - PRODUCTS

2.1 CORNER GUARDS

.1 Product: surface mounted 90º angle profile stainless steel guard with 2” legs, one of the following products:

.1 CG-51 Stainless Steel Corner Guard by Pawling.

.2 Stainless Steel Corner Guards by Construction Specialties.

2.2 MATERIALS

.1 Stainless steel: Type 304 with #4 finish.

.2 Adhesive: moisture curing polyether sealant/adhesive: ADH-50 by Pawling or M1 by Chem Link Products or equivalent product recommended by corner guard manufacturer.

2.3 FABRICATION

.1 Fabricate angle profile corner guards of minimum 16 gauge stainless steel, height as indicated.

.2 Cover exposed stainless steel surfaces with self adhesive protective film.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Examine existing conditions to ensure they are acceptable to receive the work of this Section. Start of work shall imply acceptance of conditions.

3.2 INSTALLATION

.1 Install corner guards at locations shown, straight, plumb and securely adhesive bonded to supporting work. Extend corner guards from top of base to heights indicated.

.2 Prepare outside wall corners for guard installation by removing any oil or dust using mild soap and water or common household cleaners.

.3 Apply a ¼" bead of adhesive to the backside of each leg in a zig-zag pattern the full length of the corner guard, keep adhesive about ¾" from the edge.

.4 Install the corner guard by aligning the bottom of the corner guard with the top of the wall base and moving the guard into position along the apex of the wall.

.5 Rub each leg with a clean soft cloth and apply medium hand pressure to ensure maximum adhesion to the wall surface.

.6 Remove protective film when directed by Consultant.

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Toilet partitions: Section 10 21 33

1.3 SHOP DRAWINGS

.1 Submit manufacturer's catalogue cut of each component required.

.2 Submit a washroom accessories schedule indicating all accessories required, on a room by room basis, showing model number, finish and mounting height.

1.4 WARRANTY

.1 At no cost to Owner, replace mirrors should defects in silvering occur within a period of 5 years from date of Substantial Performance.

PART 2 - PRODUCTS

2.1 FABRICATION - GENERAL

.1 Fabricate work true to dimensions, square and plumb.

.2 Thickness of metal shall be adequate for the various conditions, and intended uses.

.3 Finished work shall be free from warping, open seams, weld marks, rattles and other defects. Drilling shall be reamed and exposed edges finished smooth.

.4 Fastenings shall be concealed or theftproof type where possible. Exposed fastenings shall be neatly executed and shall be of the same material and finish as the base metal on which they occur.

.5 Accessories required, in each case, are specified by a reference to a particular product by one manufacturer. The products listed shall serve to establish a standard of acceptance. Accessories of the same materials, construction and finishes, similar in function, design appearance and conforming to the standard of those specified, manufactured by the following are acceptable:

.1 Bobrick
.2 Bradley
.3 Frost
.4 Watrous

2.2 WASHROOM ACCESSORIES

.1 Toilet tissue dispenser: supplied only by Owner.

.2 Sanitary napkin disposal: surface mounted, stainless steel with satin finish, embossed "napkin disposal" label; self-closing door; deodorant block holder: Bobrick B-270.

.3 Paper towel dispenser: supplied only by Owner

.4 Sanitary napkin vendor: supplied only by Owner

.5 Soap dispenser: supplied only by Owner.

.6 Mirror: No. 1 quality, ¼" thick heavy galvanized steel back, stainless steel frame with mitred corners; tamperproof mounting: Bobrick B-290 Series, sizes as shown.

.7 Mirror: No. 1 quality, ¼" thick mirror; heavy galvanized steel back; stainless steel channel frame with mitred corners; tamperproof mounting: Bobrick B-165; sizes as shown.

.8 Mirror: No. 1 quality, ¼" thick mirror; heavy galvanized steel back; stainless steel channel frame with mitred corners; tamperproof mounting: Gamco C-Series; sizes as shown.

.9 Waste receptacle: semi-recessed stainless steel with satin finish; 12 gallon capacity: Gamco WR-6.

.10 Shelf: 8" deep, stainless steel with satin finish: Bobrick B298; lengths as shown.

.11 Hooks: heavy duty stainless steel, exposed mounting: Bobrick B233.

.12 Baby change station: horizontal, recessed; stainless steel exterior with satin finish; high density polyethylene interior; nylon safety strap; 2 hooks for bags; Koala Kare KB 110-SSRE.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install components at locations shown. Where location is not given install as directed by Consultant.

.2 Install Owner supplied accessories.

.3 Fastenings shall be non-corrosive type.

.4 Provide mounting and anchorage devices to be built into walls and other construction elements as required to securely anchor components in place.

.5 Securely anchor components in place. Method of fastenings shall ensure that components will be capable of withstanding expected loads without movement.

.6 Install mirrors with concealed wall hangers and lock in place with theftproof screws.

.7 Insulate accessory surfaces to prevent electrolysis due to contact with dissimilar metal surfaces. Use bituminous paint or other approved means.

3.2 CLEANING AND ADJUSTMENT

.1 Upon completion of work or when directed, remove all traces of protective coatings or paper.

.2 Test mechanisms, hinges, locks and latches and where necessary, adjust and lubricate and ensure that accessories are in perfect working order.

END

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results for Mechanical.

1.2 References

1 Authority Having Jurisdiction (AHJ)

.1 Conform to the requirements of the Authority having Jurisdiction. The Authority having Jurisdiction for this project is The Fire Commission of Canada.

.2 Province of Nova Scotia Fire Safety Act (2002).

.2 National Fire Protection Association (NFPA)

.1 NFPA 10, Standard for Portable Fire Extinguishers.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 Fire Extinguishers

.1 Provide quantity of extinguishers of type and size shown on the drawings.

.2 Each extinguisher (except those designated as 'spares') to be supplied with bracket for support.

.3 Acceptable Products: Ansul, Badger, CFH, Diamond, Flagg, National Fire Equip., Pyrene, Strike First

2.2 Cabinets

.1 Flush, surface or semi-recessed type as indicated on drawing, constructed of 1/16" thick steel, 180 degrees opening door of 1/8" thick steel with latching device.

.2 Cabinet to maintain fire resistive rating of construction in which they occur.

.3 Cabinet door to be c/w glass panel as shown on the drawings.

.4 Finish:

.1 Tub: prime coated.

.2 Door and frame: No.4 satin finish stainless steel.

.5 Acceptable Products: Ansul, Badger, CFH, Diamond, Flagg, National Fire Equip., Pyrene, Strike First.

2.3 Identification

.1 Identify extinguishers in accordance with recommendations of NFPA 10.

.2 Attach bilingual tag, bar code or label to extinguishers, indicating month and year of installation. Provide space for service dates.

2.4 Spare Extinguishers

.1 Provide spare extinguishers, quantity as per drawings.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install or mount extinguishers in cabinets or on brackets as indicated in accordance with NFPA 10.

3.3 Field Quality Control

.1 Ensure extinguishers are full and have been ‘inspected’ at time of turnover to Owner.

.2 Show location of fire extinguishers / fire extinguisher cabinets on sprinkler ‘As-Built’ Drawings.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Toilet partitions: Section 10 21 33

.2 Wire mesh partitions : Section 10 22 13

.3 Corner guards : Section 10 26 13

.4 Washroom accessories: Section 10 28 13

1.3 SUBMITTALS

.1 Submit brochures of equipment clearly showing model number, dimensions, tolerances, all installation accessories and fasteners.

.2 Upon Consultant's request, submit samples of all units complete with fastenings, for approval by Consultant and do not supply units to site until approval is obtained.

.3 Provide maintenance and operating instructions for inclusion into manual specified in Section 01 70 19.

PART 2 - PRODUCTS

2.1 DOLLY

.1 Product: H-1543 Solid Top Hardwood Dolly by ULine Canada.

.2 Description: 30” x 18” x 7/8” thick hardwood platform with 4 solid rubber swivel casters; countersunk bolts.

.3 Quantity: two required.

2.2 WALK RAMP

.1 Product: Model AWKR-P-2-32-8A by Doverco Inc.

.2 Description: apron mount, aluminium walk ramp with 2000 lbs loading capacity; width overall: 32”; length: 8’-0”; ramp surface with perforated traction grip; minimum incline; 8º (13”); maximum incline: 20º (30”); safety chains and pins.

.3 Quantity: one required.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install components in accordance with manufacturer's directions in locations indicated.

.2 Coordinate installation with work of other sections providing adjacent construction as required to achieve the conditions shown.

.3 Securely fasten components level and plumb. Mounting heights, where applicable, as shown; where not shown, as directed by Consultant.

END

1 General

The Executed Agreement between the Owner, including General Conditions, General Requirements, Specification-Sections, Division 1, applicable Drawings and Amendments are part of and are to be read in conjunction with this Section.

1.1 RELATED WORK: SPECIFIED ELSEWHERE

.1 Division 01 00 00 - General Requirements

.2 Section 03 30 00 - Cast in Place Concrete: (Floor Depressions)

.3 Section 11 40 10 - Food Service Equipment

.4 Division 22 & 23- Mechanical Services Including Connections to Equipment

.5 Division 26 - Electrical Power Connection to Equipment and Supplementary Wiring: Remote Receptacles and Switches

1.2 ACCEPTABLE MANUFACTURERS

.1 Equipment specified by means of non-proprietary Specification be produced by a manufacturer having Engineering personnel and plant facilities to design, detail and fabricate equipment of the type required, and having a record of at least five years production.

1.3 QUALIFICATIONS OF INSTALLER

.1 Equipment shall be installed by a company having personnel competent in the installation of food service equipment and having at least five years continuous experience.

1.4 PERMITS AND FEES

.1 Apply for and obtain all necessary permits from the proper authorities and pay all charges.

1.5 LIABILITY INSURANCE

.1 Maintain such and pay assessments as well protect the Contractor and the Owner from Claims for damages for personal injury, including death and from claims for property damage which may arise from operations under this Contract. Provide proof of same to the Owner within ten (10) days after notification of award of the contract

1.6 SHOP DRAWINGS AND PRODUCT DATA

.1 Shop drawings have been supplied as part of this section as a guide by the consultant, however the successful bidder is required to submit their own shop drawings and cut sheet for review and approval.

1.7 APPROVALS

.1 Prior to commencing fabrication or ordering, obtain all necessary approvals.

.2 Electrical and mechanical equipment to comply with requirements of Canadian Standards Association (CSA), The Nova Scotia Power Corporation and the Nova Scotia Department of Labour.

.3 Equipment to comply with applicable Federal, Provincial and local Municipal Health Department requirements.

1.8 MAINTENANCE DATA AND OPERATING INSTRUCTIONS

.1 Comply with requirements of Section 01730 – Operation and Maintenance Data.

.2 Provide maintenance data and operating instructions for incorporation in maintenance manual.

.3 Provide necessary spare parts lists together with supplier names, addresses and telephone numbers.

.4 Manuals to bear item numbers to agree with equipment list and to be in numerical sequence. Every item of equipment to be identified with catalogue data, operating and maintenance instructions, model.

.5 Provide operating instructions on a metal plaque or decal and apply to the following equipment; coffee urns, convection ovens, cutters and slicers, kettles, skillets, dishwashers, microwave ovens, and all other mechanically, electrically and hydraulically operated equipment.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle equipment to prevent damage and disfigurement. This contractor shall make good any such damage or disfigurement to any product.

.2 Protect surfaces from damage during transit and installation.

.3 Provide temporary skids under units weighing more than 150 Lbs

1.10 COORDINATION

.1 Co-operate with other Sections to suit schedule dates and sequence or operations.

1.11 IDENTIFICATION

.1 Identify equipment with durable plates, or labels. Where applicable include the following manufacturer's information:

1.12 INSPECTION AND FIELD MEASUREMENT

.1 Visit site and become fully informed of all existing and expected conditions.

.2 Check all necessary field measurements. Fabricate or order equipment to suit.

.3 Prior to pouring the floor slab this contractor shall inspect the mechanical and electrical connection locations and verify accuracy of same.

.4 Supervise all mechanical and electrical connecting up by other trades.

1.13 STARTING SYSTEMS

.1 Prior to demonstration and in conjunction with related sections start up equipment to ensure proper supply of services and junction of units.

1.14 TESTING, ADJUSTING BALANCING

.1 After start up of equipment, tests, adjust and balance equipment.

1.15 DEMONSTRATION

.1 Demonstrate operation of equipment at a time agreeable to the Owner.

.2 Instruct food service staff to ensure correct and safe operation of equipment, to the satisfaction of the Owner.

.3 Time shall be allotted for maintenance instruction on all new equipment. The Equipment Contractor will coordinate with the head of Maintenance at the Pier 21 site as to the timing and allotment of time for each piece of equipment requiring this service.

1.16 WARRANTY

.1 No provision in the Contract shall relieve the Contractor from responsibility for faulty materials or workmanship which shall appear within a period of one (1) year from the date of acceptance of the work and additional four (4) year's warranty on refrigeration condensing units.

.2 Submit warranty on sample form included in the Tender Documents.

1.17 ERRORS AND OMISSIONS

.1 If errors or omissions are observed in the Contract Documents, immediately notify the Consultant in writing of all such errors or omissions. In the event no such notice is given, the Contractor will be HELD responsible for the results of any such error or omission and the cost of rectifying the same.

1.18 WORK INCLUDED

.1 The work includes, but is not limited to, the furnishing of all labour, materials, tools, plant and services for the supply, installation and completion of all equipment to the full extent of the Drawings and Specifications, excluding connection to mechanical and electrical services, unless otherwise noted in the specifications

.2 The supply of all dimensioned roughing-in information for the installation of the equipment specified.

.3 The arrangement and payment for all necessary permits and inspections and delivery of such permits and certificates of the Owner.

.4 The supply and delivery to the Building of all inserts, anchors, bolts, sleeves, ferrules and similar items required to be attached to or built into masonry, concrete and other work for the proper anchorage and fixing of the equipment to be installed under this Section including necessary templates, instructions, directions and/or assistance in the location and installation of all such items by other Sections.

.5 The supply and installation of all refrigeration, walk-in boxes, machinery, lines, controls and control wiring, including coils and blowers for units supplied under this Section and all inter wiring from Junction boxes to lights and heaters and pressure relief ports and as specified.

.6 The supply and installation of all drain tubing, flexible or rigid, from condensate, evaporator and drip drains to hub or funnel drains in floor and drilling of access holes and openings in equipment for electrical and mechanical services.

.7 The protection of all control valves, switches and the like, on all specified items where they are protruding or otherwise exposed and subject to damage.

.8 The testing, cleaning and adjusting of all equipment and apparatus installed under this Section and the refinishing of any painted and finished surfaces damaged during erection and handing over of the completed installation in first class condition and working order.

.9 The protection against abuse by other trades with plastic or canvas covers. The provision for all special arrangements which may be necessary during the progress of the work of this Section, to fully protect such work and any surrounding or adjacent work, and the repair of all work damaged or disfigured due to the lack of failure of such protection.

.10 The supply of any other work shown or called for or necessary to provide complete installation.

.11 The provision of a competent supervisor for the installation of the equipment capable of supplying information required by other Sections for the proper connection and completion of the installation.

.12 The submission of the Efficiency Nova Scotia energy rebate forms for the following refrigeration and lighting categories associated with the walk-in cooler/freezer LED lighting, evaporator fan motor controls, intelligent freezer defrost controls. These forms are to be completely filled out and submitted to the food service consultant.

.13 The supply and installation of painted angle iron compressor racks and weather hoods as noted on dwg. H501 and location as noted on dwg. H105.

.14 The removal of all trash resulting from the unpacking of equipment shall be promptly carried out.

.15 The demonstration of all equipment by a competent representative to assure its proper function and to demonstrate its proper operation. This service shall be rendered on agreeable dates just prior to opening. The representative shall also be present on opening day.

.16 The presentation of three sets of operating and maintenance instruction folders and two “As Built” floor plans to the Owner’s staff prior to the opening. These shall include all necessary instructions for the operation and maintenance (including recommended preventive maintenance programs). These are over and above instructions supplied to other Sections for connection purposes. The manuals shall bear item numbers to agree with the plan, be in numerical sequence and be bound in hard cover.

1.19 RELATED WORK UNDER OTHER TRADES

.1 Plumbing: Read Division 22, Mechanical Services. Work under Division 22 to include but not limited to the following:
Roughing-in of all mechanical services to connection points on equipment and connecting up, hot and cold water supply, direct drains, funnel and floor drains and vents. Supply and installation of shut-off valves in all supply lines, “P” traps, grease interceptors, pressure reducing valves, line strainers, steam traps and

temperature-pressure gauges. Grease interceptors to be surface mounted on the floor, clear of food service equipment for free access to cleanout covers. Drains from scrap troughs and garbage disposals where encased in concrete, to be minimum 3", with a minimum of elbows and bends. Install hot water boosters, floor drain and bends. Install hot water boosters, floor drain pans, faucets, gauges and valves supplied by Kitchen Contractor. Supply and install hand wash sinks. Supply and install water treatment equipment where required for protection of kitchen related hot water producing equipment and boilers. Disconnect existing equipment from services. Where equipment is to be re-used in new premises, make ready for reconnection to services and reconnect. Where piping is expose thoroughly degrease and spray with aluminum paint. Where possible all services and connections to be concealed within equipment.

.2 Ventilation: Read Division 23, Mechanical Services. Work under Division 23 to include but not limited to the following:
Duct work, accessories and equipment including connections to exhaust canopies unless otherwise specified. Fan motor magnetic starters ready for connection of electrical services by Division 26.

.3 Electrical: Read Division 26, Electrical Services. Work under Division 26 to include but not limited to the following:
Roughing-in of electrical services and connection to equipment. Supply of disconnect switches, breaker panels (other than those built into equipment). Breakers and relays where required. Junction boxes to receptacles in work tables. All to include necessary transformers, relays and breakers. Disconnect existing equipment from services. Where equipment is to be re-used in new premises, make ready for reconnection to services and reconnect. All external rigid conduit and fittings to be thoroughly degreased, cleaned and spray painted aluminum. Where possible all services and connections to be concealed within the equipment.

.4 All mechanical and electrical work related to the food service equipment to be in strict accordance with prevailing codes.

.5 Architectural-Construction: Read Division 02000, 03000, 04000, and 06000 for demolition, cast-in-place concrete, masonry and rough carpentry. Work to include but not limited to the following: Floor depression for drain pan and walk-in cooler freezer box. Grouting in of all gaps around floor drain pans and walk-in cooler freezer box. Flat floors in all areas except in pot and dish wash where floor slopes 1/8" to one foot to floor pan. Stub walls and partitions, corners to be square and true. Provide holes and openings through walls, floor and ceiling where required for services to kitchen and server equipment. Installation of floor finish to be commenced only after placement and securing of walk-I cooler freezer.

.6 Work by Owner: To include the following: Provision of safe storage of equipment designated for re-use, either in its present location or on site until ready for transport to its new location. Disposal of all existing equipment not required for re-use. Purchase, or lease, of all equipment designated "N.I.C."

1.20 EQUAL PRODUCTS

.1 Trade names mentioned herein are included to indicate the size, construction, material, finish and operation of the equipment required. The Tender shall be submitted on the basis of the supply and installation of all items as specifically called for and it shall be assumed that all items mentioned by name in the Specification shall be provided and installed for the amount of the Tender.

.2 Should the Contractor desire to provide alternate equipment other than that specified and is equal in all respects to that specified, he shall submit his request in writing to the Architect ten (10) working days prior to Tender closing in accordance with Section 01630 – Substitutions and Product Options. He shall clearly state the make and model number of the alternate together with drawing and/or cut for each alternate with his request for acceptance.

.3 Any variations between the alternate unit and that specified shall be clearly stated at the time of request. Any changes in number, type or location of services, curbs, bases, depressions or hoods which would be necessitated by the acceptance of any alternate must also be clearly stated and Tender must include any cost difference involved in making these changes.

PART 2 - LIST OF EQUIPMENT

2.1 Itemized Equipment

ITEM .26 - WALK-IN COOLER–15’-6” x 11’-6” x 8’NORMAL 3.3°C/ 38°F

Quantity	-	1
Type	-	Norbec
Finish	-	White exterior, galvanized unexposed, painted white interior.
Equipment	-	Standard. 4” construction as specified and shown on drawing S-101380. Unit set in floor depression as shown.
Accessories	-	Gray polyethylene 9/8” x 6” two rubrails on exposed exterior walls, 6” and 36” high. ss kick and rub plate on door exterior. 15” x 20” viewing window, LED fixture K1806 jelly-jar 12 ga. Ss corner guards on exposed exterior corners. Supply intell system and install and interwire alarm system complete with control box, audio-visual alarm and transformer ready for power hook-up. Filler strips at joints with structural walls and partitions,

		Tecumseh outdoor air cooler condensing unit Model RUC-OHA-C11900-2-4TT, R404A, 208/230/1/60 Evaporator model KLP211MA-S1B Low profile 120/1/60, package pre-assembled evap, KE2 demand defrost w/sporlan txv, factory installed package item demand defrost electronic controller, factory installed expansion valve, sporlan txv, liquid line solenoid valve, sporlan factory installed
Services	-	208 compressor 120V to lights and blower 1" indirect drain.

ITEM .27 - WALK-IN FREEZER–6'-0" x 6'-6" x 8'NORMAL -23°C/ -10°F

Quantity	-	1
Type	-	Norbec
Finish	-	White exterior, galvanized unexposed, painted white interior.
Equipment	-	Standard. 4" construction as specified and shown on drawing S-101380. Unit set in floor depression as shown.
Accessories	-	Gray polyethylene 9/8" x 6" two rubrails on exposed exterior walls, 6" and 36" high. ss kick and rub plate on door exterior. 15" x 20" viewing window, LED fixture K1806 jelly-jar 12 ga. Ss corner guards on exposed exterior corners. Supply intell system and install and interwire alarm system complete with control box, audio-visual alarm and transformer ready for power hook-up. Filler strips at joints with structural walls and partitions,
		Tecumseh outdoor air cooler condensing unit Model RUC-OHA-F06300-2-4TT, R404A, 208/230/1/60 Evaporator model KLP106LE-S2B Low profile 208/1/60, package pre-assembled evap, KE2 demand defrost w/sporlan txv, factory installed package item demand defrost electronic controller, factory installed expansion valve, sporlan txv, liquid line solenoid valve, sporlan factory installed
Services	-	208 compressor & blower 120V to lights 1" indirect drain.

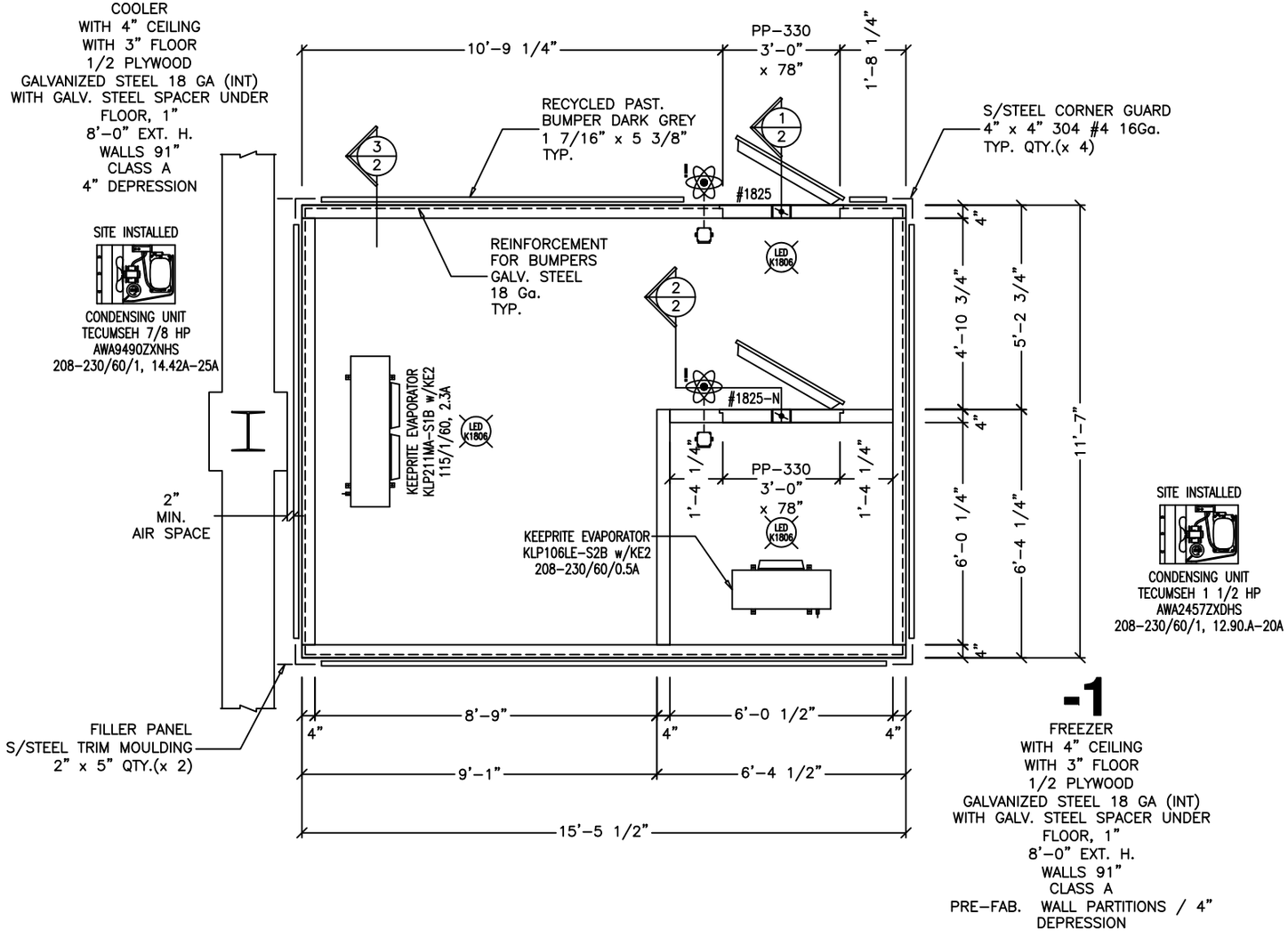
ITEM .27A - FREEZER SHELVING

Quantity	-	2 2 - 60” wide, 63” post
Type	-	Tarrison 4 tier high, 18” deep, polyseal Shelves
Finish	-	Standard

LIST OF DOCUMENTS FOR THIS SECTION

1.	**SPECIFICATION SECTION 11 40 00**	**9 PAGES**
2.	**WALK-IN COOKER/FREEZER SHOP DWGS**	**3 PAGES**
3.	**KITCHEN LAYOUT**	**1 PAGE**
4.	**EQUIPMENT SCHEDULE**	**1 PAGE**
5.	**EQUIPMENT TENDER FORM**	**3 PAGES**

END OF SECTION



Warning: Ambient conditions

Ambient temperature around refrigeration system must be no more than 90°F (32°C) and adequate air circulation (supplied by others) must be provided around unit. It is even more critical if the top of the cold room is concealed Failure to provide adequate ventilation will void warranty. Refrigeration system warranty does not cover loss of material due to malfunction or failure of the system.

LEGENDE / LEGEND

- VAPOR PROOF LIGHT
- 2"ø DIAL THERMOMETER (FLUSH MOUNT)
- SWITCH AND PILOT LIGHT (2 WAYS)
- SWITCH AND PILOT LIGHT (3 WAYS)
- SUSPENSION
- PRESSURE RELIEF VENT
- TEMPERATURE ALARM (INSTALLED ON SITE)
- INTELLIGENCE MODULE

NO.	REVISION	NOM	DATE
3	DEPRESSION 4"	É.B.	30/05/2014
2	FLOOR THK. / DEPRESSSION	É.B.	14/04/2014
1	ADDED DEPRESSION	É.B.	15/01/2014

NORBEC
SYSTÈMES NORBEC INC.
97 de Vaudreuil, Boucherville
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Tél.: (450) 449-1499
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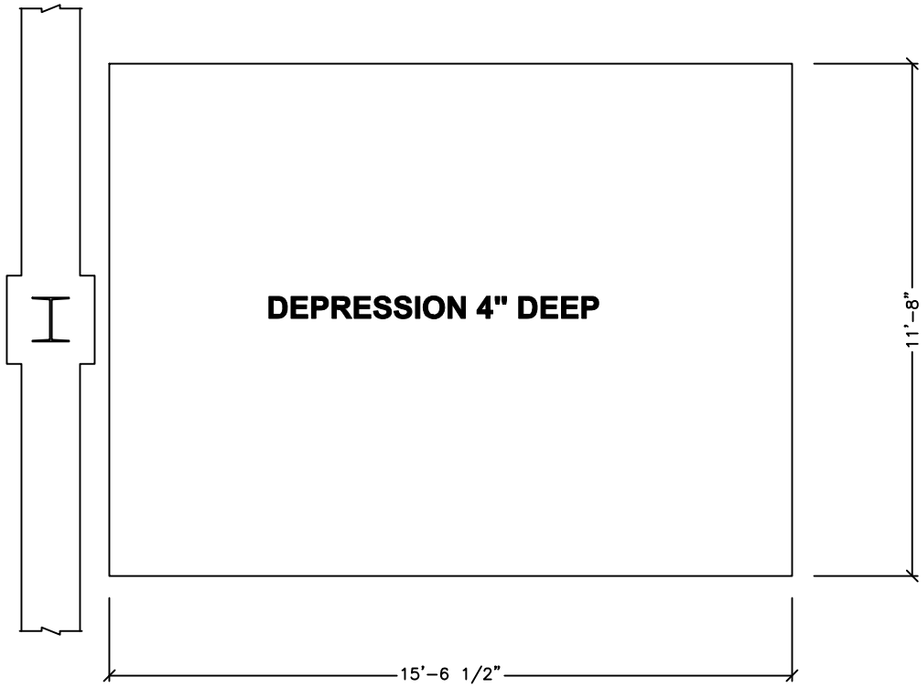
technical@norbec.com

PROJET / PROJECT
PIER 21

CLIENT
JOE GEORGE FOOD SERV.

DESSIN / DRAWING
WALLS LAYOUT

No. DE SOUMISSION / QUOTATION No.	No. DE CONTRAT / CONTRACT No.
S-101380	
DATE: 14/01/2014	PAR / BY: É.B.
ECHELLE / SCALE: 1/4"=1'-0"	PAGE: 1/3
REVISION: 3	



-APPROVAL-

I have verified all dimensions and specifications indicated on these documents.

- ☐ **Approved for fabrication as drawn***
- ☐ **Approved for fabrication as noted***
- ☐ **Revise and resubmit for approval as noted****

* **The current manufacturing lead time is 03 to 04 weeks after receipt of approved plans and a duly completed purchase order.**

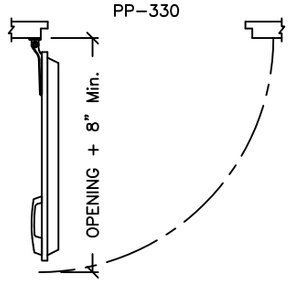
** **I agree that all changes made upon my request following approval for fabrication will be subject to additional costs and delays in manufacturing and shipment.**

Co. :_____

Name :_____

Date :_____

Signature :_____



DOOR SWING CLEARANCE
TYPICAL DETAIL
(left hinge shown)

Ceiling load limit

Ceiling spans exceeding 12 ft or panels that form a bulkhead or opening larger than 10 ft must be supported in accordance with Norbec typical suspension details. A maximum load (uniformly distributed) of 10 lbs/sq.ft. is allowed provided that ceiling is suspended in accordance with Norbec installation details.
Ceiling of more than 16' can be produced in more than one span. Installation costs must be adjusted in consequence.
If suspension system is provided by others it must be adequately designed to support both ceiling panels and any other loading that the panels may be subject to.
Under no circumstances is the ceiling to be used to support merchandise or equipment. Exceeding this limit may lead to structural damage and/or personal injury.
Norbec assumes no liability if any of the above restriction is exceeded.

Protective Film

All panels are supplied with a protective film to avoid scratches during handling. It is strongly recommended to peel-of the protective film before assembling the panels together otherwise; part of the film may remain in the joint and interfere with the joint sealant application.

Warning:

As metal panels and trims may have sharp edges, it is recommended that proper safety gloves be worn to avoid personal injury while handling merchandises.

LISTED

CLASSIFIED BUILDING UNITS (COMPOSITE TYPE)
SURFACE BURNING CHARACTERISTICS 9R14
Classified as to surface burning characteristics in accordance With the Standard CAN / ULC-S102, UL-723 and ULC S138

UNITÉ DE BÂTIMENT CLASSÉ (TYPE COMPOSITE)
CARACTÉRISTIQUES DE COMBUSTION SUPERFICIELLE 9R14
Classé Par Caractéristiques de Combustion Superficielle Conformément aux Standards CAN / ULC-S102, UL-723 et ULC S138

LISTED / ÉNUMÉRÉS

Material Details / Détails Des Matériaux	Classification or Rating / Classement ou Notation: Flame spread / Propagation de la Flamme	Smoke developped / Dégagement de Fumée
CAN/ULC-S 102 NORBEC		
Finished panels/Panneaux Finis	20	335
Polyurethane foam core/Noyau en Mousse Polyuréthane 127 mm Maximum	415	390
UL-723/(ASTM E-84) NORBEC		
Finished panels/Panneaux Finis	20	+500
Polyurethane foam core/Noyau en Mousse Polyuréthane 127 mm Maximum	20	450
CAN/ULC S138 NORBEC With Sprinkler/Avec Gicleur D'incendie 127 mm Maximum		

Insulated Building Panel For Use with Sprinkler Protection (ULC / ORD-C378)
Polyurethane sandwich panels with the following metal skins:
Painted Galvanized Steel, Plain Galvanized Steel or Stainless Steel, .019" minimum thickness.

Panneau de Bâtiment Isolé à Utiliser Avec Gicleur D'incendie (ULC / ORD-C376)
Panneau Sandwich De Polyuréthane Avec Fini de Métaux Suivants:
Acier Galvanisé Prépeint, Acier Galvanisé ou Acier Inoxydable,
Épaisseur minimum .019"

Systèmes Norbec inc. Boucherville, Qc, Canada

LEGENDE / LEGEND

- VAPOR PROOF LIGHT
- 2"ø DIAL THERMOMETER (FLUSH MOUNT)
- SWITCH AND PILOT LIGHT (2 WAYS)
- SWITCH AND PILOT LIGHT (3 WAYS)
- SUSPENSION
- PRESSURE RELIEF VENT
- TEMPERATURE ALARM (INSTALLED ON SITE)
- INTELLIGENCE MODULE

NO.	REVISION	NOM	DATE
3	DEPRESSION 4"	É.B.	30/05/2014
2	FLOOR THK. / DEPRESSSION	É.B.	14/04/2014
1	ADDED DEPRESSION	É.B.	15/01/2014

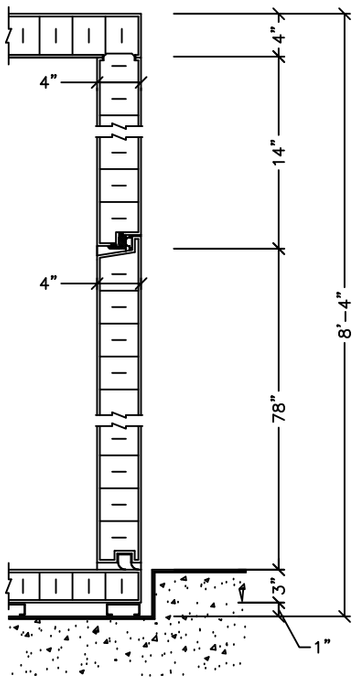
NORBEC
SYSTÈMES NORBEC INC.
97 de Vaudreuil, Boucherville
Quebec, Canada J4B 1K7
Tél.: (450) 449-1499
Fax.: (450) 641-4657
technical@norbec.com

PROJET / PROJECT
PIER 21

CLIENT
JOE GEORGE FOOD SERV.

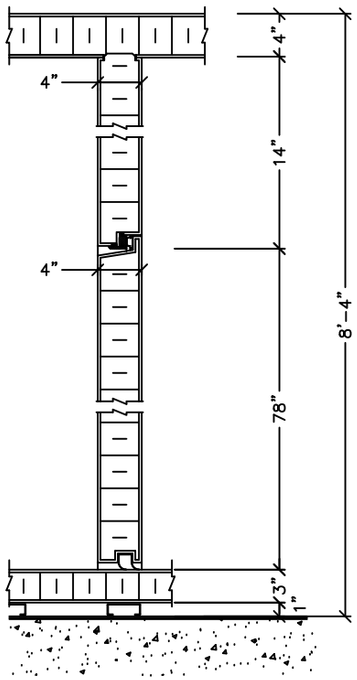
DESSIN / DRAWING
DEPRESSION LAYOUT

No. DE SOUMISSION / QUOTATION No.	No. DE CONTRAT / CONTRACT No.
S-101380	
DATE: 14/01/2014	PAR / BY: É.B.
ECHELLE / SCALE: 1/4"=1'-0"	PAGE: 2/3
REVISION: 3	



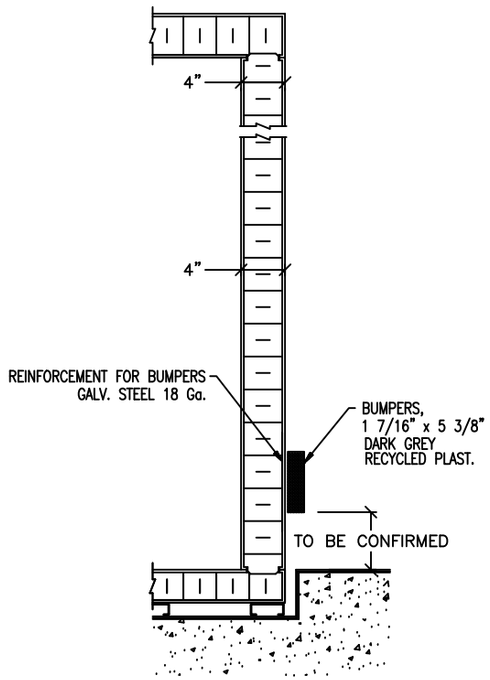
1 / 1 HINGED DOOR PP-330

(SCALE: N.T.S.)



2 / 1 HINGED DOOR PP-330

(SCALE: N.T.S.)



3 / 1 BUMPERS SECTION

(SCALE: N.T.S.)

LEGENDE / LEGEND

- VAPOR PROOF LIGHT
- 2"ø DIAL THERMOMETER (FLUSH MOUNT)
- SWITCH AND PILOT LIGHT (2 WAYS)
- SWITCH AND PILOT LIGHT (3 WAYS)
- SUSPENSION
- PRESSURE RELIEF VENT
- TEMPERATURE ALARM (INSTALLED ON SITE)
- INTELLIGENCE MODULE

NO.	REVISION	NOM	DATE
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PROJET / PROJECT
PIER 21

CLIENT
JOE GEORGE FOOD SERV.

DESSIN / DRAWING
SECTIONS

No. DE SOUMISSION / QUOTATION No.	No. DE CONTRAT / CONTRACT No.
S-101380	
DATE: 14/01/2014	PAR / BY: É.B.
ECHELLE / SCALE: NONE	PAGE: 3/3
REVISION: 3	

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 DESCRIPTION

.1 The work of this Section includes the following (dimensions are approximate and must be verified in the field) :

.1 MAIN DRAPE

One 18'-0"H x 34'-0"W CUSTOM COLOUR 20oz. IFR Velour Main Traveller
- 2 x 17'-0"ft (includes 12" Overlap)
- 50% Fullness
- Top Finish with Webbing, Grommets @ 12"o.c. and S Hooks
- Side Finish with a 12" Hem
- Bottom Finish with a Chain in a Lined Pocket

One ADC #270 BLACK Bi-Part, Manual Pull Traveller Track
- Comes with all the Necessary Accessories
- 36ft (2 x 18ft)
- Stage Left Draw

.2 SIDE DRAPES

Two 12'-1"H x 6'-0"W CUSTOM 20oz IFR Velour SL Side Drape
- 50% Fullness
- Top Finish with Webbing. Grommets @ 12"o.c. and S Hooks
- Side Finish with a 2" Hem
- Bottom Finish with a Chain in a Lined Pocket

Two 14'-2"H x 6'-0"W CUSTOM 20oz IFR Velour SR Side Drape
- 50% Fullness
- Top Finish with Webbing. Grommets @ 12" o.c. and S Hooks
- Side Finish with a 2" Hem
- Bottom Finish with a Chain in a Lined Pocket

Two ADC #273 BLACK Manual Pull Track
- 12ft
- supports the sides drapes and allows them to move upstage and downstage to close off the wings

.3 TRUSS BORDER

Three 2'-0"H x 32'-0"W CUSTOM 20oz IFR Velour SL Truss Border
- 50% Fullness
- Top Finish with Webbing. Grommets @ 12"o.c. and Ties
- Side Finish with a 2" Hem
- Bottom Finish with a 3" Hem

.4 MID TRAVELLER

Two 18'-0"H x 34'-0"W CUSTOM 20oz IFR Velour SL REAR Drape
- 2 x 17'-0"ft (includes 12" Overlap)
- 50% Fullness
- Top Finish with Webbing. Grommets @ 12"o.c. and S Hooks

- Side Finish with a 12" Hem
- Bottom Finish with a Chain in a Lined Pocket

One ADC #270 BLACK Bi-Part, Manual Pull Traveller Track
- Comes with all the Necessary Accessories
- 2 x 18ft
- Stage Left Draw

.5 REAR TRAVELLER

Two 18'-0"H x 34'-0"W CUSTOM 20oz IFR Velour SL REAR Drape
- 2 x 17'-0"ft (includes 12" Overlap)
- 50% Fullness
- Top Finish with Webbing. Grommets @ 12"o.c. and S Hooks
- Side Finish with a 12" Hem
- Bottom Finish with a Chain in a Lined Pocket

One ADC #270 BLACK Bi-Part, Manual Pull Traveller Track
- Comes with all the Necessary Accessories
- 2 x 18ft.
- Stage Left Draw

1.3 SUBMITTALS

.1 Submit detailed shop drawings showing layout, materials, tracks, rigging and anchorages. Shop drawings shell bear seal and signature of a professional engineer licensed to practice in the province of the project. Verify dimensions on site prior to submission of shop drawings.

.2 Submit duplicate, minimum 12" x 12" samples of each type of curtain fabric with required colour.

.3 Submit duplicate samples, minimum 12" long of each type of curtain track.

1.4 PRODUCT DELIVERY, HANDLING AND STORAGE

.1 Deliver products to site in manufacturer's original packaging with identifying labels intact and Legible.

.2 Store products in fully enclosed dry location, protected from moisture and any other damage until Required for installation.

1.5 JOB CONDITIONS

.1 Do not start installation until building is fully enclosed and environmental conditions in installation areas approximate those when building is in use.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER AND SUPPLIER

.1 Rose Brand, Theatrical Fabrics
Canadian representative Technically Yours Inc.
288 Judson Street, Unit 5
Toronto, ON
M8Z 5T6
Phone: 416-361-9390
Toll Free: 1-800-22-1624 x17
Sales Contact: Tony Devai

.2 Alternates would need to match pre-approved custom fabric colours and detailed layouts. Architect and Client to review and approve any alternates prior to them being accepted.

2.2 FABRICATION - GENERAL

.1 Fabric shall be free of any flaws and shall be made from 1 dye lot.

.2 Fabric shall be inherently flame retardant. Supplier must supply a fire retardant certificate stating the fabric is IFR and meets the Canadian FR Standard CAN/ULC S109-3.

.3 Fabric to be sewn NAP DOWN!

.4 Standard top finish shall be with 75mm (3") Poly Webbing with #3 BLACK grommets attached 19mm (3/4") from the top at 300mm (12") centres.

.5 Standard side finish for both sides shall be 305mm (12") flat hem turnback.

.6 Standard bottom finish shall be 127mm (5") hem with a 25mm (1") turnunder. Inside the bottom hem shall contain a #8 Jack Chain in a line fabric pocket.

.7 Each drape shall have a label sewn to the bottom offstage hem that shall contain;
- Manufacturer's name
- Date of manufacture
- Fabric type and colour
- Indication that fabric is IFR
- Name and size of panel

.8 Each drape shall have a minimum 102mm (4") x 204mm (8") FR swatch of the same fabric being used sewn into the offstage hem within 1220mm (48") of the FR label.

.9 All drapes to be installed on the associated tracks. The final drape height shall hang between 12mm (1/2"), but no more than 25mm (1"), above the finished stage floor.

2.3 STAGE DRAPES

.1 MAIN TRAVELLER

1. Provide two (2) Panels each being 5490mm (18'-0") H x 5180mm (17'-0") W
2. Measurements to include a 305mm (12") Centre overlap
3. Black 2" S Hooks
4. Each Panel to be made at 50% Fullness
5. Fabric shall be Rose Brand 20oz IFR Crescent Velour
6. Custom Colour to match approved colour by Owner

.2 MID TRAVELLER

1. Provide two (2) Panels each being 5490mm (18'-0") H x 5180mm (17'-0") W
2. Measurements to include a 305mm (12") Centre overlap
3. Black 2" S Hooks
4. Each Panel to be made at 50% Fullness
5. Fabric shall be Rose Brand 20oz IFR Crescent Velour
6. Custom Colour to match approved colour by Owner

.3 REAR TRAVELLER

1. Provide two (2) Panels each being 5490mm (18'-0") H x 5180mm (17'-0") W
2. Measurements to include a 305mm (12") Centre overlap
3. Black 2" S Hooks

4. Each Panel to be made at 50% Fullness
5. Fabric shall be Rose Brand 20oz IFR Crescent Velour
6. Custom Colour to match approved colour by Owner

.4 TRUSS BORDER

1. Provide three (3) Panels each being 610mm (2'-0") H x 9754mm (34'-0") W
2. Supply with Black 18" Twill Ties to tie off to top of each truss
3. Side Finish for both sides to be 76mm (3") flat hem turnback
4. Each Panel to be made at 50% Fullness
5. Fabric shall be Rose Brand 20oz IFR Crescent Velour
6. Custom Colour to match approved colour by Owner

.5 STAGE RIGHT SIDE CURTAIN

1. Provide two (2) Panels each being 3535mm (11'-7") H x 1829mm (6'-0") W
2. Black 2" S Hooks
3. Top finish to have HIDDEN grommets attached 25mm (1") below to the top finish to hide more of the Track Carrier.
4. Side Finish for both sides to be 76mm (3") flat hem turnback
5. Each Panel to be made at 50% Fullness
6. Fabric shall be Rose Brand 20oz IFR Crescent Velour
7. Custom Colour to match approved colour by Owner

.6 STAGE LEFT SIDE CURTAIN:

1. Provide two (2) Panels each being 4175mm (13'-8") H x 1829mm (6'-0") W
2. Black 2" S Hooks
3. Top finish to have HIDDEN grommets attached 25mm (1") below to the top finish to hide more of the Track Carrier.
4. Side Finish for both sides to be 76mm (3") flat hem turnback
5. Each Panel to be made at 50% Fullness
6. Fabric shall be Rose Brand 20oz IFR Crescent Velour
7. Custom Colour to match approved colour by Owner

2.4 STAGE TRACKS

.1 TRAVELLERS

1. Supply and install three (3) complete ADC #270 BLACK Bi-Part, Manual Draw Traveller Tracks attached to pipe battens for the MAIN, MID, and REAR Travellers.

2. Each track to comprise of two (2) 5486mm (18'-0") sections (no joints) complete with all associated hardware including;

   .1 Track
   .2 Hanging and Batten Clamps with a maximum spacing of 1829mm (6'-0")
   .3 End Stops
   .4 Lap Clamps (2)
   .5 Centre Pipe Support
   .6 Single Carriers
   .7 Master Carriers
   .8 Live and Dead End Pulleys
   .9 Adjustable Floor Tension Pulley (on Stage Left Side)
   .10 Draw Cord

3. Pipe Battens for Traveller tracks to be attached to roof steel. Attaching to the wood sections of the roof IS NOT ALLOWED. Method of mounting to these battens to be shown by bidder and approved.

.2 SIDE DRAPES

1. Supply and install two (2) complete ADC #273 BLACK Walkalong Tracks
2. Each track to comprise of one (1) 3658mm (12'-0") sections complete with all associated hardware including;
   - Track
   - Hanging Clamps with a maximum spacing of 1829mm (6'-0")
   - End Stops
   - Single Carriers
3. Track to be attached to steel beams on either side of the stage.
   Method of mounting to these track to be shown by bidder and approved.\

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Examine existing conditions to ensure that they are satisfactory to receive the work of this Section.

.2 Start of installations shall imply acceptance of conditions.

3.2 INSTALLATION

.1 Install the work of this Section in accordance with reviewed shop drawings and in conformance with manufacturer's directions.

.2 Provide rigging and anchorages for support of tracks as required and in accordance with engineered shop drawings. Install tracks level, at required locations, and securely anchored to rigging.

.3 Install drapes and test operation of each drape to ensure proper and smooth operation

END

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 RELATED WORK

.1 Electrical power connections: Division 26

1.3 QUALITY ASSURANCE

.1 Acceptable manufacturers:

.1 Solarfective

.2 Sunproject

.2 Installer qualifications: forces in the direct employ or under the control of the system manufacturer, skilled, trained and experienced in work of similar scope and complexity of work specified herein.

.3 Shade fabric:

.1 Shade fabric shall hang flat, without buckling or distortion.

.2 Fabric edge, when trimmed shall hang straight without ravelling.

.3 An unguided roller shade cloth shall roll true and straight, without shifting sideways more than 3 mm in either direction due to warp, distortion or weave design.

.4 Fabric shall pass "Small Scale Vertical Burn Test" in accordance with CAN/ULC-S109-03.

.4 Electrical components shall be labelled by CSA.

1.4 SUBMITTALS

.1 Submit detailed shop drawings showing configurations, materials, finishes, methods of operation, wiring diagrams, joint locations and method of joining, anchorage details. Verify dimension in the field prior to submission of shop drawings.

.2 Submit duplicate, minimum 8” x 8” samples of each shade fabric required.

.3 Submit duplicate, minimum 2” x 4” samples of each metal finish / colour required.

.4 Submit samples of each type of hembar required.

.5 Provide operating and maintenance instructions for inclusion into maintenance manual. Include instructions on care, maintenance and cleaning of shade fabrics.

.6 Submit test results from recognized independent testing agency, acceptable to jurisdictional authorities showing that fire hazard classification of shade fabric meets regulatory requirements.

PART 2 - PRODUCTS

2.1 MOTORIZED SHADES

.1 Shade system: motorized double shading system (solar and blackout) utilizing linear motors, fabloc tubes and all necessary accessories for motorized operation in accordance with requirements shown. Sunproject Dual Shades Model MDL Dual 11-140 EM/LL with front fascia, side channel, oversize quick connect plug system.

.2 Internal limit switches: adjustable by two hex key switches to allow exact setting of travel in both the raise and lower positions. Micro switches shall provide circuit breaking at the end of the run. Limit switch setting shall not be disturbed by the action of the roller tubes.

.3 Brake: solenoid activated disk brake mechanism shall stop and hold in any position. Brake shall automatically disengage when motor is operating.

.4 Motor: asynchronous with built-in reversible capacitor start and run, made to be operated with 95-125V-AC at 60 Hz, Single Phase (DC motors not acceptable). Temperature Class A (maximum temperature rating 140°C). Thermally protected, totally enclosed. Maintenance free with locking disconnect plug assembly finished with each operator. Motor operator shall be concealed inside the shade tube.

.5 Gear box: 3 levels of satellite gears for load distribution, planetary type gears machined to close tolerance of tempered steel. Speed varies according to model from 12 RPM to 30 RPM.

.6 Assembly: two screws lock the drive end of the motor to the tube. A notched section in the tube turns the ring which activates the shade assembly and lower stop positions.

.7 Controls: maximum two motors shall be operated by a 3-position rocker switch, located remotely as directed by the Consultant. Where required, motors shall be hooked up to a "Motor Logic Control" located as shown on the manufacturer's wiring diagrams. Supply the switches and the "M.L.C." for installation and hook-up by Division 26. Provide brushed stainless steel coverplates.

.8 Tubes: extruded aluminum tube, AA 6063-T5 alloy, minimum 2 ½” o.d. with internal keyway to receive tubular motor. Tube shall be extruded with two fabric mounting channels. Channels shall be designed to accept fabloc fabric mounting spline.

.9 Fabric mounting spline: extruded vinyl with 65 mm asymmetrical locking channels and embossed fabric guide, for use with o.d. tube. Spline shall be snapped and locked into snaploc tube and have sufficient capacity to support fabric shade. Spline shall be readily removable without dismounting snaploc tube from end brackets.

.10 End brackets (drive and idler): shall consist of 1/8” thick sheet steel. Wall jamb, or ceiling mounted as required.

.11 Tube end plug: Delrin end cap shall have steel pin which permits up to 8 mm lateral adjustment in tube width.

.12 Fascia: extruded AA 6063-T5 aluminum fascia, 6” high, factory painted to match walls. Fascia shall snap onto mounting clips and end brackets without any exposed fastening devices. Fascia shall encase top of tube so as not to restrict airflow over top of shade.

.13 Fascia filler: furnish a compatible snap-in, snap-out filler to bridge 3/8” reveal or mullions and provide a uniform transition between adjacent fascias. Fascia filler shall be readily removable and permit clear access for installation of a demising wall, filler panel or other space dividing system.

.14 Hembar: extruded aluminum flat bar, single lengths for each shade panel. Insert in fabric pocket and sew both ends.

.15 Blackout side and bottom channels: extruded aluminum as recommended by system manufacturer, factory painted to match walls.

2.2 SHADE FABRICS

.1 Solar shade fabric: Sunproject EAS 8406M.

.2 Black-out fabric: Sunproject BO 106D.

.3 Where shade fabrics are sewn, needle holes shall not permit light penetration.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Incorporate shades into acoustic panel ceiling system in accordance with shade manufacturer's directions.

.2 Install work of this Section, plumb, level, square, in required configurations and locations, securely anchored to supporting work.

.3 Make all systems fully operational.

.4 Locate equipment, controls, switches in locations shown, or if not shown, as directed by Consultant.

.5 Check test operation of each unit and, if necessary make adjustments to ensure proper operation.

.6 Provide side and bottom channels at blackout shades.

.7 Install key operated control for motorized shades at location indicated.

.8 For motorized shades, provide electrical wiring from motor to control and limit switches. Coordinate with Division 26 for required electrical power connection.

END

1 General

1.1 General

.1 Provide new materials, equipment and plant of proven design and quality and of current models with published ratings for which replacement parts are readily available.

.2 New Museum:

.1 **Definition of 'Clean Space'**

All reviewed and agreed on the following 'Clean Space' definitions. MHPM has added the commissioning requirements to the Master Project Schedule. MHPM has added the definition to the front end specification for GC RFP for Project 1. MHPM will add the definitions to the front end specs for GC RFP for Project 2/3.

.2 **Clean Space Definition Phase 1: for Projects 1, 2, & 3**

In order to begin and complete the installation of exhibits and artifacts in the Museum, the GC must first provide a clean and secure space. The intent is to provide a definition that will support a discrete handover between the GC and Exhibit Design/Builder, the two contractors. In all spaces, a clean space is defined as a fully functional, completely commissioned, dust free environment. The GC and all sub-contractors are substantially complete (all mechanical, electrical, controls, fire protection, and lighting systems are installed and operating), and all known deficiencies have been completed. HVAC systems will have been in operation for at least 10 days and filters changed at least once. At the clean space handover, the Exhibit Design/Builder will start installing exhibit related materials (but not artifacts). It is expected that the HVAC and air pressure system will still be in the process of being balanced and commissioned. This would allow all the necessary readings to take place so that when the artifacts are ready to be installed, the galleries are working as a controlled environment.

.3 Clean Space Definition Phase 2: for Projects 2, & 3

In order to begin and complete the installation artifacts within the galleries, the GC must first provide a clean and secure space. A clean space is defined as a fully functional, completely commissioned, dust free environment. Work by the Exhibit Design/Builder is substantially complete and all known deficiencies have been completed.

All mechanical, electrical, controls, and fire protection systems are complete with no outstanding items pending resolution.

HVAC systems have been installed, balanced, tested and commissioned to provide and maintain 22.2 Degrees Celsius and 50% RH for a minimum period of 30 days. Both temperature and relative humidity (RH) shall be recorded/trend logged for 30 days. Submittal of hourly, daily, and weekly reports for review by the consultant is mandatory.

Dust Particulate levels shall be recorded (4 hours continuous) by the GC at the start of the 30 day period (reference-baseline) and at the end of the 30 day period. Particulate matter levels to be a minimum (PM10) of <50ug/m3. Submit the dust particulate report for review by the project team.

Room air pressure shall be maintained at +2.5 Pa relative to the adjacent spaces and recorded during the same 30 day period. Submit the space pressurization report for review by the project team. At the start of the 30 day period, the final permanent air filters shall be installed in the AHU. After the 30 day period, these air filters shall be replaced with a new set of air filters.
Permanent clean power has been distributed, terminated, and is functioning as contracted.
Lighting control systems are fully functional/commissioned.

1.2 Related Sections

.1 Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM).
.2 Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
.3 Section 01 33 00 - Submittal Procedures.
.4 Section 01 35 29.06 - Health and Safety Requirements.
.5 Section 01 45 00 - Quality Control.
.6 Section 01 47 15 - Sustainable Requirements: Construction.
.7 Section 01 74 11 - Cleaning
.8 Section 01 47 17 - Sustainable Requirements: Contractor's Verification.
.9 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
.10 Section 01 78 00 - Closeout Submittals.
.11 Section 01 91 13 - General Commissioning (Cx) Requirements.
.12 Section 02 81 01 - Hazardous Materials.

1.3 Included Work

.1 Work described in the following sections is part of the Plumbing Sub Contractor's work.
  .1 07 84 00 – Fire Stopping.
  .2 08 31 00.01 – Access Doors – Mechanical.

.2 Work described in the following sections is part of the Heating Sub Contractor's work.
  .1 07 84 00 – Fire Stopping.
  .2 08 31 00.01 – Access Doors – Mechanical.

.3 Work described in the following sections is part of the Ventilation Sub Contractors work.
  .1 07 84 00 – Fire Stopping.
  .2 08 31 00.01 – Access Doors – Mechanical.

.4 Work described in the following sections is part of the Controls Sub Contractor's work.
  .1 07 84 00 – Fire Stopping.
  .2 08 31 00.01 – Access Doors – Mechanical.

.5 Work of the following sections is part of the Fire Protection Sub Contractor's work.
  .1 07 84 00 – Fire Stopping.
  .2 08 31 00.01 – Access Doors – Mechanical.
  .3 10 44 16.19 – Fire Extinguishers and Safety Blankets

.6 This project is being Commissioned by an independent Commissioning Agent. Provide support required by Commissioning agent including, but not limited to running equipment, simulating alarm conditions, and completing required documentation.

1.4 Referenced Codes And Standards

.1 Use following latest editions and amendments in effect at time of Tender Call:

AABC Associated Air Balance Council
ACGIH American Conference of Industrial Hygienists
ADC Air Diffusion Council
AMCA Air Moving and Conditioning Association
ARI Air Conditioning and Refrigeration Institute
ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME American Society of Mechanical Engineers
ASSE American Society of Sanitary Engineers
ASTM American Society for Testing and Materials
AWS American Welding Society
AWWA American Water Works Association
CaGBC Canada Green Building Council
CEMA Canadian Electrical Manufacturers Association
CFUA Canadian Fire Underwriters' Association
CGSB Canadian General Standards Board
CGA Canadian Gas Association
CHVAC Canadian Heating, Ventilation and Air Conditioning Code (NRC)
CSA Canadian Standards Association
CUA Canadian Underwriters' Association
GSES Green Seal Environmental Standards
HRA Heating, Refrigeration and Air Conditioning Institute of Canada
LEED Leadership in Energy and Environmental Design
NACE National Association of Corrosion Engineers
NBC National Building Code of Canada (2010)
NBFU National Board of Fire Underwriters'
NBS National Bureau of Standards
NECC National Energy Code of Canada for Buildings
NFC National Fire Code of Canada (2010)
NFPA National Fire Protection Association
- NFPA 10, Standard for Portable Fire Extinguishers (2010)
- NFPA 13, Standard for the Installation of Sprinkler Systems (2013).
- NFPA 14, Standard for the Installation of Standpipe and Hose Systems (2014)
- NFPA 17A, Standard for Wet Chemical Extinguishing Systems (2002)
- NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems (2008)
- NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations (2011)

NPC National Plumbing Code of Canada (2010)
NS DOL Nova Scotia Department of Labour
NSC National Standards of Canada

SAE	Society of Automotive Engineers
SMACNA	Sheet Metal and Air Conditioning Contractors National Association Inc.
TIAC	Thermal Insulation Association of Canada
TIMA	Thermal Insulation Manufacturers Association
ULC	Underwriters' Laboratories of Canada

1.5 Submittals

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submittals shall be in the imperial system and use the same unit as shown in the contract documents.

.3 Shop Drawings

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia where noted.

.2 Submit shop drawings for all equipment listed and for all equipment the contractor wishes to substitute for provided such alternative equipment has prior approval.

.3 Work is not to commence until shop drawings have been reviewed by the Engineer.

.4 The Engineer's review of these drawings is general. It is not intended to release the Contractor from necessity of furnishing materials and performing the work as required by the plans and specifications.

.5 All shop drawings must be checked against the requirements of the plans and specifications by this Contractor prior to submitting them. Drawings not checked will be returned without approval.

.6 All shop drawings must be first quality reproductions with all details, lettering, etc. distinct and legible.

.7 Shop drawings to show:

a) Mounting arrangements.
b) Operating and maintenance clearances.

.8 Shop drawings and product data accompanied by:

a) Detailed drawings of bases, supports, and anchor bolts.
b) Acoustical sound power data, where applicable.
c) Points of operation on performance curves. (provide complete family of curves)
d) Manufacturer to certify current model production.
e) Certification of compliance to applicable codes.

.9 Upon receipt of product shop drawings by the mechanical contractor he shall review them to ensure that they meet the requirements of the specification in all respects, that they are clear an legible, all options are being provide are clearly indicated and that dimensions, weights, power requirements, quantities and capacities are consistent with the requirements of the plans and specifications. The contractor shall complete Appendix A at the end of this section verifying that he as completed these tasks. The contractor shall then forward the shop drawings through the appropriate channels for final review by the engineer. Shop drawings that are not accompanied by Appendix A clearly indicating that the contractor has completed this review will

not be reviewed by the engineer and will be returned to the contractor.

.10 Equipment of each specification section to be submitted separately

.11 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.4 Operation and Maintenance Manuals:

.1 Operation and maintenance manual approved by, and final copies deposited with, Consultant before final inspection.

.2 Provide three (3) copies to the Owner of the Maintenance manual. Each copy to be suitable bound, three ring binders containing letter sized pages. Larger pages, suitably folded, or folded in pockets may be used where necessary.

.3 Binders shall be no more than 2/3 full leaving room to add material in the future. Where necessary additional binders shall be provided.

.4 The Maintenance Manuals shall include the following:

.1 Have a title sheet, or sheets, preceding data on which shall be recorded Project name, date, list of contents, and Trade Contractor's name.

.2 Be organized into applicable Sections of work with each Section separated by hard paper dividers with plastic covered tabs marked by Section.

.3 Contain a list of local (or nearest) representative of each piece of equipment including mail address, e-mail address, web site, and phone number.

.4 One (1) copy of each final approved shop drawing on which have been recorded changes made during fabrication and installation.

.5 Typed or printed information and notes, and neatly drafted drawings.

.6 Maintenance and operating instructions on all building equipment supplied by the Trade Contract.

.7 General and specific instructions for the maintenance and operation of automatic and adjustable controls. (see section 25 05 03)

.8 Brochures and parts list for all equipment.

.9 Sources of supply for all proprietary products used in the work.

.10 Lists of supply sources for maintenance of all equipment in the project of which more detailed information is not included above.

.11 Lists of recommended spare parts.

.12 A Preventive Maintenance schedule.

.5 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.2 Provide separate tab for MSDS for all hazardous material installed and left stored on site or with the Owner. First page of tab to be an index of MSDS included.

.3 Provide separate tab for all equipment startup reports. First page of tab to be an index of reports included.

.4 Provide separate tab for copies of all equipment manufacturers warranties. A copy of the warrantee to also be included with the equipment O & M data. First page of tab to be an index of warrantees included.

.5 Provide an analysis of hydronic systems water after cleaning and treatment of piping.

.6 Include serial number of equipment furnished with serial numbers.

.5 Shop Drawing and Maintenance Manual Submittal Summary

	Shop Drawings						Maintenance Manuals						
	Model No.	Dimension	Service Requirements	Weight	Electrical	Performance Data	Shop Drawing	O & M Data	Start Up Report	As-Built Drawing	Spare Parts List	MSDS	Serial No.
Common Items													
Access Doors (wall / ceiling)	●	●					●	●					
Bases and Supports		●					●			●			
Drain Valves	●	●					●						
Existing Identification Systems (note 13)													
Fire Stopping	●					●	●					●	
Flexible Pipe Connection	●	●					●						
Grooved Fittings and Valves	●	●		●			●	●					
Pipe Guides and Anchors	●	●					●						
Pipe Hangers and Supports	●	●		●			●						
Pipe Identification (note 11)	●	●											
Pipe Unions	●						●						
Thermometers and Pressure Gauges	●	●				●	●						
Vibration Isolation (bases, pads, springs, hangers, and mounts)	●	●		●		●	●	●			●		
Insulation													
Duct		●				●	●						
Equipment		●				●	●						
Pipe		●				●	●						
Plumbing													
DHW Expansion Tank	●	●	●	●			●						
DHW Heater	●	●	●	●	●	●	●	●	●		●		●
DHW Storage Tank	●	●	●	●			●	●					●
Fixtures and Trim	●	●	●	●	●	●	●	●			●	●	
Fixture Carriers	●	●		●			●						
Pipe	●	●		●			●						
Plumbing Specialties – Backflow Preventer,	●	●	●	●			●			12			

Floor Drain, Grease Interceptor, Trap Primer, Hose Bibb, Strainer, Cleanouts, Vacuum Breaker, Water Hammer Arrestor													
Pressure Regulators	●	●	●				●						
Pump – DHW Recirculation	●	●	●	●	●	●	●	●			●		●
Valves (all Services) – Backwater, Balancing, Check, Mixing, Pressure Reducing, Pressure Relief, Pressure – Temperature Relief, Shut-off	●	●	●	●			●	●		1			
Valve - Solenoid	●	●	●	●	●		●	●					
Water Make-up Assemblies	●	●	●	●			●						
Water Treatment System	●	●	●	●	●	●	●	●	●		●	●	●
Heating													
Air Separator	●	●		●			●						
Anchors and Guides	●	●		●			●			1			
Boiler	●	●	●	●	●	●	●	●	●		●		●
Cabinet Unit Heater / Force Flow Heaters	●	●	●	●	●	●	●	●					
Chemical Treatment Pot Feeder Treatment Chemicals and equipment Treatment procedure	●						●		4			●	
Condensate Receiver	●	●	●	●	●	●	●	●			●		
Expansion Tank	●	●		●			●	●					
Fin Tube Radiation	●	●	●			●	●	●					
Glycol	●											●	
Glycol Fill Package	●	●	●	●	●	●	●						
Heat Exchanger	●	●	●	●		●	●						●
Heating Specialties AAV, Flexible Pipe Connections, Manual Air Vent, Strainer, Suction Diffusers	●	●		●		●	●						
Heating / Cooling Coils	●	●	●	●	5	●	●						●
Steam Trap	●	●	●	●		●	●	●		1			
Unit Heater	●	●	●	●	●	●	●	●					
Valves (all Services) – Anti-syphon, Balancing, Check, Mixing, Pressure Reducing, Pressure Relief, Pressure – Temperature Relief, Shut-off, Triple Duty	●	●		●			●	●		1			
Valve - Solenoid	●	●	●	●	●		●	●					
Ventilation													
Air Handling Units	●	●	●	●	●	●	●	●	●	1	●		●

Dampers – Backdraft Balancing Fire and Smoke	● ● ●	● ●	 ●				● ● ●	● ●		1 1 1	 ●		
Duct Access Doors	●	●		●									
Duct Construction and Proprietary Joints	●	●											
Duct Sealant	●											●	
Fans	●	●	●	●	●	●	●	●	●	1	●		●
Filters	●	●				●	●						
Filter Gauges	●	●					●						
Flexible Ductwork	●					●	●						
Grilles, Registers, and Diffusers	●	●				●	●	●		1			
Humidifiers	●	●	●	●	●	●	●	●	●	1	●		●
Louvers / Louvered Penthouses	●	●				●	●			1			
Silencers	●	●		●		●	●	●		1			
Turning Vanes	●	●					●			1			
VAV boxes	●	●	●	●	●	●	●	●		1			
Fire Protection													
Alarm Valves	●	●	●		●		●	●	●	1			
Backflow Preventor	●	●	●	●	●	●	●	●	●	1			
Electric Gong	●				●		●	●		1			
Fire Equip. Cabinets & Accessories	●	●					●			1			
Fire Extinguishers	●	●		●			●			1	1	●	
Kitchen Hood Suppression System	●	●	●	●	●	●	●	●	●	●	●	●	●
Pipe and Pipe Fittings	●	●					●						
Pipe Hangers	●	●					●						
Pressure / Flow Switches	●	●			●		●						
Sprinklers and Guards	●	●				●	●			1	1		
Sprinkler System	10							8	9	1	1		
Valves and Valve Boxes	●	●					●			1			
Control													
See Section 25 05 02													

Note 1 : Show location on 'As-Built' drawings
Note 2 : Provide component dimensions
Note 4 : Provide pressure test report (dates, pressures, duration, etc)
Note 4 : Provide flushing report (dates, times, etc)
Note 5 : If Applicable
Note 6 : not used
Note 7 : Provide MSDS for refrigerant
Note 8 : Provide a copy of current edition of NFPA 25
Note 9 : Include Material Test Report as per NFPA 13
Note 10 : Sprinkler System Layout drawings to be stamped by a professional Engineer licensed in Nova Scotia
Note 11 : See Individual Section
Note 12 : Provide Water Meter Certificate of Calibration

Note 13 : Provide list of identification to be used if following an existing identification standard (eg pipe markings, equipment tags, underceiling identification.

.6 Site records:
- .1 Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
- .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
- .3 Use different colour waterproof ink for each service.
- .4 Make available for reference purposes and inspection.

.7 Co-ordination Drawings:
- .1 Co-ordination drawings shall be prepared for all areas of the building and shall include plans, sections and elevations necessary to clearly show the spatial relationship of the building and systems components. The coordination drawings shall be prepared using a larger scale compared to the design drawing scale. A scale of 1:50 is acceptable for general areas, whereas, as scale of 1:25 is required for congested areas and mechanical rooms. The Contractor shall prepare AutoCAD interference/co-ordination drawings ensuring that each of the sub-trades are assigned a different layer and different colour.
- .2 Co-ordination drawings will be prepared by the Ventilation Subcontractor. Other trades and subcontractors to provide appropriate information so that the interference drawings can be produced in a timely manner. This interference includes, but is not limited to location of above ceiling control panels, above ceiling equipment, pipe runs, cable trays, and electrical conduit.
- .3 Submit the completed coordination drawings to the Consultant for review, prior to fabrication and on site construction.
- .4 See also section below regarding coordination

.8 As-Built Drawings:
- .1 The Consultant will provide one set of reproducible mechanical drawings for As-Built Drawing purposes. The Contractor shall mark thereon all significant changes and deviations from contract documents as work progresses and as changes occur.
- .2 On a (weekly) basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
- .3 Mark changes on white prints in ‘Red’.
- .4 Make available for reference purposes and inspection at all times.
- .5 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built/record drawings.
- .6 Identify each drawing in lower right hand corner in letters at least ½" high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
- .7 Submit to Consultant for approval and make corrections as directed.
- .8 TAB to be performed using as-built drawings.

.9 Submit completed reproducible as-built/record drawings to consultant for review.

.10 The Consultant shall use the Contractor's marked up As-Built Drawings to produce electronic copies, known as Record Drawings.

1.6 Quality Assurance

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Provide the office of the Engineer copies of the following inspections:
- .1 Fire Protection System Inspections by AHJ
- .2 NSPI inspection of control wiring.

.3 The Contractor shall review each of the Consultant's Site Observation Reports in a timely manner and sign off/respond to each item when requested. The Contractor shall forward their written response to the Consultant for review."

.4 Milestone Reviews : Before requesting a 'milestone' review (such as an above ceiling review) both the Trade Contractor and the General Contractor confirm that the work is generally complete and demonstrate that they have reviewed it by each providing a punch list of the area to be reviewed.

1.7 Maintenance Material

.1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
- .1 One set of packing for each pump.
- .2 One casing joint gasket for each size pump.
- .3 One gasket set for each heat exchanger.
- .4 One glass for each gauge glass.
- .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set installed at turn over.
- .6 One set of belts for each piece of machinery.
- .7 Two (2) pressure gauges and two (2) thermometers for each type and range used.
- .8 Six (6) fusible links of each size used in Fire Dampers
- .9 Sprinklers and related tools - as per NFPA 13
- .10 Fire Extinguishers - as per Fire Protection Drawings

.2 Furnish one (1) set of special or proprietary tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

.3 Identify spare parts containers as to contents and replacement parts number.

.4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

.5 Furnish a groove tool for each drive belt size.

1.8 Delivery, Storage And Handling

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Store materials in a clean, dry location protected from damage. Protect equipment from dirt and dust.

.4 Waste Management and Disposal:
.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.9 Temporary Heat

.1 Temporary Heat for new Construction shall be the responsibility of the General Contractor. The use of any equipment installed on the job will only be permitted as noted in the Architectural General Conditions or in the Instructions to Bidders.

.2 Before using any of the mechanical equipment for temporary heat service, the equipment must be installed complete with all accessories. Such equipment shall be installed and operated with all component parts in working order.

.3 The General Contractor shall be liable for all service charges and calls for any piece of mechanical equipment being used for temporary heat.

.4 Upon completion of the work, the General Contractor shall be responsible for cleaning all equipment and forwarding to the Architect, letters from equipment suppliers stating that such equipment used for temporary heat is in satisfactory operating condition and acceptable for the guarantee. The guarantee on all equipment shall be from the date of acceptance of the equipment by the Owner.

.5 All costs for temporary heat shall be the responsibility of the General Contractor.

1.10 Packaged Equipment

.1 The contractor shall note that whenever ‘Packaged Equipment’ is specified it is intended that this equipment shall be a complete package with all necessary accessories to allow for safe automatic operation.

.2 These accessories shall include all necessary starters, disconnects, relays, transformers, pressure switches, sensors, timers, etc. Where subject to the weather, the device shall be enclosed in a "weatherproof" enclosure.

.3 The Contractor shall be responsible for checking with the supplier of the equipment to ensure that the package equipment is complete with all necessary accessories. He shall also determine which accessories are factory mounted and which ones are shipped loose with the equipment. The Contractor shall include in his Tender an amount for all necessary wiring and piping, etc. necessary to incorporate any pieces of equipment which are shipped separately into the job at no additional cost to the Owner.

.4 The Contractor shall note that this refers to all package equipment including boilers, chillers, pump sets, etc. and it shall be his responsibility to co-ordinate this

with the supplier of the equipment and to either have the supplier include an amount in his price or the Contractor shall include the necessary amount to ensure the supply and installation of any accessories necessary for the operation of this equipment.

1.11 Electrical Connections, Motors And Starters

.1 Electrical equipment shall bear CSA label. Obtain special inspection labels required by Provincial Authority Having Jurisdiction.

.2 Use 3 phase, 600 volts for motors 1/2 hp and larger. Use single phase, 115 volts for motors less than 1/2 hp.

.3 Use 1750 rpm, open drip-proof, ball bearing motors manufactured to CEMA standard for 40 degrees C temperature rise and designed for continuous service and vibration free, quiet operation.

.4 Motors to be premium efficiency in accordance with the NECC.

.5 Where motors may be subject to high moisture levels such as in the air stream after cooling coils or in areas subject to washdown, such motors will be splashproof or totally enclosed fan cooled.

.6 Conform to requirements of Canadian Electrical Code, Local and Municipal and Provincial Authorities, and specified standards.

.7 All equipment not located in mechanical rooms shall be supplied complete with a disconnect switch. Where exposed to the weather, "weatherproof" disconnects shall be provided.

1.12 Belt Drives

.1 Provide high efficiency notched / cogged belts for all belt driven equipment.

.2 Provide a minimum of two (2) belts for motors larger than 1 hp.

.3 Multiple belts shall be matched

.4 Provide for each belt drive a perforated galvanized iron belt guard, constructed with a round galvanized iron frame and access openings for tachometers

.5 Acceptable Material: Browning (Division of Emerson), Gates

1.13 Protection Of Openings

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

1.14 Painting

.1 Finish painting by others unless specifically noted. Where finish painting is required, prime painting by the appropriate trade contractor.

.2 Piping, ductwork, and equipment identification is the responsibility of the appropriate trade contractor.

.3 Apply to hangers, supports and equipment fabricated from ferrous metals at least one (1) coat of corrosion resistant paint before shipment to job site.

.4 Prime and touch up marred finished paintwork to match original.

.5 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up. Do not paint over nameplates.

.6 Do painting in accordance with Section 09 91 23 - Interior Painting.

1.15 Demonstration Of Complete System

.1 At the conclusion of the job, the Contractor shall review and demonstrate to the Owner all equipment and their respective functions, operation, and maintenance. Such demonstration shall be provided for such reasonable periods of time as the complexity of the job warrants, and as approved by the Engineer. Such review and demonstration shall be made by an authorized representative of the Contractor, fully knowledgeable of the project, it's installation, and operation.

.2 Provide the Engineer and Owner with a schedule of system demonstration at least two (2) weeks prior demonstration

.3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.4 Use operation and maintenance manual, as-built/record drawings, audio visual aids, etc. as part of instruction materials.

.5 Instruction duration time requirements as specified in appropriate sections.

.6 Where deemed necessary, the Consultant and/or Owner may record these demonstrations for future reference.

1.16 Cleaning

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of fans, air handling units, plenums, etc.

2 Ductwork that has been deemed dirty by the consultant at the completion of construction shall be cleaned by wiping it clean and vacuuming it.

.3 Clean the job site daily. If the site is not cleaned to the Owner’s satisfaction, then the Owner shall make arrangements for cleaning and charge the cost against the Contract.

.4 At conclusion of project remove surplus material, rubbish, tools, and equipment.

1.17 Building Flush-Out

.1 The building shall be thoroughly flushed out at the completion of construction using 100% outside air continuously until the total flushing air volume equates to 14,100 cu.ft. of outside air per sq.ft. of building floor area prior to occupancy. Internal building temperature shall be at least 16 C (60 deg F). All systems including AHU's and force flow cabinet heaters shall use the construction set of filters at the beginning of the flush out period. After the flush out period, the filter media shall be replaced with new. This set of filters is in addition to the spare set of filters required by the specifications.

1.18 Definitions

.1 Acceptable Materials - Any product mentioned may be used provided it meets or exceeds the quality, performance capability, and space requirements of the equipment shown and called for on the plans and in the specifications. Alternates, other than those specified, must be submitted for approval prior to Tender closing.

.2 Provide - "supply and install" unless otherwise indicated.

.3 Standard of Acceptance – Only the product listed may be used unless alternate products are included in an addendum.

1.19 Drawings And Specifications

.1 Not intended to show structural details or architectural features.

.2 Except where dimensioned, indicates general mechanical layouts only. Do not scale.

.3 If required by the Engineer, provide field drawings to show the relative position of various services. Obtain Engineers review before beginning work.

.3 The Mechanical Trade Contractor shall check the content of the drawings, specifications and dimensions, and before proceeding, report to the Consultant any error or omission between Mechanical or Electrical and Architectural plans.

.4 These specifications are to be considered as an integral part of the drawings which accompany them, neither the drawings nor the specifications shall be used alone. Any item which is omitted in one but which is reasonably implied in the other, shall be considered properly and sufficiently specified and must, therefore, be provided under the Contract. The decision of the Consultant shall be final, if interpretation is required.

.5 Misinterpretation of drawings and specifications shall not relieve the Mechanical Trade Contractor of responsibility.

.6 All Mechanical Trade Contractors shall make themselves familiar with the overall intended operation of the mechanical systems prior to installation so that all necessary accessories such as dampers, vents, valves, controls, etc., can be installed during the normal progress of the work. Failure to do so will result in the Mechanical Trade Contractor's responsibility in providing such devices, at his expense when the need of such devices becomes apparent during start-up.

1.20 Site Visits

.1 Before commencing work, visit site and verify that requirements of Plans and Specifications are consistent with site conditions. Note: other Tender packages have already been awarded for this project.

.2 Advise Consultant, in writing, of any discrepancies or conflicts.

.3 No allowance shall be made for failure to include items which a thorough investigation would have shown to be required.

1.21 Guarantees

.1 This Mechanical Trade Contractor shall guarantee all his work free from defects for a period of one (1) year, unless specifically noted otherwise, after final acceptance of such work by the Owner and shall make good all defects other than normal wear and tear during the life of the guarantee. This Mechanical Trade Contractor shall guarantee all work and equipment supplied by him to work quietly and satisfactorily and to accomplish the work for which it was installed during the life of the above guarantee. At any time during this period, he shall make any necessary changes and adjustments or replacements, to accomplish this at his own expense.

.2 Submit manufacturers' written guarantees to the Consultant for review.

.3 Provide copies of all guarantees in a separate tab of the O & M manual.

.4 Each guarantee shall include:
- .1 Project name and address.
- .2 Guarantee time period (commencement date shall be as date shown on Project Final Certificate of Completion unless otherwise indicated).
- .3 Clear and concise definition of what is guaranteed and remedial action provided.
- .4 Signatures of Mechanical Trade Contractor and a company officer of the manufacturing firm.
- .5 Include all extended guarantees (and service contracts) as specified in individual sections.

.5 Extended Guarantees
- .1 Provide Extended Guarantees for:
  1. Chillers and Cold Generators – 5 years
  2. Computer Room AC Units – 5 years
  3. Damper Gaskets – 10 year
  4. DHW Tanks (Storage) – 3 years
  5. DHW Tanks (Electric) – 3 years
  6. Humidifiers – 2 years
  7. Stainless Steel Chimneys – 15 years

1.22 Permits And Regulations

.1 All Mechanical Trade Contractors shall comply with all regulations of authorities having jurisdiction, where applicable, including but not limited to the following:
- Provincial Department of Labour
- Provincial Fire Marshal

- Municipal Plumbing Inspector
- Provincial Board of Insurance Underwriters
- Provincial Department of Health

.2 The Mechanical Trade Contractor shall obtain and pay for any permits required by Local Codes and Regulations and arrange for inspections.

.3 Any additional materials or labour required to conform to any of these rules and regulations will be furnished under the Contract with no additional cost to the Owner.

1.23 Co-Ordination

.1 Co-ordinate work with other trades to avoid conflict.

.2 Locate distribution systems, equipment and materials to provide minimum interference and maximum useable space.

.3 Co-ordinate location of duct drops, pipe drops and risers with trades erecting walls and ceilings to ensure that all pipes and ducts are concealed in walls or ceilings spaces. If space is not available in walls or ceilings, locate ducts and pipes so that they can be easily boxed in by the relevant trades. Where pipes are shown rising in concrete block walls, placement of the pipe shall be done in conjunction with the erection of the wall.

.4 The Mechanical Contractor shall meet regularly with the structural and other relevant trades during the production of coordination drawings to obtain physical dimension, access requirements and preferred location for the services.

.5 In the event that conflicts arise, the Mechanical Contractor shall work with all other relevant Contractor(s) to ensure that the necessary adjustments are made so that all components fit in the space available with adequate clearance for servicing and removal. If after a through effort to fit equipment in a space and provide adequate space for servicing and removal, the Contractor determines that additional space is required, he may request assistance to resolve the issue through the Construction Manager.

.6 All adjustments or re-routing of the mechanical, electrical and sprinkler systems required to avoid conflict an provide adequate space for servicing and removal of equipment shall be made at the expense of the relevant trade contractor.

.7 Prepare coordination drawings showing the routing of main ducts, piping mains. Main sprinkler pipe, electrical conduit runs, and sprinkler piping in critical areas shall be shown.

.8 Rerouting of pipes and ducts to be reviewed by the Engineer.

.9 See also the section above regarding co-ordination drawings.

.10 This project is being tendered in various trade packages. It is the Contractor's responsibility to review current and previously tendered trade packages to determine any and all issues that could impact the space available for installation

of equipment and systems that he is responsible for coordinating. In addition, the Contractor shall obtain copies of all subsequent trade packages and immediately review these trade packages to determine any and all issues that could impact the space available for installation of equipment and systems that he is responsible for coordinating. Any issues that arise shall be referred to the Construction Manager for resolution.

1.24 Alternates

.1 Wherever an item or class of material is specified exclusively by trade name of maker or by catalogue reference or under "Acceptable Materials", only such item shall be used unless the Consultant's approval for an alternative is secured in writing.

.2 Should the Mechanical Trade Contractor desire to substitute another material for one or more specified by name, he shall apply in writing for such permission at least ten (10) calendar days before closing date of the Tender package. He shall also provide data and/or samples for the Consultant's consideration. The Contractor shall be fully responsible for any additional costs that might result due to equipment substitution.

.3 Equipment submitted as alternate to that specified on the drawings or in the specifications by model number or catalogue reference must be capable of meeting the full range of operating parameters as the specified equipment. It must also be configured and set to meet the specific design point parameters as called for on the plans or in the specifications.

.4 The Mechanical Trade Contractor shall note that all layouts on the mechanical drawings are based on the specified equipment and any changes necessitated in service connections, etc., will be done at the Mechanical Trade Contractor's expense. Furthermore, if it is found that the provisions made regarding space conditions are not met, the right is reserved by the Consultants to require installation of the equipment used preparing the layout.

1.25 Cutting And Patching

.1 Cutting and patching to be performed by each trade Contractor for penetrations less than or equal to 8” dia. or 8” x 8”. For larger penetrations, co-ordinate with the Construction Manager.

.2 Make every effort to minimize cutting and patching and provide dimensions, locations and other data for bases, sleeves, boxes, etc., to be built in as construction proceeds. Set sleeves and make openings in concrete forms and masonry before placing concrete and masonry.

1.26 Excavation And Backfilling

.1 Excavation and backfilling will be performed by the Construction Manager. Supervision by this Contractor.

1.27 Pipe Tests

.1 Notice of Tests: Give written notice for a minimum of four (4) working days prior to date when tests will be made.

.2 Prior Tests: Concealed or insulated work shall remain uncovered until completely tested and approved, but if construction schedule requires, arrange for prior tests on parts of system as approved.

.3 Acceptance Tests: Conduct in presence of the Consultant's representative or representative of the Authorities Having Jurisdiction.

.4 Costs: Bear all costs in connection with tests conducted.

.5 Certificates: Obtain acceptance certificates from the authorities having jurisdiction. Work is not considered complete until certificates have been delivered to the Consultant.

.6 Water and Steam Systems: Fill with water and hydraulically test at 1½ times system operating pressure or at 100 psig, whichever is greatest. Unless otherwise noted maintain test pressures without loss for a four (4) hour period. Use valves to isolate equipment not rated for this pressure. An air test is acceptable for metal piping systems.

.7 Test plumbing sanitary sewer, storm sewer and vent piping as required by National Building Code, Canadian Plumbing Code, and Municipal Regulations.

.8 Sanitary, storm and vent piping shall be tested by sealing outlets and filling the system to the highest point with water. The water level shall remain constant for a minimum of two (2) hours.

.9 Hammer test all welded joints.

.10 For testing of engine exhaust, fuel oil, compressed air, lab vacuum, reverse osmosis water, propane, refrigeration, natural gas, or fire protection piping see individual specification sections.

1.28 Sleeves And Escutcheons

.1 Sleeves:

.1 Unless otherwise specified, supply pipe sleeves for all points where pipe passes through masonry or concrete walls or floors, fire rated assemblies, and elsewhere as indicated. Sleeve shall be supplied by the Mechanical Sub-Contractor and built-in by the appropriate trade.

.2 Where concrete walls or floors are core drilled to accommodate pipe, sleeves are not required except where indicated in sub-paragraph 5 below.

.3 Unless otherwise specified, construct sleeve of galvanized sheet steel with lock seam joints of minimum 22 gauge.

.4 Use galvanized sch 10 steel pipe sleeves with perimeter fin continuously welded at mid point.

.1 Where sleeve extends above finished floor.

.2 Pipe penetrations through concrete foundation walls shall be sealed using proprietary pre-manufactured, water-tight seals.

.1 Acceptable Products: Link-Seal, Metraflex.

.5 In kitchens, washrooms, laboratories, and other wet areas where water from spills or leaks may penetrate the floor slab, extend sleeves 6 mm

above the finished floor. This does not apply to concrete slabs on grade. In all other areas, sleeves shall be flush with the finished floor.

.2 Sizes:
- .1 Provide approximately 12 mm clearance, all around, between sleeve and pipes or between sleeve and insulation.
- .2 Through footings, use sleeves large enough to accommodate hub of cast iron soil pipe (where applicable).
- .3 Where piping passes below footings, provide minimum all round clearance of 50 mm between piping and sleeves. Backfill up to underside of footing with concrete of same strength as footing.
- .4 Unless otherwise specified, terminate sleeves flush with walls and ceilings.
- .5 Sleeves shall be sized to accommodate the insulated pipe diameter.

.3 Unless otherwise indicated for pipes passing through roofs, use galvanized or cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction; caulk between sleeve recess and pipe; fasten roof flashing to clamp device; make watertight durable joint.

.4 Caulking:
- .1 Where pipes pass through on grade concrete slab floors, caulk open spaces with non-hardening mastic.
- .2 Ensure no contact between copper tube or pipe and ferrous sleeve.

.5 Escutcheons and Plates:
- .1 Provide on pipes passing through finished walls, partition floors and ceilings.
- .2 Use chrome or nickel plated brass, either split or solid type, with set screws for ceiling or wall-mounted. For equipment room, use cast iron type.
- .3 Inside diameter shall fit around finished pipe insulation or uninsulated pipe. Outside diameter shall cover sleeve.
- .4 Where sleeve extends above finished floor, escutcheons or plates shall be bell shaped to cover the sleeve extension.
- .5 Secure to pipe or sleeve but not to insulation.

.6 Penetrations of Fire Separations:
- .1 Where pipes or ducts pass through walls or floors which provide fire separations, seal around openings with ULC or cUL classified fire stop system. Material shall be installed to manufacturers' recommendations by factory trained installers and shall provide a fire rating equal to that of the separation which has been penetrated.
- .2 Consultant reserves the opportunity for destructive testing of a sample of the installation in order to examine the thickness of sealant and installation of the backing material.
- .3 Each trade Contractor shall be responsible for his/her own firestopping.
- .4 <u>Acceptable Materials:</u>
  - .1 Dow Corning Fire Stop System.
  - .2 3M Fire Barrier Penetration Sealing System.
  - .3 Hilti Fire Stop System.

.4 Royal Quickstop.

1.29 Di-Electric Unions

.1 All connections between steel and copper or brass for pipe 2" and smaller shall be made of di-electric unions, except on all closed systems. On pipe 2½" and larger, use flanged connections with non-metallic gasket and plastic sleeves for bolts.

1.30 Completion

.1 Nothing herein contained can be constructed to relieve the Trade from making good and perfect work in all usual details of construction and in accordance with best standard practice and in strict compliance with provisions of any and all laws and ordinances, and the rules and regulations of any duly constituted public body having jurisdiction over this work.

.2 This Trade shall be held responsible to provide and furnish all necessary labour and to bear all expenses incidental to the satisfactory completion of the work.

1.31 Owner Supplied Equipment

.1 Provide all necessary piping and duct connections as necessary to leave the equipment ready for operation.

1.32 Manufacturers Review

.1 It shall be the responsibility of the Contractor to have the equipment supplier or his representative review all proposed connections, clearances, sizes, valves, breakers, etc. including wire and pipe sizes to his equipment before installation commences. At that time, he shall inform the Consultant of any changes required to make the equipment function satisfactorily.

.2 Provide the Contractor with a letter accepting all connections as proposed and where required, recommend necessary changes.

.3 If any changes or additional material and labour are required to make the equipment function properly to capacity and the manufacturer has not pointed out this work prior to commencement of work, the additional and/or corrective work shall then be done at the expense of the equipment supplier.

1.33 Related Work Performed By Others

.1 Concrete housekeeping pads.

.1 Housekeeping pads to be smooth, level, and c/w chamfered edges.

.3 Saw-cutting of concrete/masonry walls, floors and/or ceilings (larger than 8" or 8" x 8" openings).

.4 Work of other trades not to be supported from mechanical equipment, pipes, ducts, conduits or their supports.

1.34 Related Work Performed By This Section

.1 Welding:

.1 All welding to be performed by Mechanical Contractor for all mechanical piping and structural supports and hangers.

.2 All welding shall be performed by certified welders in accordance with the Provincial Labour Requirements.
.3 See also Section 23 05 17 - Pipe Welding.

.2 Support
.1 Work of each sub trade to be supported directly from structure independent of other sub trades unless prior approval obtained from office of engineer.

1.35 Field Quality Control

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in Submittal section above.

.2 All work to be performed by qualified personal or with appropriate training and qualifications in the field in which they are engaged. Apprentices and labourers shall be under the continuous supervision of a qualified tradesperson.

.3 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 Submittal section above.
.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.

1.36 Protection

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

1.37 Breakdown Of Contract Value

.1 Submit a breakdown of contract value to the Engineer prior to commencement of work.

.2 This breakdown shall be used as the basis for the Contractor's Progress Claim.

.3 The breakdown shall be reviewed and approved by the Engineer. Where required, evidence indicating the accuracy of the breakdown shall be submitted.

.4 The format of the breakdown shall be as follows:

Mechanical	
.1 Mobilization	
.2 Control Closeout	
.3 Balancing	
.4 Mechanical Insulation - Plumbing	
.5 Mechanical Insulation - Heating	
.6 Mechanical Insulation - Ventilation	

.7 Plumbing Rough-in Material	
.8 Plumbing Rough-in Labour	
.9 Plumbing Fixtures and Equipment Installation Material	
.10 Plumbing Fixtures and Equipment Installation Labour	
.11 Heating Rough-in Material	
.12 Heating Rough-in Labour	
.13 Heating Equipment and Installation Material	
.14 Heating Equipment and Installation Labour	
.15 Air Distribution Rough-in Material	
.16 Air Distribution Rough-in Labour	
.17 Air Distribution Equipment and Installation Material	
.18 Air Distribution Equipment and Installation Labour	
.19 Controls - Mobilization	
.20 Controls - Rough-in	
.21 Controls - Installed Equipment or Material	
.22 Controls - Inspection and Validation	
.23 Contract Close-Out (Maintenance Manuals, Record Drawings, Training)	
Sub-total (Items .1 to .23)	

1.38 Through Penetration Fire-Stopping

.1 SCOPE/APPLICATION

.1 Provide installed fire-stop products that limit the spread of fire, heat, smoke, and gasses through otherwise unprotected openings in rated assemblies, including walls, partitions, floors, roof/ceilings, and similar locations, restoring the integrity of the fire rated construction to its original fire rating.

.2 Provide fire-stop systems listed for the specific combination of fire-rated construction, type of penetrating item, annular space requirements, and fire rating, and the following criteria:

.1 F-Rating: Equal to or greater than the fire-resistance rating of the assembly in which the fire-stopping will be installed.

.2 T-Rating: In habitable areas where penetrating items are exposed

to potential contact with materials on exposed side(s) of rated assembly, T-rating must equal its F-rating.

.3 L-Rating: L-rating of 1 CFM per linear foot (5.5 cu m/h/m) maximum at ambient temperatures. For those applications that require air leaking protection.

.4 W-Rating: meets UL Water Leakage Test, W Rating – Class 1 requirements for systems tested and listed in accordance with ANSI/UL 1479.

.5 Wall Penetrations: Through penetration systems must be symmetrical, with the same rating from both sides of the wall. Membrane penetrations may be asymmetrical.

.6 Testing: Determine ratings in accordance with ASTM E 814 or UL 1479.

.2 3M Fire Barrier Ultra RC Pack: One piece metal collar assembly encasing intumescent material for fire-stopping of pipes and cables through rated walls and floors.

.1 Fire Resistance: For use in 1 or 2 hour fire-rated systems.

.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.3 3M Fire Barrier Ultra Plastic Pipe Device: Intumescent device for fire-stopping of plastic pipe and cables through rated walls and floors.

.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.

.2 Configuration: One-piece metal collar, with locking latch and bendable tabs to secure; equipped also for conventional anchoring.

.3 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.4 3M Fire Barrier RC-1 Restricting Collar with either FS 195+ Wrap Strip or 3M Interam Ultra GS Wrap Strip . (See product descriptions below): For fire-stopping of plastic pipes from 4 inches (102 mm) to 10 inches (254mm) in diameter.

.1 Fire Resistance: For use in 1or 2 hour fire-rated systems.

.2 Material: 28 gauge steel.

.3 Size: 25 foot (7.6 m) roll.

.4 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.5 3M Fire Barrier CP25WB+ Sealant: High-performance, intumescent, water-based sealant. No-sag, fast drying, paintable, red in color. Versatile fire-stop sealant for pipes (not for use with CPVC), cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.

.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.

.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.3 STC rating of 54 when tested in STC 54-rated wall assembly.

.6 3M Fire Barrier IC 15WB+ Sealant: General-purpose, intumescent, water-based sealant. No-sag, fast drying, paintable, yellow in color. Economical fire-stop sealant for pipes, cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.

.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.

.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.3 STC rating of 54 when tested in STC 54-rated wall assembly.

.7 3M Fire Barrier Sealant FD 150+: Single-part, water-based, acrylic latex sealant. No-sag, low-shrinkage, low VOC. Blue, red or limestone color. Used to fire-stop for pipe penetrations (not for use with CPVC).
.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
.3 STC rating of 54 when tested in STC 54-rated wall assembly.

.8 3M Fire Barrier Water Tight Sealant 3000 WT: Single-part, water-tight, intumescent silicone fire-stop sealant for filling voids in concrete gypsum, metal, plastic, wood and insulation. Light gray color with black flecks. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
.3 STC rating of 53 when tested in STC 54-rated wall assembly.

.9 3M Fire Barrier Water Tight 1000 NS Sealant: Single-part, non-slump fire-stopping silicone sealant for floor and wall openings. Light gray color. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems..
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
.3 STC rating of 56 when tested in STC 56-rated wall assembly.

.10 3M Fire Barrier Water Tight Sealant 1003 SL: Single-part, self-leveling fire-stopping silicone sealant for floor openings. Light gray color. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems..
.2 Locations: For horizontal assemblies only.
.3 STC rating of 56 when tested in STC 56-rated wall assembly.

.11 3M Fire Barrier Sealant 2000 NS: Single-part, non-slump elastomeric silicone fire-stop sealant. Sag-resistant, low VOC. Light grey color. Used in mechanical, electrical and plumbing applications to fire-stop openings and penetrations through fire-rated floor or wall assemblies. Typical penetrants include: metallic pipe, non-metallic pipe (FGG/BM system CPVC compatible), conduit, power and communication cable and telephone or electrical wiring.
.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
.2 Locations: Vertical and horizontal assemblies.
.3 STC-Rating of 56 when tested in STC 56-rated wall assembly.

.12 3M Fire Barrier Sealant 2000+: Single-part, elastomeric silicone fire-stop sealant. Sag-resistant, low VOC. Light grey color. Used in mechanical, electrical and plumbing applications to fire-stop openings and penetrations through fire-rated floor or wall assemblies. Typical penetrants include: metallic pipe, non-metallic pipe (FGG/BM system CPVC compatible), conduit, power and communication cable and telephone or electrical wiring.
.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
.2 Locations: Vertical and horizontal assemblies.
.3 STC-Rating of 56 when tested in STC 56-rated wall assembly.

.13 3M Fire Barrier Moldable Putty+: One-part, 100 percent solids intumescent fire-stop. Remains pliable, flexible and easily re-enterable. Non-toxic synthetic

formula. Versatile putty for pipes, cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.
.1 Type: Stick or Pad
.2 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
.3 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.14 3M Fire Barrier Mortar: For sealing openings in concrete and masonry walls and floors. Self Leveling, non-sag, low VOC.
.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.15 3M Interam Ultra GS Wrap Strip: Graphite based, flexible, largely inorganic, intumescent mat. For use around non-metallic piping with or with RC-1 collar.
.1 Fire Resistance: For use in 1, 2 or 3 hour fire rated systems..
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.16 3M Fire Barrier FS-195+ Wrap/Strip: One-part, organic/inorganic intumescent strip with foil on one side. May be cut to fit irregular shapes. For use around non-metallic piping with or with RC-1 collar.
.1 Length: 24 inch (610 mm).
.2 Width: 1 or 2 inches.
.3 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
.4 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.17 3M Fire Barrier Tuck-In: Graphite-based, flexible, intumescent wrap strip for use around non-metallic piping. Adhesive closure tab.
.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

1.39 Contractor Extras And Credits During Construction

.1 The Contractor shall submit to the Consultant supplier actual “back-up” documentation with their quotations to support all material costs identified.
.2 The Contractor’s standard labour rates and costs will accompany the above for all quotes.
.3 Pre-determined “Overhead and Profit (OH&P)” amounts and percentages will be documented and provided on the quotes.
.4 The use of “Allpri$er” for material costs is not permissable and will not be accepted by the Consultant.

3 Execution

3.1 Fire Stopping

.1 Do not begin installation until substrates have been properly prepared.

.2 Conduct tests according to manufacturer's written recommendations to verify that substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt and other foreign substances capable of impairing bond of fire-stopping.

.3 Verify that items penetrating fire rated assemblies are securely attached, including

sleeves, supports, hangers, and clips.

.4 Verify that openings and adjacent areas are not obstructed by construction that would interfere with installation of fire-stopping, including ducts, piping, equipment, and other suspended construction.

.5 Verify that environmental conditions are safe and suitable for installation of fire-stopping.

.6 If substrate preparation is the responsibility of another installer, notify Architect or Engineer of Record of unsatisfactory preparation before proceeding.

.7 Prepare substrates in accordance with manufacturer's instructions and recommendations.

.8 Install masking and temporary coverings as required to prevent contamination or defacement of adjacent surfaces due to fire-stopping installation.

.9 Install in strict accordance with manufacturer's detailed installation instructions and procedures.

.10 Install so that openings are completely filled and material is securely adhered.

.11 Where fire-stopping surface will be exposed to view, finish to a smooth, uniform surface flush with adjacent surfaces.

.12 After installation is complete, remove combustible forming materials and accessories that are not part of the listed system.

.13 Repair or replace defective installations in accordance with manufacturer’s recommendations, listed systems details and applicable code requirements.

.14 At each through penetration, attach identification labels on both sides in location where label will be visible to anyone seeking to remove penetrating items or fire-stopping.

.15 Clean fire-stop materials off surfaces adjacent to openings as work progresses, using methods and cleaning materials approved in writing by fire-stop system manufacturer and which will not damage the surfaces being cleaned.

.16 Notify Authority Having Jurisdiction (AHJ) when fire-stopping installation is ready for inspection; obtain advance approval of anticipated inspection dates and phasing, if any, required to allow subsequent construction to proceed.

.17 Do not cover fire-stopping with other construction until approval of authority having jurisdiction has been received.

.18 Owner will engage an independent testing agency to inspect installed fire-stopping and to prepare reports indicating whether the installed work complies with the contract documents.

.19 Notify testing agency at least 7 days prior to date when fire-stopping installation will be ready for inspection; obtain advance approval of general schedule and phasing, if any, required to allow subsequent construction to proceed.

.20 Remove left over material and debris from Work area. Use necessary means to protect fire protection product(s) before, during, and after installation.

.21 Touch-up, repair or replace damaged products before Substantial Completion.

.22 Install identification Labels for Through Penetration: Pressure sensitive self-adhesive vinyl labels, preprinted with the following information:

.1 The words "Warning - Through Penetration Fire-stop System - Do not Disturb. Notify Building Management of Any Damage."
.2 Listing agency's system number or designation.
.3 System manufacturer's name, address, and phone number.
.4 Installer's name, address, and phone number.
.5 General contractor's name, address, and phone number (if applicable).
.6 Date of installation.

.23 Installation shall be completed by qualified Tradesmen, properly trained by the manufacturer and in accordance with the product listing. In lieu of this, the Contractor shall engage the services of a qualified firm/company to complete the fire-stopping.

3.2 Appendix A 13-288

SHOP DRAWINGS

MECHANICAL CONTRACTOR'S REVIEW CONFIRMATION

The Shop Drawings Have Been Reviewed by the Mechanical Contractor and All Items Are In Conformance with the Plans and Specifications? □ Yes □ No
Are Specified Model Numbers and/or Options Indicated? □ Yes □ No

If No, Explain: _____
Confirmed by Contractor: _____
Print Name
Contractor's Signature: _____
Date: _____
Item: _____
Specification Section and Item Number: _____
Drawing Reference: _____

General Contractor: _____

Mechanical Contractor: _____

Mechanical Contractor's Project Representative: _____

Phone Number: _____ Fax Number: _____ E-mail: _____

END OF SECTION

1 General

1.1 Related Sections

.1 Section 08 31 00 – Access Doors - Mechanical.
.2 Section 21 05 01 – Common Work Results – Mechanical.
.3 Section 23 05 19.01 - Thermometers and Pressure Gauges - Piping Systems.
.4 Section 23 05 53.01 - Mechanical Identification.
.5 Section 28 31 00 - Fire Detection and Alarm.

1.2 References

.1 Authority Having Jurisdiction
  .1 Conform to the requirements of the Authority having Jurisdiction. The Authority having Jurisdiction for this project is The Fire Commissioner of Canada,
  .2 Province of Nova Scotia Fire Safety Act (2002).

.2 National Fire Prevention Association (NFPA)
  .1 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 Canadian Standards Association (CSA)
  .1 CAN/CSA B64.10 – Selection, Installation, and Field Testing of Backflow Preventors.

1.3 Submittals

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

.2 Drawings:
  .1 Prepare 48” x 36” detailed working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)".
  .2 Show data essential for proper installation of each system.
  .3 Show details, plan view, elevations, and sections of systems supply and piping.
  .4 Show piping schematic of systems supply, devices, valves, pipe, and fittings.
  .5 Prepare revised drawings at time of turn over to Owner showing ‘As-Built’ Conditions. Submit to Office of Engineer for review and include revised drawings in Maintenance manual.

.3 Provide copies of hydraulic calculations using proposed piping layout drawings prepared by contractor. Have drawings and calculations reviewed by Office of the Engineer prior to starting construction.

.4 Test reports: Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

1.4 Quality Assurance

.1 Qualifications: Installer: company or person specializing in wet sprinkler systems with documented experience.

.2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer.

1.5 Maintenance Material Submittals

.1 Provide spare sprinklers and tools in accordance with NFPA 13.

2 Products

2.1 System Requirements

.1 Contractor to modify existing automatic wet pipe fire suppression sprinkler and standpipe systems in accordance with plans, specifications, NFPA 13, and requirements of the Authority Having Jurisdiction. Work shall include the removal and disposal of system components as shown on plans described below.

.2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.

.3 Each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.

.4 Locate sprinkler heads in consistent pattern as shown on plans. Avoid conflict with ceiling mounted equipment including, but not limited to ceiling grid, lights, diffusers, grilles, chilled beams, and speakers.

.5 Devices and equipment to be ULC approved for use in wet pipe sprinkler systems.

.6 Sprinkler Head Location:

.1 Sprinkler heads to be located as shown on the Reflected Ceiling Plans (RCP). Where RCP and Sprinkler Plans differ seek clarification from the Office of the Engineer.

.2 Locate sprinklers below large ducts and equipment as required by NFPA 13.

.7 Water Supply

.1 System design is based on the pressure test made in 2006.

.2 Contractor to arrange for and pay for a new flow test within 10 business days of award of contract. Submit results to Office of the Engineer.

2.2 Above Ground Piping Systems

.1 Provide fittings for changes in direction of piping and for connections. Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.

.2 Perform welding in shop; field welding will not be permitted.

.3 Conceal piping in areas with suspended ceiling and where shown.

.4 Identify pipe mains and cross mains as per Section 23 05 53.01 - Mechanical Identification.

2.3 Pipe, Fittings And Valves

.1 Pipe: Ferrous: to NFPA 13.

.2 Fittings and joints to NFPA 13:

- .1 Ferrous: screwed, welded, flanged or roll grooved.
  - .1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.
- .2 Provide welded, threaded, grooved-end type fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.
- .3 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.
- .4 Rubber gasketted grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 1¼" and larger.
- .5 Fittings: ULC approved for use in wet pipe sprinkler systems.
- .6 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.
- .8 Side outlet tees using rubber gasketted fittings are not permitted.
  - .1 Mechanical Tees equal to Victaulic 920 and 922 are permitted. Connection to pipe main top and bottom.
- .9 Flexible Sprinkler Fitting
  - .1 Unit to be a ULC listed assembly connecting sprinkler head to sprinkler piping c/w connection nipple, 1" braided hose, sprinkler reducing nipple, and support bracket.
  - .2 Maximum permitted length is 48"
  - .3 Minimum hose bend radius to be 2".
  - .4 Hose to be capable of 360 degree, total bend.
  - .5 Approved Products: Victaulic VicFlex.

.3 Valves:

- .1 ULC listed for fire protection service.
- .2 Gate valves: open by counterclockwise rotation.
- .3 Provide indicating valves as shown on system schematic in each riser.
- .4 Check valves: flanged clear opening swing or spring actuated check type with flanged inspection and access cover plate for sizes 4" and larger.
- .5 Provide supervised shut off valves in piping protecting elevator hoistways, machine rooms, machinery spaces, and other spaces shown on plans and as required by NFPA 13.

.4 Pipe hangers to be ULC listed for fire protection services in accordance with NFPA.

2.4 Sprinkler Heads

.1 General: to NFPA 13 and ULC listed for fire services.

.2 Sprinkler Head Type: material, finish, orientation, orifice size, k value, required protection, and temperature rating shown on drawings

2.5 Water Flow Alarms

.1 Provide alarms approved weatherproof and guarded type, to sound locally on flow of water in each corresponding sprinkler system.

.2 Mount alarms on outside of outer walls of each building at location as directed.

.3 Wiring of Alarm by Fire Alarm Contractor..

2.6 Supervisory Switches

.1 General: to NFPA 13 and ULC listed for fire service.

.2 Valves:

.1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.

.3 Pressure or flow switch type:

.1 With normally open and normally closed contacts and supervisory capability.

.2 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.

.3 Connect into building fire alarm system.

.4 Connection of switch: Section 28 31 00 - Fire Detection and Alarm.

.5 Alarm actuating device: mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and instantly recycle.

.6 Acceptable Manufacturers: Potter

.4 Pressure alarm switch:

.1 With normally open and normally closed contacts and supervisory capability.

2.7 Pressure Gauges

.1 ULC listed and to Section 23 05 19.01 - Thermometers and Pressure Gauges - Piping Systems.

.2 Maximum limit of not less than twice normal working pressure at point where installed.

2.8 Pipe Sleeves

.1 Provide hot dipped galvanized steel pipe sleeves where piping passes through walls, floors, and roofs. Core drilling of poured concrete slabs and walls is an acceptable alternative when cavities in core-drilled hole are completely grouted smooth.

.2 Secure sleeves in position and location during construction.

.3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs.

.4 Provide 1" minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.
- .1 Firmly pack space with mineral wool insulation.
- .2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass, provide mechanically adjustable segmented elastomeric seal.
- .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.
- .4 Sleeves in floors of wet areas above the lowest level (eg Mechanical Room, Kitchen, Laboratories, etc) shall be sealed and extend 1" AFF.

2.9 Escutcheon Plates

.1 Provide one piece, split hinge type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.

.2 Provide polished stainless steel plates in washrooms and other areas noted on drawings. In all other areas chromium-plated finish on copper alloy plates are acceptable in finished spaces.

.3 Provide paint finish on metal plates in unfinished spaces.

2.10 Inspector's Test Connection

.1 Locate inspector's test connection at hydraulically most remote part of each zone and as shown on the drawings.

.2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.

.3 Provide discharge orifice of same size as corresponding sprinkler orifice.

2.11 Signs

.1 Attach properly lettered English metal or lamicoid signs to each valve and alarm device to NFPA 13.

.2 Permanently fix hydraulic design data nameplates to riser of each system.

2.12 Spare Parts Cabinet

.1 Provide metal cabinet with extra sprinkler heads adjacent to existing spare parts cabinet if additional space is required. Number and types of extra sprinkler heads as specified in NFPA 13.

2.13 Access Doors

.1 Where components requiring service (eg drain valves, pressure switches) are located above finished ceilings or finished walls supply access doors in accordance with section 08 31 00 (Access Doors - Mechanical) for installation by others.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25.

.2 Position sprinklers located in Acoustic Tile Ceilings within each tile as per detail on drawings unless noted otherwise.

.3 Access Doors

.1 Arrange location of equipment requiring access so that use of access doors is minimized.

.2 Where equipment requiring the installation of an access door(s) for access is to be located in places other than shown on the drawing obtain the permission of the Engineer or Architect before proceeding with installation.

.4 Shield sprinkler heads with protective covering while painting and other dirty work is in progress. Upon completion of painting / dirty work, remove protective covering from sprinkler heads. Replace sprinkler heads which have been painted or cannot be cleaned.

3.3 Pipe Installation

.1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.

.2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.

.3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.

.4 Inspect piping before placing into position.

.5 All sprinkler system main drains shall be piped to discharge to the exterior and not into interior building drains. Where drain piping is below grade, a small auxiliary drain shall be installed to a floor drain to permit complete drainage of the exterior main drain piping.

3.4 Electrical Connections

.1 Electrical work associated with this section provided by Fire Alarm Contractor and/or Electrical Contractor under Section 26 05 01 - Common Work Results - Electrical. Coordinate device location with these contractors.

3.5 Disinfection

.1 Disinfect new piping and existing piping.

.2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.

.3 Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply.

.4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

3.6 Backflow Preventor

.1 Install backflow preventer to requirements of Authority having jurisdiction and the Municipal Water Authority.

.2 Install so that unit is within 48” of finished floor or fixed access platform.

.3 Provide outdoor test connection for backflow preventer.

.4 Test unit to the requirements of the Municipal Water Authority.

3.7 Field Painting

.1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.

.2 Clean surfaces to remove dust, dirt, rust, and loose mill scale. Apply coatings to clean, dry surfaces, using clean brushes.

.3 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 ml.

.4 Finish painting is by others. Provide protection for unpainted sprinkler system components (ie sprinkler heads, valves, switches, etc) during this work.

.5 Exterior drain pipes shall be prime painted.

3.8 Field Quality Control

.1 Site Test, Inspection:
- .1 Perform test to determine compliance with specified requirements in presence of Consultant.
- .2 Test, inspect, and approve piping before covering or concealing.
- .3 Preliminary Tests:
  - .1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
  - .2 Flush piping with potable water in accordance with NFPA 13.
  - .3 Piping above suspended ceilings: tested, inspected, and reviewed by consultant before installation of ceilings.
- .4 Formal Tests and Inspections:

.1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.
.2 Submit written request for formal inspection at least 15 days prior to inspection date.
.3 Repeat required tests as directed.
.4 Correct defects and make additional tests until systems comply with contract requirements.
.5 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.
.6 Authority of Jurisdiction will witness formal tests and approve systems before they are accepted.

.2 Site Tests:
.1 Testing to be witnessed by Authority Having Jurisdiction.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 10 44 16.19 Fire Extinguishers and Safety Blankets.
.2 Section 21 01 05 Common Work Results – Mechanical.
.3 Section 28 31 00 - Fire Detection and Alarm.

1.2 References

1 Authority Having Jurisdiction (AHJ):
  .1 Conform to the requirements of the Authority having Jurisdiction. The Authority having Jurisdiction for this project is The Municipal Fire Chief.
  .2 Province of Nova Scotia Fire Safety Act (2002).

.2 NFPA:
  .1 NFPA 17A, Standard for Wet Chemical Extinguishing Systems.
  .2 NFPA 96, Standard for Ventilation Control and Fire protection of Commercial Cooking Operations

.3 Underwriters' Laboratories Inc. (UL) / Underwriters' Laboratories of Canada (ULC)
  .1 UL 300-2005, Standard for Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment.
  .2 ULC/ORD C1254.6

1.3 Submittals

.1 Product Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

.2 Shop Drawings:
  .1 Provide drawings stamped and signed by Professional Engineer registered or licensed in Nova Scotia.

2 Products

2.1 SCOPE Of WORK

.1 Provide pre-engineered appliance specific design Wet Chemical fire suppression system for Kitchen hood as shown on plan. System to be c/w all sensors, switched, nozzles, manual release, and signage for a complete operating system.

.2 System to protect below kitchen hood, behind kitchen hood filters, and kitchen hood exhaust duct.

.3 Coordinate connections to Fire Alarm system with Fire Alarm contractor.

.4 Contractor to complete all acceptance / certifications and leave system ready for use by Owner.

2.2 Acceptable Material

.1 Acceptable Systems: Ansul R-102, Kidde Range Guard.

.2 Acceptable Installing Subcontractors: Breton, Grinnell.

2.3 Components

.1 ULC listed pre-engineered system.

.2 Design to NFPA 17A

.3 Design systems to UL 1254 requirements; include in operating manual the following:

- .1 Description of system operating details.
- .2 Description of fire risks to be protected.
- .3 Pipe and fitting limitations.
- .4 Nozzle limitations, including maximum dimensional and area coverage, and installation location.
- .5 Requirements for equipment maintenance.

2.4 Storage Containers

.1 Pressure gauge on each container.

.2 Approved container mounting and retaining system.

.3 Caps, plugs or valves connected to pressurized cylinder must have at least four full threads of engagement.

.4 Provide means of relieving pressure when minimum of two full threads are engaged between device and cylinder, to prevent potential injury when cylinder valve assembly is pressurized while being serviced.

2.5 Piping And Fittings

.1 To ANSI/NFPA 17A.

.2 Finish: chrome plated or polished stainless steel in exposed areas.

.3 Scarf or notch bottom of siphon tubes used to transport extinguishing agent through pressure vessel and valve to distribution piping to provide for uninterrupted flow of extinguishing agent.

2.6 Nozzles

.1 Stainless steel or non-ferrous with satin finish.

.2 Provide frangible discs or blow-off caps at each nozzle.

2.7 Fire Detection System

.1 ULC listed, automatic, to NFPA 17A.

.2 Detection wire running exposed in kitchen to be run in Stainless Steel conduit.

2.8 Operating Devices

.1 ULC listed operating system to NFPA 17A.

.2 Provide manual control ULC listed operating station to NFPA 17A, located as indicated.

.3 Shut down devices in accordance with manufacturer's listing.

2.9 Building Fire Alarm Connections

.1 Provide trouble and discharge terminal points for tying into building fire alarm system in accordance with Section 28 31 00 - Fire Detection and Alarm.

3 Execution

3.1 Application

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Installation

.1 Install in accordance with ULC listing.

.2 Control panel to be located in an accessible location.

.3 Include 24 hr /day, 7 day / week contact information of servicing contractor on control panel identification.

.4 Provide red lamicoid with white letters mechanically fastened to wall at manual release identifying release as ‘KITCHEN HOOD FIRE SUPPRESSION”

3.3 Site Tests

.1 Test to acceptance in accordance with ANSI/NFPA 17A.

.2 Provide Office of Engineer with 72 hours notice of acceptance tests. Have tests witnessed by the Office of the Engineer or his representative.

.2 Test system units for use with each type of cooking appliance referenced in manufacturer's installation instructions. Conduct tests in accordance with appropriate fire test method specified in UL 300.

3.4 Recharging

.1 After completion of tests, ensure each cylinder in both initial and reserve banks contains correct chemical and weight of extinguishing agent and expellant gas. Restore systems to normal condition.

END OF SECTION

1 General

1.1 Related Sections
.1 Section 21 05 01 – Common Work Results – Mechanical.

1.2 References
.1 Not Used.

1.3 Submittals
.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 Domestic Hot Water Circulating Pumps
.1 Construction: closed-coupled, in-line centrifugal, all bronze construction, stainless steel shaft, stainless steel or bronze shaft sleeve, two oil-lubricated bronze sleeves or ball bearings. Rated for 700 kPa and 105 degrees C continuous service.

.2 Motor: drip-proof, with thermal overload protection.

.3 Supports: provide as recommended by manufacturer.

.4 Acceptable Materials: Armstrong, Grundfoss, ITT Bell & Gossett, Taco, Wilo.

3 Execution

3.1 Manufacturer's Instructions
.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage, and installation instructions, and datasheets.

3.2 Installation
.1 Make piping and electrical connections to pump and motor assembly and controls as indicated.

.2 Ensure pump and motor assembly do not support piping.

.3 Ensure pumps are readily accessible for servicing without interfering with installation or operation of other equipment.

3.3 Start-up

.1 Run-in pumps for 12 continuous hours.

.2 Eliminate causes of cavitation, flashing, air entrainment.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results - Mechanical.
.2 Section 23 05 05 – Installation of Pipework.
.3 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

1.2 References

.1 ASME
  .1 ANSI/ASME B1.20.1-1983 (R2006), Pipe Threads, General Purpose.
  .2 ANSI/ASME B16.15-06, Cast Bronze Threaded Fittings, Classes 125 and 250.
  .3 ANSI/ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
  .4 ANSI/ASME B16.22-01, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  .5 ANSI/ASME B16.24-01, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.

.2 ASTM International Inc.
  .1 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  .2 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.
  .3 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
  .4 ASTM B283 - Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
  .5 ASTM B505/B505M-08a, Standard Specification for Copper-Base Alloy Continuous Castings
  .6 ASTM B88M-05, Standard Specification for Seamless Copper Water Tube (Metric).

.3 AWWA
  .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 CSA
  .1 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.

.5 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
  .1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions
  .2 MSS-SP-67-02a, Butterfly Valves.
  .3 MSS-SP-70-06, Gray Iron Gate Valves, Flanged and Threaded Ends.
  .4 MSS-SP-71-05, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
  .5 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
  .6 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

.6 NSF
  .1 NSF/ANSI 61 – Drinking Water Systems Components – Health Effects

.7 National Plumbing Code of Canada (NPC) - 2010.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical

2 Products

2.1 Piping

.1 Domestic hot, cold and recirculation systems, within building.
- .1 Piping material as per section 23 05 05
- .2 The following premanufactured joining systems are acceptable alternatives to soldering: Victaulic, Veiga ProPress Copper Piping, Aquarise" by IPEX.

2.2 Fittings

.1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.

.3 Cast copper, solder type: to ANSI/ASME B16.18.

.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.5 2" and larger: ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.

.6 Smaller than 2": wrought copper to ANSI/ASME B16.22 cast copper to ANSI/ASME B16.18; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 200 psi.

2.3 Cathodic Protection

.1 Provide cathodic protection using anode rods (minimum of three).

2.4 Joints

.1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.

.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.3 Solder: 95/5 tin copper alloy.

.4 Teflon tape: for threaded joints.

.5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.

.6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

.7 Acceptable Materials: Gruvlok, Victaulic "No-Sweat", Shurjoint

2.5 Valves

.1 Except for specialty valves, all valves to be of one manufacturer.

.2 Valves to be 'lead free'.

.3 End Connections : Cu – Soldered, flanged, or grooved

.4 Provide lockshield valves as shown on drawings.

.5 Provide valves with extended stems where piping (and valves) are insulated.

2.6 Gate Valves

.1 Requirements common to gate valves, unless specified otherwise:
- .1 Standard specification: MSS SP-80, class 125.
- .2 Bonnet: union with hexagonal shoulders.
- .3 Connections: soldered.
- .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
- .5 Packing: non-asbestos.
- .6 Handwheel: non-ferrous.
- .7 Handwheel Nut: bronze to ASTM B62.

.2 2" and under, soldered or screwed: Bronze body, screw-in bonnet, solid wedge disc.

.3 2 ½" and over, in mechanical rooms, grooved, soldered, or flanged: Rising stem: flat flange faces, bronze body, OS&Y bronze trim.

.4 2 ½" and over, other than mechanical rooms, flanged: Non-rising stem: flat flange faces, bronze body, bronze trim, bolted bonnet

2.7 Globe Valves

.1 Requirements common to globe valves, unless specified otherwise:
- .1 Standard specification: MSS SP-80, class 125.
- .2 Bonnet: union with hexagonal shoulders.
- .3 Connections: soldered.
- .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
- .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
- .6 Handwheel: non-ferrous.
- .7 Handwheel Nut: bronze to ASTM B62.

.2 2" and under, soldered or screwed: bronze body, renewable rotating PTFE composition disc, regrindable bronze seat. Screwed over bonnet.

2.8 Swing Check Valves

.1 Requirements common to check valves, unless specified otherwise:
- .1 Standard specification: MSS SP-80, class 125.
- .2 Connections: soldered
- .3 Bronze body / bronze disc.
- .4 Regrindable seat.

.2 2" and under : Screw in cap

.3 2 ½" and over : Flat flange faces, bolted cap

2.9 Ball Valves

.1 2" and under
- .1 Class 150.
- .2 Connections: soldered
- .3 Bronze body
- .4 Chrome plated brass or stainless steel ball, PTFE adjustable packing, brass gland, and PTFE seat, removable steel lever handle.

.2 2 ½" and over, soldered, flanged, or grooved:
- .1 To ANSI/ASME B16.18, Class 150.
- .2 Chrome plated brass or stainless steel ball, flat flanges, PTFE adjustable packing, brass gland, and PTFE seat, removable steel lever handle.

2.10 Butterfly Valves

.1 2 ½" and over, grooved or flanged:
- .1 To MSS-SP-67, Class 200
- .2 Cast bronze, with copper-tube dimensioned grooved ends, stainless steel integrally cast stem, EPT liner.
- .3 Lever operated, 200 mm and over, gear operated.

2.11 Balancing Valves

.1 All Sizes:
- .1 Standard specification: MSS SP-72, Class 150
- .2 Provide where shown on drawings.
- .3 Valves to be lead free and c/w grooved, soldered, or flanged ends.
- .4 Valves to provide multi turn throttling adjustment for proportional balancing of systems and shut off capacity.
- .5 Provide c/w readout to allow valve to be replaced in a known position and P/T plugs c/w caps.

2.12 Acceptable Products

Up to 2" diameter

Manufacturer	Figure Nos.			
	Gate *	Ball	Globe	Check
Crane	1324	9322	1310	1342
Kitz	41	59	12	23
Apollo	102S-LF	32LF-200	120S-LF	161S-LF
Victaulic	——	722	——	712

* Use only where specifically asked for.

2 ½" diameter and Larger

Manufacturer	Figure Nos.			
	Gate *	Ball	Globe	Check
Crane	465 J	351 J	44-BXZ-L	373
Kitz	72	76	6122 EL 6122 GL	78
Apollo	30LF	70LF-200	33LF	163S-LF
Victaulic	YY	YY	300	712

3 Execution

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.2 Installation

1. Install in accordance with NPC Code and local authority having jurisdiction.

2. Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.

3. Assemble piping using fittings manufactured to ANSI standards.

4. Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.

5. Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

3.3 Valves

1. Isolate equipment, fixtures and branches with ball valves unless shown otherwise on drawings.

2. Balance recirculation system using lockshield globe valves or balancing valves. Mark settings and record on as-built drawings on completion.

3.4 Flushing And Cleaning

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and Consultant

.3 Coordinate with Section 33 11 16- Site Water Utility Distribution Piping and Section 33 11 16.01 - Incoming Site Water Utility Distribution Piping

.4 Flush entire system for minimum of 8 hours (longer if required by AHJ). Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Federal potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

.5 Upon completion, provide laboratory test reports on water quality to Consultant.

3.5 Start-Up

1. Timing: start up after:
   - .1 Pressure tests have been completed.
   - .2 Disinfection procedures have been completed.
   - .3 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:
   - .1 Establish circulation and ensure that air is eliminated.
   - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
   - .3 Bring HWS storage tank up to design temperature slowly.
   - .4 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.
   - .5 Check control, limit, safety devices for normal and safe operation.

3.6 Performance Verification

.1 Scheduling:
   - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued.

.2 Procedures:

.1 Verify that flow rate and pressure meet Design Criteria.

.2 TAB HWC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

.4 Sterilize HWS and HWC systems for Legionella control.

.5 Verify performance of temperature controls.

.6 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

.3 Reports:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.

.2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.
.2 Section 23 05 05 – Installation of Pipework.
.3 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
.4 Section 23 05 53 – Mechanical Identification.

1.2 References

.1 ASTM International Inc.
  .1 ASTM B32-08, Standard Specification for Solder Metal.
  .2 ASTM B306-02, Standard Specification for Copper Drainage Tube (DWV).
  .3 ASTM C564-03a, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

2. Canadian Standards Association (CSA International).
  .1 CSA B67-1972 (R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
  .2 CAN/CSA-B70-06, Cast Iron Soil Pipe, Fittings and Means of Joining.
  .3 CAN/CSA-B125.3-05, Plumbing Fittings.

1.3 Submittals

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

2 Products

2.1 Copper Tube And Fittings

.1 Above ground sanitary, storm, and vent Type DWV to: ASTM B306.
  .1 Fittings.
    .1 Cast brass: to CAN/CSA-B125.3.
    .2 Wrought copper: to CAN/CSA-B125.3.
  .2 Solder: lead free - 95:5.

2.2 Cast Iron Piping And Fittings

.1 Above ground sanitary, storm, and vent: to CAN/CSA-B70.
  .1 Joints: Neoprene or butyl rubber compression gaskets with stainless steel clamps.

3 Execution

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Installation

.1 In accordance with Section 23 05 05 - Installation of Pipework.

.2 Install in accordance with National Plumbing Code and local authority having jurisdiction.

.3 Arrange and pay for all inspections required by municipal Authorities. Provide copy of reports resulting from these visits to the Office of the Engineer.

.4 Install deep seal trap on duct plenums and duct drains. Run DWV copper piping from trap to floor drains or hub drains as indicated on design plans. Drain lines running below ducts may be supports from supports of ducts they drain. Coordinate with other trades.

.4 Install piping parallel and close to walls to conserve headroom and ceiling space; grade as indicated.

3.3 Testing

.1 Test integrity of CI fittings prior to installation.

.2 Hydraulically test to verify grades and freedom from obstructions.

.3 Provide copies of test reports to the Office of the Engineer.

3.4 Performance Verification

.1 Cleanouts:
- .1 Ensure accessible and that access doors are correctly located.
- .2 Open, cover with linseed oil and re-seal.
- .3 Verify that cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Ensure that fixtures and/or equipment is properly anchored, connected to system and effectively vented.

3.5 As-Built Drawings

.1 Note changes from sizes and routing of piping on contract documents as per section 21 05 01 – Common Work Results, Mechanical.

.2 Record inverts of underground piping at bottom of all pits and where piping exits the building.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results - Mechanical.
.2 Section 23 05 05 – Installation of Pipework.
.3 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
.4 Section 23 05 53 – Mechanical Identification.

1.2 References

.1 ASTM International Inc.
  .1 ASTM D2235-04, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
  .2 ASTM D2564-04e1, Standard Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.

.2 Canadian Standards Association (CSA International)
  .1 CAN/CSA-Series B1800-06, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.

.3 Green Seal Environmental Standards (GSES)
  .1 Standard GS-36-00, Commercial Adhesives.

1.3 Submittals

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01, Common Work Results - Mechanical.

2 Products

2.1 Material

.1 Adhesives and Sealants:
  .1 Maximum VOC limit in accordance with table below:

Specialty Application	VOC Limit (g/L Less Water)
PVC Welding	510
CPVC Welding	490
ABS Welding	325

2.2 Piping And Fittings

.1 For above ground DWV piping to CAN/CSA B1800:

2.3 Joints

.1 Solvent weld for PVC: to ASTM D2564.

.2 Solvent weld for ABS: to ASTM D2235.

2.4 Building Sanitary Drainage Piping

.1 PVC pipe and fittings to have flame spread rating less than 25 and smoke development rating less than 50.

.2 Store materials to avoid shock and damage. Do not use chains or cables through the pipe bore. Store gaskets away from the sunlight and away from petroleum products.

.3 Above Grade Sanitary Plastic Piping:
- .1 Where elected by the contractor, limited use of drainage and vent piping shall be PVC Type DWV with flame spread rating of not greater than 25 and a smoke development rating not greater than 50.
- .2 Fittings: Same as pipe.
- .3 Joints: To be solvent weld joints to ASTM D2564.
- .4 Combustible plastic pipe and fittings are not permitted for use in a ceiling return air plenum.
- .5 Combustible plastic pipe and fittings penetrating fire separations to be sealed with a fire stop system approved by the National Building Code.

3 Execution

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Installation

.1 In accordance with Section 23 05 05 - Installation of Pipework.

.2 Install in accordance with National Plumbing Code and local authority having jurisdiction.

.3 Arrange and pay for all inspections required by municipal Authorities. Provide copy of reports resulting from these visits to the Office of the Engineer.

.4 Install piping parallel and close to walls to conserve headroom and ceiling space; grade as indicated.

3.3 Testing

.1 Pressure test systems in accordance with National Plumbing Code and local authority having jurisdiction.

.2 Hydraulically test to verify grades and freedom from obstructions.

.3 Provide copies of test reports to the Office of the Engineer.

3.4 Performance Verification

.1 Cleanouts:
- .1 Ensure accessible and that access doors are correctly located.
- .2 Open, cover with linseed oil and re-seal.
- .3 Verify that cleanout rods can probe as far as the next cleanout, at least.

3.5 As-Built Drawing

.1 Note changes from sizes and routing of piping on contract documents as per section 21 05 01 – Common Work Results, Mechanical.

END OF SECTION

1 General

1.1 Related Requirements

.1 Section 21 05 01 – Common Work Results for Mechanical.
.2 Section 23 07 14 – Thermal Insulation for Equipment.

1.2 References

.1 CSA B51-03 (R2007), Boiler, Pressure Vessel, and Pressure Piping Code.
.2 CAN/CSA C22.2 No.110-94 (R2004), Construction and Test of Electric Storage Tank Water Heaters.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 General

.1 Tanks and heaters to be CSA listed c/w :
1. Hose end drain valve
2. ASME rated temperature and pressure relief valve sized for full capacity of heater or control valve, having discharge terminating over floor drain and visible to operators

.2 Size and Capacity noted on drawings.

2.2 Commercial Electric DHW Heater

.1 Tank:
.1 Integral rigid polyurethane insulation with minimum R16 insulation factor. Outer casing of sheet steel with baked-on enamel paint finish.
.2 Provide adjustable immersion type thermostat control with 16 to 60°C range.
.3 Glass lined construction, fitted with distributor tube and sacrificial anode for cathodic protection.
.4 Designed for 150 psig working pressure.
.5 Single panel control box c/w hinged door. CSA terminal block.
.6 38 mm DCW and DHW piping connections.

.2 Heaters- Electric:
.1 Heating: to C.S.A. C22.2 No. 110-1973.
.2 Elements: Screw-in type elements, SS outer sheath, immersion type.
.3 Unit c/w magnetic contactors, terminal block, pre-wired internally, grounding screw, internal fusing.

.3 Acceptable Materials: A.O Smith, Giant, Rheem/Rudd, Wood.

3 Execution

3.1 Installation

.1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.

.2 Provide housekeeping pad underneath floor mounted tank.

.3 Locate tank to ensure proper access to elements for servicing and removal.

.4 Install unions at inlet and outlet of tank.

.5 Pipe T&P Relief valve to floor drain.

3.2 Field Quality Control

.1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results - Mechanical.

1.2 References

.1 Canadian Standards Association (CSA International).
- .1 CAN/CSA-B45 Series, Plumbing Fixtures.
- .2 CAN/CSA-B125, Plumbing Fittings.
- .3 CAN/CSA-B651-, Barrier-Free Design.

.2 National Building Code.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 Manufactured Units

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.

.3 Exposed plumbing brass, pipes, and stops to be triple chrome plated.

.4 Report any plumbing fixture location/quantity discrepancies between architectural and mechanical drawings to the office of Engineer prior to installation. Number, locations: architectural drawings to govern.

.5 Common Manufacturers :
- .1 All vitreous china/porcelain fixtures to be product of a single manufacturer. All fixtures to be white.
- .2 All stainless steel fixtures to be product of a single manufacturer.
- .3 All acrylic fixtures to be product of a single manufacturer.
- .4 All trim to be product of a single manufacturer.

.6 Materials
- .1 Vitreous china to C.S.A. B45.10
- .2 Stainless steel fixtures to C.S.A. B45.4 Class II, Type 302 in accordance with C.S.A. G110.6 unless otherwise stated; Class I, Type 316 in accordance with C.S.A. and B110.6
- .3 Plumbing fittings to C.S.A. B125
- .4 Brass P trap with clean out on each fixture not having integral trap

.7 Refer to the Plumbing Fixture Schedule on the drawing.

.8 Provide Factory manufactured floor-mounted carrier systems (fixed type) for all wall-mounted fixtures.

.9 Hands Free Sensors
- .1 Activated by infra-red.
- .2 Sensor: waterproof, with impact-resistant, anti scratch coated plastic lens, sensitivity adjustable from 100 mm to 450 mm.
- .3 Adjustable run time for sinks and lavatories between 0 and 60 seconds.
- .4 Controls: interchangeable receptacles for stainless steel sheathed sensor and modular plug-type solenoid connections, 12 VDC, slow-closing commercial solenoid(s) for 860 kPa, 85 degrees C.
  - .1 Transformer: 120/12 VDC, UL and CSA listed, type, sized for up to 8 solenoids.
  - .2 Equipped with manual override.

.10 Service sinks:
- .1 Supply fitting: with vacuum breaker, heavy cast brass spout with pail hook, aerator, brace to wall, integral stop valves. Provide accessories to limit maximum flow rate to 8.35 l/minute at 413 kPa.
- .2 Provide Rim Guard for all exposed sides and stainless steel splash guard for all walls at sink.

.11 Stainless steel counter-top sinks.
- .1 From 20 ga type 302 stainless steel, self-rimming, undercoated, clamps.

2.2 Acceptable Materials

- .1 Vitreous China fixtures (except urinals): American Standard, Crane, Eljer, Fiat, Kindred, Kohler, Zurn
- .2 Urinals: American Standard, Zurn
- .3 Emergency Eyewash / Drench Showers : Acorn, Bradley, Guardian, Haws, Speakman
- .4 Trim: Crane, American Standard, Waltec, Emco, Brasscraft, Cambridge Brass, Chicago Faucet, Kohler, Sloan, Delta, Zurn, McQuire, Symmons and equal in quality to the specified product.

3 Execution

3.1 Installation

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage, and installation instructions, and datasheets.

.2 Point of use temperature mixing valves to be located so they are unaccessible to the regular building occupants.

.3 Mounting heights:

.1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified below.
.2 Wall-hung fixtures: as indicated measured from finished floor.
.3 Physically handicapped: to comply with most stringent of either NBCC or CAN/CSA B651.
.4

Fixture	Height (AFF)	Barrier Free Ht (AFF)
Water Closet	15 " (to top of bowl rim)	17" (to top of seat)
Urinal (to top of bowl rim)	22"	19 ½"
Wall Hung Lavatory	See architectural	34" max to top of rim
Hose Bibb (interior)	36"	-

.4 Locate flush valve handle or flush lever on access side of all toilets unless specifically shown otherwise on the drawings.

.5 Each fixture shall be separately trapped

.6 Provide supports necessary to set fixtures square and level.

.7 Provide lockshield stops on the hot and cold water supply to each fixture.

.8 Provide check valves on supplies to mixing faucets and thermostatically controlled mixing valves.

.9 Supplies in cabinets or concealed paces may be Speedway CP tubing with CP escutcheons at walls.

.10 Fixtures mounted on glazed tile surfaces shall have ground faces to finished surface.

.11 Fixtures shall be serviced as shown on the drawings.

.12 Seal between the base of the water closet and the floor, between wall hung lavatories and the wall, and between the top of the tanks and wall on tank type water closets with mildew resistant silicone sealant.

3.2 Adjusting

.1 Adjustments:
.1 Adjust water flow rate to design flow rates.
.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
.3 Hands free lavatories and sinks to run for 20 seconds.

.2 Verify temperature settings of Thermostatic controls:

END OF SECTION

1 General

1.1 Related Sections

.1 Section 08 31 00 – Access Doors for Mechanical Equipment.
.2 Section 21 05 01 – Common Work Results – Mechanical.
.3 Section 23 05 05 – Installation of Pipework.

1.2 References

.1 American Society for Testing and Materials International (ASTM):
  .1 ASTM A126-[95(2001)], Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  .2 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.

.2 American Water Works Association (AWWA):
  .1 AWWA C700-02, Cold Water Meters-Displacement Type, Bronze Main Case.
  .2 AWWA C701-02, Cold Water Meters-Turbine Type for Customer Service.
  .3 AWWA C702-1-01, Cold Water Meters-Compound Type.

.3 Canadian Standards Association (CSA International):
  .1 CSA-B64 Series-01, Backflow Preventers and Vacuum Breakers.
  .2 CSA-B79-94(R2000), Floor, Area and Shower Drains, and Cleanouts for Residential Construction.
  .3 CSA-B356-00, Water Pressure Reducing Valves for Domestic Water Supply Systems.

.4 Plumbing and Drainage Institute (PDI):
  .1 PDI-G101-96, Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.
  .2 PDI-WH201-92, Water Hammer Arresters Standard.

1.3 Submittals

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and 21 05 01 – Common Work Results – Mechanical.

2 Products

2.1 Floor Drains

.1 Floor Drains and Trench Drains: to CSA B79.

.2 Strainers shall be nickel Bronze in ‘Finished’ areas.

.3 Drains shall have a cast iron clamping collar and trap primer connections.

.4 General duty; cast iron body, adjustable head, sediment basket nickel bronze strainer, integral seepage pan, and clamping collar.
  .1 Standard of Acceptance : Zurn ZN 415 BPY.

.5 Funnel Floor Drain (FFD); cast iron body with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer with integral oval funnel.
1. Standard of Acceptance : ZN 415 BFPY.

.6 Acceptable Materials: Ancon , Jay R. Smith , Mifab , Watts Drainage, Zurn.

2.2 Cleanouts

.1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
.1 Standard of Acceptance : Zurn ZN1602-SP
.2 Acceptable Materials: Zurn ZN1602-SP, Ancon, J.R. Smith, Mifab, Watts Drainage.

.2 Access Covers:
.1 Wall Access: See Section 08 31 00.
.2 Floor Access: cast iron body and frame with adjustable secured nickel bronze top and:
.1 Plugs: bolted bronze with neoprene gasket.
.2 Cover for Unfinished Concrete Floors: cast iron, nickel bronze, round or square, gasket, vandal-proof screws.
.3 Cover for Terrazzo Finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.
.4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
.5 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.
.6 Standard of Acceptance : Zurn ZANB-1460-13
.7 Acceptable Materials: Zurn ZANB-1460-13, Ancon, Enpoco, Josam, Rototech-Smith Inc., Wade, Jay R. Smith, William Bros, Mifab, Watts Drainage.

2.3 Water Hammer Arrestors

.1 Stainless steel construction, bellows piston type: to PDI-WH201.

.2 Acceptable Materials: Ancon, Jay R. Smith, Mifab, Precision Plumbing Products Ltd, Shoktrol, Watts Drainage, Zurn.

2.4 Back Flow Preventers

.1 Preventers: to CSA-B64 Series, application as indicated, reduced pressure principle type double check valve assembly back flow preventer with intermediate atmospheric vent or vacuum breaker.

.2 Standard of Acceptance: Watts 909-S-QT.

.3 Acceptable Materials: Ames, Beeco , Braukmann, Colt, Conbraco, Febco, Flomatic valves, Honeywell, Watts 909-S-QT, Wilkins.

2.5 Vacuum Breakers

.1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric laboratory faucet intermediate.

.2 Acceptable Materials : Braukmann, Febco, Watts, Wilkins.

2.6 Hose Bibbs And Sediment Faucets

.1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

.2 Acceptable Material: Acorn #8121, Crane C-5046, Jay R. Smith, Mifab, Watts, Wilkins, Zurn.

2.7 Water Meters

.1 Turbine type to AWWA C701.

.2 Accessories: remote readout device and leads for connection to BAS.

.3 Acceptable Materials: Badger, Neptune.

2.8 Trap Seal Primers

.1 Trap primers shall be complete with shut-off valve, vacuum breaker, control valve, and a drain valve as shown on the drawing and integral timer.

.2 Provide 18 gauge metal guard for units that are exposed.

.3 CW pipe upstream of control valve to be insulated.

.4 Pipe as specified in Section 23 05 05 – Installation of Pipework.

.5 Units to be c/w with all necessary components for connection to 120 V power supply.

.6 Acceptable Materials: Mifab, PPP.

2.9 Strainers

.1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.

.2 2" and under, bronze body, screwed ends, with brass cap.

.1 Acceptable Materials: Spirax/Sarco BT, Armstrong F4SC, Crane 988-½ , Braukmann FY32, Leitch BE with 530 strainer, Watts 777, *Wilkins Mod. S*.

.3 2 ½" and over, cast iron body, flanged ends, with bolted cap.

.1 Acceptable Materials: Spirax/Sarco F-250, Armstrong F4FL, Crane 989-½, Braukmann FH33, Leitch 528 pipeline basket type, Watts 77F-250.

2.10 Grease Interceptors

.1 Enzymatic type interceptor, tested and rated in accordance with PDI G101, complete with acid resistant interior enamel finish for mounting flush with floor with non-skid covers on floor complete with flow control fitting suitably vented.

.2 Supply one case of four 2.5 lb cans of enzyme activator with interceptors.

2.11 Running Traps

.1 Cast iron body, piping connections to suit piping size, minimum seal equal to 5".

.2 Acceptable Material: Ancon, J.R. Smith, Watts, Zurn Z-1000.

2.12 Domestic Hot Water Expansion Tanks

.1 Diaphragm type pre-pressurized expansion vessel, fabricated and design in accordance with the ASME code, for use on potable domestic hot water systems up to 125 psig and 200°F maximum.

.2 Provide stainless steel system connection, air valve, butyl rubber diaphragm, acrylic primer finish.

.3 Acceptable Materials: Armstrong AST Series, Hamlet & Garneau Expanflex BFA Series, ITT B&G, Myres, Taco.

2.13 Domestic Hot Water Self-Contained Thermostatic Mixing Valve

.1 Bronze construction, single body design, stainless steel piston and liner, high/low thermostatic controller, 3-way scalding protection, with integral check stops, temperature gauges, removable cartridge with strainer, stainless steel piston, liquid filled thermostat/sensing bulb and liquid fill thermal motor with bellow element mounted out of water.

.2 Temperature gauges not required for mixing valves serving lavatories and sinks.

.3 Valve complete with cold water fail safe position.

.4 ASSE 1017 and CSA B125.3 approved.

.5 86°F to 120°F field setting range.

.6 Install unit in stainless steel cabinet or prime coated steel cabinet where installed in finished spaces.

.7 Acceptable Materials: Bradley, Hawes, Leonard, Lawler Model 802, Symmons, T & S, Watts

3 Execution

3.1 Installation

.1 Install in accordance with National Plumbing Code of Canada, provincial codes and local authority having jurisdiction.

.2 Install in accordance with manufacturer's instructions and as specified.

3.2 Cleanouts

.1 Install cleanouts at base of soil and waste stacks, rainwater leaders, at locations required code, at every cumulative horizontal change in direction exceeding 135 degrees, at all ground floor slab penetrations by drainage pipe (except from Lavatories), and as indicated.

.2 Bring cleanouts of drainage pipe serving all Mechanical Rooms, Food Preparation Areas, and Laboratories to finished floor. Other cleanouts to be brought to the wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum 100 mm.

3.3 Floor Drains

.1 Floor drains to be installed flush with finished floor and level.

.2 Protect grates, funnels, etc from damage.

.3 Install body of floor drains directly connected to buried pipe separately from grates, hubs, funnels, etc. and protect openings with blank cleanout plate. Set aside grates, hubs, funnels etc for installation after floor is finished.

.4 Install body of funnel floor drains and hub drains not directly connected to buried pipe separately from hubs and funnels and protect openings with blank cleanout plate. Set aside hubs and funnels for installation after floor is finished.

3.4 Water Hammer Arrestors

.1 Install on branch supplies to fixtures or group of fixtures where indicated.

.2 Provide access to units. Where fixtures are in walls or above finished ceilings use access doors. Access through removable light fixtures is not acceptable.

3.5 Back Flow Preventors

.1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.

.2 Pipe discharge to terminate over nearest drain and or service sink.

.3 Unit to be fully accessible, installed with centerline between 24” and 60” of finished floor unless noted otherwise or provided with a fixed platform for access.

.4 Unit to be tested and tagged by certified technician.

3.6 Hose Bibbs And Sediment Faucets

.1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.7 Trap Seal Primers

.1 Install for floor drains and elsewhere, as indicated.

.2 Provide water hammer arrestor on inlet piping to trap primer.

.3 Do not feed traps on different floors from a common trap primer unit.

.4 Trap primers installed in 'finished' areas to be concealed in walls behind a labeled access door unless noted otherwise.

3.8 Strainers

.1 Install with sufficient room to remove basket.

3.9 Grease Interceptors

.1 Install with sufficient space, as indicated, for ease of maintenance.

3.10 Water Meters

.1 Install water meter provided by local water authority.

.2 Install water meter as indicated.

.3 Provide certificate of calibration

3.11 Start-Up

.1 Start-up only after:
- .1 Pressure tests have been completed.
- .2 Disinfection procedures have been completed.
- .3 Certificate of static completion has been issued.
- .4 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

3.12 Testing And Adjusting

.1 Timing:
- .1 After start-up deficiencies rectified.
- .2 After certificate of completion has been issued by authority having jurisdiction.

.2 Application tolerances:
- .1 Pressure at fixtures: +/- 70 kPa.
- .2 Flow rate at fixtures: +/- 20%.

.3 Adjustments:
- .1 Verify that flow rate and pressure meet design criteria.
- .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

END OF SECTION

1 General

1.1 Scope of Work

.1 Provide all piping in the building as shown on plans and described in the specification.

.2 Trim pipe lengths left in previous contract as necessary to connect piping and equipment installed in this contract. Provide all flanges, welds, and/or material to make these connections.

1.2 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.
.2 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
.3 Section 23 05 53.01 – Mechanical Identification.
.4 Section 23 08 02 – Cleaning and Start up of Mechanical Systems.

1.3 References

.1 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.2 Canadian Standards Association (CSA International)
  .1 CSA B139-[04], Installation Code for Oil Burning Equipment.

.3 Green Seal Environmental Standards (GSES)
  .2 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.

2 Products

2.1 Material

.1 Pipe material as per the following table:

Service	Sizes	Material	Specification Section
Above Ground Drainage, Interior (See below for Urinal Piping)	1" and smaller	Cu- Type L	22 13 17
	1 1/4" and larger	Cu - DWV	22 13 17
		CI	22 13 17
		ABS - DWV	22 13 18
		PVC - DWV	22 13 18
AHU Condensate Drain	All	Cu - DWV	22 13 17
Breeching / Chimney Drain	All	Stainless Steel	23 21 13.02

Urinal Drain (and vent below flood rim)	All	ABS - DWV	22 13 18
		PVC - DWV	22 13 18
		CI	22 13 17
Plumbing Vent	All	Cu - DWV	22 13 17
Above Ground Domestic Water	All	Cu - Type L	22 11 16
Above Ground Trap Primer (Exposed)	All	Cu - Type K	22 42 01
Above Ground Trap Primer (Concealed) - Note 3	All	Cu - Type K	22 42 01
		Pex	
Above Ground Trap Primer (concealed in slab)	All	Pex	22 42 01
Above Ground Natural Gas (860 kPa and below)	All	Steel Sch 40	23 11 23
Above Ground Heating Water	under 8"	Steel - sch 40	23 21 13
	over 6"	Steel - sch 30	23 21 13
HVAC Water Treatment	All	Steel - sch 80	23 25 00
Chilled Water	All	Steel Sch 40	23 21 13
Humidification Steam	All	Cu - Type K	23 21 13.01
Steam (15 psi and below)	All	Steel Sch 40	22 23 13
Steam (above 15 psi)	under 8"	Steel Sch 40	22 23 13
	over 6"	Steel Sch 30	
Steam Condensate	All	Steel Sch 80	22 23 13
Refrigerant		Cu - SCR	23 23 00
Fire Protection	All	To NFPA 13	

Note 1: All insulation thicknesses noted in above table are subject to “unless noted otherwise on drawings”
Note 2: ‘Trap Primer’ lines are considered the portion of the lines downstream of trap primer manifold
Note 3: Pex pipe not permitted in R/A plenums

2.2 Paint

.1 Paint: zinc-rich to CAN/CGSB-1.181.
- .1 Primers and Paints: in accordance with manufacturer's recommendations for surface conditions.
- .2 Primer: maximum VOC limit 250 g/L.
- .3 Paints: maximum VOC limit 150 g/L.

3 Execution

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Connections To Equipment

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 Clearances

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and required by relevant codes.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer and as indicated without interrupting operation of other system, equipment, components.

3.4 Drains

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe following drain discharges to above floor drain.
- .1 Air Separator air vents.
- .2 Hot system PRVs
- .3 AHU drain pans
- .4 Air Plenum drain pans

.4 Drain valves: ¾" gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 Air Vents

.1 Install manual air vents at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping from Air Separator vents to terminate above floor drain.

3.6 Di-electric Connections

.1 General: compatible with system, to suit pressure rating of system.

.2 Use brass fittings (eg valves, strainers) to join dissimilar metals on closed systems.

.3 Use di-electric unions to join dissimilar metals on open systems (ie domestic water) 50 mm and smaller.

.4 Use isolating flanges to join dissimilar metals on open systems (ie domestic water) 50 mm and larger.

.5 Where di-electric connections are concealed provide access through access doors or removable ceiling tiles.

3.7 Pipework Installation

.1 Screwed fittings jointed with Teflon tape. Use pink Teflon tape for glycol systems.

.2 Cover open ends of pipe to protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible and as indicated.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use concentric reducers at pipe size changes unless shown differently on contract drawings.

.13 Provide for thermal expansion as indicated.

.14 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless indicated.

.4 Valves accessible for maintenance without removing adjacent piping.
.5 Install globe valves in bypass around control valves.
.6 Use gate, ball or butterfly valves at branch take-offs for isolating purposes except where specified.
.7 Install butterfly valves on chilled water and related condenser water systems only.
.8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
.9 Install ball valves for glycol service.
.10 Use chain operators on valves 2 ½" and larger where installed more than 96" above floor in Mechanical Rooms.

.15 Check Valves:
.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
.2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.8 Sleeves

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Pipe sleeves shall be sch 10 steel pipe except in wet areas where sleeves extend above finished floor (eg mechanical rooms) where they shall be sch 40 black steel pipe.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: ¼" minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:
.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
.2 Other floors: terminate 1" above finished floor.
.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:
.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
.2 Elsewhere:
.1 Provide space for firestopping.
.2 Maintain fire rating integrity.
.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
.4 Ensure no contact between copper pipe or tube and sleeve.

3.9 Escutcheons

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws.
.1 Chrome or nickel plated brass or type 302 stainless steel..

.3 Sizes: outside diameter to cover opening or sleeve.
.1 Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 Preparation For Fire Stopping

.1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.

.2 Uninsulated unheated pipes not subject to movement: no special preparation.

.3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 Flushing Out Of Piping Systems

.1 Flush system in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

.2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant mechanical sections.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 Pressure Testing Of Equipment And Pipework

.1 Advise Consultant 72 hours minimum prior to performance of pressure tests.

.2 Pressure test pipework according to following table:

Service	Minimum Pressure	Test Length	
Domestic water pipe	125 psi or 150% of maximum system pressure	-	
Heating Pipe	125 psi or 150% of maximum system pressure	-	
Gas Pipe		-	
Steam Pipe	100 psi	-	

.3 Maintain specified test pressure without loss for time specified on test form in Appendix to this section unless specified for longer period of time above.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Consultant or approved third party.

.6 Pay costs for repairs or replacement, retesting, and making good. Consultant to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after review of tests by Consultant.

.8 Record test results on form provided in Appendix of this section and provide copy to consultant.

3.13 Existing Systems

.1 Connect into existing piping systems at times coordinated with HPA.

.2 Be responsible for damage to existing systems by this work.

3.14 Appendix A

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Mechanical
Piping Test Form

Project Name: _____

Mechanical Contractor: _____

Date and Time Test Conducted: _____

Type of Piping System: _____

G	Plumbing Vent (2 Hrs Min.)	G	Hot Water Heating (4 Hrs. Min.)
G	Sanitary (2 Hrs Min.)	G	Glycol/Water- Heating (4 Hrs. Min.)
G	Domestic Cold Water (2 Hrs. Min.)	G	Glycol/Water- Chilled Water (4 Hrs Min.)
G	Domestic Hot Water (2 Hrs. Min.)	G	Reverse Osmosis Water (2 Hrs Min.)
G	Domestic Hot Water Re-circulation (2 Hrs. Min.)		
G	Acid Resistant Sanitary (2 Hrs Min.)	G	Radioisotope Sanitary (2 Hrs Min.)
G	Sprinkler (2 Hrs. Min.)	G	Oxygen (24 Hrs. Min.)
G	Propane Gas (see Table 6.3, CAN/CSA-B149.1-05)	G	Medical Air (24 Hrs. Min.)
		G	Medical Vacuum (24 Hrs. Min.)
G	Lab Air (24 Hrs. Min.)	G	Lab Vacuum (24 Hrs. Min.)
G	Steam (4 Hrs. Min.)	G	Condensate (4 Hrs. Min.)
G	Natural Gas and Propane (3 Hrs. Min.)	G	Nitrous Oxide (24 Hrs. Min.)
G	Fuel oil (4 Hrs. Min.)		

Piping Material: _____

Types of Joints: _____

Type of Test: G Ball G Air G Water G Final

Duration of Test: _____ Hours _____ Minutes

Results: _____

Comments: _____

Tests Conducted By: _____

Witnessed/Verified By: _____

END OF SECTION

1 General

1.1 Related Sctions

.1 Section 21 05 01 - Common Work results – Mechanical.

1.2 References

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturers' Association Council (EEMAC).

1.3 Submittals

.1 Shop drawing and maintenance manual submittals for each motor to be included with the equipment the motor is serving..

2 Products

2.1 General

.1 Motors: premium efficiency, in accordance with local Electrical Utility standards and to ASHRAE 90.1. If premium efficient motor is not readily available for the fractional HP motor sizes, then high efficiency motors will be acceptable.

2.2 Motors

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 373 W, 1/2 HP: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 600 V, unless otherwise indicated.

.4 **Motors controlled by VFD's shall be equipped with shaft grounding rings/bearing protection rings to minimize bearing raceway deterioration and failures and ball bearing deterioration and failures.**

2.3 Temporary Motors

.1 If delivery of specified motor will delay completion or commissioning work, install motor approved by consultant and equipment supplier for temporary use. Work will only be accepted when specified motor is installed.

2.4 Belt Drives

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

.3 For motors under 10 HP: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 10 HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

2.5 Drive Guards

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;
- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 18 ga sheet metal tops and bottoms.
- .3 1 ½" dia holes on both shaft centres for insertion of tachometer.
- .4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.-

.5 Guard for flexible coupling:
- .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
- .2 Securely fasten in place.
- .3 Removable for servicing.

.6 Unprotected fan inlets or outlets:
- .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
- .2 Net free area of guard: not less than 80% of fan openings.
- .3 Securely fasten in place.
- .4 Removable for servicing.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Make removable for servicing, easily returned into, and positively in position.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.

1.2 References

.1 American Society of Mechanical Engineers (ASME).
- .1 ASME B40.100-01, Pressure Gauges and Gauge Attachments.
- .2 ASME B40.200-01, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB).
- .1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
- .2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.3 Submittals

.1 Shop Drawing and Maintenance Manual submittals in accordance with Sections 01 33 00 - Submittal Procedures and 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 General

.1 Design point to be at mid point of scale or range.

.2 Ranges: as indicated.

.3 Pressure gauges shall display imperial and metric units

2.2 Direct Reading Thermometers

.1 Industrial, variable angle type, liquid filled, 5” scale length.

.2 Liquid to be tinted red.

.3 Acceptable Materials: Ashcroft, Taylor, Trerice BX, Winters Vari-angle, Weiss.

2.3 Thermometer Wells

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

2.4 Pressure Gauges

.1 4” dia, dial type: to (ASME B40.100), Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:
- .1 Snubber operation.
- .2 Gasketted pressure relief back with solid front.

.3 Bronze stop cock or mini ball valve.
.4 Oil filled.

.3 Acceptable Materials: Ashcroft, Morrison Taylor-Weiss, Terice, Winters.

3 Execution

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage, and installation instructions, and datasheets.

3.2 General

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.3 Thermometers

.1 Install in wells on piping. Provide heat conductive material inside well.

.2 Install in locations as indicated and on inlet and outlet of:
.1 Heat exchangers.
.2 Liquid heating and cooling coils.
.3 Water boilers.
.4 DHW tanks.

.3 Install wells, without thermometers as indicated where shown on drawings.

.4 Use extensions where thermometers are installed through insulation.

3.4 Pressure Gauges

.1 Install as shown on drawings and at the following locations:
.1 Suction and discharge of pumps.
.2 Upstream and downstream of PRV's.
.3 Inlet and outlet of coils.
.4 Inlet and outlet of liquid side(s) of heat exchangers.
.5 Outlet of boilers.
.6 Top of Sprinkler System Standpipe Risers.

.2 Install gauge cocks for balancing purposes, elsewhere as indicated.

.3 Use extensions where pressure gauges are installed through insulation.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results - Mechanical.

1.2 References

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME B31.1-07, Power Piping.

.2 ASTM International
- .1 ASTM A125-1996 (2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
- .2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
- .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
- .2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
- .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 Underwriter's Laboratories of Canada (ULC).

1.3 Submittals

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 21 05 01 – Common Work Results - Mechanical

2 Products

2.1 System Description

.1 Design Requirements:
- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

2.2 General

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 Pipe Hangers

.1 Finishes:
- .1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture but before installation.
- .2 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.2 Upper attachment structural: suspension from lower flange of I-Beam:
- .1 Cold piping 2" maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
  - .1 Acceptable Materials: Myatt Fig. 586; Grinnell Fig. 131, Hunt.
- .2 Cold piping 2 ½" or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed FM approved to MSS-SP58 and MSS-SP69.
  - .1 Acceptable Materials: Myatt Fig. 514; Grinnell Fig. 131, Hunt.

.3 Upper attachment structural: suspension from upper flange of I-Beam:
- .1 Cold piping 2" maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved to MSS SP69.
  - .1 Acceptable Materials: Myatt; Grinnell Fig. 62, Hunt.
- .2 Cold piping 2 ½" or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed FM approved.
  - .1 Acceptable Materials: Myatt Fig. 506; Grinnell Fig. 267, Hunt

.4 Upper attachment to concrete:
- .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye ¼" minimum greater than rod diameter.
- .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed FM approved to MSS SP69.

.5 Hanger rods: threaded rod material to MSS SP58:
- .1 Ensure that hanger rods are subject to tensile loading only.
- .2 Provide linkages where lateral or axial movement of pipework is anticipated.

.6 Pipe attachments: material to MSS SP58:
- .1 Attachments for steel piping, fluid temperatures below 200 deg F: carbon black steel
  - .1 Standard of Acceptance: Myatt Fig 12.
- .2 Attachments for steel piping, fluid temperatures above 200 deg F: carbon black steel

.1 Standard of Acceptance: Myatt Fig 261 c/w fig 210 insulation shield.

.3 Attachment for copper piping fluid temperatures above 70 deg F: copper or epoxy plated black steel.
.1 Standard of Acceptance: Myatt Fig 124L.

.4 Attachment for steel or copper piping fluid temperatures below 70 deg F: oversize hangers to accommodate insulation thickness.
.1 Standard of Acceptance: Myatt Fig 124.

.5 Use insulation shields and rigid insulation/buck-a-roos where insulation is between piping and hanger.

.6 Attachment for cast iron drainage pipe:
.1 Acceptable Materials: Bibby 6600 Series; Hunt; Anvil.

.7 Adjustable clevis: material to MSS SP69 UL listed FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

.8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
.1 Acceptable Materials: Myatt Fig. 158/261; Grinnell Fig. 181/171, Anvil, Taylor, Hunt, Cooper B-Line, Hunt; Anvil.

.9 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
.1 Finishes for steel pipework: (black) (galvanized).
.2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated.

.10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

.11 Wall brackets: carbon steel prime coated.
.1 Acceptable Materials: Myatt Fig. 321; Grinnell Fig. 195, Anvil, Taylor, Hunt, Cooper B-Line, Hunt; Anvil.

.12 Acceptable Materials: Anvil, Bibby, Grinnell, Hunt, Myatt.

2.4 Riser Clamps

.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42.
.1 Acceptable Materials: Anvil Fig. 261, Hunt; Myatt; Grinnell

.2 Copper pipe: carbon steel copper or epoxy plated to MSS SP58, type 42.
.1 Acceptable Materials: Anvil Fig. CT-121, Hunt; Myatt, Grinnell

.3 Cold Water pipe: For pipes with liquids below 70 deg F use pre-insulated riser clamps.
.1 Acceptable Materials: Bergen, Pipe Shields Piping Technology and Products, Tolco Fig 6F

.4 Bolts: to ASTM A307, Nuts: to ASTM A563.

2.5 Insulation Protection Shields

.1 Insulated cold piping:

.1 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:
.1 Curved plate 12" long, with edges turned up, welded-in centre plate.

2.6 Equipment Supports

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.7 Equipment Anchor Bolts And Templates

.1 Provide templates to ensure accurate location of anchor bolts.

2.8 House-Keeping Pads

.1 Provide 4" high concrete housekeeping pads for base-mounted equipment; size pads 2" larger than equipment; chamfer pad edges.

.2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

2.9 Other Equipment Supports

.1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings.

.2 Submit structural calculations with shop drawings.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Vibration Control Devices:
.1 Install on piping systems at pumps, boilers, chillers, and as indicated.

.2 Clamps on riser piping:
.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
.2 Bolt-tightening torques to industry standards.
.3 Steel pipes: install below coupling or shear lugs welded to pipe.
.4 Cast iron pipes: install below joint.

.3 Clevis plates:
.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.3 Pipe Hanger Spacing (Horizontal)

.1 Plumbing piping: to National Plumbing Code except as modified below.

.2 Fire Protection and Natural Gas: to applicable codes.

.3 Cast Iron pipe: At or adjacent to each hub or joint, at 120" intervals. and at 36" if the pipe has mechanical joints and the length of pipe between adjacent fittings is 300 mm or less.

.4 Non Metallic pipe hanger spacing as per following table:

Material	Spacing	Notes
ABS	48"	Additional hanger at end of branches, fixture drains, all changes of direction, and all changes in elevation.
PVC		

.5 Provide support within 12" of each elbow

.6 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

Maximum Pipe Size	Hanger Rod Dia	Pipe Hanger Maximum Spacing (in)		
		Steel	Copper	ABS PVC
Up to ½"	3/8"	72"	60"	N/A
¾" to 1 ¼"	3/8"	84"	72"	
1 ½"	3/8"	108"	96"	48"
2"	3/8"	120"	108"	
2 ½"	3/8"	144"	120"	
3"	½"	144"	120"	
4"	½"	168"	120"	
6"	¾"	200"		
8"	7/8"	225"		

.8 Pipework greater than NPS 12: to MSS SP69.

.9 Fire protection: to NFPA 13.

3.4 Hanger Spacing (Vertical)

.1 Support metallic vertical piping at every other floor or 25' intervals unless noted otherwise below.

.2 Support plastic vertical piping at every floor or 12' intervals.

.3 Vertical sanitary sewer pipes shall be supported at each floor by means of iron hooks or straps placed directly below hub or fittings. Maximum distance between vertical pipe hangers to be 12'.

.4 Vertical drops to fixture shall be supported at top of riser to prevent strain on fixture connection.

3.5 Hanger Installation

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.6 Horizontal Movement

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than ½", offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.7 Final Adjustment

.1 Adjust hangers and supports:
- .1 Ensure that rod is vertical under operating conditions.
- .2 Equalize loads.

.2 Adjustable clevis:
- .1 Tighten hanger load nut securely to ensure proper hanger performance.
- .2 Tighten upper nut after adjustment.

.3 C-clamps:
- .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:
- .1 Hammer jaw firmly against underside of beam.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.

1.2 References

.1 National Fire Protection Association (NFPA):

.1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.

.2 National Building Code of Canada (NBC) – 2010.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 General

.1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 Elastomeric Pads

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

.5 Acceptable Materials: Kinetics, Korfund, Masdom VM, Mason, Vibro-Acoustics, Vibron, Vibra-Sil Inc., Vimco.

2.3 Elastomeric Mounts

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

.2 Acceptable Materials: Kinetics, Korfund, Masdom VM, Mason, Vibro-Acoustics, Vibron, Vibra-Sil Inc., Vimco.

2.4 Springs

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Cadmium plate for outdoor 100% relative humidity installations.

.4 Colour code springs.

.5 Acceptable Materials: *Vibra-Sil Inc., Vimco,* Vibron, Vibro-Acoustics, Mason, Korfund, Kinetics.

2.5 Spring Mount

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

.6 Performance: as indicated.

.7 Acceptable Materials: Kinetics, Korfund, Masdom VM, Mason, Vibro-Acoustics, Vibron, Vibra-Sil Inc., Vimco, VAW.

2.6 Hangers

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

.6 Performance: as indicated.

.7 Acceptable Materials: Kinetics, Korfund, Masdom VM, Mason, Vibro-Acoustics, Vibron, Vibra-Sil Inc., Vimco.

2.7 Acoustic Barriers For Anchors And Guides

.1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

.2 Acceptable Materials: Korfund, Vibro-Acoustics, Vibron, Kinetics, Mason.

2.8 Horizontal Thrust Restraint

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.

.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

.3 Acceptable Materials: Kinetics, Korfund, Masdom VM, Mason, Vibro-Acoustics, Vibron, Vibra-Sil Inc., Vimco.

2.9 Structural Bases

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 25 mm minimum.

.4 Acceptable Materials: Vibro-Acoustics, Vibron, Kinetics, Mason, Korfund.

2.10 Inertia Base

.1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gussetted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.

.2 Pump bases: "T" shaped, where applicable, to provide support for elbows.

.3 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

.4 Acceptable Materials: Korfund, Masdom VM, Mason, Vibro-Acoustics, Vibron, Kinetics.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Seismic control measures to meet requirements of NBC.

.2 Install vibration isolation equipment in accordance with manufacturer’s instructions and adjust mountings to level equipment.

.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
- .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.
- .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.5 Where isolation is bolted to floor use vibration isolation rubber washers.

.6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 Field Quality Control

.1 Manufacturer's Field Services:
- .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
- .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
  - .1 After delivery and storage of Products.
  - .2 After preparatory work is complete but before installation commences.
  - .3 Twice during the installation, at 25% and 60% completion stages.
  - .4 Upon completion of installation.
- .3 Submit manufacturer's reports to Consultant within 3 days of manufacturer representative's review.

.4 Make adjustments and corrections in accordance with written report.

.2 Inspection and Certification:

.1 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).

.2 Submit complete report of test results including sound curves.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 Common Work Results – Mechanical.

1.2 References

.1 Canadian Gas Association (CGA):
- .1 CSA/CGA B149.1-10, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
- .2 CAN/CGSB-24.3-92, Identification of Piping Systems.

.3 Canadian Standards Association (CSA):
- .1 CSA B128.1-06 – Non Potable Water Systems

.4 National Fire Protection Association (NFPA):
- .1 NFPA 13 - Standard for the Installation of Sprinkler Systems..

.5 National Fire Code of Canada.

1.3 Submittals

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures and Section 21 05 01 Common Work Results – Mechanical.

.2 Provide list of abbreviations for pipe and duct labeling in shop drawing submittal.

.3 Provide pipe banding colour in shop drawing submittal.

.4 Submit valve tag list for review prior to installing tags.

2 Products

2.1 Manufacturer's Equipment Nameplates

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:
- .1 Equipment: manufacturer's name, model, size, serial number, capacity.
- .2 Motor: voltage, Hz, phase, power factor, duty, frame size, efficiency.

2.2 Existing Identification Systems

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, submit identification system for review.

2.3 Nameplate Construction

.1 Lamicoid
- .1 3 mm thick laminated plastic matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .2 Use maximum of 25 letters/numbers per line.

.2 Brass Tags
- .1 Brass tags to be made of 18 ga brass.
- .2 Tags to be round or rectangular with rounded corners.
- .3 Attach to valves / equipment with chain.

2.4 Piping Systems Governed By Codes

.1 Natural gas: to CSA/CGA B149.1.

.2 Sprinklers: to NFPA 13.

2.5 Piping Systems

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows.

.2 Where background colour marking does not cover full circumference of pipe provide full circumference banding at both ends of identifier.

.3 Background colour to be full length of pipe identifier.

.4 Identification of pipe to include Pictograms where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.

.5 Use block capital letters 50 mm high for pipes of 75 mm nominal and larger o.d. including insulation and not less than 19 mm high for smaller diameters.

.6 Arrows showing direction of flow:
- .1 OD of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
- .2 OD of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
- .3 Use double-headed arrows where flow is reversible.
- .4 Pre-manufactured banding incorporating arrows is acceptable.

.7 Materials for background colour marking, legend, arrows:
- .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
- .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
- .3 Waterproof and Heat Resistant Pressure Sensitive Plastic Marker Tags: for pipes and tubing 19 mm nominal and smaller.
- .4 Acceptable Materials: SMS Coilmark, W.H. Brady Inc., Seton Name Plate Corp..

.8 Stencilled Identification:

.1 As an alternate to manufactured pipe markers identification may be stencilled on pipe except PVC piping using a first quality oil base paint and colour bands. Colored bands to be installed at each end of idfentification. Letters shall be a minimum of 50 mm high. Text to be black.

.2 Have a small sample of stenciled identification (at least one (1) of each service) reviewed by engineer prior to identifying pipework.

.9 Outdoor Pipe:

.1 Use stenciled identification on aluminum jacket.

.2 Provide waterproof colored adhesive banding suitable for temperatures below -30 deg C at each end of identification. Banding to wrap around pipe and lap itself.

.3 Gas / Propane pipe painted yellow need not be identified.

.10 Colours and Legends:

.1 All pipes to be identified. Where not listed, obtain direction from Consultant.

.2 Colours for legends, arrows: to following table:

Background Colour	Text and Arrows
Black	White
Black/White	White/Black
Green	White
Grey	Black
Light Grey	Black
Light Blue	White
Purple	White
Red	White
Black / White Striped	Black
White (Oxygen)	Green
White (Others)	Black
Yellow	Black

.3 Background colour marking and legends for piping systems:

Contents	Banding	Background Colour Marking	Legend
Plumbing			
Coil Condensate Drain	Green	Green	COND
Domestic hot water supply	Green	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	Green	DOM. HW CIRC
Domestic cold water supply	Green	Green	DOM. CW SUPPLY
Tempered Water Supply	Green	Green	TEMPERED WATER (## Deg C)

Contents	Banding	Background Colour Marking	Legend
Plumbing Vent	Green	Green	VENT
Sanitary Sewer	Green	Green	SAN
Heating / Cooling			
Chilled water return	Light Blue	Light Blue	CH. WTR. RETURN
Chilled water supply	Light Blue	Light Blue	CH. WTR. SUPPLY
Condenser water supply	Purple	Purple	COND. WTR. SUPPLY
Condenser water return	Purple	Purple	COND. WTR. RETURN
Glycol Heating Supply	Black/Yellow	Yellow	GLY. HEAT SUPPLY
Glycol Heating Return	Black/Yellow	Yellow	GLY. HEAT RETURN
Glycol Heat Reclaim Supply	Black/Yellow	Yellow	GLY. HR SUPPLY
Glycol Heat Reclaim Return	Black/Yellow	Yellow	GLY. HR RETURN
Hot water heating supply	Black/Yellow	Yellow	HEATING SUPPLY
Hot water heating return	Black/Yellow	Yellow	HEATING RETURN
Hot Water Reheat Coil Supply	Black/Yellow	Yellow	HW REHEAT SUPPLY
Hot Water Reheat Coil Supply	Black/Yellow	Yellow	HW REHEAT RETURN
Make-up water	Green	Green	MAKE-UP WTR
Boiler feed water	Green	Green	BLR. FEED WTR
Steam ___kPa	Black/Yellow	Yellow	___ kPa STEAM
Steam condensate (gravity)	Black/Yellow	Yellow	ST.COND.RET (GRAVITY)
Steam condensate (pumped)	Black/Yellow	Yellow	ST.COND.RET (PUMPED)
Safety valve vent	Black/Yellow	Yellow	STEAM VENT
Fire Protection			
Kitchen Hood System		See appropriate Fire Protection Specification section	
Sprinkler System	Red/White	White	FIRE
Standpipe System	Red/White	White	STANDPIPE
Fuels and Engine			
Natural gas	Yellow	Yellow	NAT GAS
Gas regulator vents	Yellow	to Codes	
Refrigeration			
Refrigeration suction	Black/Yellow	Yellow	REF. SUCTION (R-###)
Refrigeration liquid	Black/Yellow	Yellow	REF. LIQUID (R-###)
Refrigeration hot gas	Black/Yellow	Yellow	REF. HOT GAS (R ###)

.7 Exposed Ceilings Painted Black

.1 Pipe identification to be consist of a grey band at each end of the identification, grey directional arrows, and the service written in grey.

2.6 <u>Ductwork Systems</u>

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

.3 Where the ductwork and exposed ceiling is painted black use grey letters and grey directional arrows.

.4 Rooftop exterior ductwork to be identified. Exterior ductwork running along the sides of buildings is not to be identified.

2.7 Valves and Controllers

.1 Brass tags with 12 mm stamped identification data filled with black paint or black lamicoid tags with 12 mm high white letters.

.2 Follow the existing Valve Tagging System Currently in use by the Owner

.3 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

.4 Where access doors are provided for valves provide lamicoid mechanically fastened to door identifying valve service. Where not listed in table below seek clarification from consultant.

Service	Identification
Elevator / Elevator Pit Sprinkler shut off valve	Red lamicoid, White letters 6 mm high – "ELEVATOR SPRINKLER SYSTEM'
Gas Shut-off valves	Red lamicoid, White letters 6 mm high – "GAS SHUT-OFF VALVE'

.5 Chain operated valves to have chain threaded through a 10" long 1 ½" dia PVC pipe section with the direction for opening (or closing) the valve clearly indicated with the word 'Open' (or 'Close') accompanied with arrows. Color of text and arrows to match pipe identification color. Burrs to be files from cut ends of pipe.

2.8 Controls Components Identification

.1 In addition to other identification specified in this section the following requirements apply.

.1 Identify all field devices (valve, damper, temperature sensors, etc) with plastic encased cards attached with a chain. Lettering on card to be a minimum of 4 mm high and to include the EMCS point name, point address and failsafe position (if applicable).

.2 EMCS cabinet associated with these devices to include a list of all device point name and point address for each device.

.3 Room temperature sensors to have identification specified above attached with adhesive.

.4 Room humidity and temperature sensors to be provided without manufacturer's name visible

.5 Provide warning sign at all motors and fans under remote EMCS control. Sign to be Red lamicoid with White 19 mm high letters and be attached to equipment or wall near equipment. Sign to read, " CAUTION : EQUIPMENT UNDER REMOTE CONTROL OF EMCS AND MAY START AT ANY TIME"

.2 Wiring:
- .1 Provide numbered tape markings on wiring at panels, junction boxes, and devices.
- .2 Use colour coded wiring throughout.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.
- .4 Control system wiring conduit to be identified by painting couplings Red / White.
- .5 Pull and Junction Boxes
  - .1 Coloured inside and out red and white.
  - .2 Ensure a clearly defined diagonal line from corner to corner of box cover plate separated the two (2) colors.
  - .3 Apply coloring prior to installation.

.3 Pneumatic Tubing:
- .1 Provide numbered tape markings on tubing to provide uninterrupted tracing capability.

2.9 Ceiling Mounted Equipment

.1 Where valves, dampers, fans, VAV boxes, and other mechanical equipment are installed above accessible ceilings, identification in accordance with the tables below. Underceiling identification shall be installed on the ceiling T-Bar spline or Access door frame directly below the access to the equipment. Adhesive discs shall be 19 mm diameter, white or black center disc (if necessary) to be 6 mm diameter. Letters on underceiling lamicoids to be 6 mm high unless noted otherwise. Letters on equipment lamicoids to be 12 mm high unless noted otherwise In no case shall a valve or box be installed in a ceiling space that is not considered accessible unless a proper access hatch is provided by the appropriate Trade Contractor.

.2 Where multiple similar devices are accessed through the same tile or access door only one (1) adhesive disc of each color is needed. If the device is identified with a lamicoid but no unique number only one (1) lamicoid is required stating the device and the quantity (ie 3 Fire Dampers)

.3 Provide framed legend of colour coding used and mount in the main Mechanical Room. Include a copy of legend in each of the Operation and Maintenance Manuals.

.4 Underceiling Identification Table

Service	Identification
DHW Recirculation Pump	Green Adhesive Disc and White lamicoid, Black letters with pump identification
Plumbing System Valves	Green Adhesive Disc
Natural Gas System Valves	
DHW Mixing Valves	Green Adhesive Disc and White lamicoid, Black letters with 'DHW Mixing Valve'
Trap Primer	Green Adhesive Disc and White lamicoid, Black letters with 'Trap Primer'
Water Hammer Arrestor	Green Adhesive Disc
Heating System Valves	Yellow Adhesive Disc with Black center
Chilled Water System Valves	Yellow Adhesive Disc with Black center
Sprinkler System Valves	Red lamicoid, with White letters
Fire Protection System Components	Red lamicoid, White letters identifying equipment (eg 'Auxiliary Drain', 'Zone Valve')
Back Draft Dampers	Blue Adhesive Disc
Balancing Dampers	Blue Adhesive Disc
Duct Access Doors	Blue Adhesive Disc
Fan Coil Units / Heat Pumps / Fans	White lamicoid, Black letters with unit identifier (eg FC-##)
Fire Dampers	Red lamicoid, White letters identifying equipment (eg 'Fire Dampers')
Heating / Cooling Coil	Yellow Adhesive Disc with Black center and White lamicoid, Black letters with coil identifier (eg HC-##)
Humidifier	Yellow Adhesive Disc with Black center and White lamicoid, Black letters with unit identifier (eg H-##)
Operating Dampers	See Section 23 05 54
VAV Box Air terminal unit	Blue Adhesive Disc and White lamicoid, Black letters with unit identifier (eg 'AV-##').
EMCS / Control Devices	Red Adhesive Disc with White center
EMCS System Transformers	White lamicoid, Black letters with unit identifier (eg EMCS Transformer)

.5 Ceiling Mounted Equipment Identification Table

Service	Identification
DHW Recirculation Pump	White lamicoid, Black letters with pump identification
Plumbing System Valves	Valve Tags
Natural Gas System Valves	Valve Tags
DHW Mixing Valves	Valve Tags

Trap Primer	White lamicoid, Black letters with 'Trap Primer'
Water Hammer Arrestor	None
Heating System Valves	Valve Tags
Chilled Water System Valves	Valve Tags
Sprinkler System Valves	Red lamicoid valve tag with White letters
Fire Protection System Components	Red lamicoid, White letters identifying equipment (eg 'Zone Valve")
Back Draft Dampers	Blue Adhesive Disc
Balancing Dampers	Spray paint damper handle blue
Fan Coil Units / Heat Pumps / Fans	White lamicoid, black letters with unit identifier (eg FC-##)
Fire Dampers	Red lamicoid, White 6 mm high letters identifying equipment (eg 'Fire Dampers')
Heating / Cooling Coil	White lamicoid, Black letters with coil identifier (eg HC-##)
Humidifier	White lamicoid, Black letters with unit identifier (eg H-##)
Operating Dampers	See Section 23 05 54
VAV Box / Air terminal unit	White lamicoid, Black letters with unit identifier (eg 'AV-##').
EMCS Devices	See Control System Identification Section above
EMCS System Transformer	White lamicoid, Black letters with unit identifier (eg EMCS Transformer ### V – ## V)

.6 Lamicoid plates to be attached to splines, access door frames, and equipment with two (2) rivets each.

2.10 <u>Equipment In Cabinets And Concealed Behind Walls</u>

.1 All Mechanical equipment (Trap Primers, Shut-Off Valves, Infloor Heat Headers, etc.) accessed through access door in walls or concealed in cabinets to be identified and to have identification on the access door. Where not listed in table below seek clarification from Consultant.

.2 All EMCS panels to be identified on door.

.3 Lamicoids to be mechanically fastened to access doors / panels. Tags to be attached to valves equipment with chains or rivits.

.4 Access door / panel identification letters to be 6 mm high unless noted otherwise.

.5 Equipment label letters to be 12 mm high unless noted otherwise.

.6 Where multiple devices such as fire dampers or valves that do not require unique identification are behind an access door / panel a single identifier may be used on the access point. Each device, however, must be labeled.

.7 Access door / Panel Identification:

Service	Identification
Elevator / Elevator Pit Sprinkler shut off valve	Red lamicoid, White letters – "ELEVATOR SPRINKLER SYSTEM'
EMCS Panels	White lamicoid, Black letters, 6 mm high
Fire Damper	Red lamicoid, White letters – "FIRE DAMPER'
Gas Shut-off valves	Red lamicoid, White letters – "GAS SHUT-OFF VALVE'
Infloor Heat Header	White lamicoid, Black letters – "INFLOOR HEAT HEADER - ##'
Kitchen Hood Fire Suppression System	Red lamicoid, White letters – "KITCHEN HOOD FIRE SUPRESSION'
Plumbing Cleanout	None
Plumbing System Drain Valve	White lamicoid, Black letters – "DRAIN''

.8 Equipment Identification:

Service	Identification
Fire Damper	Red lamicoid, White letters 6 mm high – "FIRE DAMPER'
Gas Shut-off valves	Valve Tag
Infloor Heat Header	White lamicoid, Black letters – "INFLOOR HEAT HEADER - ##'
Kitchen Hood Fire Suppression System	None
Plumbing Cleanout	None
Plumbing System Drain Valve	Valve Tag

2.11 Equipment

.1 Identify Mechanical equipment (Compressors, Refrigerated Air Dryers, DHW Tanks, Pumps, Air Handling Units, Expansion Tanks, Heat Exchangers, chilled beams, etc.) with lamicoid plates attached to equipment with chain or minimum of two (2) rivits.

.2 All equipment to be identified using identification used in contract documents. Where not listed, obtain direction from Consultant.

.3 Identification to be visible by an individual standing on the floor.

.4 Identification label lettering to be 25 mm high unless noted otherwise.

.5 Equipment Identification

Service	Identification
Common Items	
Thermometers / Pressure Gauges	None
DHW Heater / Tank	Black lamicoid, White letters with unit identifier (eg T-##)
DHW Expansion Tank	Black lamicoid, White letters with unit identifier (eg ET-##)
Plumbing Fixtures	None
Pressure Regulator	Valve Tag
Pump	Black lamicoid, White letters with unit identifier (eg P-##)
Trap Primer	Black lamicoid, White letters with unit identifier (eg TP-##)
Water Treatment System	Black lamicoid, White letters with unit identifier (eg WT-##)
Sprinkler System Components	To NFPA 13, 14, 20 and Sections 21 13 13, 21 13, 14, and 21 30 00
Hydronic Systems	
Air Separator	None
Boiler	Black lamicoid, White letters with unit identifier (eg B-##)
Cabinet Unit Heater	Black lamicoid, white letters 6 mm high with unit identifier (eg “CUH-X’) in lower corner of unit.
Chemical Treatment Tank	Black lamicoid, White letters with unit identifier (eg T-##)
Condensate Meter	Black lamicoid, White letters attached with chain with unit identifier (eg CM)
Condensate Receiver	Black lamicoid, White letters attached with chain with unit identifier (eg CR-XX)
Expansion Tank	Black lamicoid, White letters with unit identifier (eg ET-##) attached to insulation jacket near nameplate.
Fin Tube Radiation	None
Force Flow Heaters	Black lamicoid, white letters 6 mm high with unit identifier (eg “CUH-X’) in lower corner of unit.
Glycol Fill Package	Black lamicoid, White letters with unit identifier (eg G-##)
Heat Exchanger	Black lamicoid, White letters with unit identifier (eg ET-##) attached to insulation jacket near nameplate.
Heat Pump	Black lamicoid, White letters with unit identifier (eg HP-##)
Heating Specialties	None
Heat / Cool Coils in ducts	Black lamicoid, White letters with unit identifier (eg RH-##)

Infloor Heat Header	Black lamicoid, White letters attached with unit identifier (eg INFL-XX)
Reheat Coil	Black lamicoid, White letters with unit identifier (eg RH-##)
Steam Meter	Black lamicoid, White letters attached with chain with unit identifier (eg SM)
Steam Trap	Brass tag, punched attached with chain. Each unit to have unique identifier (eg ST-XX)
Unit Heater	None
Ventilation	
Air Handling Units	Black lamicoid, White letters with unit identifier (eg AHU-##)
Energy Recovery Ventilators	Black lamicoid, White letters with unit identifier (eg ERV-##)
Fans	Black lamicoid, White letters with unit identifier (eg EF-##)
Filter Gauges	None
Grilles, Registers, and Diffusers	None
Heat Pumps	Black lamicoid, White letters with unit identifier (eg HP-##)
Heat Recovery Ventilators	Black lamicoid, White letters with unit identifier (eg HRV-##)
Humidifier	Black lamicoid, White letters with unit identifier (eg H-##)
Louvers	None
Rooftop Gooseneck / Hood	Black lamicoid, White letters with unit identifier (eg LP-##) where unit has been called up uniquely on drawings.
Silencer	Black lamicoid, White letters with unit identifier (eg SL-##)
Split System AC / HP	Black lamicoid, White letters with unit identifier (eg AC-##). Tags to be on both evaporator and condenser.
VAV Box	Black lamicoid, White letters with unit identifier (eg VAV-##)

2.12 Other Identification

1. Emergency Fuel Shut-off
   - .1 Provide red lamicoid sign with white letters stating “GAS SHUT OFF” fastened to wall adjacent to each emergency fuel shut off valve..
   - .2 In Mechanical and Service Rooms lettering to be 25 mm high.
   - .3 In Kitchens lettering to be 12 mm high

2.13 Language

1. Identification to be in English.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Timing

.1 Provide identification only after painting specified Section 09 91 23 - Interior Painting has been completed.

3.3 Existing Panels And Identification

.1 Correct existing nameplates and legends to reflect changes made during Work.

3.4 Nameplates

.1 Install in conspicuous location to facilitate easy reading and identification from operating floor.

.2 Provide standoffs for nameplates on hot and/or insulated surfaces.

.3 Do not paint, insulate or cover.

3.5 Location Of Identification On Piping And Ductwork Systems

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 50’ intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.10 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

.11 Maximum distance between non potable pipe identification to be 1500 mm.

3.6 Valves, Controllers

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Engineer. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results, Mechanical.

1.2 Qualifications Of Tab Personnel

.1 Submit names of TAB sub contractor to Consultant within 90 days of award of contract.

.2 Upon request provide documentation confirming qualifications, successful experience.

.3 TAB: performed in accordance with the requirements of industry standards, such as:

- .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
- .2 National Environmental Balancing Bureau (NEBB), TABB Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

- .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
- .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 Purpose Of TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 Exceptions

.1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 Co-Ordination

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently, where interlocked with other systems, in unison with those systems.

1.6 Pre-Tab Review

.1 Review contract documents before project construction is started and confirm in writing to Consultant adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Consultant in writing proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 Start-Up

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 Operation Of Systems During TAB

.1 Operate systems for length of time required for TAB and as required by Consultant for verification of TAB reports.

1.9 Start Of TAB

.1 Notify Consultant 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed including:
- .1 Installation of ceilings, doors, windows, other construction affecting TAB.
- .2 Application of weather-stripping, sealing, and caulking.
- .3 Pressure, leakage, other tests specified elsewhere Division 23.
- .4 Provisions for TAB installed and operational.

.5 Start-up, verification for proper, normal / safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
- .1 Proper thermal overload protection in place for electrical equipment.
- .2 Air systems:
  - .1 Filters in place, clean.
  - .2 Duct systems clean.
  - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
  - .4 Correct fan rotation.
  - .5 Fire, smoke, volume control dampers installed and open.
  - .6 Coil fins combed, clean.
  - .7 Access doors, installed, closed.
  - .8 Outlets installed, volume control dampers open.
- .3 Liquid systems:
  - .1 Flushed, filled, vented.
  - .2 Correct pump rotation.
  - .3 Strainers in place, baskets clean.
  - .4 Isolating and balancing valves installed, open.
  - .5 Calibrated balancing valves installed, at factory settings.
  - .6 Chemical treatment systems complete, operational.

1.10 Application Tolerances

.1 Do TAB to following tolerances of design values:
- .1 Other HVAC systems: plus 5 %, minus 5 %.
- .2 Hydronic systems: plus or minus 10 %.

1.11 Accuracy Tolerances

.1 Measured values accurate to within plus or minus 2 % of actual values.

1.12 Instruments

.1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

1.13 Submittals

.1 Submit to consultant, prior to commencement of TAB:
- .1 Proposed methodology and procedures for performing TAB if different from referenced standard.
- .2 List of instruments to be used including certificate of calibration.

.2 Preliminary TAB Report to include:
- .1 Details of instruments used.
- .2 Details of TAB procedures employed.
- .3 Calculations procedures.
- .4 Summaries.

.3 TAB Report
- .1 Format in accordance with referenced standard.
- .2 TAB report to show results using units used on contract documents.

.3 Include measured voltages and current draw for each phase of 3 phase motors.
.3 Include system schematics.
.4 Final report to be submitted in *.pdf format, in English, and be indexed.

1.14 Verification

.1 Reported results subject to verification Owner and / or Consultant.

.2 Provide personnel and instrumentation to verify up to 30 % of reported results.

.3 Number and location of verified results as directed by Owner and / or Consultant.

.4 Pay costs to repeat TAB as required to satisfaction Owner and / or Consultant.

1.15 Settings

.1 After TAB is completed to satisfaction of Consultant, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.16 Completion Of TAB

.1 TAB considered complete when final TAB Report received and approved by Consultant.

1.17 Air Systems

.1 Standard: TAB to most stringent of this section or TAB standards of AABC.

.2 Qualifications: personnel performing TAB qualified to standards of AABC or NEBB.

.3 Quality assurance: perform TAB under direction of supervisor qualified by to standards of AABC or NEBB.

.4 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.5 Locations of equipment measurements: to include as appropriate:
.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
.2 At controllers, controlled device.

.6 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.18 Other TAB Requirements

.1 Zone pressure differences:

.1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with systems in every possible combinations of normal operating modes.

.2 Measure and report the pressure difference between the room and adjoining spaces (with doors closed) for Housekeeping / Janitor's Rooms.

1.19 Post-Occupancy TAB

.1 Measure DBT, WBT (or %RH), air velocity, air flow patterns, NC levels, in occupied zone of following areas:

.2 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of Warranty Period.

2 Products

2.1 Balancing

.1 Acceptable Contractors: Griffin Air Balance, Scan Air Balance, Scotia Air Balance 1996 Limited, Source Management Ltd., Systems Balance 2006 Limited, BABS.

3 Execution

NOT USED

END OF SECTION

1 General

1.1 Related Sections

.1 Related Sections:
- .1 Section 21 05 01 – Common Work Results - Mechanical.
- .2 Section 23 05 93 – Testing, Adjusting, and Balancing.
- .3 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa.
- .4 Section 23 31 13.02 – Metal Ducts – High Pressure to 2500 Pa.

1.2 References

.1 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
- .1 SMACNA HVAC Air Duct Leakage Test Manual, 1985.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
- .1 Submit proposed report form and test report format to Consultant for approval at least three (3) months before proposed date of first series of tests. Do not start tests until Consultant's review is complete.
- .2 Prepare draft report of results and submit to (Departmental Representative) (Engineer) (Consultant) within five (5) days of completion of tests. Include:
  - .1 Schematic of entire system.
  - .2 Schematic of section under test showing test site.
  - .3 Required and achieved static pressures.
  - .4 Orifice differential pressure at test sites.
  - .5 Permissible and actual leakage flow rate (L/s) for test sites.
  - .6 Witnessed certification of results.
- .3 Include test reports in final TAB report.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's field reports specified.

2 Products

2.1 Test Instruments

.1 Test apparatus to include:
- .1 Fan capable of producing required static pressure.
- .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
- .3 Flow measuring instrument compatible with the orifice plate.

.4 Calibration curves for orifice plates used.
.5 Flexible duct for connecting to ductwork under test.
.6 Smoke bombs for visual inspections.

.2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.

.3 Submit details of test instruments to be used to Consultant at least 10 days before anticipated test date.

.4 Test instruments: calibrated and certificate of calibration deposited with Consultant with report.

.5 Re-calibrate test apparatus every six months or less.

2.2 Equipment Leakage Tolerances

.1 Equipment / system components such as VAV boxes, duct heating leakage: 2 %.

2.3 Acceptable Contractors

.1 Griffin Air Balance, Scan Air Balance, Scotia Air Balance 1996 Limited, Source Management Ltd., Systems Balance 2006 Limited, BABS.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Test Procedures

.1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.

.1 Section of duct to be tested to include fittings, branch ducts, and tap-ins.

.2 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.

.3 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.

.4 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.3 Site Tolerances

.1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.

.2 Leakage tests on following systems not to exceed specified leakage rates.

.1 Small duct systems up to 250 Pa: leakage 2%.
.2 VAV box and duct on downstream side of VAV box: leakage 2%.
.3 Large low pressure duct systems up to 500 Pa: leakage 2%.
.4 HP duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: leakage 1.

.3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 Testing

.1 Test ducts before installation of insulation or other forms of concealment.

.2 Test after seals have cured.

.3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

.4 Flexible connections to VAV boxes.

.5 Fabric ducts need not be tested.

3.5 Field Quality Control

.1 Manufacturer's Field Services.
.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.
.2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
.3 Schedule site visits, to review Work, at stages listed:
.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
.2 Twice during progress of Work at 25% and 60% complete.
.3 Upon completion of the Work, after cleaning is carried out.
.4 Obtain reports, within 3 days of review, and submit, immediately, to Consultant.

.2 Performance Verification:
.1 Provide Consultant 5 days notice of tests and the option to witness tests.

END OF SECTION

1 General

1.1 Related Requirements

.1 Section 21 05 01 - Common Work Results – Mechanical.
.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 References

.1 Reference Standards:
  .1 ANSI/ASHRAE/IESNA 90.1-04, Energy Standard for Buildings Except Low-Rise Residential Buildings.
  .2 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  .3 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
  .4 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  .5 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  .6 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
  .7 ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  .8 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  .9 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  .10 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  .11 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  .12 GSES Standard GS-36-00, Commercial Adhesives.
  .13 TIAC: National Insulation Standards (2005).
  .14 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  .15 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

1.4 Definitions

.1 For purposes of this section:
  .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  .2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC codes:
  .1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish..

1.5 Acceptable Insulation Subcontractors

.1 Guilfords (2000) Inc., Insul-Energy, Scotia Insulations Ltd, Twin City Insulation, Zink's Mechanical Insulation Ltd., Pro-Insul Ltd.; Insul-Energy Ltd.

2 Products

2.1 Fire And Smoke Rating

.1 Flame Spread and Smoke Development shall be as follows:
- .1 Maximum flame spread rating: 25.
- .2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with/without (as per schedule in section 3) factory applied vapour retarder jacket to CGSB 51-GP-52Ma.

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with/without (as per schedule in section 3)factory applied vapour retarder jacket to CGSB 51-GP-52Ma..
- .1 Mineral fibre: to ASTM C553.
- .2 Jacket: to CGSB 51-GP-52Ma.
- .3 Maximum "k" factor: to ASTM C553.

.5 Acceptable Materials: Certainteed, Roxul, Owens Corning, Manson, Knauf, Johns Manville

2.3 Jackets

.1 Canvas:
- .1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.
- .1 Maximum VOC limit 100 g/L

.3 Aluminum:
- .1 To ASTM B209 with and without moisture barrier as per PART 3.
- .2 Indoor Application : 0.40 mm Stucco Embossed sheet with 12 mm wide type 304, 0.25 mm thick stainless steel banding.
- .3 Outdoor Application:
  - .1 0.50 mm Stucco Embossed sheet with 19 mm wide type 304, 0.50 mm thick stainless steel banding.

.2 Joining: Longitudinal and circumferential slip joints with 25 mm laps.
.3 Fittings: 0.50 mm thick die-shaped fitting covers with factory-attached protective liner.
.4 Seal joints and make watertight.

2.3 Accessories

.1 Maximum VOC limit for all adhesives : 100 g/L.

.2 Vapour retarder lap adhesive:
.1 Water based, fire retardant type, compatible with insulation.
.1 Acceptable Materials: Permastik 2001, Sealfast 30.36.

.3 Indoor Vapour Retarder Finish:
.1 Vinyl emulsion type acrylic, compatible with insulation.
.2 Acceptable Materials: Benjamin Foster 82-07 or Flintkote 230-04.

.4 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.5 Outdoor Vapour Retarder Mastic:
.1 Vinyl emulsion type acrylic, compatible with insulation.
.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

.6 Tape: self-adhesive, aluminum backed, 50 mm wide minimum.

.7 Tie wire: 1.5 mm stainless steel.

.8 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on both faces of insulation.

.9 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

3 Execution

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Pre-Installation Requirements

.1 Pressure test ductwork systems complete, witnessed and certified.

.2 Ensure surfaces are clean, dry, free from foreign material.

3.3 Installation

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer's instructions and as indicated.

.3 Insulate ductwork as specified at end of this section. Include insulation of diffuser/register/grille boots and plenums as part of this section.

.4 Use staggered joints when multiple layers insulation installed.

.5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Ensure hangers, and supports are outside vapour retarder jacket.

.6 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
.1 Apply high compressive strength insulation, minimum 300 mm long, where insulation may be compressed by weight of ductwork.

.7 Fasteners: install at 8" on centre, minimum 2 rows each side.

.8 Insulation to run continuously when duct pass through non fire/smoke rated partitions.

.9 Use stand-offs for duct mounted control accessories.

.10 Adhere and seal vapour barrier using vapour seal adhesive.

.11 Seal and finish exposed ends of insulation with aluminum backed tape or insulating cement. No insulation to be left exposed.

.12 Bevel and finish edge of insulation at duct access doors, instrumentation, and other areas where duct access required.

.13 Insulation at instrumentation to be Provide removable insulation where access to duct necessary.

.14 Secure insulation with steel bands at 1000 mm on center before application of finish / jacket. Secure multi-layer insulation with wire or bands at 400 mm intervals minimum.

3.4 <u>Jackets</u>

.1 Indoor – Use Canvas and lagging on all ductwork exposed indoors.

.2 Outdoor – Use Aluminum on all ductwork installed exposed to weather.

.3 Locate seams of canvass jacketing inconspicuously. Locate seams of aluminum jacket on bottom of ducts.

.4 Cement: Apply over insulation in 2 – 6 mm thick layers reinforced by 25 mm mesh galvanized steel wire netting.

.5 Canvas: Sewn and pasted on to all insulation.

.6 Metal Jacket: provide minimum of 25 mm overlap, secure with stainless steel bands.

3.5 Cleaning

.1 Insulation sub-contractor to remove all garbage relating to the installation of their product from site including, but not limited to insulation scraps, tape backing, scraps of jackets, material containers, etc.

.2 Insulation sub-contractor to coordinate with the appropriate trade contractor to have splatter of lagging cleaned from other surfaces including but not limited to. equipment , pipe, duct, walls, structure, and floor.

.3 Insulation sub-contractor to coordinate with the appropriate trade contractor to repair or replace equipment damaged by splatter of lagging or the cleaning of the splatter.

.4 The final cleanup described in this section shall constitute no less than 10% of the progress billing for this sub-contractor.

3.6 Ductwork Insulation Schedule

.1 Insulation types, thicknesses, and finish: conform to following table:

	Shape	Location	Type	Vapour Barrier	Thickness / Min Rsi	Finish
Exhaust Air	rectangular	concealed	Flexible Mineral Fiber Blanket	No	25 mm / Rsi 0.58	Factory Finish
		exposed	Rigid Mineral Fiber Board	No	25 mm / Rsi 0.58	Canvass & Lagging
	round	concealed	Flexible Mineral Fiber Blanket	No	25 mm / Rsi 0.58	Factory Finish
		exposed	Flexible Mineral Fiber Blanket	No	25 mm / Rsi 0.58	Canvass & Lagging
Outdoor Air / Mixing Plenum	rectangular	concealed	Flexible Mineral Fiber Blanket	Yes	50 mm / Rsi 0.88	Factory Finish
		exposed	Rigid Mineral Fiber Board	Yes	50 mm / Rsi 0.88	Canvass & Lagging
Outdoor Air Ducts	rectangular	concealed	Flexible Mineral Fiber Blanket	Yes	50 mm / Rsi 0.88	Factory Finish
		exposed	Rigid Mineral Fiber Board	Yes	50 mm / Rsi 0.88	Canvass & Lagging
	round	concealed	Flexible Mineral Fiber Blanket	Yes	50 mm / Rsi 0.88	Factory Finish
		exposed	Flexible Mineral Fiber Blanket	Yes	50 mm / Rsi 0.88	Canvass & Lagging

	Shape	Location	Type	Vapour Barrier	Thickness / Min Rsi	Finish
Return Air Ducts			Uninsulated			
Supply Air Ducts T < 18 ºC	rectangular	concealed	Flexible Mineral Fiber Blanket	Yes	25 mm / Rsi 0.58	Factory Finish
		exposed	Rigid Mineral Fiber Board	Yes	25 mm / Rsi 0.58	Canvass & Lagging
	round	concealed	Flexible Mineral Fiber Blanket	Yes	25 mm / Rsi 0.58	Factory Finish
		exposed	Flexible Mineral Fiber Blanket	Yes	25 mm / Rsi 0.58	Canvass & Lagging
Supply Air Ducts 18 < T < 25 ºC			Uninsulated			
Supply Air Ducts (T > 25 ºC) (note 2)	rectangular	concealed	Flexible Mineral Fiber Blanket	Yes	25 mm / Rsi 0.58	Factory Finish
		exposed	Rigid Mineral Fiber Board	Yes	25 mm / Rsi 0.58	Canvass & Lagging
	round	concealed	Flexible Mineral Fiber Blanket	Yes	25 mm / Rsi 0.58	Factory Finish
		exposed	Flexible Mineral Fiber Blanket	Yes	25 mm / Rsi 0.58	Canvass & Lagging
Acoustically lined ducts			Uninsulated			

Note 1: Insulate E/A duct for lesser of 3000 mm from exterior penetration / between exterior penetration and motorized dampers.

Note 2: S/A ducts to be uninsulated when exposed in rooms in which they serve.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 20 05 01 - Common Work Results - Mechanical.

1.2 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
- .1 ANSI/ASHRAE 90.1-04-SI Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.:
- .1 ASTM C449/C449M-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .2 ASTM C533-07, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- .3 ASTM C547-07, Standard Specification for Mineral Fiber Pipe Insulation.
- .4 ASTM C553-02, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .5 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- .6 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .7 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB):
- .1 CGSB 51-GP-52MA-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .2 CAN/CGSB 51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts..

.4 Thermal Insulation Association of Canada (TIAC) National Insulation Standards 2005.

.5 Underwriters Laboratories of Canada (ULC):
- .1 CAN/ULC-S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

1.4 Definitions

.1 For purposes of this section:
- .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
- .2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC codes:
.1 CRF: Code Rectangular Finish.
.2 CPF: Code Piping Finish.

1.5 Acceptable Insulation Subcontractors

.1 Guilfords (2000) Inc., Insul-Energy, Scotia Insulations Ltd, Twin City Insulation, Zink's Mechanical Insulation Ltd., Pro-Insul Ltd.; Insul-Energy Ltd.

2 Products

2.1 Fire And Smoke Rating

.1 Fire and smoke ratings to CAN/ULC-S102:
.1 Maximum flame spread rating: 25.
.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre: includes glass fibre, rock wool, slag wool.
.1 Recycled content: (Post-Consumer + 1/2 Post-Industrial) in accordance with Section 01 35 21 - LEED Requirements.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
.1 Mineral fibre: ASTM C547.
.2 Maximum "k" factor: ASTM C547.

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
.1 Mineral fibre: ASTM C547.
.2 Jacket: to CGSB 51-GP-52MA.
.3 Maximum "k" factor: ASTM C547.

.5 TIAC Code C-1: rigid mineral fibre board, unfaced.
.1 Mineral fibre: ASTM C612.
.2 Maximum "k" factor: ASTM C612.

.6 TIAC Code C-4: rigid mineral fibre board faced with factory applied vapour retarder jacket.
.1 Mineral fibre: ASTM C612.
.2 Jacket: to CGSB 51-GP-52MA.
.3 Maximum "k" factor: ASTM C612.

.7 TIAC Code C-2: mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
.1 Mineral fibre: ASTM C553.
.2 Jacket: to CGSB 51-GP-52MA.
.3 Maximum "k" factor: ASTM C553.

.8 TIAC Code A.6: flexible unicellular tubular elastomer.
- .1 Insulation: with vapour retarder jacket.
- .2 Jacket: to CGSB 51-GP-52MA.
- .3 Maximum "k" factor.
- .4 Certified by manufacturer free of potential stress corrosion cracking corrodents.

.9 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
- .1 Insulation: ASTM C533.
- .2 Maximum "k" factor: ASTM C533.
- .3 Design to permit periodic removal and re-installation.

.10 Acceptable Matierials : Certainteed, Johns Manville, Knauf, Manson, Owens Corning, Roxul

2.3 Cement

.1 Thermal insulating and finish
- .1 To: ASTM C449/C449M.
- .2 Hydraulic setting or air drying on mineral wool, to ASTM C449.

2.4 Jackets

.1 Polyvinyl Chloride (PVC):
- .1 One-piece moulded type and sheet to CAN/CGSB 51.53 with pre-formed shapes as required.
- .2 Colours: to match adjacent finish paint selected by Consultant.
- .3 Minimum service temperatures: -20 degrees C.
- .4 Maximum service temperature: 65 degrees C.
- .5 Moisture vapour transmission: 0.02 perm.
- .6 Thickness: ___ mm.
- .7 Fastenings:
  - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
  - .2 Tacks.
  - .3 Pressure sensitive vinyl tape of matching colour.
- .8 Outdoor PVC to be UV rated material at least 0.5 mm thick.
- .9 Covering adhesive: compatible with insulation, Maximum VOC limit: 100 g/l.

.2 Canvas:
- .1 220 and 120 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: compatible with insulation.
  - .1 Maximum VOC limit: 100 g/L.
  - .2 Acceptable Materials: Alpha Moritea 3451-RW, Clairmont Deplay 60, S. Fattal Thermo-Canvas.

.3 Aluminum:
- .1 To ASTM B209.
- .2 Thickness: 0.50 mm sheet.

.3 Finish: stucco embossed.
.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

.4 Stainless steel:
.1 Type: 316.
.2 Thickness: 0.25 mm.
.3 Finish: stucco embossed.
.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.5 Insulation Securements

.1 Tape: self-adhesive, aluminum, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

2.6 Vapour Retarder Lap Adhesive

.1 Water based, fire retardant type, compatible with insulation. Maximum VOC limit: 100 g/L.

2.7 Indoor Vapour Retarder Finish

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 Outdoor Vapour Retarder Mastic

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

2.9 Mineral Fibre Insulation

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Ceramic fibre insulation shall be rated for a maximum service temperature of 480°C and have a linear shrinkage no greater than 2% after a 24 hour period at temperature.

.3 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335.

2.10 Glass Fibre Board

.1 To have a maximum operating temperature of 232°C and ULC flame spread rating of 15.

2.11 Equipment Below Ambient

.1 The insulation will be fibre glass duct insulation, rigid or flexible, manufactured from fine inorganic glass fibre bonded by a thermal setting resin.

.2 The facing for the insulation will consist of high intensity white, chemically-treated kraft paper, fibre glass yarn reinforced and aluminum foil, laminated together with a nonflammable adhesive.

.3 Johns Manville Faced 800 Series Spin-glass and Fibreglass Canada rigid vapour-seal or faced flexible duct insulation. Compliance with CGSB-51-GP-10 and CGSB-51-GP-11 (Type 1) Specifications.

2.12 Accessories

.1 Stainless steel wire, 18 gauge, Type 304, dead soft annealed.

.2 Galvanized wire, 16 gauge, annealed.

.3 Stainless steel mesh, hexagonal mesh, 20 gauge, Type 304.

.4 Galvanized mesh, hexagonal mesh, 16 gauge, galvanized annealed.

.5 Aluminum straps, will be ½" x 0.02".

.6 Stainless steel straps, will be ½" x 0.02", Type 304, dead soft.

.7 Lagging adhesive, will be Permastik 2001 or Sealfast 30.36.

.8 Vapour barrier mastic, will be Benjamin Foster 82-07 or Flintkote 230-04.

.9 Fasteners: 0.08" diameter pins with 1-1/4" diameter clips. Length of pins to suit thickness of insulation.

2.13 Acceptable Materials

.1 Products of the following manufacturers are acceptable: Bakor; CertainTeed Corp.; Owens Corning Canada LP; Johns Manville; Knauf Insulation.

3 Execution

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Pre- Installation Requirements

.1 Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 Installation

.1 Install in accordance with TIAC National Standards
- .1 Hot equipment: To TIAC code 1503-H.
- .2 Cold equipment: to TIAC code 1503-C.

.2 Elastomeric Insulation: to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.

.3 Provide vapour retarder as recommended by manufacturer.

.4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.

.5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes by locating hangers and supports outside vapour retarder jacket.

.7 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 Removable, Pre-Fabricated, Insulation And Enclosures

.1 Application: At expansion joints, valves, primary flow measuring elements, flanges and unions at equipment.

.2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

3.5 Cleaning

.1 Insulation sub-contractor to remove all garbage relating to the installation of their product from site including, but not limited to insulation scraps, tape backing, scraps of jackets, material containers, etc.

.2 Insulation sub-contractor to coordinate with the appropriate trade contractor to have splatter of lagging cleaned from other surfaces including but not limited to. equipment , pipe, duct, walls, structure, and floor.

.3 Insulation sub-contractor to coordinate with the appropriate trade contractor to repair or replace equipment damaged by splatter of lagging or the cleaning of the splatter.

.4 The final cleanup described in this section shall constitute no less than 10% of the progress billing for this sub-contractor.

3.6 Equipment Insulation Schedules

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

Equipment	Insulation	Thickness
Chilled Water Pumps	Removable Insulation Blanket	1"
Converters/Heat Exchangers	Fibreglass / Mineral Wool	2"
Condensate Pumping Traps	Fibreglass / Mineral Wool	2"
Condensate Receiver	Fibreglass / Mineral Wool	2"
DHW Recirculation Pumps	Removable Insulation Blanket	1"
Ductwork	See section 23 07 13	-
DHW Uninsulated Storage Tank	Fibreglass / Mineral Wool	1"
Plate and Frame Heat Exchangers	Removable Insulation Blanket	2"
Steam Pressure Reducing Station	Removable Insulation Blanket	2"
Expansion Tanks	Fibreglass / Mineral Wool	2"
Vortex Air Separators	Fibreglass / Mineral Wool	2"
Hot water & Glycol Heating Pumps	Removable Insulation Blanket	1"
Potable & Non Potable Domestic Water Backflow Preventors	Removable Insulation Blanket	1"
Water Meters	Removable Insulation Blanket	1 ½ "

.2 Hot Equipment:
- .1 TIAC code A-1 or C-1 with mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
- .2 TIAC code C-2 unfaced with wire or bands and 13 mm cement precede by one layer of reinforcing mesh.
- .3 Thicknesses:

.3 Cold equipment:
- .1 TIAC A-3 or C-4 with mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
- .2 TIAC C-2 faced with vapour retardant jacket and with wire or bands and ½" cement preceded by one layer of reinforcing mesh.
- .3 TIAC A-6 or C-4 with mechanical fastenings or wire or bands.
- .4 Thicknesses: chillers (except factory insulated) 2".

.4 Finishes:
- .1 Equipment in mechanical rooms: TIAC code CEF/1 with Canvass/ Lagging jacket.
- .2 Equipment elsewhere: TIAC code CEF/2 with ½" cement jacket.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.
.2 Section 23 05 05 – Installation of Pipework.

1.2 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
  .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM):
  .1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
  .2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  .3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  .5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
  .6 ASTM C547-2003, Mineral Fiber Pipe Insulation.
  .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB):
  .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Thermal Insulation Association of Canada (TIAC) National Insulation Standards 2005.

.5 Underwriters' Laboratories of Canada (ULC):
  .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
  .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings
  .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

1.4 Definitions

.1 For purposes of this section:
- .1 CONCEALED - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
- .2 EXPOSED - will mean "not concealed" as specified.
- .3 RUN-OUT(s) – piping, not exceeding 4000 mm long, to individual equipment

.2 TIAC codes:
- .1 CRF: Code Rectangular Finish.
- .2 CPF: Code Piping Finish.

1.5 Acceptable Pipe Insulation Contractors

.1 Guilfords (2000) Inc., Insul-Energy, Scotia Insulations Ltd, Twin City Insulation, Zink's Mechanical Insulation Ltd., Pro-Insul Ltd.; Insul-Energy Ltd.

2 Products

2.1 Fire And Smoke Rating

.1 Maximum flame spread rating: 25.
.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
- .1 Mineral fibre: to CAN/ULC-S702
- .2 Maximum "k" factor: to CAN/ULC-S702.

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
- .1 Mineral fibre: to CAN/ULC-S702.
- .2 Jacket: to CGSB 51-GP-52Ma.
- .3 Maximum "k" factor: to CAN/ULC-S702.

.5 TIAC Code C-2: mineral fibre blanket faced (with) (without) factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
- .1 Mineral fibre: to CAN/ULC-S702.
- .2 Jacket: to CGSB 51-GP-52Ma.
- .3 Maximum "k" factor: to CAN/ULC-S702.

.6 TIAC Code A-6: flexible unicellular tubular elastomer.
- .1 Insulation: with vapour retarder jacket.
- .2 Jacket: to CGSB 51-GP-52Ma.
- .3 Maximum "k" factor: 0.039 W/m-degC.
- .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

.7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
- .1 Insulation: to ASTM C533.
- .2 Maximum "k" factor: to 0.039 W/m-degC.
- .3 Design to permit periodic removal and re-installation.

.8 Acceptable Materials: Certainteed, Johns Manville, Knauf, Manson, Owens Corning, Roxul.

2.3 Insulation Securement

.1 Tape: self-adhesive, aluminum, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 Cement

.1 Thermal insulating and finishing cement:
- .1 Hydraulic setting or air drying on mineral wool, to ASTM C449/C449M.

2.5 Vapour Retarder Lap Adhesive

.1 Water based, fire retardant type, compatible with insulation.

2.6 Indoor Vapour Retarder Finish

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 Outdoor Vapour Retarder Finish

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m^2.

2.8 Jackets

.1 Polyvinyl Chloride (PVC):
- .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
- .2 Colours: to match adjacent finish paint by Consultant.
- .3 Minimum service temperatures: -20 degrees C.
- .4 Maximum service temperature: 65 degrees C.

.5 Moisture vapour transmission: 0.02 perm.
.6 Thickness: ___ mm.
.7 Fastenings:
.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
.2 Tacks.
.3 Pressure sensitive vinyl tape of matching colour.
.8 Outdoor Jackets to be UV rated material at least 0.5 mm thick.

.2 Canvas:
.1 220 and 120 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
.2 Lagging adhesive: compatible with insulation.

.3 Aluminum:
.1 To ASTM B209.
.2 Thickness: 0.50 mm sheet.
.3 Finish: stucco embossed.
.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

.4 Stainless steel:
.1 Type: 304.
.2 Thickness: 0.25 mm.
.3 Finish: stucco embossed.
.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
.7 Acceptable Materials: Alpha-Maritex 3451- RW, Clairmont Diplag 60, S. Fattal Thermocanvas

2.9 Weatherproof Caulking For Jackets Installed Outdoors

.1 Caulking to: Section 07 92 10 - Joint Sealing.

2.10 Mineral Fibre Insulation

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Pipe insulation will be preformed fibre with a nominal density of 5.5 lb/cu ft.

2.11 Calcium Silicate Insulation

.1 Calcium silicate insulation will be in block form having a density of 13.0 lb/ft3, a maximum linear shrinkage of 1.1% after a 24 hour period at 650oC and a maximum service temperature rating of 815oC.

2.12 Elastomeric Insulation

.1 Flexible elastomeric insulation may be used on domestic water piping in concealed spaces, 1½" and under - 5/16" thick, 2" and under 3" - ½" thick.

.2 Flexible elastomeric insulation, 5/16", shall be used on refrigerant piping, with an aluminum jacket where exposed to exterior weather conditions.

2.13 Acceptable Materials

.1 Elastomeric Insulation supported by the following manufacturers are acceptable:

.1 Armstrong, Tundra.

.2 Fiberglass Insulation supported by the following manufacturers are acceptable:

.1 Bakor; Owens Corning Canada LP; Johns Manville; Knauf Insulation.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Pre-Installation Requirement

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 Installation

.1 Install in accordance with TIAC National Standards.

.2 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes by installing hangers, supports outside vapour retarder jacket.

.4 At oversized hangers apply high compressive strength insulation suitable for service, buck-a-roos, or saddles. Provide insulation shields between insulation covering and hanger.

3.4 Removable, Pre-Fabricated, Insulation And Enclosures

.1 Application: at expansion joints, valves, primary flow measuring elements, strainers, flanges, and unions at equipment.

.2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:
- .1 Insulation, fastenings and finishes: same as system.
- .2 Jacket: high temperature fabric.

.4 Refrigerant piping (suction, liquid, discharge) shall be Armstrong AP Armaflex.

.5 Finishes:
- .1 Exposed indoors: PVC jacket.
- .2 Exposed in mechanical rooms: PVC jacket where the temperature is less than 65°C.
- .3 Concealed, indoors: insulation jacketed with PVC or removable blanket on valves, fittings. No further finish.
- .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
- .5 Outdoors: Water-proof Aluminum.
- .6 Finish attachments: SS bands, at 6" oc.
- .7 Installation: To appropriate TIAC code CRF/1 through CPF

3.5 Installation Of Elastomeric Insulation

.1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.

.2 Use the sealer recommended by manufacturer to join ends of insulation sections.

.3 Use Ca-Si insulation at pipe clamps so that insulation at pipe clamps is unbroken.

.4 Provide vapour retarder as recommended by manufacturer.

.5 Refrigeration liquid and suction line insulation to be unbroken between equipment.

3.6 Cleaning

.1 Insulation sub-contractor to remove all garbage relating to the installation of their product from site including, but not limited to insulation scraps, tape backing, scraps of jackets, material containers, etc.

.2 Insulation sub-contractor to coordinate with the appropriate trade contractor to have splatter of lagging cleaned from other surfaces including but not limited to. equipment , pipe, duct, walls, structure, and floor.

.3 Insulation sub-contractor to coordinate with the appropriate trade contractor to repair or replace equipment damaged by splatter of lagging or the cleaning of the splatter.

.4 The final cleanup described in this section shall constitute no less than 10% of the progress billing for this sub-contractor.

3.7 Piping Insulation Schedules

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 Thickness of insulation as listed in following table.

Application	Temp deg C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run out	to 1	1 ¼ to 2	2 ½ to 4	5 to 6	8 & over
Steam	< 175	A-1	38	50	65	75	90	90
Steam, Saturated and Super heated	> 175	A-1	38	65	65	75	90	90
Steam Condensate Return	60 - 94	A-1	25	38	38	38	38	38
Pumped Condensate return	< 94	A-1	25	38	38	38	38	38
Boiler Feed Water		A-1	25	25	25	25	25	25
Hot Water Heating	60 - 94	A-1	25	38	38	38	38	38
Hot Water Heating	< 59	A-1	25	25	25	25	38	38
Glycol Heating	60 - 94	A-1	25	38	38	38	38	38
Glycol Heating	< 59	A-1	25	25	25	25	38	38
Glycol Heat Reclaim	< 10		25	25	25	25	25	25
Glycol Heat Reclaim	10 - 30		Insulation not required					
Glycol Heat Reclaim	> 30		25	25	25	25	25	25
Potable/Non Potable Domestic HWS		A-1	25	25	25	38	38	38
Tempered Water	20 - 35		Insulation not required					
Domestic HW Recirculation								
Potable/non Potable Domestic CWS		A-3	25	25	25	25	25	25
Domestic CWS with vapour retarder		C-2	25	25	25	25	25	25
Chilled Water	4 - 13	A-3	25	25	25	25	25	25
Chilled Water or Glycol	< 4	A-3	25	25	38	38	38	38
Chilled Water Pump Casing		A-3	25	25	25	25	25	25
Condenser Water Outdoors			___	___	___	___	___	___
Condenser Water Indoors			___	___	___	___	___	___
Refrigerant	< 4	A-6	25	25	38	38	38	38
Refrigerant	4 - 13	A-6	25	25	38	25	25	25
Refrigerant	>13	A-6	25	25	38	38	38	38
Refrigerant Relief Pipe – note 1	All		25	25	25	25	25	25
Condensate Drain	< 10	C-2	25	25	25	25	25	25

Note 1 – Insulate pipe for 3000 mm prior to roof / exterior wall penetration
Note 2 – See detail on drawing
Note 3 - Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, and fittings unless noted on drawings.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 01 91 31 – Commissioning Plan.
.2 Section 21 05 01 – Common Work Results – Mechanical.

1.2 References

.1 American Society for Testing and Materials International (ASTM)
  .1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 Commissioning

.1 The work of this project is being Commissioned to the requirements of LEED. Provide documentation and assistance required by Commissioning Agent as documented elsewhere in the specification.

1.4 Hydronic Systems - Performance Verification (PV)

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

.2 When systems are operational, perform following tests:
  .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
  .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
    .1 Pump operation.
    .2 Boiler and/or chiller operation.
    .3 Pressure bypass open/closed.
    .4 Control pressure failure.
    .5 Maximum heating demand.
    .6 Maximum cooling demand.
    .7 Boiler and/or chiller failure.
    .8 Cooling tower (and/or industrial fluid cooler) fan failure.
    .9 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

1.5 Condenser Water And Humidification Systems

.1 In addition to procedures specified above, perform following:
  .1 Add chemicals as required.
  .2 Perform TAB as specified Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  .3 Set up and adjust drip feeders, timer controls, pump strokes as required to maintain required chemical feed rates.
  .4 Inject inhibitor into cooling tower sump.

1.6 Glycol Systems

.1 Test to prove concentration will prevent freezing to - 40 degrees C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

1.7 Steam Systems

.1 Performance verification:
- .1 When systems are operational, perform relevant tests of steam and condensate return piping systems as specified under hydronic systems.
- .2 Verify operation of components of steam system including:
  - .1 Steam traps by:
    - .1 Measuring temperature of condensate return and/or
    - .2 Using audio-sensing devices.
    - .3 Use of other approved methods.
  - .2 Flash tanks.
  - .3 Thermostatic vents.
- .3 Verify performance of condensation units, including:
  - .1 Pump capacity at design temperature.
  - .2 Controls.
- .4 Verify performance of condensate return system to ensure return of maximum quantity of condensate return water at with minimum temperature drop.
- .5 Adjust piping system as required to eliminate water hammer.

.2 Monitor system continuously until acceptance for proper operation of components including steam traps, thermostatic vents, flash tanks and condensate pumping units.

1.8 Gaseous Fuel Systems

.1 Operation tests:
- .1 Measure gas pressure at gas meter outlet and at burner manifold.
- .2 Verify settings, operation, venting of high and low pressure cut-outs, alarms.
- .3 Check terminals of vents for gas pressure regulators.

1.9 Potable Water Systems

.1 When cleaning is completed and system filled:
- .1 Verify performance of equipment and systems as specified elsewhere in Division 23.
- .2 Check for proper operation of water hammer arrestors. Run one outlet at each washroom group and in kitchen for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
- .3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

1.10 Sprinkler And Standpipe System

.1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 23 and Division 26.

.2 Verify operation of interlocks between HVAC systems and fire alarm systems.

1.11 Sanitary And Storm Drainage Systems

.1 Ensure that traps are fully and permanently primed.

.2 Ensure that fixtures are properly anchored, connected to system.

.3 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.

.4 Cleanouts: refer to Section 22 42 16 - Commercial Lavatories and Sinks.

1.12 Reports

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, supplemented as specified herein.

2 Products

NOT USED

3 Execution

NOT USED

END OF SECTION

1 General

1.1 Related Sections
.1 Section 21 05 01 – Common Work Results – Mechanical.

1.2 References
.1 American Society for Testing and Materials International (ASTM):
.1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 Submittals
.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 Cleaning Solutions
.1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.

.2 Sodium carbonate: 0.40 kg per 100 L water in system.

.3 Low-foaming detergent: 0.01 kg per 100 L water in system.

3 Execution

3.1 Manufacturer's Instructions
.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Cleaning Hydronic And Steam Systems
.1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:
.1 Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.

.4 Cleaning procedures:
.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
.1 Cleaning procedures, flow rates, elapsed time.
.2 Chemicals and concentrations used.
.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.
.5 Special precautions for protecting piping system materials and components.
.6 Complete analysis of water used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems:
.1 Systems: free from construction debris, dirt and other foreign material.
.2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
.3 Strainers: clean prior to initial fill.
.4 Install temporary filters on pumps not equipped with permanent filters.
.5 Install pressure gauges on strainers to detect plugging.

.6 Report on Completion of Cleaning:
.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Hydronic Systems:
.1 Fill system with water, ensure air is vented from system.
.2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).
.3 Use water metre to record volume of water in system to +/- 0.5%.
.4 Add chemicals under direct supervision of chemical treatment supplier.
.5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
.6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
.7 Add chemical solution to system.
.8 Establish circulation, raise temperature slowly to [maximum design] [82 degrees C minimum]. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

.8 Glycol Systems:
.1 In addition to procedures specified above perform specified procedures.
.2 Test to prove concentration will prevent freezing to minus 40 degrees C. Test inhibitor strength and include in procedural report. Refer to ASTM E202.

.9 Steam Systems: in addition to general requirements as specified above, perform following:
.1 Remove internal components of steam traps until flushing and warm-up have been completed.
.2 Open drip points to atmosphere. If needed for protection of personnel or environment, install flexible hose and direct discharge to safe location.

.3 Starting at drip point closest to source, verify removal of condensate, then re-install steam trap internal parts. Repeat sequence down the line.
.4 Water hammer: determine source and eliminate cause.

3.3 Start-Up Of Hydronic Systems

.1 After cleaning is completed and system is filled:
.1 Establish circulation and expansion tank level, set pressure controls.
.2 Ensure air is removed.
.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
.5 Clean out strainers repeatedly until system is clean.
.6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.
.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
.8 Repeat with water at design temperature.
.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
.10 Bring system up to design temperature and pressure slowly over a 48 hour period.
.11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
.12 Adjust pipe supports, hangers, springs as necessary.
.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
.14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
.15 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
.16 Check operation of drain valves.
.17 Adjust valve stem packings as systems settle down.
.18 Fully open balancing valves (except those that are factory-set).
.19 Check operation of over-temperature protection devices on circulating pumps.
.20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 - Common Work Results – Mechanical.
.2 Section 23 05 05 – Installation of Pipework.

1.2 References

.1 American Society of Mechanical Engineers (ASME)
  .1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
  .2 ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
  .3 ASME B16.22-01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
  .4 ASME B18.2.1-96, Square and Hex Bolts and Screws Inch Series.

.2 American Society for Testing and Materials International (ASTM)
  .1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
  .2 ASTM A53/A53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  .3 ASTM B75M-99, Standard Specification for Seamless Copper Tube.
  .4 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.

.3 Canadian Standards Association (CSA International)
  .1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.

.4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
  .1 CAN/CSA B149.1- Natural Gas and Propane Installation Code Handbook.

.5 Authority Having Jurisdiction
  .1 The Authority Having Jurisdiction for this project is The Nova Scotia Department of Labour.

1.3 Submittals

.1 Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 21 05 01 Common Work Results – Mechanical.

2 Products

2.1 Pipe

.1 Materials for pipe as per Section 23 05 05 – Installation of Pipework

.2 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless, plain end, welded.

.3 Copper tube: to ASTM B837.

2.2 Jointing Material

.1 Welded fittings: to CSA W47.1.

.2 Flange gaskets: nonmetallic flat.

.3 Brazing: to ASTM B837.

2.3 Fittings

.1 Steel pipe fittings flanged or welded:
- .1 Steel pipe flanges and flanged fittings: to ASME B16.5.
- .2 Welding: butt-welding fittings.
- .3 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
- .4 Bolts and nuts: to ASME B18.2.1.
- .5 Nipples: schedule 40, to ASTM A53/A53M.

.2 Copper pipe fittings flanged or soldered:
- .1 Cast copper fittings: to ASME B16.18.
- .2 Wrought copper fittings: to ASME B16.22.

2.4 Valves

.1 Provincial Code approved, lubricated ball type.

.2 Acceptable Materials: Crane, Kitz, Milwaukee, Red & White, Toyo

2.5 Existing System

.1 Connect to existing gas system as shown on drawings.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Authority Have Jurisdiction

.1 Comply with the requirements of the relevant codes and the Authority Having Jurisdiction.

3.3 Piping

.1 Install in accordance with Section CAN/CSA B149.1, CAN/CSA B149.2, requirements of the Authority Having Jurisdiction, and as supplemented below.

.2 Install drip points:
- .1 At low points in piping system.
- .2 At connections to equipment.

.3 Co-ordinate interruption of gas service to building with Owner in advance of interruption.

3.4 Valves

.1 Install valves with stems upright or horizontal unless otherwise approved by Consultant.

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.5 Field Quality Control

.1 Site Tests/Inspection:

.1 Test system in accordance with CAN/CSA B149.1, CAN/CSA B149.2, and requirements of authorities having jurisdiction.

.2 Manufacturer's Field Services:

.1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its product[s], and submit written reports, in acceptable format, to verify compliance of work with Contract.

.2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.

.3 Schedule site visits to review work at stages listed:

.1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.

.2 Twice during progress of work at 25% and 60% complete.

.3 Upon completion of work, after cleaning is carried out.

.3 Obtain reports within 3 days of review and submit immediately to Consultant.

3.6 Adjusting

.1 Purging: purge after pressure test in accordance with CAN/CSA B149.1 and CAN/CSA B149.2.

.2 Pre-Start-Up Inspections:

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains, entire installation is approved by authority having jurisdiction.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.
.2 Section 23 05 05 – Installation of Pipework.
.3 Section 23 05 53.01 – Mechanical Identification.
.4 Section 23 08 02 – Cleaning and Start Up of Mechanical Piping Systems.

1.2 References

.1 American National Standards Institute (ANSI)/American Welding Society (AWS)
  .1 ANSI/AWS A5.8/A5.8M-04, Specification Filler Metals for Brazing and Bronze Welding.

.2 American Society of Mechanical Engineers (ASME)
  .1 ANSI/ASME B16.4-98, Gray-Iron Threaded Fittings.
  .2 ANSI/ASME B16.15-1985(2004), Cast Bronze Threaded Fittings.
  .3 ANSI B16.18-2001, Cast Copper Alloy, Solder Joint Pressure Fittings.
  .4 ANSI/ASME B16.22-2001, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.3 American Society for Testing and Materials International (ASTM)
  .1 ASTM B32-04, Standard Specification for Solder Metal.
  .2 ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings.
  .3 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
  .4 ASTM B88M-03, Standard Specification for Seamless Copper Water Tube Metric.
  .5 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.4 Manufacturers Standardization Society (MSS)
  .1 MSS SP67-2002a, Butterfly Valves.
  .2 MSS SP70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends.
  .3 MSS SP71-1997, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  .4 MSS SP80-2003, Bronze Gate, Globe, Angle and Check Valves.
  .5 MSS SP85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 Submittals

.1 Product Data:
  .1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 Piping

.1 Type “L” hard drawn copper tubing: to ASTM B88M.

.2 Roll grooved copper piping may be used but products must be of one manufacturer throughout.

.3 Acceptable Materials: Victaulic, Gruvlock.

2.2 Fittings

.1 Cast bronze threaded fittings: to ANSI/ASME B16.15.

.2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.

.3 Cast iron threaded fittings: to ANSI/ASME B16.4.

.4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

2.3 Flanges

.1 Brass or bronze: threaded.

.2 Cast iron: threaded.

.3 Orifice flanges: slip-on, raised face, 2100 kPa.

2.4 Joints

.1 Solder, tin-antimony, 95:5: to ASTM B32.

.2 Silver solder BCUP: to ANSI/AWS A5.8.

.3 Brazing: as indicated.

2.5 Valves

.1 Connections:
- .1 NPS 2 and smaller: solder.
- .2 NPS 2 1/2 and larger: flanged or grooved.

.2 Gate Valves Application: isolating equipment, control valves, pipelines:
- .1 NPS 2 and under:
  - .1 Mechanical Rooms: Class 125, rising stem split wedge disc - Bronze.
  - .2 Elsewhere: Class 125, non- rising stem, solid wedge disc - Bronze.
  - .3 Acceptable Materials: Crane 428, Jenkins 810, Kitz 24, Hattersley T607M, Toyo 293, Milwaukee Valve Company, Parker Kaefer Inc.
  - .4 Rising stem: to ANSI/MSS SP-80-1987, Class 125, bronze body, solid wedge disc.

.1 Acceptable Materials: Crane 465½, Jenkins 454J, Mueller A-2483-6, Hattersley T504, Toyo 421JA, Watts 408, Milwaukee Valve Company, Kitz #72, Parker Kaefer Inc.

.2 NPS 2 1/2 and over:
- .1 Mechanical Rooms: rising stem, split wedge disc, bronze trim.
- .2 Elsewhere: Non- rising stem, solid wedge disc, bronze trim, - Cast Iron.
- .3 Acceptable Materials: Crane 465½, Jenkins 454J, Mueller A-2483-6, Hattersley T504, Toyo 421JA, Watts 408, Milwaukee Valve Company, *Kitz #72*. Crane 461, Jenkins 452, Kitz 75, Mueller A-2380-6, Hattersley T501, Toyo 415JA, Watts 400, Milwaukee Valve Company.

.3 Butterfly valves: application: isolating each cell or section of multiple component equipment (eg. multi-section coils, multi-cell cooling towers):
- .1 NPS 2 1/2 and over: grooved ends:.

.4 Globe valves: application: throttling, flow control, emergency bypass :
- .1 NPS 2 and under:
  - .1 Mechanical Rooms: with PFTE disc, Bronze.
  - .2 Elsewhere: globe, with composition disc, Bronze.
  - .3 Acceptable Materials: Crane 5, Jenkins 106BP, Nibco S-211-Y, Toyo, Kitz, Milwaukee Valve Company, Hattersley A50M; Parker Kaefer Inc.
- .2 NPS 2 1/2 and over:
  - .1 With bronze disc/ trim), Cast Iron.
  - .2 Acceptable Materials: Crane 351, Jenkins 2342, Kitz 76, Hattersley 731, Toyo 400 JA, Milwaukee Valve Company, Parker Kaefer Inc.

.5 Balancing, for TAB:
- .1 Y style globe valve, designed to provide precise flow measurement and control, with valved ports for connecting to differential pressure meter.
- .2 Readout to be within plus or minus 2% of actual flow at design flow rate.
- .3 Sizes: calibrated balancing valves, as specified.
- .4 Flow control: at least four full turns of handwheel with digital hand wheel and tamperproof concealed mechanical memory.
- .5 Insulation: Use prefabricated shipping packaging of R-5.4 polyurethane as insulation for installation. Tape all joints for balancing valves installed in the chilled water and geothermal piping system.
- .6 NPS 2 and under:
  - .1 Pressure die-cast zinc dezincification resistant copper alloy (Ametal) construction; maximum WP: 125 psig, maximum temperature: 121°C, screwed ends, Teflon disc, screwed in bonnet.
  - .2 Acceptable Materials: ITT Bell & Gossett, Armstrong, Tour & Anderson, Taco, Danfoss, Oventrop.
- .7 NPS 2½ and over:
  - .1 Body: epoxy resin coated cast iron: bonnet and trim: zinc-dezincification resistant copper alloy (Ametal), bonnet bolts of

stainless steel maximum WP, 125 psig, maximum temperature: 250°F, ANSI Class 125 flanged ends or grooved ends.

.2 Flow control: at least 8 full turns of handwheel with vernier type or digital type ring settings and tamperproof concealed mechanical memory.

.3 Acceptable Materials: ITT Bell & Gossett, Armstrong, Taco, Tour & Anderson, Danfoss.

.8 Drain connection:

.1 NPS 3/4 valved and capped drain connection suitable for hose socket to be incorporated into the valve body or provided as separate item.

.6 Drain valves

.1 On radiation: Solid forged brass construction, solid brass body, forged brass cap, brass chain and hook, composition disc suitable for 250^{O}C, working pressure 200 psig at 250^{O}C.

.1 Acceptable Material: Dahl #21.616.

.2 On Mains: Forged brass body, brass cap, steel handle, brass stem and ball, Teflon seat, hose end, 250 psig at 250^{O}C.

.1 Acceptable Material: Dahl #50.430.

.7 Bypass valves on globe valves NPS 8 and larger: NPS 3/4, globe, with PFTE disc, Bronze.

.8 Swing check valves:

.1 NPS 2 and under:

.1 Class 125, swing, with composition disc, Bronze.

.2 NPS 2 1/2 and over: Flanged or Grooved ends, Cast Iron.

.9 Silent check valves:

.1 NPS 2 and under:

.1 Acceptable Materials: Durabla GLC, Toyo, Kitz, Crane, Jenkins, Milwaukee Valve Company, Hattersley, Parker Kaefer Inc.

.2 NPS 2 1/2 and over:

.1 Flanged or Grooved ends: Cast Iron.

.2 Acceptable Materials: Durabla GLC, Moyes & Groves 500 series, Toyo, Kitz, Crane, Jenkins, Milwaukee Valve Company, Hattersley, Parker Kaefer Inc.

.3 NPS 4 and over, for roll grooved end pipe:

.1 To ANSI/MSS SP-71-1990, Class 125, ductile iron body, bronze discs, EPDM seat.

.2 Acceptable Materials: Victaulic 711, 715, 716.

.10 Ball valves:

.1 NPS 2 and under: Bronze.

.2 Acceptable Materials: Jenkins 901FJ and 902FJ, Crane, Toyo, Kitz, Hattersley, Milwaukee Valve Company.

.12 Lift Check Valves

.1 50 mm and under:

.1 Class 125, swing check, Y-pattern, threaded ends, bronze disc with bronze hinge and stainless steel hinge pin, screw cap.
.2 Acceptable Materials:
.1 Crane Fig 37, Jenkins Fig. 4092J, Kitz Fig 22

2.6 Grooved End Valves

.1 Where grooved piping concept is used in place of welded or threaded systems, Contractor shall incorporate grooved end valves of comparable construction.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Piping Installation

.1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.

.3 Slope piping in direction of drainage and for positive venting.

.4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Assemble piping using fittings manufactured to ANSI standards.

3.3 Valve Installation

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Install butterfly valves on chilled water and condenser water lines only.

.3 Install gate, ball or butterfly valves at branch take-offs and to isolate each piece of equipment, and as indicated.

.4 Install globe valves for balancing and in by-pass around control valves as indicated.

.5 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.

.6 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

.7 Install chain operators on valves NPS 2 1/2 and over where installed more than 2400 mm above floor in Boiler Rooms and Mechanical Equipment Rooms.

.8 Install plug cocks or ball valves for glycol service.

3.4 Circuit Balancing Valves

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and TAB is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.5 Flushing And Cleaning

.1 Provide Consultant with five (5) days notice of flushing and cleaning of system.

.2 Flush in accordance with section 23 08 02 - Cleaning and Start Up of Mechanical Piping Systems

.3 Re-install strainer screens/baskets.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 - Common Work Results for Mechanical.
.2 Section 23 05 17 - Pipe Welding.
.3 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
.4 Section 23 05 01 - Installation of Pipework.

1.2 References

.1 American Society of Mechanical Engineers (ASME).
  .1 ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.
  .2 ASME B16.3-98, Malleable Iron Threaded Fittings.
  .3 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
  .4 ASME B16.9-01, Factory-Made Wrought Buttwelding Fittings.
  .5 ASME B18.2.1-03, Square and Hex Bolts and Screws (Inch Series).
  .6 ASME B18.2.2-87 (R1999), Square and Hex Nuts (Inch Series).

.2 American Society for Testing and Materials International, (ASTM).
  .1 ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings.
  .2 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  .3 ASTM A536-84(1999)e1, Standard Specification for Ductile Iron Castings.
  .4 ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings.
  .5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
  .6 ASTM E202-00, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.3 American Water Works Association (AWWA).
  .1 AWWA C111-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).
  .1 CSA B242-M1980(R1998), Groove and Shoulder Type Mechanical Pipe Couplings.
  .2 CAN/CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
  .1 MSS-SP-67-025, Butterfly Valves.
  .2 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.
  .3 MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends.
  .4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
  .5 MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 Pipe

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
- .1 To 50 mm : BW Steel, Sch 40.
- .2 65 mm to 150 mm : ERW Steel, Sch 40.
- .3 200 mm and larger : ERW Steel, Sch 10.

2.2 General

.1 Do piping system work including hanger in accordance with ANSI B31.1 or B31.9.

.2 Products shall have current CRN numbers for the applicable province.

.3 All grooved products to be one manufacturer.

2.3 Pipe Joints

.1 50 mm and under: screwed fittings with PTFE tape or lead-free pipe dope.

.2 65 mm and over: welding fittings and flanges to CAN/CSA W48.

.3 Roll grooved: coupling to CSA B242.
- .1 All grooved couplings to be designed with angle bolt pads to provide a rigid joint unless otherwise noted
- .2 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.
- .3 Standard of Acceptance: Victaulic Style 07 Zero-Flex.
- .4 Victaulic Style 77 flexible couplings shall be used for a maximum of three joints at pumps and circulators for vibration and noise control. They are to be used at expansion loops and offsets intended to absorb pipe expansion.
- .5 Coupling gaskets to be Grade “E” (EPDM) for water services -30 degrees F to +230 degrees F, and oil free compressed air. For oil saturated compressed air use Grade “T” Nitrile gaskets.
- .6 Acceptable Materials: Gruvlock, Victaulic.

.4 Flanges: plain or raised face, weld neck to AWWA C111.

.5 Orifice flanges: slip-on raised face, 2100 kPa.

.6 Flange gaskets: to AWWA C111.

.7 Pipe thread: taper.

2.4 Fittings

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:
.1 Cast iron: to ASME B16.1, Class 125.
.2 Steel: to ASME B16.5.

.3 Butt-welding fittings: steel, to ASME B16.9.

.4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.

.5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M.

.6 Acceptable Materials: Gruvlock, Victaulic.

2.5 Valves

.1 Connections:
.1 50 mm and smaller: screwed ends.
.2 65 mm and larger: flanged or grooved ends.

.2 Gate valves: to MSS-SP-70 or to MSS-SP-80 Application: Isolating equipment, control valves, pipelines:
.1 50 mm and under:
.1 Mechanical Rooms: bronze, class 125, rising stem, split wedge disc
.2 Elsewhere: bronze, class 125, non- rising stem, solid wedge disc.
.3 Acceptable product: Crane Fig 1700, Kitz #24

.2 65 mm and over:
.1 Mechanical Rooms: rising stem, split wedge disc, bronze trim.
.2 Elsewhere: Non- rising stem, solid wedge disc, bronze trim.
.3 Acceptable product: Crane Fig 465 ½., Kitz #72.

.3 Butterfly valves: to MSS-SP-67
.1 Isolation and control valves shall be grooved end, 300 psi bubble tight shut-off on dead end service meeting the following criteria:
.1 Valves to be manufactured from ductile iron ASTM A-536.
.2 Nickel coated ductile iron disk.
.3 Seat: Grade “EPDM”.
.4 416 stainless steel stem.
.5 2.5" to 6" to have lever lock handles.
.6 8" to 12" to be supplied with gear operators.
.2 Acceptable Materials: Crane Fig 44-BXZ-L, Kitz #6122, Vic 300 Master Seal, Victaulic Style 300 butterfly valves,

.4 Globe valves: to MSS-SP-80 or MSS-SP-85 Application: Throttling, flow control, emergency bypass:
.1 50 mm and under:
.1 Mechanical Rooms: bronze with PTFE disc
.2 Elsewhere: bronze, with composition disc.
.3 Acceptable Product: Crane Fig.5TF, Kitz #03.
.2 65 mm and over:
.1 Cast Iron, with composition bronze disc ,bronze trim,.

.2 Acceptable Product: Crane Fig 351.

.5 Balancing, for TAB:
- .1 50 mm and under shall be Y-pattern style design and all metal parts of non-ferrous pressure die cast, non-porous copper alloy. IPS connections unless otherwise noted. The valve shall have four 360 degrees adjustment turns of hand wheel for maximum setting.
- .2 65 mm and larger (grooved or flanged connections) shall be Y-pattern style design with ductile iron body, with all other metal parts of non-ferrous copper alloy. The valve shall have (8), (12) or (16) 360 degrees adjustment turns of the hand wheel for maximum setting. Hand wheel shall have digital readout.
- .3 Acceptable Products: Armstrong, Taco, Bell & Gossett, Tour & Anderson, Danfoss Victaulic.

.6 Drain valves: Bronze gate valve, Class 125, non-rising stem, solid wedge disc.
- .1 On radiation: Solid forged brass construction, solid brass body, forged brass cap, brass chain and hook, composition disc suitable for 480^{O}F, working pressure 200 psi at 480°F.
  - .1 Acceptable Product: Dahl #21.616; Parker Kaefer Inc.
- .2 On Mains: Forged brass body, brass cap, steel handle, brass stem and ball, Teflon seat, hose end, 250 psig at 480^{O}F
  - .1 Acceptable Product: Dahl #50.430; Parker Kaefer Inc.

.7 Swing check valves: to MSS-SP-71.
- .1 50 mm and under:
  - .1 Bronze, class 125, swing, with composition disc.
- .2 65 mm and over:
  - .1 Flanged or Grooved ends.

.8 Silent check valves:
- .1 Check valves shall be grooved end 30-0 psi minimum working pressure, non-slamming spring-loaded disk.
- .2 Acceptable Material: Victaulic Style 716 Check Valve, Parker Kaefer Inc.

.9 Lift check valves
- .1 2" and under:
  - .1 Class 125, swing check, Y-pattern, threaded ends, bronze disc with bronze hinge and stainless steel hinge pin, screw cap.
  - .2 Acceptable Materials: Crane Fig 37, Kitz #22, Parker Kaefer Inc.
- .2 2.1/2" and over:
  - .1 30 psig and under: Class 125, bolted cap, flanged ends, bronze trim, solid bronze disc up to 150mm bronze faced cast iron on larger sizes,
  - .2 Acceptable Materials: Crane Fig 373, Kitz #78, Parker Kaefer Inc.

.10 Ball valves:
- .1 50 mm and under:
  - .1 Acceptable Product: Crane Fig 9202, Kitz #58.

.11 Coil Connections:
- .1 The Contractor may install in lieu of standard malleable iron or copper fittings the following component system consisting of the following:
  - .1 A complete three-component multi-functioned packaged.
  - .2 Rated for 250 degrees F (120 degrees C) up to 300 psi.
  - .3 Suitable for hot, cold, treated, and untreated water.
  - .4 UP union port fitting and STADK CBV to have unions sized to accommodate standard modulating valves.
- .2 Acceptable Materials: Victaulic 78K Koil - Kit.

3 Execution

3.1 Piping Installation

.1 Install pipework in accordance with Section 23 05 01 - Installation of Pipe Work.

.2 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage, and installation instructions, and datasheets.

3.2 Circuit Balancing Valves

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove hand wheel after installation and when TAB is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.3 Cleaning, Flushing And Start-Up

.1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

3.4 Testing

.1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.

.2 For glycol systems, retest with glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

3.5 Balancing

.1 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.6 Glycol Charging

.1 Provide mixing tank and positive displacement pump for glycol charging.

.2 Retest for concentration to ASTM E202 after cleaning.

3.7 Performance Verification

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping.

END OF SECTION

1 General

1.1 Related Requirements

.1 Specification 21 05 01 – Common Work Results – Mechanical.

1.2 References

.1 American Society of Mechanical Engineers (ASME):
  .1 ASME-04 (2007), Boiler and Pressure Vessel Code.

.2 ASTM International Inc.:
  .1 ASTM A47/A47M-99 (2004), Standard Specification for Ferritic Malleable Iron Castings.
  .2 ASTM A278/A278M-01 (2006), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
  .3 ASTM A516/A516M-06, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
  .4 ASTM A536-84(2004), Standard Specification for Ductile Iron Castings.
  .5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International):
  .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 Diaphragm Type Expansion Tank

.1 Horizontal or Vertical steel pressurized diaphragm type expansion tank.

.2 Renewable diaphragm sealed in EPDM suitable for 115 degrees C operating temperature.

.3 Working pressure: 125 psi with ASME stamp and certification.

.4 Air precharged to 84 kPa (initial fill pressure of system).

.5 Provide Saddles for horizontal installation, base for vertical installation.

.6 Supports: provide supports with hold down bolts

.7 Acceptable Materials: Amtrol, Armstrong, Expanflex, ITT Bell & Gossett, Taco, Extrol

2.2 Automatic Air Vent

.1 Standard float vent: brass body and NPS 1/8.

.2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 125 psi working pressure.

.3 Float: solid material suitable for 115 degrees C working temperature.

.4 Acceptable Materials: Amtrol, Armstrong, Braukmann, Taco, ITT Bell & Gossett, Honeywell, Maidomist

2.3 Air Separator - Boiler Mounted

.1 Complete with dip tube.

.2 Working pressure: 125 psi.

2.4 Air Separator - Expansion Tank Fitting

.1 Complete with adjustable vent tube and built-in manual vent valve.

.2 Working pressure: 125 psi.

3 Acceptable Materials: Amtrol, ITT Bell & Gossett, Taco

2.5 Air Separator - In-Line

.1 Working pressure: 125 psi.

.2 Size: NPS 1 ½.

.3 Acceptable Materials: Amtrol, ITT Bell & Gossett, Taco, Armstrong, Rolairtrol

2.6 Combination Separators/Strainers

.1 Welded steel construction, tested and stamped in accordance with Air Section 8D of ANSI/ASME Code, for 125 psig operating pressure, with integral strainer with 0.20" perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

.2 Size: Same size as pipe.

.3 Applications:
- .1 Chilled water system.
- .2 Heating hot water system.
- .3 Glycol/water heating system.
- .4 Heat reclaim / recovery loops (2)

.4 Insulate as per Section 23 07 13 - Thermal Insulation for Equipment

.5 Acceptable Materials: Amtrol, Armstrong, ITT Bell & Gossett, Taco

2.7 Combination Low Pressure Relief And Reducing Valve

.1 Adjustable pressure setting: 30 psi relief, 55 to 25 psi reducing.

.2 Low inlet pressure check valve.

.3 Removable strainer.

.4 Acceptable Materials: Amtrol, ITT Bell & Gossett, Taco, Watts

2.8 Pipe Line Strainer

.1 NPS 1/2 to 2: bronze body to ASTM B62, (solder end) connections, Y pattern.

.2 NPS 2 1/2 to 12: cast steel body to ASTM A278/A278M, Class 30, flanged connections.

.3 NPS 2 to 12: T type with ductile iron body to ASTM A536, grooved ends.

.4 Blowdown connection: NPS 1.

.5 Screen: stainless steel or brass with 1.19 mm perforations.

.6 Working pressure: 125 psi.

.7 Acceptable Materials: Mueller, Parker Kaefer Inc., Spriax/Sarco, Victaulic; Style 732

2.9 Suction Diffuser

.1 Suction diffusers required for all base mounted pumps.

.2 Body: cast iron with flanged connections.

.3 Strainer: with built-in, disposable 1.19 mm mesh, low pressure drop screen and NPS 1 blowdown connection.

.4 Permanent magnet particle trap.

.5 Full length straightening vanes.

.6 Pressure gauge tappings.

.7 Adjustable support leg c/w 10 mm thick elastomeric vibration isolation pad between the base plate and the concrete floor.

.8 Gaskets to be compatible with fluid.

.9 Acceptable Materials: Armstrong, ITT Bell & Gossett, Taco, Victaulic, Grundfoss.

2.10 Triple Duty Valves

.1 Class 125, 125 psig bronze fitted cast iron, F.F. ANSI flanges, replaceable bronze or brass disc and soft EPDM seat, angle pattern, non-slam, calibrated nameplate, stainless steel stem and spring, teflon-graphite packing, adjustable pipe support legs complete with 1/2" thick elastomeric pad.

.2 Valve to combine the following functions:
.1 Shut-off.
.2 Balancing with brass readout/meter ports.
.3 Non-slam swing check.

.3 Gaskets shall be compatible with type of fluid.

.4 Provide removable insulation enclosure for each triple duty valve.

.5 Acceptable Materials: Armstrong, ITT Bell & Gossett, Grundfos, Taco, Victaulic Tri-service, Xylem

2.11 Glycol Fill Packages

.1 Provide packaged pre-assembled unit complete with glycol gear pump, pump suction hose, pump thermal cutout, control panel, pressure switch, polyethylene (PE) mixing/storage tank and cover, low level pump cut-outswitch and alarm (tied into DDC system), check valve, pressure relief valve, pressure gauge, complete with one year supply of chemicals; inlet strainer, cord and plug; pre-charged accumulator tank with EPDM diaphragm, manual diverter valve, pressure regulating valve (5-55 psig), union.

.2 Capacity: 1.0 USGPM; 0.7 AMPS; 115V/1/60. PE Reservoir: 48 US Gallon.

.3 The unit shall be equipped with a low level switch and alarm.

.4 Certified to CSA C22.2#68.

.5 Propylene Glycol: Interstate Chemical Company “Inter-cool”.

.6 Acceptable Material: Armstrong Model GLA, Axiom Industries Ltd Model SF100, Expanflex, Hamlet & Garneau Mod. GMP2, Metex Corp, Ltd., Model AG5 1500, Chem Aqua.

2.12 Pressure Safety Relief Valves

.1 Safety valves of the correct rating for equipment to be protected.

.2 Standard of Acceptance: Consolidated Fig. 1541 or Fig. 1511

.3 Acceptable Materials: Armstrong, Faries 1855-OL and 1900 Series, ITT, Kunkle, Parker Kaefer Inc, Spirax-Sarco Fig. 6000 or Fig. 252, Watts Fig. 174A

2.13 Combination Coil Fittings

.1 Reheat coil connection combination fitting consisting of shut-off ball valve, pressure temperature port, strainer c/w valved hose end connection for cleaning, and union is an accepted alternate to the piping shown on coil inlet piping schematic.
.1 Acceptable Material: Victaulic 78K-SBV, Anvil International.

.2 Combination fittings incorporating union, balancing fitting, two pressure temperature ports, and air vent port is an accepted alternate to the piping shown on coil inlet piping schematic.

.1 Acceptable Material: Victaulic 78K-UP and 78K- STADK.

3 Execution

3.1 General

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

.1 Run drain lines and blow off connections to terminate above nearest drain.

.2 Maintain adequate clearance to permit service and maintenance.

.3 Should deviations beyond allowable clearances arise, request and follow Consultant's directive.

.4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.2 Strainers

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump and where shown on drawings.

.4 Install ahead of each automatic control valve larger than NPS 1, at radiation, and as indicated.

3.3 Air Vents

.1 Install at high points of systems.

.2 Install stop cock on automatic air vent inlet. Run discharge to nearest drain or service sink.

3.4 Expansion Tanks

.1 Adjust expansion tank pressure as indicated to suit design criteria.

.2 Install lockshield type valve at inlet to tank.

.3 Where tanks are installed vertically provide restrains such as a metal band secured to the adjacent wall or a cage secured to floor to prevent them from tipping.

3.5 Pressure Safety Relief Valves

.1 Run discharge pipe to terminate above nearest drain.

3.6 Suction Diffusers

.1 Install on inlet to pumps having suction size greater than 2".

.2 Provide removable insulation enclosures for each suction diffuser.

3.7 Glycol Package

.1 Provide sufficient inhibited propylene glycol to maintain a 50% glycol (by weight) concentration in the system.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.
.2 Section 23 05 05 – Installation of Pipework.
.3 Section 23 05 53.01 – Mechanical Identification.

1.2 References

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
  .1 Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers Advisory Council (EEMAC).

.4 Canadian Standards Association (CSA International)
  .1 CSA-B214-07, Installation Code for Hydronic Heating Systems.

.3 National Electrical Manufacturers' Association (NEMA)
  .1 NEMA MG 1-2006, Motors and Generators.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

2 Products

2.1 Vertical In-Line Circulators

.1 Volute: cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.

.2 Impeller: brass or bronze.

.3 Shaft: alloy steel with bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: mechanical for service to 135 degrees C.

.5 Coupling: self-aligning.

.6 Motor: Premium efficiency to NEMA MG 1 resilient mounted, drip proof, sleeve bearing.

.7 Acceptable Materials: Armstrong, Bell and Gossett, Grundfos, Taco

3 Execution

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Installation

.1 Install hydronic pumps to: CSA-B214.

.2 In line circulators: install as indicated by flow arrows.
- .1 Support at inlet and outlet flanges or unions.
- .2 Install with bearing lubrication points accessible.

.3 Ensure that pump body does not support piping or equipment.
- .1 Provide stanchions or hangers for this purpose.
- .2 Refer to manufacturer's installation instructions for details.

.4 Pipe drain tapping to floor drain.

.5 Install volute venting pet cock in accessible location.

.6 Check rotation prior to start-up.

.7 Install pressure gauge test cocks.

3.3 Start-Up

.1 Procedures:
- .1 Run-in pumps for 12 continuous hours minimum.
- .2 Replace seals if pump used to degrease system or if pump used for temporary heat.

.2 TAB
- .1 Where pumps are controlled with VFDs use the VFD as the 1'st stage to balance the system, keep the balancing valve(s) open and use these for measurement only. Throttle the system with balancing valves to achieve design flow only when the pump is operating at its minimum position.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.
.2 Section 23 05 05 – Installation of Pipework.
.3 Section 23 05 53.01 – Mechanical Identification.

1.2 References

.1 American National Standards Institute (ANSI) / American Society of Mechanical Engineers (ASME)
  .1 ASME B16.1-05, Cast Iron Pipe Flanges and Flanged Fittings: Class 25, 125, 250 and 800.
  .2 ASME B16.25-07, Buttwelding Ends.
  .3 ASME B16.3-06, Malleable Iron Threaded Fittings: Classes 150 and 300.
  .4 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
  .5 ANSI/ASME B16.9-07, Factory-Made Wrought Steel Buttwelding Fittings.
  .6 ANSI B18.2.1-96(R2005), Square and Hex Bolts and Screws (Inch Series).
  .7 ANSI/ASME B18.2.2-87(R2005), Square and Hex Nuts (Inch Series).

.2 American National Standards Institute (ANSI) / American Water Works Association (AWWA)
  .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.3 ASTM International Inc.
  .1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
  .2 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  .3 ASTM A126-04, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.4 Canadian Standards Association (CSA International)
  .1 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.

.5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
  .1 MSS-SP-70-2006, Cast Iron Gate Valves, Flanged and Threaded Ends.
  .2 MSS-SP-71-2005, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
  .3 MSS-SP-80-2003, Bronze Gate, Globe, Angle and Check Valves.
  .4 MSS-SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 Pipe

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
- .1 Steam;
  - .1 To 2": BW Steel, Sch 40.
  - .2 2 ½" and larger: ERW Steel, Sch 40.
- .2 Condensate: ERW, Sch 80.

2.2 Pipe Joints

.1 2" and under: screwed fittings with PTFE tape or lead-free dope.

.2 2 ½" and over: welding fittings and flanges to CSA W48.

.3 Flanges: plain or raised face. Flange gaskets to ANSI/AWWA C111/A21.11.

.4 Pipe thread: taper.

.5 Bolts and nuts: carbon steel, to ANSI/ASME B18.2.1 and ANSI/ASME B18.2.2.

.6 Buttwelding ends: to ANSI/ASME B16.25.

2.3 Fittings

.1 Pipe flanges: cast-iron to ASME B16.1, Class 125.

.2 Screwed fittings: malleable iron to ASME B16.3, Class 150.

.3 Steel pipe gaskets, flanges and flanged fittings: to ANSI/ASME B16.5.

.4 Buttwelding fittings: steel to ANSI/ASME B16.9.

.5 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.

2.4 Valves

.1 Connections:
- .1 2" and smaller: screwed ends.
- .2 2 ½" and larger:
  - .1 Equipment: Welded or Flanged ends.
  - .2 Elsewhere: Welded or Flanged ends.

.2 Gate valves: Application: Steam service, for isolating equipment, control valves, pipelines.
- .1 2" and under:
  - .1 Mechanical Rooms: Class 125, rising stem, split wedge disc, Bronze.
    - .1 Acceptable Materials: Crane Fig 1700, Red & White, Toyo 281A, Jenkins, Milwaukee Valve Company, Kitz #24.
  - .2 Elsewhere: Class 125, non-rising stem, solid wedge disc, Bronze.

.1 Acceptable Materials: Crane Fig B3604XU-F, Red & White, Toyo 281A, Jenkins, Milwaukee Valve Company, Bonney Forged HL-11T.

.2 2 ½" and larger:

.1 Mechanical Rooms: Class 150, rising stem, split wedge disc, cast iron, bronze trim, Cast Iron.

.1 Acceptable Materials: Crane Fig 465 ½., Red & White, Toyo 421A, Jenkins, Milwaukee Valve Company, Kitz #72.

.2 Elsewhere: Class 150, Non- rising stem, solid wedge disc, cast iron with bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.

.1 Acceptable Materials: Crane Fig 33, Red & White, Toyo 281A, Jenkins, Milwaukee Valve Company, Bonney Forged #3-11RF.

.3 Globe valves: Application: Steam service, throttling, flow control, emergency bypass.

.1 2" and under:

.1 Mechanical Rooms: with PFTE disc, Bronze.

.1 Acceptable Materials: Crane Fig.5TF, Red & White, Toyo 222, Jenkins, Milwaukee Valve Company, Kitz #09.

.2 Elsewhere: with composition disc Bronze.

.1 Acceptable Materials: Crane Fig. B3644XU-T, Red & White, Toyo 222, Jenkins, Milwaukee Valve Company, Bonney Forged HL31T.

.2 2 ½" and over:

.1 With composition disc, cast iron with bronze trim, Cast Iron.

.1 Acceptable Matierals: Crane Fig 351, Red & White, Toyo 400A, Jenkins, Milwaukee Valve Company, Kitz #76.

.3 Acceptable Materials: Crane, Red & White, *Toyo*, Jenkins, Milwaukee Valve Company, *Kitz*, Bonney Forged

.4 Gate valves: Application: pumped and gravity condensate return service, steam drip point assemblies.

.1 2" and under:

.1 Mechanical Rooms: Class 125, rising stem, split wedge disc, Bronze.

.2 Elsewhere: Class 125, non-rising stem, solid wedge disc, Bronze.

.2 2 ½" and over:

.1 Mechanical Rooms: Class 125, rising stem, split wedge disc, cast iron, (bronze) trim, Cast Iron.

.2 Elsewhere: Class 125, non- rising stem, solid wedge disc, cast iron with bronze trim, Cast Iron.

.3 Acceptable Materials: Crane, Red & White, Toyo, Jenkins, Milwaukee Valve Company, Kitz.

.5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, Bronze.

.1 Acceptable Materials: Crane, Red & White, *Toyo*, Jenkins, Milwaukee Valve Company, *Kitz*, Bonney Forged.

.6 Bypass valves around large size gate and globe valves, Cast Steel.

.7 Lift check valves:
- .1 2" and under: Class 125, lift, with composition disc, Bronze.
- .2 2 ½" and over: Cast Iron.
- .3 Acceptable Materials: Crane, Red & White, *Toyo*, Jenkins, Milwaukee Valve Company, *Bonney Forged*

2.5 Valve Operators

.1 Handwheel with chain operators: on valves installed more than 2400 mm above floor in Boiler Rooms and Mechanical Equipment rooms.

2.6 **Ball Valves**

.1 High pressure steam application, operating steam pressure less than 80 psig.

.2 Investment cast components, two piece construction, threaded, stainless steel ball valve, Class 250, stainless steel lever & nut, adjustable packing gland, blow-out stem design, RPTFE seats & stuffing box ring, 316 stainless steel ball.

.3 Acceptable Materials: Apollo 76 - 100 Series.

3 Execution

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Piping

.1 Install pipework in accordance with Section 23 05 05 – Installation of Pipework supplemented as specified below.

.2 Connect branch lines into top of mains.

.3 Install piping in direction of flow with slopes as follows, unless indicated:
- .1 Steam: 1:240.
- .2 Condensate return: 1:70.

.4 Make provision for thermal expansion as indicated.

.5 Drip pocket: line size.

3.3 Valves

.1 Install globe valves around, NPS 8 and over, gate valves.

3.4 Testing

.1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.

.2 Test pressure: 1-1/2 times maximum system operating pressure or 860 kPa whichever is greater.

3.5 System Start-Up

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.
.2 Section 23 05 05 – Installation of Pipework.

1.2 References

.1 American Society for Mechanical Engineers (ASME International).

.2 ASTM International Inc.
- .1 ASTM A126-04, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- .2 ASTM A167-99(2004), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- .3 ASTM A216/A216M-07, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service.
- .4 ASTM A240/A240M-07e1, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- .5 ASTM A276-06, Standard Specification for Stainless Steel Bars and Shapes.
- .6 ASTM A278/A278M-01(2006), Standard Specification for Gray Iron Castings for Pressure - Containing Parts for Temperatures up to 350 Degrees C.
- .7 ASTM A351/A351M-06, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
- .8 ASTM A564/A564M-04, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
- .9 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 Materials

.1 Cast steel: to ASTM A216/A216M.

.2 Cast iron: to ASTM A278, Class 300.

.3 Bronze: to ASTM B62.

.4 Stainless steel: to ASTM A351/A351M.

2.2 Inverted Bucket Steam Trap

.1 Application: for drips, humidifiers, and as indicated.

.2 Materials: body – Type 304 stainless steel; valve - stainless steel; bucket - stainless steel; valve seat - stainless steel.

.3 Acceptable Materials: Armstrong 1010/1012, Spirax/Sarco Series SIB30, Watson McDaniel.

2.3 Vacuum Breakers 0.85-68 KPA

.1 Application: on inlets to steam coils, heat exchangers as indicated.

.2 Materials: body and cap – stainless steel; spring - stainless steel; stem and seat – stainless steel.

.3 Acceptable Materials: Spirax/Sarco VB21, Watson McDaniel

2.4 Drip Pan Elbows

.1 Application: on discharge of steam safety relief valves as indicated.

.2 Cast iron or steel with screwed or flanged inlet and threaded drain connections.

.3 Acceptable Material: Spirax/Sarco DPE, Armstrong, Watson McDaniel.

2.5 Pipe Line Strainers Up To 2"

.1 Application: ahead of condensate pumps, steam traps, control valves and elsewhere as indicated.

.2 Working pressure: 860 kPa.

.3 Body: bronze.

.4 Connections: screwed.

.5 Screen: stainless steel with 0.8 mm perforations.

.6 Acceptable Products: Spirax/Sarco, Model YS, Watson McDaniel.

2.6 Pipe Line Strainers NPS 2 ½" And Over

.1 Application: ahead of condensate pumps, steam traps, control valves as indicated.

.2 Working pressure: 860 kPa.

.3 Body: cast iron.

.4 Connections: flanged.

.5 Blowdown connection: NPS 1-1/4 complete with gate valve and cap.

.6 Screen: stainless steel with 3.2 mm perforations.

.7 Standard of Acceptance :
.1 Working Pressure < 15 psi Spirax/Sarco Model CI-125.
.2 Working Pressure > 15 psi Spirax/Sarco Model CI-250.

.8 Acceptable Materials: Armstrong, Watson McDaniel.

3 Execution

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

.2 Maintain recommended clearance around equipment to permit maintenance.

3.2 Strainers

.1 Install as indicated.

.2 Ensure clearance for removal of basket.

.3 Install valved blow-down as indicated.

3.3 Safety Relief Valve

.1 Pipe to atmosphere independent of other vents and in accordance with applicable code.

.2 Support discharge pipe against reaction forces and to take up thermal movement.

.3 Drain pipe from drip pan elbow to terminate over floor drain.

3.4 Steam Traps

.1 Install unions on inlet and outlet.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results - Mechanical.
.2 Section 23 05 05 - Installation of Pipework.
.3 Section 23 07 15 – Insulation of Pipework.

1.2 References

.1 American Society of Mechanical Engineers (ASME)
  .1 ASME B16.22-01, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
  .2 ASME B16.24-02, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
  .3 ASME B16.26-88, Cast Copper Alloy Fittings for Flared Copper Tubes.
  .4 ASME B31.5-01, Refrigeration Piping and Heat Transfer Components.

.2 American Society for Testing and Materials International (ASTM)
  .1 ASTM A307-04, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  .2 ASTM B280-03, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA International)
  .1 CSA B52-99, Mechanical Refrigeration Code.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

2 Products

2.1 PIPE And TUBING

.1 ACR, copper, dehydrated, cleaned and capped.

.2 ¾" and below : Soft annealed copper tubing:

.3 Larger than ¾" : Hard drawn copper tubing: do not bend.

.2 Provide braided flexible piping connections at equipment- both ends of piping.

.3 Insulate all piping as per Section 23 07 15.

.4 Provide all pipeline accessories and valves not provided by the equipment manufacturers

2.2 Fittings

.1 Service: design pressure 2070 kPa and temperature 121 degrees C.

.2 Brazed:
.1 Fittings: wrought copper to ASME B16.22.
.2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.

.3 Flanged:
.1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
.2 Gaskets: suitable for service.
.3 Bolts, nuts and washers: to ASTM A307, heavy series.

.4 Flared:
.1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 Pipe Sleeves

.1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.4 Valves

.1 25 mm and under: Class 500, 3.5 MPa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

.2 Over 25 mm: Class 375, 2.5 MPa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 General

.1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 01 - Installation of Pipework.

3.3 Brazing Procedures

.1 Bleed inert gas into pipe during brazing.

.2 Remove valve internal parts, solenoid valve coils, sight glass.

.3 Do not apply heat near expansion valve and bulb.

3.4 Piping Installation

.1 General:
.1 Soft annealed copper tubing: bend without crimping or constriction. Hard drawn copper tubing: do not bend. Minimize use of fittings.

.2 Pipe clamps to be on the outside of insulation so that insulation remains unbroken

.2 Hot gas lines:
- .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
- .2 Provide trap at base of suction line risers greater than 36" high and at each 144" thereafter.
- .3 Provide trap at base of discharge line risers greater than 72" mm high and at each 144" thereafter
- .4 Provide inverted deep trap at top of risers.
- .5 Provide double risers for compressors having capacity modulation.
  - .1 Large riser: install traps as specified.
  - .2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

3.5 Pressure And Leak Testing

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.

.2 Leak test to CSA B52 before evacuation to 2 MPa and 1 MPa on high and low sides respectively.

.3 Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.6 Field Quality Control

.1 Site Tests/Inspection:
- .1 Close service valves on factory charged equipment.

.2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.

.3 Use copper lines of largest practical size to reduce evacuation time.

.4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.

.5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

.6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
- .1 Twice to 14 Pa absolute and hold for 4 hours.
- .2 Break vacuum with refrigerant to 14 kPa.
- .3 Final to 5 Pa absolute and hold for at least 12 hours.
- .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
- .5 Submit test results to Consultant.

.7 Charging:
- .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
- .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
- .3 Re-purge charging line if refrigerant container is changed during charging process.

.8 Checks:
- .1 Record and report measurements Consultant.

.9 Manufacturer's Field Services:
- .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product(s) and submit written reports, in acceptable format, to verify compliance of Work with Contract.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, at stages listed:
  - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of the Work, after cleaning is carried out.
- .4 Obtain reports, within 3 days of review, and submit, immediately to Consultant.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.
.2 Section 23 05 05 – Installation of Pipework.

1.2 References

.1 American Society of Mechanical Engineers (ASME)
  .1 ASME Boiler and Pressure Vessel Code, Section VII-2004.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 Manufacturer

.1 Equipment, chemicals, service provided by one supplier.

2.2 Pot Feeder

.1 Welded steel, pressure rating 2000 kPa. Temperature rating: 90 degrees C.

.2 Capacity: 11 litres to control sludge, seale and corrosion.

.3 Provide phosphate polymer for scale control and catalysed sodium sulphate for oxygen removal. Provide minimum one year supply of chemicals complete with MSDS sheets.

.4 Provide micron filter, capacity 2% of pump recirculating rate at operating pressure complete with six sets of filter cartridges.

.5 Acceptable Materials: Chem Aqua Canada; J.L. Wingert Co.(supplied by T. Donovan & Sons (1997) Ltd.); Ashland Hercules Water Technologies; GE Water and Process Technologies; Neptune Chemical Pump Co. Inc.

2.3 Chemical Feed Piping

.1 See Section 23 05 05 – Installation of Pipework.

2.4 Shipping/Feeding Chemical Containers

.1 High density moulded polyethylene, with liquid level graduations, cover.

2.5 Chemicals

.1 Provide 1 years supply.

2.6 Test Equipment

.1 Provide one set of test equipment for each system to verify performance.

.2 Complete with carrying case, reagents for chemicals, specialized or supplementary equipment.

3 Execution

3.1 INSTALLATION

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

.2 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

.3 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.2 Chemical Feed Piping

.1 Install crosses at changes in direction. Install plugs in unused connections

3.3 Cleaning Of Mechanical Systems

.1 Provide copy of recommended cleaning procedures and chemicals for review by Consultant.

.2 Flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Use chemicals to inhibit corrosion of various system materials that are safe to handle and use.

.3 Examine and clean filters and screens, periodically during circulation of cleaning solution, and monitor changes in pressure drop across equipment.

.4 Drain and flush system(s) until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.

.5 Disposal of cleaning solutions approved by authority having jurisdiction.

3.4 Water Treatment Services

.1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:

- .1 Initial water analysis and treatment recommendations.
- .2 System start-up assistance.
- .3 Operating staff training.
- .4 Visit plant every 28 days during period of operation and as required until

system stabilizes, and advise on treatment system performance.
.5 Provide necessary recording charts and log sheets for one year operation.
.6 Provide necessary laboratory and technical assistance.
.7 Provide clear, concise, written instructions and advice to operating staff.

3.5 Field Quality Control

.1 Start-up:
  .1 Start up water treatment systems in accordance with manufacturer's instructions.

.2 Commissioning:
  .1 Commissioning Agency: to be installing water treatment sub-contractor.
  .2 Timing:
    .1 After start-up deficiencies rectified.
    .2 After start-up and before TAB of connected systems.
  .3 Pre-commissioning Inspections: verify:
    .1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.
    .2 Suitability of log book.
    .3 Currency and accuracy of initial water analysis.
    .4 Required quality of treated water.
  .4 Commissioning procedures - applicable to Water Treatment Systems:
    .1 Establish, adjust as necessary and record automatic controls and chemical feed rates.
    .2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.
    .3 Establish test intervals, regeneration intervals.
    .4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.
    .5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.
    .6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).
    .7 Advise Consultant in writing on matters regarding installed water treatment systems.
  .5 Commissioning procedures - Closed Circuit Hydronic Systems:
    .1 Analyze water in system.
    .2 Based upon an assumed rate of loss approved Consultant, establish rate of chemical feed.
    .3 Record types, quantities of chemicals applied.
  .8 Training:
    .1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.
    .2 Train O&M personnel in softener regeneration procedures.

.9 Certificates:

.1 Upon completion, furnish certificates confirming satisfactory installation and performance.

.10 Commissioning Reports:

.1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Consultant.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 07 84 00 – Fire Stopping.
.2 Section 21 05 01 – Common Work Results – Mechanical.
.3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
.4 Section 23 05 53.01 – Mechanical Identification.
.5 Section 23 05 94 - Pressure Testing of Ducted Air Systems.
.6 Section 23 07 13 – Thermal Insulation for Ductwork.

1.2 References

.1 American Society for Testing and Materials International, (ASTM):
  .1 ASTM A480/A480M-[03c], Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  .2 ASTM A635/A635M-[02], Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  .3 ASTM A653/A653M-[03], Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.2 National Fire Protection Association (NFPA):
  .1 NFPA 33- 2011 – Standard for Spray Applications Using Flammable or Combustible Materials.
  .2 NFPA 90A-2009, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  .3 NFPA 90B-2009, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
  .4 NFPA 96-2011, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 3'rd Edition 2005.
  .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.

1.3 Submittals

.1 Submit shop drawings and product data in accordance with Sections 01 33 00 - Submittal Procedures and 21 05 01 – Common Work Results – Mechanical.

1.4 Delivery, Storage And Handling

.1 Protect stored or installed material from moisture damage and dirt.

2 Products

2.1 Duct Construction

.1 Galvanized Steel Duct
  .1 Round ductwork.

.1 Construction shall be of galvanized steel of the following US Standard Gauges :

Duct Diameter	Spiral Duct Work	Plain Duct Gauge
< 8”	28	24
9” – 14”	26	24
16”	24	22
17” – 26”	24	not permitted
27” – 36”	22	
37” – 50”	20	
> 50”	18	

.2 Longitudinal joints for round duct shall be butt welded, SMACNA Type RL-4 or grooved seam, SMACNA Type RL-5.

.3 Concealed round branch ducts up to 16" diameter may be constructed with longitudinal seams.

.4 Concealed round branch ducts over 16" and all exposed round ducts shall be factory fabricated conduit consisting of helically wound galvanized iron strips with spiral lock seams. Fittings for these conduits shall be fabricated of 20 gauge galvanized sheet steel with butt welded seams.

.5 Transverse joints beaded crimp joints with at least 1” lap to accommodate screws at a maximum of 15” centers. Minimum of three (3) screws per joint.

.2 Square / Rectangular Duct

.1 Construction shall be of galvanized steel of the following US Standard Gauges:

Longest Duct side	Duct Ga	Transverse Joints		Reinforcing	
		Short Side	Long Side	Size	Spacing
< 12”	28	T1, T6	T1, T6	none	
13” – 18”	22	T1, T6	T1, T6	none	
	26	T1, T6	T1, T6	¾”x3/4”x20 ga. L	Each Joint Max 96”
		T10	T10	none	
19” – 30”	24	T10	T10	none	
		T1, T6	T1, T6	1” x 1” x 20 ga L	Each Joint Max 60”
31” – 48”	24	T10	T10	none	
		T1, T6	T1, T6	1¼” x 1¼” x 20 ga L	Each Joint Max 60”
49” – 60”	22	T1, T6	T1, T6	1¼” x 1¼” x 1/8” L	Each Joint Max 60”
61” – 84”	20	T1, T6	T1, T6	2” x 2” x 1/8” L	Each Joint Max 60”

.2 Ductwork is to be prefabricated using drive slip joints sized 18" or greater. Joints 14" or larger are to be reinforced.
.3 Ductmate 25 and 35 and Nexus G and J shall be approved as an acceptable equal to the above requirements, with neoprene gaskets and HM572 sealant for bolted assembly.

.2 Black Steel:
.1 18 ga to ASTM A635/A635M.
.2 Fabrication: ducts and fittings to SMACNA.
.3 Reinforcement: as indicated.
.4 Joints: continuous weld.

2.2 Seal Classification

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed

.2 Seal classification:
.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant, tape or combination thereof.
.3 Class C: transverse joints and connections made air tight with gaskets, sealant, tape or combination thereof. Longitudinal seams unsealed.
.4 Unsealed seams and joints.

2.3 Sealant

.1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

.2 Acceptable Materials: Bakor Duct-Seal, Duro Dyne DSW, Ductmate PROseal, Foster

2.4 Tape

.1 Tape: polyvinyl treated, open weave fiberglass tape, 2” wide.

.2 Acceptable Materials: Bakor 990-06, Duro Dyne FT-2

2.5 Duct Leakage

.1 In accordance with section 23 05 94, Pressure Test of Ducted Air Systems.

2.6 Fittings

.1 Fabrication: to SMACNA.

.2 Radiused elbows.
.1 Rectangular: standard radius (Centreline radius: 1.5 times width of duct) or short radius with single thickness turning vanes.

.2 Round: smooth radius, five piece. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:
- .1 To 16": with single thickness turning vanes.
- .2 Over 16": with double thickness turning vanes.

.4 Branches:
- .1 Rectangular main and branch to have 45 degrees entry on branch.
- .2 Round main and branch: enter main duct at 45 degrees with conical connection.
- .3 Provide volume control damper in branch duct near connection to main duct.
- .4 Main duct branches: with balancing damper unless shown otherwise..

.5 Transitions:
- .1 Diverging: 20 degrees maximum included angle.
- .2 Converging: 30 degrees maximum included angle.

.6 Offsets: As Indicated

.7 Obstruction deflectors: maintain full cross-sectional area.
- .1 Maximum included angles: as for transitions.

2.7 Fire Stopping

.1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.

.2 Fire stopping material and installation must not distort duct.

2.8 Galvanized Steel

.1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.

.2 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

.3 Acceptable Materials: Ductmate Canada Ltd.,, Exanno Nexus

2.9 Kitchen Exhaust Systems

.1 Construct in accordance with NFPA 96.

.2 Material: black steel

.3 Fabrication: as indicated.

.4 Drainage: Provide drains at low point in ductwork where water may collect.

.5 Grease filters: Provided with Kitchen Hood.

2.10 Hangers And Supports

.1 Hanger Configuration to SMACNA.

.2 Hanger rods to be galvanized steel rods sized as per tables below.

.3 Upper hanger attachments:
- .1 For concrete: manufactured concrete inserts.
- .2 For steel joist: manufactured joist clamp.
- .3 For steel beams: manufactured beam clamps:
- .4 Acceptable Materials: Grinnell Fig. 86, Myatt 492/494; Fig 586; Fig. 586

.4 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
- .1 Maximum size duct supported by strap hanger: 18" dia. or longest side of rectangular duct to be 18".

.5 Wire Hangers:
- .1 Maximum size duct supported by strap hanger: 18" dia. or longest side of rectangular duct to be 18"
- .2 Acceptable Manufacturers : Ductmate, Gripple

.6 Rectangular Duct:
- .1 Hangers: prime painted black steel or galvanized steel angle with galvanized steel rods to SMACNA following table:

Duct Width	Angle Size	Rod Size	Spacing
up to 30"	1" x 1" x 1/8"	¼"	120"
31" to 42"	1 ½" x 1 ½" x 1/8"	¼"	120"
43" to 60"		3/8"	120"
61" to 82"	2" x 2" x 1/8"	3/8"	96"
83" to 94"	2" x 2" x ¼"	3/8"	96"
95" and over		3/8"	96"

.7 Round / Oval Duct
- .1 Hanger construction and spacing to the following table

Duct Dia	Rod dia,	Strap	Wire dia	Spacing
< 10"	1 x ¼"	1" x 22 ga	1 x 12 ga	144"
11" – 18"			2 x 12 ga	
19" – 24"			2 x 10 ga	
25" – 36"	1 x 3/8"	1" x 20 ga	2 x 8 ga	
37" – 50"	2 x 3/8"	2 x 1" x 20 ga	N/A	
51" – 60"		2 x 1" x 18 ga		
61" – 84"		2 x 1" x 16 ga		
85" – 94"	2 x ½"	2 x 1 ½" x 16 ga		

2.12 Sheet Metal Plenums

.1 Nominal 18 ga. galvanized steel sheet re-squared and formed into 24" wide panels with 2" deep standing seams in accordance with SMACNA HVAC equipment and casings standard.

.2 Formed channel sections top and bottom of vertical sections and at all wall and floor intersections.

.3 Galvanized 2" x 2" x 1/8" thick angle frames around all duct and access door openings.

3 Execution

3.1 General

.1 Do work in accordance with NFPA 90A, NFPA 90B, SMACNA, and as indicated.

.2 Do not break continuity of insulation vapour barrier with hangers or rods. Provide rigid insulation between hangers and insulated duct.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

.7 Provide sealed access patches in ductwork every 10 m to allow for cleaning.

.8 The following table outlines the type of ductwork required in each system

Name of System	Description	Material	Comments
Fresh Air Intake	Duct from Louver into Building	Galvanized Steel	Make bottom watertight, install drain
Fresh Air Ducting	Duct from Plenum to AHU	Galvanized Steel	
General S/A	Ductwork between AHU and diffusers unless noted otherwise	Galvanized Steel	
General Return / Exhaust	Ductwork between grilles and exhaust fan and from fan to outside the building unless noted otherwise	Galvanized Steel	
Kitchen Hood Exhaust	Ductwork between	Type 304 SS or 16	All-welded

	Kitchen Hood and outside	gauge black steel	

3.2 Hangers

.1 Strap / Wire hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Trim hanger rods so that rods are no further than 25 mm below supported element.

.4 Trim ends of wire hanger cable so that 'free' end is no longer than 100 mm.

3.3 Watertight Duct

.1 Provide watertight duct for:
- .1 Fresh air intake.
- .2 Minimum 120" from duct mounted humidifier in all directions.
- .3 Where indicated.

.2 Form bottom of horizontal duct without longitudinal seams.
- .1 Solder or weld joints of bottom and side sheets.
- .2 Seal other joints with duct sealer.

.3 Slope horizontal branch ductwork down towards fume hoods served.
- .1 Slope header ducts down toward risers.

.4 Fit base of riser with 6" deep drain sump and 1 ¼" drain connected, with deep seal trap and valve and discharging to as indicated.

3.4 Kitchen Exhaust Systems

.1 Install to NFPA 96 and as indicated.

3.5 Sealing And Taping

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

3.6 Leakage Tests

.1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.

.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.3 Do leakage tests in sections.

.4 Make trial leakage tests as instructed to demonstrate workmanship.

.5 Do not install additional ductwork until trial test has been passed.

.6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.

.7 Complete test before performance insulation or concealment Work.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common, Work Results – Mechanical.

1.2 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A653/A653M-05, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM C423-02a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

.3 ASTM E90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.4 ASTM E477-99, Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

.3 National Building Code (NBC) – 2010.

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

.2 In addition to requirements of section 21 05 01, Common Work Results – Mechanical Shop drawing submittal for duct silencers shall include location, dimensions, independent laboratory certified dynamic insertion loss, self-noise, and pressure drop for each silencer.

1.4 Performance Requirements

.1 Rating Data:

.1 Provide performance rating data, certified by professional engineer or accredited test laboratory and supported by calculations and verified by test results in accordance with referenced standards as follows:

.1 Silencer: insertion loss, pressure drop at design conditions, generated noise level.

.2 Acoustic plenums: transmission loss and acoustical absorption.

.3 Acoustical performance measurements in accordance with ASTM E477, ASTM E90 and ASTM C423, except where specified otherwise.

2 Products

2.1 Absorption And Insulating Media

.1 Filler material shall be inorganic mineral or glass fibre of a density sufficient to obtain the specified acoustic performance and be packed under not less than 5% compression. Material shall be inert, vermin and moisture proof. The material shall be enclosed with a tight woven fabric beneath the perforated liner.

.2 Combustion rating of the filler and sealant material shall meet or exceed the following when tested in accordance with ASTM E84, NFPA Standard 255 or U.L. No. 723:

Flame Spread	= 25
Smoke Development Rating	= 0
Fuel Combustion	= 20

2.2 Silencers

.1 Factory manufactured of prime coated or galvanized steel, compatible with ductwork specified elsewhere and to ASHRAE and SMACNA standards.

.2 Casings for rectangular units shall be not lighter than 22 gauge and those for round units shall be not lighter than shown in the following:
Up to 24” - 22 gauge
25” to 36” - 20 gauge
37” to 50” - 18 gauge
50” to 60” - 16 gauge

.3 Interior casings for rectangular silencers shall be made of not less than 26 gauge, galvanized, perforated steel.

.4 Additional air tightness when required shall be provided by use of duct sealing compound applied at the job site.

.5 Silencers shall not fail structurally when subjected to a differential air pressure of 8 in wg inside to outside of casing.

.6 Acoustic rating of silencers shall be determined in duct to reverberant room test facility which provides for air flow in both directions through the test silencer during rating. The test set-up and procedure shall be such that all effects due to end reflection, directivity, flanking transmission, standing waves and test chamber sound absorption are eliminated. Acoustic ratings shall include Dynamic Insertion Loss (DIL) and Self-Noise (SN) power levels with air flow of at least 2000 fpm entering face velocity.

.7 Construction of units, including those consisting of assemblies of modular units shall be inherently airtight. Leak test pressure shall be not less than 6 in wg.

.8 Sound attenuators shall be so constructed and installed that they will not pant, vibrate, rattle, or otherwise react to system pressure variations. Mechanical fastenings which may loosen, such as nuts and bolts and sheet metal screws, shall not be used in unit assemblies.

.9 Performance: as indicated on drawings.

.10 Provide HTL (High Transmission Loss) casing for silencers where indicated.

.11 Stainless steel reactive type (packless) duct silencers for Laboratory, Animal, Radioactive exhaust systems, and where indicated. Stainless steel Tedlar flim lined (packaged) for Animal supply air system and where indicated.

.12 Acceptable Materials: E.H Price, Kinetics, VAW Systems, Vibro-Acoustics, Vibron

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Noise flanking: where indicated, install in wall sleeve with uniform clearance around to ensure no contact of silencer with wall sleeve. Pack with flexible, non hardening caulking on both sides of sleeves.

.2 Silencers to be supported from structure independently of ductwork and work of other trades.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.
.2 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa.
.3 Section 23 31 13.02 – Metal Ducts – High Pressure to 2500 Pa.

1.2 References

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 General

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 Flexible Connections

.1 Frame
  .1 For black steel or galvanized steel ductwork use galvanized sheet metal frame 24 ga thick with fabric clenched by means of double locked seams.
  .2 For stainless steel or aluminum ductwork use galvanized type 304 stainless steel metal frame 24 ga thick with fabric clenched by means of double locked seams.

.2 Material:
  .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m^2.

.3 Acceptable Materials: Duro-Dyne, Dyn-Air, Metal Fab

2.3 Access Doors In Ducts

.1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 24 ga complete with sheet metal angle frame.

.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 24 ga complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:
  .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
  .2 301 to 450 mm: four sash locks complete with safety chain.

.3 451 to 1000 mm: piano hinge and minimum two sash locks.
.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
.5 Hold open devices.
.6 300 x 300 mm glass viewing panels.
.7 Acceptable Products: AMI, Atlas, Ductmate, Dyn Air, Farr, Nailor Industries, Nexus, NR Murphy, Ruskin, Vent products Co.

2.4 Spin-In Collars

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to co-responding round duct standards.

2.5 Access Doors In Plenums

.1 Insulated: sandwich construction of same material as plenum wall (nominal 22 ga.) complete with 16 ga. sheet metal angle frame and 2" thick rigid glass fibre insulation.
.2 Gaskets: Neoprene.
.3 Hardware:
.1 Piano hinge and two 'T' handle cam-locks operable from both sides, corrosion resistant materials.
.2 Hold open device.
.3 12"x12" wired glass viewing panel.

2.6 Turning Vanes

.1 Factory or shop fabricated single thickness with trailing edge, to recommendations of SMACNA and as indicated.

3 Execution

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 Installation

.1 Flexible Connections:
.1 Install in following locations:
.1 Inlets and outlets to supply air units and fans.
.2 Inlets and outlets of exhaust and return air fans.
.3 As indicated.
.2 Length of connection: 100 mm.
.3 Install in accordance with recommendations of SMACNA.
.4 When system is operating:
1. Cross section of opposing openings to be in alignment
2. Minimum distance between metal parts : 75 mm
3. Ensure slack material in flexible connection

.2 Access Doors and Viewing Panels:
  .1 Size:
    .1 600 x 600 mm for person size entry.
    .2 300 x 300 mm for servicing entry.
    .3 150 x 150 mm for viewing.
    .4 or as indicated
  .2 Locations:
    .1 Fire and smoke dampers.
    .2 Control dampers.
    .3 Devices requiring maintenance.
    .4 Required by code.
    .5 Upstream and Downstream of duct mounted heating coils.
    .6 Elsewhere as indicated.
  .3 Remove sharp edges from ductwork where duct has been cut for access door installation.

.3 Turning vanes:
  .1 Install in accordance with recommendations of SMACNA and as indicated.

END OF SECTION

1 General

1.1 Related Sections
.1 Section 21 05 01 – Common Work Results for Mechanical.
.2 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa.

1.2 References
.1 Sheet Metal and Air Conditioning National Association (SMACNA)
  .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.

1.3 Submittals
.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 General
.1 Manufacture to SMACNA standards.

.2 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

2.2 Splitter Dampers
.1 Provide with control rod with locking device, position indicator, piano hinge pivot, folded leading edge, and configured to prevent end from entering duct.

2.3 Single Blade Dampers
.1 V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 Multi-Blade Dampers
.1 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.2 Maximum blade height: 4”.

.3 Linkage: shaft extension with locking quadrant.

.4 Channel frame of same material as adjacent duct, complete with angle stop.

.5 Acceptable Materials: Dyn Air, Nailor Ind.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate balancing dampers in each branch duct, for supply, return and exhaust systems, where indicated, and in such other locations where required to properly balance the systems. In all cases, sufficient dampers shall be installed in the dampers so that the dampers installed in the diffusers are for 'fine tuning' only.

.3 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.4 Dampers: vibration free.

.5 Ensure damper operators are observable and accessible.

.6 Corrections and adjustments conducted by Engineer.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.
.2 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa.
.3 Section 23 33 00 – Air Duct Accessories.
.4 Section 25 30 02 – EMCS Field Control Devices.

1.2 References

.1 American Society for Testing and Materials International (ASTM):
  .1 ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.
.2 Include product performance criteria and limitations.

2 Products

2.1 Multi-Leaf Dampers

.1 Opposed blade type as indicated. Provide parallel blade units for mixing applications.

.2 Mixing dampers to be extruded Aluminum, interlocking blades c/w extruded EPDA elastomer seals, and extruded aluminum frame.

.3 Fresh Air, Exhaust Air, and other dampers as noted dampers to be extruded Aluminum, interlocking blades c/w internal polyurethane blade insulation, extruded thermoplastic frame seals, and extruded aluminum frame c/w polystyrene insulation. RSI of frames and blades to be RSI 0.88

.4 Bearings comprised of a celcon inner bearing fixed to a 0.43” aluminum hexagon blade pin rotating within a polycarbonate outer bearing inserted in the frame, no metal-to-metal or metal-to-plastic contact.

.5 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod. Linkage hardware is installed in frame side and constructed of aluminum and corrosion resistant zinc and nickel-plated steel, complete with cup-point trunnion screws for a slip-proof grip.

.6 Operator as specified in the control section.

.7 Performance:
  .1 Leakage: in closed position less than 18 cfm at 4.00 in wg differential across damper.

.2 Pressure drop: at full open position less than 0.30 in wg differential across damper at 0.30 fpm.

.8 Standard of Acceptance :
.1 Non insulated - Tamco 1000
.2 Insulated – Tamco 9000

.9 Acceptable Materials: Alumavent, Nailor Industries, Ruskin, Ventex, Tamco.

2.2 Back Draft Dampers

.1 Automatic gravity operated. Dampers to be made of same material as duct. Units c/w nylon bearings, center pivoted spring assisted or counterweighted, as indicated.

.2 Standard of Acceptance: Tamco Series 7000

.3 Acceptable Materials: Fantech, Greenheck, Labcono, Nailor Industries, NCA, Ruskin, Ventex; Alumavent.

3 Execution

3.1 General

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

.2 All motorized dampers not part of manufactured boxes shall be supplied by the control supplier and installed by the Sheet Metal contractor.

.3 Backdraft dampers shall be supplied and installed by the Sheet Metal contractor.

.4 All exhaust air systems, including roof and wall exhausters shall be complete with motorized dampers or automatic backdraft dampers as shown on the drawings.

3.2 Installation

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Ensure dampers are observable and accessible.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.
.2 Section 23 05 53.01 – Mechanical Identification.
.3 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa.
.4 Section 23 33 00 – Air Duct Accessories.

1.2 References

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
  .1 ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Underwriters Laboratories of Canada (ULC)
  .1 CAN4-S112-M1990, Fire Test of Fire Damper Assemblies.
  .2 CAN4-S112.2-M84, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
  .3 ULC-S505-1974, Fusible Links for Fire Protection Service.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 Fire Dampers

.1 Fire dampers shall be made of the same material as the duct and have a minimum 90 minute fire rating unless noted otherwise. Blades shall be hinged on brass or bronze bearings and shall be counter weighted when necessary to ensure closing.

.2 Fire dampers shall close against an angle stop with a spring catch. Dampers shall close in the direction of air flow.

.3 Fire dampers shall be held open by approved fusible links.

.4 Fire dampers shall be static and/or dynamic, as required, and bear label of ULC and/or cUL, and meet requirements of authority having jurisdiction.

.5 Fire Dampers in ducts whose smaller dimension is less than 18” mm shall keep the undeployed damper blades out of the air stream.

.6 Shop fabricated fire dampers will not be accepted.

.7 Acceptable Materials: Alumavent, AMI, Atlas, CAA Limited, Greenheck, Nailor Industries, NCA, Ruskin, EH Price; Arrow United Industries/Mestek.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Fire Dampers

.1 Install Fire Dampers where shown on plans, at all locations where ducts penetrate floors, at all locations where ducts penetrate walls required to have a fire resistance rating (including but not limited to shafts, Elevator Machine Rooms, Mechanical Rooms, Electrical Rooms, Janitor's Rooms, Wood Shops, Kitchens, and Laboratories), and where required by the NBC.

.2 Install 1 ½" x 1 ½" x 1/8" retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.3 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.

.4 Ductwork adjacent to each damper shall be equipped with a suitable located access door to section 23 33 00 to allow resetting of the damper. Supply access door for installation by others in drywall, metal, or wood panel ceilings where required.

.5 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness unless noted otherwise.

.6 Install breakaway joints on each side of fire damper.

.7 Unless otherwise indicated, the installation details given in SMACNA.

.8 Fire Stops shall be provided where ceilings forming part of the fire rated assembly are penetrated.

.9 Identify Fire Dampers as per section 23 05 53.01.

.10 In general, fire dampers are indicated on the drawings, however, this sub-contractor shall review the Architectural drawings and provide any additional dampers that may be required in "rated' fire separations at no additional cost.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.
.2 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa.

1.2 References

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 National Fire Protection Association (NFPA).
  .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  .2 NFPA 90B-02, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.

.3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
  .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 95 (Addendum No.1, November 1997).
  .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition 1995.

.4 Underwriters' Laboratories Inc. (UL).
  .1 UL 181-96, Standard for Factory-Made Air Ducts and Air Connectors.

.5 Underwriters' Laboratories of Canada (ULC).
  .1 CAN/ULC-S110-1986 (R2001), Fire Tests for Air Ducts.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

.2 Include the following product performance criteria, and limitations.
  .1 Thermal properties.
  .2 Friction loss.
  .3 Acoustical loss.
  .4 Leakage.
  .5 Fire rating.

2 Products

2.1 General

.1 Factory fabricated to CAN/ULC-S110.

.2 Pressure drop coefficients listed is based on relative sheet metal duct pressure drop coefficient of 1.00. Maximum relative pressure drop coefficient: 3

.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

.4 Pressure range : -500 Pa to 2500 Pa.

.5 Temperature range : 18 deg C to 90 deg C

.6 Acceptable Materials: Atlas, Duro Dyne, Flexible Technologies, Flexmaster, Thermaflex

2.2 Metallic - Uninsulated

.1 Spiral wound flexible aluminum.

2.3 Metallic - Insulated

.1 Spiral wound flexible aluminum with factory applied, 37 mm thick flexible glass fibre thermal insulation with vapour barrier and aluminum jacket.

3 Execution

3.1 Installation

.1 Install in accordance with: CAN/ULC-S110, UL-181, NFPA 90A, NFPA 90B, and SMACNA.

.2 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

.3 Flexible duct permitted to be used for connections to S/A diffusers, R/A grilles, and E/A grilles where steel ductwork is permitted.

.4 Maximum length of flexible duct: 60”.

.5 Support properly at midpoint with wide strips to prevent kinks in duct.

.6 Use rigid sheet metal elbow at diffuser inlet neck. Maximum 15 degree offset with flexible duct.

.7 Flexible ducts shall not rest on the finished T-bar or GWB ceilings.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results, Mechanical.
.2 Section 23 05 13 – Common Motor Requirements for HVAC.
.3 Section 23 05 29 – Hangers and Supports for Piping and Equipment.
.4 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
.5 Section 23 05 53.01 – Mechanical Identification.
.6 Section 23 05 93 – TAB for HVAC.
.7 Section 23 33 00 - Air Duct Accessories.

1.2 References

.1 Air Conditioning and Mechanical Contractors (AMCA)
  .1 AMCA Publication 99-2003, Standards Handbook.
  .2 AMCA 300, Reverberant Room Method for Sound Testing of Fans.
  .3 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.4 National Fire Protection Association (NFPA).
  .2 NFPA 96-2011, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

.2 In addition to the items listed in section 21 05 01 provide the following with the shop drawing submittal :
  .1 Fan Curves showing expected operating point
  .2 Acoustic data

2 Products

2.1 Fans General

.1 Motors:
  .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
  .2 For use with variable speed controllers.
  .3 Provide units with motors 3 hp and larger with multi-belt V-belt drives.

.4 Sized so they draw no more than 75% of their rated maximum amp draw at design conditions

.2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet / outlet safety screens, and inlet / outlet dampers as indicated.

.3 Factory primed before assembly in colour standard to manufacturer.

.4 Scroll casing drains: as indicated.

.5 Fan wheels to be dynamically balanced.

.6 Units shall be suitable for mounting as shown on the drawings (and as indicated below). Where necessary adequate structure shall be provided to support fans (ie legs or auxiliary beams).

.7 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.8 All units shall have vibration isolators to prevent vibration transmission to building structure..

.9 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 <u>Centrifugal Fans</u>

.1 Fan wheels:
- .1 Welded construction.
- .2 Maximum operating speed of centrifugal fans not more than 50 % of first critical speed.
- .3 Air foil, forward curved, backward inclined blades, as indicated.

.2 Bearings: heavy duty, split pillow-block, flange mounted grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 80,000 hours.

.3 Shaft seals on laboratory fume hood and biological safety cabinet exhaust fans:
- .1 (Single disc) (multi-disc labyrinth) (water-cooled) (stuffing box) (carbon ring with (nitrogen) (air) purging) seals.

.4 Housings:
- .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel or aluminum for smaller wheels, braced, and with welded supports.
- .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
- .3 Provide latched airtight access doors with handles.

.5 Acceptable Materials: ACME, Greenheck CSP, Cook, Penn Barry, Twin City.

2.3 Cabinet Fans - General Purpose

.1 Fan characteristics and construction: as centrifugal fans.

.2 Single or multiple wheel with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators, motor, variable speed V-belt drive and guard inside or outside casing.

.3 Acceptable Materials: ACME, Greenheck CSP, Cook, Penn Barry, Twin City.

2.4 In-Line Centrifugal Fans

.1 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction drive.

.2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

.3 Acceptable Materials: ACME, Greenheck CSP, Cook, Penn Barry, Twin City.

2.5 Kitchen Grease Exhaust Hood Roof Exhauster

.1 Relocate existing unit.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Fan Installation

.1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

3.3 Anchor Bolts And Templates

.1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.

1.2 References

.1 American National Standards Institute (ANSI)
- .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 International Organization of Standardization (ISO)
- .1 ISO 3741-2001, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.

.3 Underwriter's Laboratories (UL)
- .1 UL 181-2003, Factory-Made Air Ducts and Air Connectors.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

2 Products

2.1 Manufactured Units

.1 Terminal units of the same type to be product of one manufacturer.

2.2 Variable Volume Boxes

.1 Pressure independent to provide air flow between minimum and maximum air volume.

.2 Sizes, capacities, differential pressures and sound ratings: as indicated.

.3 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.

.4 Sound ratings of assembly not to exceed values shown on drawings.

.5 Complete with:
- .1 Operator and controller.
- .2 Accessories, heating coils, adaptors shown in schedule on drawings.
- .3 Access door

.6 Operator to be factory mounted and calibrated:
- .1 Gauge taps for balancing with standard pressure gauge.
- .2 Controller to have adjustable flow settings.

.7 Casing: constructed of 22 ga galvanized steel, internally lined with 25 mm, 0.7 kg density fibrous glass, to UL181 and ANSI/NFPA 90A. Mount control components inside protective metal shroud.

.8 Damper: 22 ga galvanized steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.

.9 Casing Leakage not to exceed 1% of flow at 250 Pa.

.10 Acceptable Materials: E.H. Price, Kreuger, Nailor, Titus.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install in accordance with manufacturers recommendations.

.2 Support independently of ductwork.

.3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.

.4 Locate controls, dampers and access panels for easy access.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 - Common Work Results – Mechanical.

1.2 References

.1 American National Standards Institute (ANSI)

.1 ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 International Organization of Standardization (ISO)

.1 ISO 3741-2001, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.

.3 Underwriter's Laboratories (UL)

.1 UL 181-2003, Factory-Made Air Ducts and Air Connectors.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

2 Products

2.1 General

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

.2 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.3 Where grilles and registers penetrate fire walls and fire partitions, provide approved steel sleeve secured to structure in accordance with NFPA 90A and NBC.

.4 Where diffusers penetrate fire rated ceilings, provide fire stop flaps and radiation barriers in accordance with NFPA 90A and NBC.

.3 Frames:

.1 Full perimeter gaskets.
.2 Plaster frames where set into plaster or gypsum board and as specified.
.3 Concealed fasteners.
.4 Mitred corners.

.4 Provide concealed manual volume control damper operators where indicated.

.5 Finish: off white baked enamel unless noted otherwise.

.6 Floor and or Sill grilles to be capable of supporting 90 kg point load weight between supports with negligible deflection and be heel proof.

.7 Acceptable Materials: Construction Specialties, E.H. Price, Krueger, Nailor, Titus.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install in accordance with manufacturer’s instructions.

.2 Install with flat head cadmium plated screws in countersunk holes where fastenings are visible.

.3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.

.4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms and elsewhere as indicated.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.

1.2 References

.1 American Society for Testing and Materials International (ASTM):

.1 ASTM E90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

.2 Provide color chart with shop drawing submittal.

2 Products

2.1 Gravity Roof Outside Air Intakes And Relief Vents

.1 Factory manufactured aluminum, hinged at curb line c/w 12 mm stainless steel mesh birdscreen.

.2 Acceptable Material: Airolite, Cook, Greenheck, Penn, Ventex.

2.2 Gooseneck Hoods

.1 Material and Fabrication to ASHRAE and SMACNA. Kitchen hood exhaust to NFPA 96.

.2 Supports: as indicated.

.3 C/w ½" stainless steel mesh birdscreen and prefabricated, 18" high roofcurb.

2.3 Fixed Louvres - Aluminum

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: extruded aluminum alloy 6063-T5.

.3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 60".

.4 Frame, head, sill and jamb: 4" mm deep one piece extruded aluminum, minimum 1/8" thick with approved caulking slot, integral to unit.

.5 Mullions: at 60" maximum centres.

.6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

.7 Screen: ½" mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.

.8 Finish: Factory applied Fluoropolymar, Kynar or Durmar. Colour to be selected by architect at time of shop drawing submittal.

.9 Louvres shall have extended sill frame.

.10 Acceptable Materials: Aerolite, Alumavent, Construction Specialties, Cook, EH Price, Greenheck, McGill, Penn Barry, Ruskin, Ventex

2.4 Acoustic Louvres

.1 Louvres shall be acoustic type incorporating stationary, parallelogram blades in a single frame. Louvres shall be 12" deep and assembled entirely from fabricated aluminum components. Blades and frames shall be 0.08" thick aluminum, alloy 3003-H32. Blades shall be positioned 45 degrees and spaced 5" on centre. Each blade and top and bottom frame cavity shall be filled with fibreglass acoustic insulation to absorb the transmission of sound. Acoustic insulation shall be held in place by 0.032" think perforated aluminum panels.

.2 Join stationary blade and frames and frame members with fillet welds concealed from view, unless the size of the louvre makes bolted connections between louvre sections necessary. Louvre blades shall be joined to each jamb frame with a minimum of four fillet welds produced with the Pulsed Gas Metal Arc Welding (GMAW/Mig) process. Each weld shall be a minimum of 1" in length with a minimum 3/16" leg. Frames shall be joined at each corner with a full length GMAW fillet weld with a minimum 3/16" leg.

.3 Manufacturer shall design and furnish all supports required to withstand a wind force of not less than 25 lb/ft^2 (100 mph). Louvres larger than 60" wide x 96" high will be fabricated and installed in multiple section. Louvre blades, frames, mullions, and anchorages shall be demonstrated to withstand the specified wind design load.

.4 The acoustic louvres shall have a free area of at least 22.9%. The noise reduction shall be as shown on drawings.

.5 Three Coat Fluoroplymer: Louvres shall be cleaned, pretreated and finished-after-assembly with an inhibitive primer and over-cured Kynar 500 / Hylar 5000 resin coating with minimum 2.0 mils dry-film coating thickness that meets or exceeds the performance requirements of AAMA 2605, "Voluntary Specification, Performance Requirements and Test Procedures for Superior Performance Organic Coatings on Aluminum Extrusions and Panels".

.6 Acceptable Products: Airolite, EH Price, Greenheck, McGill, Ruskin, Ventex.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

END OF SECTION

1 General

1.1 Related Sections
.1 Section 21 05 01 - Common Work Results - Mechanical.

1.2 References
.1 Reference Standards:
- .1 Canadian Standards Association (CSA International):
- .2 National Fire Protection Association (NFPA).
  - .1 NFPA 96-2011, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .3 Underwriter's Laboratories of Canada (ULC).

1.3 Submittals
.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

2 Products

2.1 Kitchen Hoods
.1 Supplied and Installed by Others.

2.2 Dishwasher Hood
.1 Supplied and Installed by Others.

3 Execution

3.1 Manufacturer’s Instructions
.1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Installation
.1 This contractor to connect ductwork to hoods provided by others.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.
.2 Section 23 05 53 - Mechanical Identification.
.3 Section 23 33 00 - Air Duct Accessories.
.4 Section 23 31 13.02 - Metal Ducts High Pressure to 2500 Pa.

1.2 References

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  .1 ASHRAE 52.1-1992, Gravimetric And Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved).

.2 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
  .2 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
  .3 CAN/CGSB-115.16-M82, Activated Carbon for Odor Removal from Ventilating Systems.
  .4 CAN/CGSB-115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

2 Products

2.1 General

.1 Media: suitable for air at 100% RH and air temperatures between minus 40 and plus 50 degrees C.

.2 Number of units, size type, and thickness of filters, overall dimensions of filter bank, configuration and capacities: as indicated in schedule on drawings.

.3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

2.2 Accessories

.1 Holding frames: permanent "T" section or channel section construction of galvanized steel or extruded aluminum, 1.6 mm thick, except where specified.

.2 Seals: to ensure leakproof operation.

.3 Blank-off plates: as required, to fit all openings and of same material as holding frames.

.4 Access and servicing: through doors/panels on either side and/or from upstream face of filter bank.

2.3 Fibrous Glass Panel Filters

.1 Disposable fibrous glass media: to CAN/CGSB-115.10 with adhesive.

.2 Holding frame: 1.2 mm minimum thick galvanized steel with 3 mm diameter hinged wire mesh screen.

.3 Fire rated: to ULC -S111.

2.4 Cartridge Type Filters – Merv 13

.1 Media: disposable, high efficiency, to CAN/CGSB-115.15.

.2 Holding frame: galvanized steel with bracing.

.3 Media support: welded wire grid.

.4 Performance: average atmospheric dust spot efficiency 95 % to ASHRAE 52.1.

.5 Fire rated: to ULC-S111.

.6 Acceptable Materials: AAF, Cambridge, Farr, Flanders

2.5 Activated Carbon Type Filters

.1 Space to be left in AHUs for future installation of Carbon Filters.

.2 Holding frame: removable, non-disposable, plastic or corrosion resistant steel.

.3 Filter housing: corrosion resistant steel.

2.6 Filter Gauges - Dial Type

.1 Diaphragm actuated, direct reading.

.2 Range: 0 to 2 times initial pressure 0 to 250 Pa.

.3 Acceptable Material:
.1 Magnehelic 2000 Series.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation General

.1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.3 Replacement Media

.1 Replace media with new upon acceptance.

.2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

3.4 Filter Gauges

.1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.

.2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.

1.2 References

.1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

.2 Underwriters' Laboratories of Canada (ULC).

1.3 Submittals

.1 Submit shop drawings and Maintenance Manual material in accordance with Section 01 33 00 - Submittal Procedures and Section 21 05 01 – Common Work Results, Mechanical.

.2 In addition to items listed in 21 05 01 indicate following:

- .1 Methods of sealing sections.
- .2 Methods of expansion.
- .3 Details of thimbles.
- .4 Bases/Foundations.
- .5 Supports.
- .6 Guy details.
- .7 Rain caps.
- .8 Sizing Calculations
- .9 Installation drawings.
- .10 Confirm unit is suitable for use with a condensing appliance.

2 Products

2.1 Chimney (For Use With A Condensing Boiler)

.1 Pre-insulated, pre-fabricated, double walled (50 mm annular space), ULC listed metal chimney of the size indicated on the drawings rated for service to 760 deg C, an internal static pressure of 2500 Pa, and tested to 6250 Pa.. Unit to be to be complete with all necessary supports, guy wires, drains, roof / wall penetrations, appliance connectors, etc..

.2 Chimney to be 2700 mm higher than the highest point of the building.

.3 Chimney to have a 0.038 mm thick AL29-4C super ferritic stainless steel inner casing, and an outer casing made of Type 304 stainless steel or 0.457 mm thick aluminized steel.

.4 Inner and outer casings to be to be connected with spacer clips to maintain the concentricity of the annular space and allow for unobstructed differential thermal expansion of the casing walls.

.5 Vent shall be secured by sheet metal screws through casings. Joints shall be sealed with factory supplied gaskets.

.6 Where exposed to weather the outer closure band shall be sealed to prevent rainwater from entering annular space.

.7 Provide stainless steel drain connection at base of stack.

.8 This product to be used for the breeching also.

.9 Mineral Wool insulation to be minimum 50 mm thick.

.10 Acceptable Materials: Selkirk, Isotherm, Security.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation - General

.1 Follow SMACNA installation recommendations for shop fabricated components.

.2 Suspend breeching at 1500 mm centres and at each joint.

.3 Support chimneys at bottom, roof and intermediate levels as indicated.

.4 Install thimbles where penetrating roof, floor, ceiling and where breeching enters masonry chimney. Pack annular space with heat resistant caulking.

.5 Install flashings on chimneys penetrating roofs, as indicated.

.6 Install rain caps and cleanouts, as indicated.

.7 Provide flue gas thermometer for each Boiler stack/breeching.

.8 Clean all vent and breeching of dust and debris before connection to appliance.

.9 Run drain line from drain connection to neutralizing container and floor drain / floor / ground. Piping between stack and neutralizing tank to be stainless steel.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.

1.2 References

.1 American Boiler Manufacturer's Association (ABMA).

.2 American National Standards Institute (ANSI)
- .1 ANSI Z21.13-2004/CSA 4.9-2004, Gas-Fired Low-Pressure Steam and Hot Water Boilers.

.3 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)
- .1 ANSI/ASME Boiler and Pressure Vessel Code, Section IV, 2004.

.4 Canadian Gas Association (CGA)
- .1 CAN1-3.1-77(R2001), Industrial and Commercial Gas-Fired Package Boilers.
- .2 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code.

.5 Canadian Standards Association (CSA International)
- .1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.
- .2 CSA B139-04, Installation Code for Oil Burning Equipment.
- .3 CSA B140.7-05, Oil Burning Equipment: Steam and Hot-Water Boilers.

.6 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

1.3 Submittals

.1 Shop Drawing and Maintenance Manual submittals in accordance with Sections 01 33 00 - Submittal Procedures and 21 05 01 – Common Work Result – Mechanical.

.2 In addition to the requirements of section 21 05 01 submittals are to clearly indicate:
- .1 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
- .2 Foundations with loadings, anchor bolt arrangements.
- .3 Flame safety control system.
- .4 Stack emission continuous monitoring system to measure C0, 0, N0x, S0, stack temperature and smoke density of flue gases.
- .5 Engineering data to include:
  - .1 Boiler efficiency at 25%, 50%, 75%, 100%, and 110% of design capacity.
  - .2 Radiant heat loss at 100% design capacity.
- .6 Supplier to make available to the Consultant one (1) copy of systems supplier's installation instructions.

1.4 Maintenance

.1 Extra materials:

.1 Special tools for burners, manholes, handholes and Operation and Maintenance.
.2 Spare parts for 1 year of operation.
.3 Spare gaskets.
.4 Spare gauge glass inserts.
.5 Probes and sealants for electronic indication.
.6 Spare burner tips.
.7 Spare burner gun.
.8 Safety valve test gauge.

2 Products

2.1 General

.1 Provide Natural Gas fired hot water forced draft condensing boiler(s) c/w modulating burner(s), accessories, and controls. Units to be factory tested at rated capacity, and bear seal or nameplate certifying compliance with CSA / CGA standards; Boiler and burners shall be listed as a cUL, ULC, or CSA approved package with site verified operation for a minimum of three (3) years. Field verification is not acceptable.

.2 Ready for attachment to piping, electrical power, controls, flue gases exhaust.

.3 Designed and constructed to ANSI/ASME Boiler and Pressure vessel Code.

.4 CRN (Canadian Registration Number), to CSA B51.

.5 Boiler performance as shown on drawings. Data to be in accordance with American Boiler Manufacturers Association (ABMA) test procedures.

.6 Electrical service as shown on drawings. Electrical components to be CSA approved.

.7 Controls: factory wired. Enclosed in Electrical and Electronic Manufacturers' Association of Canada (EEMAC) 1 steel cabinet.

.8 Thermal insulation:. Seal insulation at handholes, manholes, mudholes, piping connections with insulating cement or asphaltic paint. Finish with heat resisting paint.

.9 Jackets: heavy gauge metal, finished with heat resisting paint.

.10 Support unit with a Structural steel base c/w lifting lugs.

.11 Supply Anchor bolts and templates for installation by other Divisions. Anchor bolts to be sized to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.12 Start-up, instruction, on-site performance tests: 1 day per boiler.

.13 Trial usage:
- .1 Owner and/or Consultant may use boilers for test purposes prior to acceptance and commencement of warranty period.
- .2 Supply labour, materials and instruments required for tests.

.14 Temporary use by contractor:
- .1 Contractor may use boilers only after written approval from Consultant.
- .2 Monitor and record performance continuously. Keep log of maintenance activities carried out.
- .3 Refurbish to as-new condition before final inspection and acceptance.

2.2 Hot Water Condensing Boiler

.1 General:

- .1 The hot water heating boilers shall be high-efficiency gas-fired condensing boilers.
- .2 The energy savings from the flue gas condensation collection shall be extracted sing the special corrosion-resistant stainless steel and titanium heat exchanger. The non-fin heat exchanger surfaces shall be designed with wide water passageways in between plates, and a large water volume on the pressure vessel side to enhance heat transfer.
- .3 Venting material shall be Category IV stainless steel, be water and gas tight and shall be AL29-4C stainless steel.

.2 Performance Criteria: As noted on drawings

- .1 Capacity and operating conditions noted on drawings:
- .2 Thermal efficiency shall not be below 96.2%, as tested in accordance with the harmonized standard ANSI Z21.13.CSA 4.9.
- .3 Boiler turn-down ratio shall be 1:3 or better.
- .4 The ASME maximum allowable working pressure (MAWP) shall be 207 kPa.
- .5 The ASME maximum water temperature (Fixed High Limit) shall be 99 oC.
- .6 The boiler shall operate without a flow switch.
- .7 The heat exchanger filled with water shall weigh no less than 1,052 kilograms excluding the burner, controls and jacketing.
  - .1 Input rate per heat exchanger surface area shall not exceed 30.9 kW/m^2 based on input at full fire.
  - .2 At the maximum flow rate through the heat exchanger, the boiler shall have head resistance no greater than 3.5 ft of heat of water column.
- .8 No additional safety devices shall be required to safeguard against low flow conditions.
- .9 The flue gas temperature measured at the boiler breaching shall be able to attain 10 oC above return water temperatures.
  - .1 The flue gas is to be individually direct vented with separate breeching and chimneys.

.10 The combustion air is to be drawn directly from outside through a common louver.

.11 The boiler shall have a second return water connection for water temperatures above 60 oC designed specifically not to hinder the rate of condensation from the low temperature circuit.

.12 The condensation rate, controlled by optimum combustion, shall be able to meet a CO_2 value of 10% through the entire firing range.

.13 Manufacturer shall provide two neutralizing tanks per boiler: one neutralizing tank for the chimney drain and one neutralizing tank for the boiler condensate drain.

.1 All neutralizing tanks to be complete with limestone charge and one year supply of additional limestone.

.2 Drainage piping from boilers through neutralizing tank to drain to be corrosion resistant, sloped towards the drain and complete with a P-Trap.

.14 Controls:

.1 The standard control option, integral to each boiler, shall be designed and provided by manufacturer and able to operate independently or integrate with building management system protocols (ie. Native BACnet Energy Management and Control System).

.2 The standard controls for each boiler module are to include:

.1 Solid state controller with auxiliary relay.

.2 Fan proving pressure switch and pressure sensing flame safeguard system.

.3 Combination gas control is to be provide complete with:

.1 Manual shut off valve.

.2 System pressure controlled regulator.

.3 Automatic redundant shut off valves.

.4 High limit water temperature control with adjustable differential.

.5 ASME approved pressure relief valve and temperature/pressure indicator.

.3 Each boiler module is to be factory wired operationally tested to ensure each module is suitable for:

.1 Individual firing.

.2 Step firing accomplished by firing individual modules without reducing their thermal efficiency.

.15 Construction:

.1 Boiler unit to be factory assembled and each module is to include:

.1 Combustion air inlet chamber.

.2 Pre-purge blower assembly.

.3 Air-gas fuel control valve.

.4 Welded absorption chamber with spiralled fire tubes and exhaust chamber.

.5 House assembly in insulated jacket which includes boiler mounted electrical control panel enclosure with operation sequence indicator lights.

.6 Provide coupling on combustion air inlet and exhaust chambers for connections of plastic piping, PVC for outside air intake and CPVC for outside exhaust.

.7 Provide condensate drain fitting on exhaust chamber.

.8 Boiler materials will enable operation with flue gas temperature below dew-point without corrosion.The combustion chamber, heat exchanger and condensate collector shall be constructed of high-alloy stainless steel and titanium.

.2 The R-Value of the insulation shall be equivalent to 100 mm mineral wool with nylon backing.

.3 The flue gases shall pass by the return water in a counter-flow direction only, for maximum heat transfer effectiveness.

.4 The heat exchanger shall be of two-piece design for ease of handling and incorporate a full-swing door, left- or right-hinge, to allow for easy inspection and cleaning.

.5 Boiler body and fitted boiler door with burner plate, fitted clean-out cover and fitted mating flanges including gaskets on all connectors, with flue gas collector.

.6 Boilers are to be complete with low water cut-off, safety header complete with 207 kPa pressure relief valve, air vent and pressure gage and drain valve.

.3 Acceptable Manufacturers: Viessmann, De Dietrich or Buderus.

2.3 Accessories

.1 Provide auxiliaries for each boiler and to meet ANSI/ASME requirements.

.2 Hot water boilers:

.1 Relief valve(s): ANSI/ASME rated, set at 207 kPa, to release entire boiler capacity.
.2 Pressure gauge: 100 mm diameter complete with shut-off cock.
.3 Thermometer: 100 mm diameter range 10 to 150 degrees C.
.4 Low water cut-off: with visual and audible alarms.
.5 Auxiliary low water cut-off: with separate cold water connection to boiler.
.6 Isolating gate valves: on supply and return connections.
.7 Drain valve: NPS 2.
.8 Stack thermometer: range 65 to 400 degrees C.
.9 Outdoor controller: to reset operating temperature controller.
.10 One (1) set of cleaning tools.

.3 Pot type chemical feeder.

2.4 Natural Gas Burners

.1 The natural gas-fired burner shall be a forced draft, automatic, fully modulating burner designed to burn natural gas or propane gas complete with:

- .1 Built-in blower to supply combustion air complete with motor, silencer and damper.
- .2 High voltage ignition transformer.
- .3 Flame observation port.
- .4 Easily accessible nozzles and electrodes.

.2 Performance Criteria:

- .1 Each burner shall have a firing rate noted on the drawings.
- .2 The burner turndown ratio shall be a minimum of 6:1. The O_2 levels shall be a maximum of 3% at high fire and 4.5% at low fire. CO shall not exceed 20 ppm at all rates.

.3 Construction:

- .1 Burner Housing:
  - .1 The burner housing shall be made of cast aluminum and shall be capable of hinging open to the left or to the right.
  - .2 The burner housing shall incorporate the following features:
    - .1 A flange safety interlock switch to prevent the burner from starting when in the open position
    - .2 A self-checking differential air pressure switch
    - .3 A large sight glass for viewing the flame
    - .4 A removable cover to allow free access to serviceable components
- .2 Gas pilot:
  - .1 To Building code and provincial regulations including solenoid gas valve, pressure regulator, pressure gauge, manual shut-off valve.
- .3 Main gas train:
  - .1 To Building code and provincial regulations including main shut-off valve, pressure regulator, motorized electric shut-off valve, downstream block-test valve with test connection and pressure gauge.
- .4 Fan:
  - .1 The blower wheel shall be statically and dynamically balanced.
- .5 Air Intake:
  - .1 The air intake shall consist of multiple aluminum air intake vanes on the suction side for combustion air regulation.
  - .2 Air louvers shall be controlled by a dedicated stepper motor having 900 settable increments from 90 angular degrees (open) to 0 angular degrees (closed).
  - .3 Air louvers shall be driven to the fully closed position during the "off" cycle to minimize draft losses.

.4 The air intake shall include sound attenuating material and a screen to reduce the likelihood of foreign material entering the blower.

.6 Combustion Head:

.1 The flame tube and diffuser assembly shall be made of stainless steel alloy and shall have a temperature rating of 1470°F.

.2 The diffuser, ignition electrodes, mixing assembly and all serviceable components shall be accessible without need for burner removal.

.3 The combustion head shall be adjustable such that the pressure drop across the diffuser can be optimized to match the maximum firing rate of the burner.

.4 The gas butterfly valve shall be integral to the burner allowing the gas train to be connected to the left or the right of the burner.

.5 The gas butterfly valve shall be controlled by a dedicated stepper motor having 900 settable increments from 90 angular degrees (open) to 0 angular degrees (closed).

.7 Burner Management System:

.1 The burner management system shall integrate fuel/air ratio control, flame safeguard functions, load control and communications into one control system.

.2 The fuel/air ratio control system shall be free of linkages which connect fuel control and air control functions into a common servomotor or actuator.

.3 Fuel and air control components shall be individually controlled by dedicated stepper motors programmable via the keypad.

.4 The fuel/air ratio shall be infinitely adjustable throughout the firing range.

.5 The burner shall have independent ignition position (independent of any other firing position).

.6 All functions including burner history, commissioned values, operating parameters and pressure/temperature settings shall be accessible/adjustable without the need for a laptop computer or other special tools.

.7 Both the programming pad and the main control module shall hold programmed data with capability of uploading/downloading from one to the other.

.8 The flame safeguard system shall be integrated into the control system and shall include sensor electrode (standard) or QRI infrared flicker detector (option).

.9 The combustion control system shall include built-in PID pressure/temperature control and time/temperature adjustable cold start function to protect the boiler from thermal shock.

.10 The control system shall have selectable operating modes to allow for the following:

.1 Direct modulation via the building automation system using either a 4-20 mA, 2-10V or floating type operating signal.

.2 Set-point adjustment via the building automation system using either a 4-20 mA, 2-10V or floating type operating signal.

.11 The burner control system shall be capable of providing the following functions and data signals via a MODBus interface:

.1 Burner ON/OFF

.2 Load signal

.3 Set-point and process value

.4 Operating information

.5 Actual load position of burner

.6 Lock-out with failure code

.7 Actual position (on/off) of air pressure switch, valves, fan, gas pressure, flame supervision

.8 Start-up counter

.9 Actual operating hours

.12 The control system shall incorporate a 4-line, 64 character LCD display (ABE).

.1 The ABE display shall be capable of being mounted either on the burner or in a remote control panel.

.2 ABE shall be easy to remove from its mounting while remaining connected to the wiring harness enabling a technician to have "hand held" adjustment capability.

.8 Motor:

.1 The burner shall have a three-phase (or single-phase) TEFC blower motor fully compatible for use with variable frequency drive.

.9 Controls:

.1 Electronic combustion control relay with infra-red flame detector for combustion control and flame supervision.

.2 Control to shut off fuel within 5 seconds upon pilot flame or main flame failure or upon signal of safety interlock and to ensure, when restarted, in sequence:

.1 Pre-purge.

.2 Pilot ignition and supervision.

.3 Main gas valve opening.

.4 Pilot cut-off. Pilot-proving period not to exceed 10 seconds.

.5 Burner operation.

.6 Post-purge burner shut-down.

.3 Static pressure interlock. To shut off burner upon loss of combustion air pressure.

.4 Fuel-air mixture: control through:

.1 2-position motor with end switch to provide for low-fire start and high fire run.

.2 Two-position motor with linkage to control fuel and air and with end switches to prove low-fire start and energize high fire solenoid valve for high-low fire operation.

.3 Modulating motor with end switch to provide for low-fire start and fully modulating operation down to 20% of design capacity.

.5 Visual and audible alarms to indicate burner shutdown due to flame failure, low water level, high pressure, low air pressure and low gas pressure.

.6 Selector switch to permit manual and automatic firing at any rate between low and high fire.

.4 Acceptable Manufacturers: Weishaupt or equal.

2.5 Emission Control

.1 Rate of discharge of air contaminants from boiler not to exceed:

.1 For nitrogen oxides expressed as nitrogen dioxide:

.1 22 ng/J of heat input when fired with gaseous fuel.

.2 For carbon monoxide, 125 ng/J of heat input.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install in accordance with ANSI/ASME Boiler and Pressure Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.

.2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.

.3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.

.4 Mount unit level using specified vibration isolation in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.5 Pipe hot water relief valves full size to nearest drain.

.6 Pipe steam relief valve through roof with drip pan elbow piped to nearest drain.

.7 Pipe blowdown/drain to blowdown tank/floor drain.

.8 Natural gas fired installations - in accordance with CAN/CSA-B149.1.

3.3 Mountings And Accessories

.1 Safety valves and relief valves:
- .1 Run separate discharge from each valve.
- .2 Terminate discharge pipe as indicated.
- .3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.

.2 Blowdown valves:
- .1 Run discharge to terminate as indicated.

3.4 Field Quality Control

.1 Manufacturer to:
- .1 Certify installation.
- .2 Start up and commission installation.
- .3 Carry out on-site performance verification tests.
- .4 Demonstrate operation and maintenance.

.2 Provide Consultant at least 24 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 – Common Work Results – Mechanical.

1.2 References

.1 Air Conditioning, Heating, and Refrigeration Institute (AHRI):
  .1 AHRI 400 – Liquid to Liquid Heat Exchangers.

.2 American Society of Mechanical Engineers (ASME):
  .1 ASME Boiler and Pressure Vessel Code.
    .1 BPVC-VIII B 2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 1.
    .2 BPVC-VIII-2 B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 2 - Alternative Rules.
    .3 BPVC-VIII-3 B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 3 - Alternative Rules High Press Vessels.

.3 Canadian Standards Association (CSA International):
  .1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 Submittals

.1 Submittal shop drawings and Maintenance Manual material in accordance with Section 01 33 00 - Submittal Procedures and Section 21 05 01 – Common Work Results Mechanical.

.2 In addition to items listed in Section 21 05 01 shop drawings are to include Manufacturer's recommended clearances for plate removal.

2 Products

2.1 Plate Heat Exchanger

.1 General:
  .1 Water to glycol.
  .2 Designed, constructed and tested in with accordance ASME Boiler and Pressure Vessel Code, Section VIII, CSA B51 and provincial pressure vessel regulations.
  .3 Performance data to be AHRI Certified.

.2 Frames: carbon steel with baked epoxy enamel paint, stainless steel side bolts and shroud.

.3 Plates: Type 304 stainless steel.

.4 Gaskets: as recommended by manufacturer to suit fluid temperature.

.5 Supports: as indicated.

.6 Piping connections to be sufficiently separated to permit piping to be fully insulated at connections to heat exchanger.

.7 Acceptable Materials: Armstrong, Alfa Laval, Flo-Fab, GEA, Xylem, Taco, Thermofin, Tranter.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 General: install level and firmly anchored to supports [as indicated] [in accordance with manufacturer's recommendations].

.2 Tube in shell heat exchangers: arrange piping so that tube bundle can be removed after disconnecting two unions or flanges adjacent to head and without disturbing other equipment and systems.

.3 ACCESSORIES

.1 Install with safety relief valve piped to drain and hose bib drain valve.

.2 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 - Common Work Results - Mechanical.

.2 Section 23 05 05 - Installation of Pipework.

.3 Section 23 05 13 - Common Motor Requirements for HVAC.

1.2 References

.1 Air-Conditioning and Refrigeration Institute (ARI):
- .1 ARI 550- (latest edition), Centrifugal or Rotary Water Chilling Packages.

.2 Canadian Standards Association (CSA):
- .1 CSA B52- (latest edition), Mechanical Refrigeration Code.

.3 Environment Canada:
- .1 EPS 1/RA/2- (latest edition), Code of Practice for the Reduction of Chlorofluorocarbons Emissions from Refrigeration and Air Conditioning Systems, Canada Environmental Protection Act Code of Practice.

1.3 Submittals

.1 Submit product data in accordance with Section 01300 - Submittals and section 21 05 01 - Common Work Results, Mechanical.

.2 Data to include:
- .1 Provide part load performance curves.
- .2 Details on operation, servicing and maintenance.
- .3 Recommended spare parts list.
- .4 Equipment including connections, piping and fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
- .5 Wiring as assembled and schematically.
- .6 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
- .7 Type of refrigerant used.

2 Products

2.1 General

.1 Provide complete air-cooled, glycol/water scroll type chiller package(s)/unit(s) each including: dual scroll high efficient compressors; brazed plate evaporators; condenser, motor and motor starter; controls; control centre; piping; wiring; refrigeration and oil change; ready for connection to 40 % propylene glycol/water chilled water circuit, interlocks, and electric power source, installed in welded steel frame with heavy duty gauge steel panels and access doors finished to manufacturers standard. Provide electrical weatherproof disconnect for each chiller.

.2 Acceptable Materials: McQuay, Trane, York, Carrier.

2.2 Capacity and Performance

.1 Certified ratings based on ARI 550.

.2 See drawings for capacity and performance requirements.

.3 Refrigerant: R410A.

.4 Provide anti-corrosion coating for condenser coil fins.

.5 Provide low ambient kit (to -23 deg C)

2.3 Compressor

.1 Dual scroll compressors. Provide low ambient VFD control and hot gas bypass.

.2 Compressor to include suction and discharge shut-off valves; oil sight glass and separate circuit crankcase heater.

.3 Provide nameplate to show capacity at design temperature, type of refrigerant used and total weight in system

2.4 Compressor Motor

.1 Scroll compressor type with overload protection and manual restart.

2.5 Evaporator

.1 Steel shell and seamless copper tube, gasketted heads, direct expansion: to CSA B52. Insulated to R=0.53 m ² . C/W minimum.

2.6 Condenser

.1 Air cooled:

.1 Aluminum fins mechanically bonded to copper tube, pressure tested to 450 psig.

.2 Direct driven, steel or aluminum propeller type fan, statically and dynamically balanced. Motor with overload protection, permanently lubricated ball bearings.

2.7 Control Centre

.1 To EEMAC standard and include:

.1 Control circuit ON/OFF switch.
.2 Oil pressure safety switch.
.3 High and low pressure safety switch
.4 Water temperature controller.
.5 Suction and discharge pressure gauges and shut-off valves.
.6 Chilled water flow switch.
.7 Compressor short cycling and restart delay timer.
.8 Starting sequence switches.
.9 Compressor and fan motor circuit breakers.
.10 Reset low water temperature cut-out switch.

.11 Motor contactors, control relays and indicator lights to include: "start-stop" switch; anti-recycle 30 minute time delay; low chilled water temperature cutout and automatic reset; excess purge signal light and reset switch; manual/automatic oil pump operating switch and signal light; oil heater signal light; manual reset power failure and signal light; chilled water flow interruption light [meter to indicate number of compressor starts and elapsed running time].

.12 Field power and control circuit terminal blocks.

.13 Alarm for refrigerant leakage.

3 Execution

3.1 General

.1 Comply with Manufacturer's written recommendations or specifications including product technical bulletins, handling, storage, and installation instructions/datasheets.

.2 Provide appropriate protection apparatus.

.3 Install unit as indicated, to manufacturers recommendations, and in accordance with EPS 1/RA/2.

.4 Ensure adequate clearances for servicing and maintenance.

.5 Manufacturer to approve installation, to supervise startup and to instruct operators. Include 1 day per unit.

.6 Provide protective fan guards.

.7 Provide flexible pipe connections in addition to unions, valves, pressure gauges, thermometers.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 - Common Work Results – Mechanical.

1.2 References

.1 American Society for Testing and Materials International (ASTM):
- .1 ASTM A48/A48M-03, Standard Specification for Gray Iron Castings.
- .2 ASTM A123/A/123M-2001, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A153/A153M-04, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .4 ASTM A536-84 (1999) el, Specification for Ductile Iron Castings.
- .5 ASTM A795-00, Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
- .6 ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings.
- .7 ASTM B117-2003, Standard Practice for Operating Salt Spray (Fog) Apparatus.
- .8 ASTM D520-2000, Standard Specification for Zinc Dust Pigment.
- .9 ASTM A135-97c, Specification for Electric-Resistance-Welded Steel Pipe.
- .10 ASTM A47/A47M-99, Specification for Ferritic Malleable Iron Castings.
- .11 ASTM A53/A53M-99b, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.2 American Society of Mechanical Engineers:
- .1 ANSI B18.2.1-1996, Square and Hex Bolts and Screws.
- .2 ASME B18.2.2-1987 (R1999), Square and Hex Nuts.

.3 Canadian Standards Association (CSA International):
- .1 CSA B52-1999 (R2004), Mechanical Refrigeration Code.
- .2 CSA W47.1-92 (R1998), Certification of Companies for Fusion Welding of Steel Structures.
- .4 CSA W47.1, Supplement No. I-MI 989 to W47.1-1983, Certification of Companies for Fusion Welding of Steel Structures.

.4 Cooling Technology Institute (CTI):
- .1 CTI-ATC-105-2000, Acceptance Test Code.

.5 National Electrical Manufacturers Association (NEMA):
- .1 NEMA MG 1-2003, Motors and Generators.

.6 ANSI/AWWA Cl11/A21.11-95, Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

2 Products

2.1 General

.1 Factory assembled condenser matched to refrigeration equipment as shown on plans.

.2 Ensure equipment has manufacturer's name, address, style, model, serial number, catalog number on plate secured to item of equipment.

.3 Coil to be Cu-Al construction with coated fins for corrosion protection.

.4 Acceptable Materials: Boiler Tech, ICE, Liebert.

2.2 Materials

.1 Steel: components fabricated of zinc-coated steel not lighter than 1.5 mm thick steel, protected against corrosion by zinc coating.

.1 Zinc coating: to ASTM A153/A153M and ASTM A123/A123M, with extra heavy coating of not less than 0.76 kg per square meter of surface.

.2 Coat galvanized surfaces damaged due to welding with zinc rich coating conforming to ASTM D520, Type 1.

2.3 Casing And Framework

.1 Materials: galvanized steel sheet or aluminum, angles and channels.

.2 Access panels: as necessary for servicing and maintenance.

2.4 Fan

.1 Fan: aluminum, direct drive, statically and dynamically balanced.

.2 Motor: single speed, totally enclosed, insulation Class B, continuous-rated type which conforms to NEMA MG 1.

2.5 Accessories

.1 Time delay relay: to limit fan motor starts to not more than 6 /h.

2.6 Vibration Isolators

.1 To Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 General

.1 Mount on structural supports and vibration isolators as indicated and to manufacturer's recommendations.

.2 Ensure clearance for servicing and maintenance as recommended by manufacturer.

.3 Manufacturers field service representative to approve installation, to supervise start up and to instruct operators.

3.3 Field Quality Control

.1 Site Tests: Test under actual operating conditions in accordance with CTI-ATC-105 to verify specified performance.

.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.

.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.

3.4 Adjusting

.1 Lubricate bearings with oil or grease as recommended by manufacturer.

.2 Tighten belts to manufacturer's specified tension.

END OF SECTION

1 General

1.1 Related Requirements

.1 Section 21 05 01 - Common Work Results - Mechanical.

1.2 References

.1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)

.1 ANSI/ARI 430-99(R2002), Central-Station Air-Handling Units.

.2 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)

.1 ANSI/ASHRAE 90.1-2007, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.4 Master Painters Institute (MPI)

.1 MPI-INT 5.3-2007, Galvanized Metal.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical..

2 Products

2.1 General

.1 Factory assembled components to form units supplying air at designed conditions, as indicated.

.2 Certify ratings: to ANSI/ARI 430 with ARI seal.

.3 Horizontal and Vertical type, as indicated, having air tight modular components, consisting of casing, and components listed on drawings.

.4 Fabricate unit with 16-gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing is not allowed.

.5 Panels and access doors shall be constructed as a 2" nominal thick; thermal broke double wall assembly, injected with foam insulation for an R-value of not less than R-13. The outer panel shall be constructed of G90 galvanized, 18 gauge steel. The inner liner shall be constructed of G90 galvanized 20 gauge steel. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure,

maximum 1250 Pa of positive or negative static pressure. Deflection shall be measured at the midpoint of the panel height. An alternative to the above is to use fibreglass insulation. The fibreglass insulation shall be 2" thick, minimum density of 3.0 lb/cu. ft., and shall have a minimum R-value of 8.33 sq. ft. *h* °F/Btu.

.6 The casing leakage rate shall not exceed 0.0025 m3/s per square meter of cabinet area at 1.24 kPa static pressure.

.7 Module to module assembly shall be accomplished with an overlapping, full perimeter, insulated, internal splice joint sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.

.8 Entire unit shall have a 6" high full perimeter base rail for structural rigidity and condensate trapping.

.9 Access Doors shall be flush mounted to cabinetry, with minimum of two 6" long stainless steel piano-type hinges, latch and full size (4.5" minimum) handle assembly (provide 10" x 10" (254 mm x 254 mm) double pane wire reinforced tempered glass viewing window for fan and humidifier sections). Door shall swing outward for unit sections under negative pressure (inward for unit sections under positive pressure). Doors limited from swinging inward (such as side access filter sections) on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.

.10 Acceptable Materials: Carrier, Engineered Air, McQuay, Racan, Trane, York Air Conditioning; Aaon.

2.2 Drain Pans

.1 Construction: 304 stainless steel c/w rounded corners and welded seams..

.2 Insulation: external foam type, minimum 13 mm thick.

.3 Drain connection: in bottom at low point.

.4 Installation: slope without sag minimum 1% to ensure no standing water at any time or at any point.

.5 Dimensions: minimum 75 mm from upstream face of coil to 150 mm beyond downstream face of coil, humidifier section, or eliminator and to include return bends and headers.

2.3 Fans

.1 Provide sheaves and high efficiency “notch” type belts (two minimum) per fan/motor required for final air balance.

.2 Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.

.3 V-Belt drives shall be cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Fixed sheaves, matched belts, and drive rated based on

motor horsepower (typically for motors less than 5 HP). Variable and adjustable pitch sheaves selected so required rpm is obtained with sheaves set at mid-position and rated based on motor horsepower (typically for motors greater than or equal to 5 HP). Contractor to furnish fixed sheaves at final rpm as determined by balancing contractor. Minimum of 2 belts shall be provided on all fans with 1 HP motors and above. Standard drive service factor shall be 1.1 S.F. (for 1/4 HP up to 10 HP); 1.3 S.F. (for 10 HP and larger), calculated based on fan brake horsepower

.4 See also schedules on the drawings. AMCA rated for sound and performance, centrifugal fans with forward curved wheels, backward inclined, air foil, or plug/plenum fan type as specified, selected to operate in stable part of performance curve at all times and 200,000 hour service self-aligning split pillow block bearings. Provide internally mounted motor as indicated complete with adjustable sheave v-belt drive. Motor sizes as indicated.

.5 Maximum sound power levels not to exceed that indicated. Co-ordinate with the silencer manufacturer to produce the required noise criteria levels in the spaces served by the air handling equipment. Offices - NC 30; Labs - NC 45; Animal Areas - NC 30; Atrium – NC45.

.6 Motors: premium efficiency, ODP type, sizes as indicated.

.7 Internally mounted motor and fan to be complete with vibration isolation.

.8 Provide extended grease lines within the AHU or exhaust fan for lubricating the bearings.

.9 Access door c/w glass viewing panel on motor side of fan cabinet.

.10 Provide fan type as indicated on drawings. Fan assemblies shall be belt-driven including fan, motor, drive belts and sheaves. Fans shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Manufacturer must ensure maximum fan rpm is below the first critical speed.

.11 Bearings shall have copper lubrication lines within the unit. Grease fittings shall be attached to the fan base assembly near access door. If not supplied at the factory, contractor shall mount copper lube lines in the field.

.12 Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on 2" deflection spring vibration type isolators inside cabinetry.

2.4 Vibration Isolation

.1 Flexible connections at inlet and outlet of fan section: to Section 23 33 00 - Air Duct Accessories.

.2 Vibration isolators on fan section in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.5 Variable Volume Devices

.1 Fan speed controlled with Variable Speed Drives as described in Control Section.

2.6 Filter Section

.1 Material to match casing. Filter arrangement: as indicated.

.1 Provide access to filter through hinged door with suitable hardware.

.2 Provide blank-off plates and gaskets to prevent air bypass.

.3 Filters: in accordance with Section 23 44 00 - HVAC Air Filtration and Filter Schedule on drawings.

.4 Manufacturer shall supply mini-helic pressure differential gauge to read pressure drop across each filter bank section for scheduling filter replacement. Design shall be equal to a Dwyer Minihelic 2 and be recessed into the cabinet to minimize chances for damage during shipment and installation. Coordinate supply of gauge with Mechanical Contractor and the Controls Contractor.

2.7 Mixing Box

.1 Material to match casing and produce uniformly mixed air temperature within plus or minus 5 degrees C of design across face of outlet.

.2 Dampers for mixing boxes: in accordance with Section 23 33 15 - Dampers - Operating:

2.8 Blender Static Air Mixing Device

.1 Pre- engineered device with no moving parts, designed to thoroughly mix warm and cold air streams, to within 3 degrees C at 80 Pa pressure drop and to provide for even velocity distribution profile:

.2 Construction: 16 ga galvanized steel.

2.9 Coils

.1 AHUs shall be provided with coils with capacity as shown on the plans and as described in the specifications. Coils to be ARI Standard 410 certified.

.2 The coils shall be of extended surface, drainable, same end connections, staggered tube and rippled fin type.

.3 Coils shall be of the slide out design type. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 125 mm beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior and gasket sleeve between outer wall and liner where each pipe extends through the unit casing to minimize air leakage and condensation inside panel assembly. If not factory packaged, Contractor must supply all coil connection grommets and sleeves. Coils shall be

removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.

.4 Construction:
- .1 Pressure Test: 1.7 Mpa.
- .2 Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.
- .3 Headers shall be seamless copper tube.
- .4 Coil tubes shall be 16 mm OD seamless Type “L” copper, expanded into fins, brazed at joints. Soldered U-bends shall be provided to minimize the effects of erosion and premature failure having a minimum tube wall thickness of 0.89 mm.
- .5 Coil connections shall be N.P.T. threaded carbon steel with connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain fittings shall be furnished on the connections, exterior to the air handler. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point to insure complete drainage and prevent freeze-up.
- .6 Coil casings shall be a formed channel frame of galvanized steel. Water heating coils, 1 and 2-row only may be furnished as uncased to allow for thermal movement and slide into a pitched track for fluid drainage.
- .7 Supply and Return headers shall be located at the base of the coil. Hot water coils shall employ return bends.
- .8 The casing shall be 12-gauge galvanized steel.

2.10 Humidifiers

.1 In accordance with Section 23 84 13 - Humidifiers.

2.11 Base Rails

.1 Minimum 6" high, formed G90 galvanized steel channel.

2.12 Electrical

.1 Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclosed terminal lugs in terminal box sized to CEC.

.2 Provide marine lights for each section of the AHU where shown on drawings and one GFI receptacle for each unit. One on/off light switch located on the outside of each AHU shall operate all lights within the unit.

.3 Fan motors shall be 1800 rpm, open drip-proof (ODP). Electrical characteristics shall be as shown in schedule.

.4 Variable speed drives by the Controls Contractor.

3 Execution

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Installation

.1 Provide appropriate protection apparatus.

.2 Ensure adequate clearance for servicing and maintenance.

3.3 Fans

.1 Install fan sheaves required for final air balance.

.2 Install flexible connections at fan inlet and fan outlets.

.3 Install vibration isolators.

3.4 Drip Pans

.1 Install deep seal P-traps and trap seal primer on drip lines.

.1 Depth of water seal to be 1.5 times static pressure at this point.

3.5 Filters

.1 Immediately prior to occupancy, replace filtration media with new filtration media.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 - Common Work Results – Mechanical.

1.2 References

.1 AHRI Standard 880-2011.

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results - Mechanical.

2 Products

2.1 Fan Coil Units

.1 Cabinet: 20 ga galvanized steel, 25 mm S/A duct collar, and 19 mm R/A duct collar. Cabinet to be factory insulated with foil backed insulation having an R-value of 2.8 or greater.

.2 Coil: Cu-Al construction, performance shown on plans.

.3 Blower motors: ECM multispeed high efficiency with resilient mount, sleeve bearings with oilers and inherent thermal overload protection with automatic reset. Power supply as shown on plans.

.4 Fan(s) : high efficiency, ARI certified performance data, double width, double inlet, forward curved centrifugal type, dynamically balanced and directly connected to the motor shaft

.5 Fresh air duct adapter.

.6 Filter: replaceable.

.7 R/A plenum shall be fully insulated with 25 mm neoprene coated glass fibre and have a filter frame for back or bottom return air.

.8 Assembly fully wired to one outlet location.

.9 Multiple knockouts for up to 38 mm diameter conduit.

.10 Acceptable Materials: Engineered Air, E.H. Price, McQuay, Trane, York.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Duct connections to be made with flexible duct connections.

.2 Make control connections.

.3 Support independently of ductwork using vibration isolation.

.4 Locate so that controls, dampers, filters, and access panels are readily accessible.

.5 Provide spare filters for each unit in addition to final operating set of filters.

.6 Air and water flows in unit to be balanced as per section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

.7 Pipe drain lines to nearest FFD. Insulate drain piping (minimum 1" thick) as per Section 23 07 15, Thermal Insulation – Piping.

.8 Co-ordinate left hand piping connections versus right hand connections to provide appropriate access.

.9 Provide flexible pipe connections for each unit.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 - Common Work Results – Mechanical.

1.2 References

.1 Hydronic Institute of Boiler and Radiator Manufacturers (IBR).

1.3 Submittals

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 01 33 00 - Submittal Procedures and section 21 05 01 – Common Work Results – Mechanical.

2 Products

2.1 Finned Tube Radiation

.1 Heating elements: NPS 1 1/4 seamless copper tubing, 1.2 mm minimum wall thickness, mechanically expanded into flanged collars of evenly spaced aluminum fins, 100 x 100 mm nominal, 130 fins per metre suitable for sweat fittings.

.2 Element hangers: ball bearings plastic lined cradle type providing unrestricted longitudinal movement on enclosure brackets. Space brackets 900 mm centres maximum.

.3 Standard enclosures: 18 ga cold rolled steel complete with components for wall-to-wall or complete with die formed end caps having no knock-outs, with inside corners, outside corners, as indicated. Provide full length channel and sealer strip at top of wall edge. Height as indicated. Joints and filler pieces flush with cabinet. Support rigidly top and bottom, on wall mounted brackets. Joints and filler pieces clear of grilles located to provide easy access to valves and vents. Provide access for valves, vents, drains, etc. Finish cabinet with factory applied baked primer coat.

.4 Dimensions for enclosures: measure site conditions. Do not scale from drawing.

.5 Provide for noiseless expansion of components.

.6 Capacity as indicated on drawings.

.7 Acceptable Materials: Engineered Air, Rosemex,, Sigma, Trane.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install in accordance with piping layout and reviewed shop drawings.

.2 Provide for pipe movement during normal operation.

.3 Maintain sufficient clearance to permit performance of service maintenance.

.4 Check final location with Consultant if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and Consultant's directive.

.5 Valves:
- .1 Install valves with stems upright or horizontal unless approved otherwise.

.6 Venting:
- .1 Install screwdriver vent on cabinet convector, terminating flush with surface of cabinet.
- .2 Install standard air vent with cock on continuous finned tube radiation where it is at a high point of piping.

.7 Clean finned tubes and comb straight.

.8 Install flexible expansion compensators as indicated.

END OF SECTION

1 General

1.1 Related Sections
.1 Section 01 33 00 - Submittal Procedures.
.2 Section 21 05 01 – Common Work Results - Mechanical.

1.2 References
.1 Not Used

1.3 Submittals
.1 Submit shop drawings and Maintenance Manuals in accordance with Section 01 33 00 - Submittal Procedures and Section 21 05 01 – Common Work Results, Mechanical.

2 Products

2.1 General
.1 Cabinet: 16 ga steel (unless noted otherwise) with rounded exposed corners and edges, removable panels, glass fibre insulation and integral air outlet and inlet.

.2 Finish with factory applied primer coat.

.3 Capacity and electrical characteristics shown on drawings.

.4 Acceptable Materials: Engineered Air, Rosemex, Trane.

2.2 Horizontal Unit Heaters
.1 Coils: seamless copper tubing, silver brazed to steel headers with evenly spaced aluminum fins mechanically bonded to tubing. Hydrostatically test to 1 MPa.

.2 Fan: direct drive propeller type, factory balanced, with anti-corrosive finish and fan guard.

.3 Motor: speed as indicated continuous duty, built-in overload protection, and resilient motor supports.

.4 Air outlet: two-way adjustable louvres.

.5 Capacity: as shown on plans

2.3 Forced Flow Unit Heaters
.1 Coils: aluminum fins mechanically bonded to copper tubes. Hydrostatically tested to 150 psi.

.2 Fans: centrifugal double width wheels, statically and dynamically balanced, direct driven, sleeve bearings, resilient mounted.

.3 Motor: multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting.

.4 Filters: removable 1" thick fibrous glass throwaway type.

.5 Control:
.1 Multi-speed key operated switch with integral overloads in cabinet.
.2 Control: DDC room temperature sensor.

3 Execution

3.1 Installation

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

.2 Provide double swing pipe joints.

.3 Check final location with Engineer if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Engineer's directive.

.4 Steam and Hot water units: See piping schematics on drawings.

.5 Electrical connections by others as shown on control and electrical drawings.

.6 Clean finned tubes and comb straight.

.7 Provide supplementary suspension steel as required.

.8 Before acceptance, set discharge patterns and fan speeds to suit requirements.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 -1 - Common Work Results – Mechanical.

.2 Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 Pa.

1.2 References

.1 Not Used

1.3 Submittals

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

2 Products

2.1 Steam-To-Steam Humidifiers

.1 Capacities: as indicated.

.2 316L Stainless Steel Heat Exchanger, 304L Stainless Steel Tank.

.3 Totally Independent Removable Heat Exchanger(s).

.4 No Chemical Additives in the Humidified Air.

.5 Min. 2" thick tank Insulation.

.6 Totally Enclosed Cabinet for Safety

.7 For use with regular potable water.

.8 Precise Water Control Level.

.9 Modulating Control.

.10 Built-in Float & Thermostatic Steam Trap(s).

.11 Integral Telescopic Stand.

.12 Day drain with no call for humidity.

.13 Full tank blow-down capability via timer.

.14 Full Size Alphanumeric Display and Keypad (SETC Only):
- .1 Time to Next Maintenance Alarm.
- .2 Internal Drain Water Cooler.
- .3 Fully Modulating Down to 15% of Total Capacity.

.15 Acceptable Materials: Armstrong, Dri-Steem, Nortec.

3 Execution

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Humidifier and evaporator media to be new and clean when project is accepted.

.2 Water service overflow drain: as indicated.

.3 Install access doors or panels in adjacent ducting.

.4 When installing in ducting, provide waterproof duct up and downstream in accordance with Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 Pa.

.5 Install trapped drain connection at low point in duct.

3.3 Field Quality Control

.1 Manufacturer's Field Services:

- .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.
- .2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, at stages listed:
  - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of the Work, after cleaning is carried out.
- .4 Obtain reports within 3 days of review and submit immediately to the Consultant.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 - Common Work Results – Mechanical.

.2 Section 25 05 01 - EMCS: General Requirements.

1.2 References

.1 Not Used.

1.3 Submittals

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.2 Final Report: submit report to Consultant.

- .1 Include measurements, final settings and certified test results.
- .2 Bear signature of commissioning technician and supervisor
- .3 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Consultant in accordance with Section 01 78 00 - Closeout Submittals.
- .4 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.4 Design Requirements

.1 Confirm with Consultant that Design Criteria and Design Intents are still applicable.

.2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.5 Commissioning

.1 Do commissioning in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

.2 Carry out commissioning under direction of Consultant. Provide Consultant advance notice of commissioning and opportunity to witness it.

.3 Correct deficiencies, re-test to requirements of Consultant.

.4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.5 Load system with project software.

.6 Consultant reserves to right to test system to verify operation.

1.6 Completion Of Commissioning

.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Consultant and Owner.

1.7 Issuance Of Final Certificate Of Completion

.1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

2 Products

2.1 Equipment

.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.

.2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.

.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.

3 Execution

3.1 Procedures

.1 Test each system independently, then in unison with other related systems, and then in unison with existing control system.

.2 Commission each system and integrated systems using procedures prescribed by the Consultant.

.3 Debug system software.

.4 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

.5 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 Field Quality Control

.1 Pre-Installation Testing.

- .1 General: consists of field tests of equipment just prior to installation.
- .2 Testing to be on site unless prior permission received from Consultant.
- .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
- .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).

.5 Additional instruments to include:
- .1 DP transmitters.
- .2 VAV supply duct SP transmitters.
- .3 DP switches used for dirty filter indication and fan status.

.6 In addition to test equipment, provide digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source and to BECC.

.7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.

.8 Transmitters above 0.5 % error will be rejected.

.9 DP switches to open and close within 2% of setpoint.

.2 Completion Testing.

.1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.

.2 Include following activities:
- .1 Test and calibrate field hardware including stand-alone capability of each controller.
- .2 Verify each A-to-D convertor.
- .3 Test and calibrate each AI using calibrated digital instruments.
- .4 Test each DI to ensure proper settings and switching contacts.
- .5 Test each DO to ensure proper operation and lag time.
- .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
- .7 Test operating software.
- .8 Test application software and provide samples of logs and commands.
- .9 Verify each CDL including energy optimization programs.
- .10 Debug software.
- .11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
- .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units.

.3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system. Provide:
- .1 technical personnel capable of re-calibrating field hardware and modifying software.
- .2 Commissioning to commence during final startup testing.
- .3 O&M personnel may assist in commissioning procedures as part of training.
- .4 Commission systems considered as life safety systems before affected parts of the facility are occupied.
- .5 Operate systems as long as necessary to commission entire project.
- .6 Monitor progress and keep detailed records of activities and results.

.4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
  .1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
    .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
  .2 Test to last at least 30 consecutive 24 hour days.
  .3 Tests to include:
    .1 Demonstration of correct operation of monitored and controlled points.
    .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
  .4 System will be accepted when:
    .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
    .2 Requirements of Contract have been met.
  .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
  .6 Correct defects when they occur and before resuming tests.
.5 Engineer reserves the right to verify reported results.

3.3 Adjusting

.1 Final adjusting: upon completion of commissioning set and lock devices in final position and permanently mark settings.

3.4 Demonstration

.1 Demonstrate to Consultant and Owner operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

END OF SECTION

1 General

1.1 Referenced Sections

.1 Section 21 05 01 - Common Work Results – Mechanical.

.2 Section 15 05 01 - EMCS General Requirements.

.3 Section 25 05 02 - EMCS Submittals and Review Process.

1.2 References

.1 Not Used.

1.3 Submittals

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS Submittals and Review Process.

.2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Consultant 30 days prior to anticipated date of beginning of training.

.1 List name of trainer, and type of visual and audio aids to be used.

.2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.

.3 Submit reports within one week after completion of each Phase of training program that training has been satisfactorily completed.

1.4 Quality Assurance

.1 Provide competent instructors thoroughly familiar with aspects of EMCS and HVAC systems installed in facility.

1.5 Instructions

.1 Provide instruction to designated personnel in adjustment, operation, maintenance, and pertinent safety requirements of EMCS installed.

.2 Training to be project-specific.

1.6 Time For Instruction

.1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.7 Training Materials

.1 Provide equipment, visual and audio aids, and materials for classroom training.

.2 Supply manual for each trainee, describing in detail data included in each training program.

.1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.8 Training Program

.1 To be in 2 phases over 6 month period.

.2 Phase 1: One (1) day program to begin before 30 day test period at time mutually agreeable to Contractor, Owner, and Consultant.
- .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
- .2 Supplement with on-the-job training during 30 day test period.
- .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
- .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.

.3 Phase 2: Two (2) day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.
- .1 Provide pre-arranged schedule. Include at least following:
  - .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
  - .2 Equipment maintenance training: provide personnel with 1 days training within 5 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
  - .3 Programmers: provide personnel with 1 days training within 5 day period in following subjects in approximate percentages of total course shown:
    - .1 Software and Architecture – 10%
    - .2 Application Programs – 15%
    - .3 Controller Programming – 50%
    - .4 Troubleshooting and debugging - 10%
    - .5 Color Graphic Generation - 15%

1.9 Additional Training

.1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.10 Monitoring Of Training

.1 Consultant reserves the option to monitor training program and may modify schedule and content.

.2 Owner reserves the right to record (Audio and/or video) training.

2 Products

2.1 Not Used

3 Execution

3.1 Not Used

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 - Common Work Results – Mechanical.
.2 Section 23 05 53.01 - Mechanical Identification.
.3 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
.4 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 References

.1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
  .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.

.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
  .1 ASHRAE STD 135-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.

.3 Consumer Electronics Association (CEA).
  .1 CEA-709.1-B-2002, Control Network Protocol Specification.

.4 Nova Scotia Department of Labour and Workforce Development
  .1 Electrical Bulletin 2012-02.

1.3 Submittals

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

1.4 Acronyms And Abbreviations

.1 Acronyms used in EMCS:
  .1 AEL - Average Effectiveness Level.
  .2 AI - Analog Input.
  .3 AIT - Agreement on International Trade.
  .4 AO - Analog Output.
  .5 BACnet - Building Automation and Control Network.
  .6 BC(s) - Building Controller(s).
  .7 BECC - Building Environmental Control Center.
  .8 CAD - Computer Aided Design.
  .9 CDL - Control Description Logic.
  .10 CDS - Control Design Schematic.
  .11 COSV - Change of State or Value.
  .12 CPU - Central Processing Unit.
  .13 DI - Digital Input.
  .14 DO - Digital Output.
  .15 DP - Differential Pressure.
  .16 ECU - Equipment Control Unit.
  .17 EMCS - Energy Management and Control System.
  .18 HVAC - Heating, Ventilation, Air Conditioning.
  .19 IDE - Interface Device Equipment.

.20 I/O - Input/Output.
.21 ISA - Industry Standard Architecture.
.22 LAN - Local Area Network.
.23 LCU - Local Control Unit.
.24 MCU - Master Control Unit.
.25 NC - Normally Closed.
.26 NO - Normally Open.
.27 OS - Operating System.
.28 O&M - Operation and Maintenance.
.29 OWS - Operator Work Station.
.30 PC - Personal Computer.
.31 PCI - Peripheral Control Interface.
.32 PCMCIA - Personal Computer Micro-Card Interface Adapter.
.33 PID - Proportional, Integral and Derivative.
.34 SP - Static Pressure.
.35 TCU - Terminal Control Unit.
.36 USB - Universal Serial Bus.
.37 UPS - Uninterruptible Power Supply.
.38 VAV - Variable Air Volume.

1.5 Definitions

.1 AEL: ratio between total test period less any system downtime accumulated within that period and test period.

.2 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
- .1 Outage of main power supply in excess of back-up power sources, provided that:
  - .1 Automatic initiation of back-up was accomplished.
  - .2 Automatic shut-down and re-start of components was as specified.
- .2 Failure of communications link, provided that:
  - .1 Controller automatically and correctly operated in stand-alone mode.
  - .2 Failure was not due to failure of any specified EMCS equipment.
- .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
  - .1 System recorded said fault.
  - .2 Equipment defaulted to fail-safe mode.
  - .3 AEL of total of all input sensors and output devices is at least 99 % during test period.

.3 Point: may be logical or physical.
- .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
- .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of

contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.

.4 Point Name: composed of two parts, point identifier and point expansion.
- .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
  - .1 Area descriptor: building or part of building where point is located.
  - .2 System descriptor: system that point is located on.
  - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
- .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.

.5 Point Object Type: points fall into following object types:
- .1 AI (analog input).
- .2 AO (analog output).
- .3 DI (digital input).
- .4 DO (digital output).
- .5 Pulse inputs.

.6 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
- .1 Printouts: to ANSI/IEEE 260.1.

1.6 Quality Control

.1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by Consultant, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

.6 Permits and fees: in accordance with general conditions of contract.

.7 Submit certificate of acceptance from authority having jurisdiction.

.8 Existing devices intended for re-use: submit test report.

1.7 System Description

.1 Expand and connect to existing Delta control system.

.2 Refer to control schematics and for system architecture.

.3 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
- .1 Building Controllers.
- .2 Control devices as listed in I/O point summary tables.
- .3 Data communications equipment necessary to effect EMCS data transmission system.
- .4 Field control devices.
- .5 Software/Hardware complete with full documentation.
- .6 Complete operating and maintenance manuals.
- .7 Training of personnel.
- .8 Acceptance tests, technical support during commissioning, full documentation.
- .9 Wiring interface co-ordination of equipment supplied by others.
- .10 Miscellaneous work as specified in these sections and as indicated.

.4 Design Requirements:
- .1 Design and provide conduit and wiring linking elements of system.
- .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed Consultant prior to installation.
- .3 Location of controllers as reviewed by Owner and Consultant prior to installation.
- .4 Provide utility power to EMCS and emergency power to EMCS as indicated.

.5 Language Operating Requirements:
- .1 System ‘front end’, programming, and documentation to use English.
- .2 Include, in English:
  - .1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).
  - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points.
  - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

.6 Systems capable of interfacing with existing Delta control system using Native BacNet provided by the following suppliers, manufacturers, and contractors are approved:
- .1 Digicon Building Control Solutions Limited.
- .2 VCI Controls Inc..
- .3 Energy Solution Professionals (ESP).
- .4 Advanced Energy Management (AEM) Ltd.
- .5 Honeywell.
- .6 Johnson Controls Inc.
- .7 Siemens Building Technologies.
- .8 Memco.
- .9 BCS Controls Ltd.
- .10 Controls & Equipment Ltd.

1.8 Quality Assurance

.1 Have local office within 50 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,

.2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.

.3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.

.4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

1.9 Delivery, Storage And Handling

.1 Provide Material Delivery Schedule to Consultant within 2 weeks after award of Contract.

1.10 Existing Conditions - Control Components

.1 Utilize existing control wiring and piping as indicated.

.2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
- .1 Do not modify original design of existing devices without written permission from Consultant.
- .2 Provide for new, properly designed device where re-usability of components is uncertain.

.3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
- .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Consultant.
- .2 Failure to produce test report will constitute acceptance of existing devices by contractor.

.4 Non-functioning items:
- .1 Provide with report specification sheets or written functional requirements to support findings.
- .2 Owner will repair or replace existing items judged defective yet deemed necessary for EMCS.

.5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.

.6 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

2 Products

2.1 Equipment

.1 Control Network Protocol and Data Communication Protocol: to ASHRAE STD 135.

.2 Complete list of equipment and materials to be used on project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

3 Execution

3.1 Manufacturer's Recommendations

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage, and installation instructions, and datasheets.

3.2 Painting

.1 Painting: in accordance with Section 09 91 23 - Interior Painting, supplemented as follows:
- .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
- .2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
- .3 Clean and prime exposed hangers, racks, fastenings, and other support components.
- .4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

END OF SECTION

1 General

1.1 Referenced Sections

.1 Section 21 05 01 - Common Work Results – Mechanical.
.2 Section 25 05 01 - EMCS: General Requirements.
.3 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 References

.1 Not Used.

1.3 Submittals

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and this section.

.2 Submit preliminary design document within 5 working days after tender closing and before contract award, for review by Consultant.

.3 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.

.4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

.5 Soft copy to be in AutoCAD - latest version and *.pdf format, structured using menu format for easy loading and retrieval on OWS.

1.4 Design Requirements

.1 Preliminary Design Review: to contain following contractor and systems information.
  .1 Location of local office.
  .2 Description and location of installing and servicing technical staff.
  .3 Location and qualifications of programming design and programming support staff.
  .4 List of spare parts.
  .5 Location of spare parts stock.
  .6 Names of sub-contractors and site-specific key personnel.
  .7 Sketch of site-specific system architecture.
  .8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
  .9 Descriptive brochures.
  .10 Sample CDL and graphics (systems schematics).
  .11 Response time for each type of command and report.
  .12 Item-by-item statement of compliance.
  .13 Proof of demonstrated ability of system to communicate utilizing BACnet.

1.5 Preliminary Shop Drawing Review

.1 Submit preliminary shop drawings within 30 working days of award of contract and include following:

.1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
.2 Detailed system architecture showing all points associated with each controller, signal levels, pressures where new EMCS ties into existing control equipment.
.3 Spare point capacity of each controller by number and type.
.4 Controller locations.
.5 Auxiliary control cabinet locations.
.6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
.7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
.8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
.9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.
.10 Compressor schematic and sizing data.

1.6 Detail Shop Drawing Review

.1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:
  .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
  .2 Wiring diagrams.
  .3 Piping diagrams and hook-ups.
  .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
  .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
    .1 Sensing element type and location.
    .2 Transmitter type and range.
    .3 Associated field wiring schematics, schedules and terminations.
    .4 Pneumatic schematics and schedules.
    .5 Complete Point Name Lists.
    .6 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
    .7 Software and programming details associated with each point.
    .8 Manufacturer's recommended installation instructions and procedures.
    .9 Input and output signal levels or pressures where new system ties into existing control equipment.

.6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
.7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plans as specified.
.8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
.9 Listing and example of specified reports.
.10 Listing of time of day schedules.
.11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
.12 Type and size of memory with statement of spare memory capacity.
.13 Full description of software programs provided.
.14 Sample of "Operating Instructions Manual" to be used for training purposes.
.15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.7 Quality Assurance

.1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:
  .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
  .2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
  .3 Review interface requirements of materials supplied by others.
  .4 Review "Sequence of Operations".

.2 Contractor's programmer to attend meeting.

.3 Owner and Consultant retains right to revise sequence or subsequent CDL prior to software finalization without cost to Owner or Consultant.

2 Products

2.1 Not Used

3 Execution

3.1 Not Used

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 - Common Work Results – Mechanical.
.2 Section 25 05 01 - EMCS: General Requirements.
.3 Section 25 05 02 - EMCS: Submittals and Review Process.
.4 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 References

.1 Not Used.

1.3 Submittals

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process..

.2 Record Documents to be in in English.

.3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
  .1 Binders to be 2/3 maximum full.
  .2 Provide index to full volume in each binder.
  .3 Identify contents of each manual on cover and spine.
  .4 Provide Table of Contents in each manual.
  .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 As-Builts

.1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
  .1 Changes to contract documents as well as addenda and contract extras.
  .2 Changes to interface wiring.
  .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
  .4 Locations of obscure devices to be indicated on drawings.
  .5 Listing of alarm messages.
  .6 Panel/circuit breaker number for sources of normal/emergency power.
  .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
  .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
  .9 Basic system design and full documentation on system configuration.

.2 Submit for final review by Owner.

.3 Provide before acceptance one (1) *.pdf copy incorporating changes made during final review.

1.5 O&M Manuals

.1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only and to provide full and complete coverage of subjects referred to in this Section.

.2 Provide three (3) complete printed sets and one (1) *.pdf copy prior to system or equipment tests.

.3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.

.4 Functional description to include:
- .1 Functional description of theory of operation.
- .2 Design philosophy.
- .3 Specific functions of design philosophy and system.
- .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
- .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
- .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.

.5 System operation to include:
- .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
- .2 Operation of computer peripherals, input and output formats.
- .3 Emergency, alarm and failure recovery.
- .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .5 General and specific instructions for the maintenance and operation of automatic and adjustable controls.
- .6 Seasonal settings and changeovers.
- .7 Document the limits of adjustment of manual controls.

.6 Software to include:
- .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
- .2 Detailed descriptions of program requirements and capabilities.
- .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
- .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device

.5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.

.6 Software for each Controller and single section referencing Controller common parameters and functions.

.7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.

.8 System configuration document:

.1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.

.2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.

.9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, and fully commented source listing of applicable driver/handler.

.10 Preventative Maintenance (PM) Schedule.

2 Products

2.1 Not Used

3 Execution

3.1 Not Used

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 05 - Common Work Results - Mechanical.

.2 Section 25 05 01 - EMCS: General Requirements.

1.2 References

.1 Canadian Standards Association (CSA International):

.1 CSA Z204-94(R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.3 Submittals

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.2 Submit detailed preventative maintenance schedule for system components to Consultant.

.3 Submit detailed inspection reports to Consultant.

.4 Submit dated, maintenance task lists to Consultant and include the following sensor and output point detail, as proof of system verification:

.1 Point name and location.
.2 Device type and range.
.3 Measured value.
.4 System displayed value.
.5 Calibration detail
.6 Indication if adjustment required and made
.7 Other action taken or recommended.

.5 Submit network analysis report showing results with detailed recommendations to correct problems found.

.6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.

.1 Maintain records and logs of each maintenance task on site.
.2 Organize cumulative records for each major component and for entire EMCS chronologically.
.3 Submit records to Consultant, after inspection indicating that planned and systematic maintenance have been accomplished.

.7 Revise and submit to Consultant in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.4 Maintenance Service During Warranty Period

.1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.

.2 Emergency Service Calls:
- .1 Initiate service calls when EMCS is not functioning correctly.
- .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
- .3 Furnish Owner and Consultant with telephone number where service personnel may be reached at any time.
- .4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
- .5 Perform Work continuously until EMCS restored to reliable operating condition.

.3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.

.4 Work requests: record each service call request, when received separately on approved form and include:
- .1 Serial number identifying component involved.
- .2 Location, date and time call received.
- .3 Nature of trouble.
- .4 Names of personnel assigned.
- .5 Instructions of work to be done.
- .6 Amount and nature of materials used.
- .7 Time and date work started.
- .8 Time and date of completion.

.5 Provide system modifications in writing.
- .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Owner or his representative.

1.5 Service Contracts

.1 Provide in-depth technical expertise and assistance to Owner and Commissioning Manager in preparation and implementation of service contracts and in-house preventive maintenance procedures.

.2 Service Contracts to include:
- .1 Annual verification of field points for operation and calibration.
- .2 Minimum of 4 visits per year for regular maintenance.
- .3 Rresponses to emergency calls during day, per year.
- .4 Complete inventory of installed system.

2 Products

2.1 Not Used

3 Execution

3.1 Field Quality Control

.1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Owner and Consultant as described in Submittal article.

.2 Perform inspections during regular working hours coordinated in advance with the Owner.

.3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
- .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
- .2 Check and calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
- .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.

.4 Minor inspections to include, but not limited to:
- .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
- .2 Check equipment cooling fans as required.
- .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
- .4 Review system performance Owner and Consultant to discuss suggested or required changes.

.5 Major inspections to include, but not limited to:
- .1 Minor inspection.
- .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
- .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
- .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
- .5 Provide mechanical adjustments, and necessary maintenance on printers.
- .6 Run system software diagnostics as required.
- .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
  - .1 Perform network analysis and provide report as described in Submittal article.

.6 Rectify deficiencies revealed by maintenance inspections and environmental checks.

.7 Continue system debugging and optimization.

.8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.

.1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 - Common Work Results – Mechanical.
.2 Section 25 05 01 - EMCS: General Requirements.

1.2 References

.1 Canadian Standards Association (CSA International).
  .1 CSA T529-95(R2000), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).
  .2 CSA T530-99(R2004), Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).

.2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.
  .1 IEEE Std 802.3™-2002, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

.3 Nova Scotia Department of Labour and Workforce Development
  .1 Electrical Bulletin 2012-02.

.4 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
  .1 TIA/EIA-568-March 2004, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.
  .2 TIA/EIA-569-A-December 2001, Commercial Building Standard for Telecommunications Pathways and Spaces.

1.3 Submittals

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

1.4 System Description

.1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529 and CSA T530.
  .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
  .2 Allow for future expansion of network, with selection of networking technology and communication protocols.

.2 Data communication network to include, but not limited to:
  .1 EMCS-LAN.
  .2 Network interface cards.
  .3 Network management hardware and software.
  .4 Network components necessary for complete network.

1.5 Design Requirements

.1 EMCS Local Area Network (EMCS-LAN).

.1 High speed, high performance, local area network over which MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.

.2 EMCS-LAN to: BACnet.

.3 Each EMCS-LAN to be capable of supporting at least 50 devices.

.4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.

.5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.

.6 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.

.7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.

.2 Dynamic Data Access.

.1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.

.2 Access to data to be based upon logical identification of building equipment.

.3 Network Medium.

.1 Network medium: twisted cable or fibre optic cable compatible with network protocol to be used within buildings. Fibre optic cable to be used between buildings.

2 Products

2.1 Not Used

3 Execution

3.1 Not Used

END OF SECTION

1 General

1.1 Related Sections

.1 Section 21 05 01 - Common Work Results – Mechanical.
.2 Section 25 05 01 - EMCS: General Requirements.
.3 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
.4 Section 25 05 03 - EMCS: Project Record Documents.
.5 Section 25 30 02 - EMCS: Field Control Devices.
.6 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 References

.1 Canadian Standards Association (CSA International).
  .1 C22.2 No.205-M1983(R1999), Signal Equipment.

.2 Institute of Electrical and Electronics Engineers (IEEE).
  .1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

1.3 Submittals

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

1.4 System Description

.1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in contract documents.
  .1 Provide sufficient controllers to meet intents and requirements of this section.
  .2 Controller quantity, and point contents to be reviewed by Consultant at time of preliminary design review.

.2 Controllers: stand-alone intelligent Control Units.
  .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
  .2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.
  .3 Capable of interfacing with operator interface device.
  .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
    .1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.3 Interface to include provisions for use USB connector to a Laptop or Tablet PC.

1.5 Design Requirements

.1 To include:
- .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
- .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
- .3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
- .4 Control of systems as described in sequence of operations.
- .5 Execution of optimization routines as listed in this section.

.2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.

.3 Field Termination and Interface Devices:
- .1 To: CSA C22.2 No.205.
- .2 Electronically interface sensors and control devices to processor unit.
- .3 Include, but not be limited to, following:
  - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
  - .2 Power supplies for operation of logics devices and associated field equipment.
  - .3 Lockable wall cabinet.
  - .4 Required communications equipment and wiring (if remote units).
  - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
  - .6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
  - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
- .4 AI interface equipment to:
  - .1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
  - .2 Provide for following input signal types and ranges:
    - .1 4 - 20 mA;
    - .2 0 - 10 V DC;
    - .3 100/1000 ohm RTD input;
  - .3 Meet IEEE C37.90.1 surge withstand capability.
  - .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
  - .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
  - .1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.
  - .2 Provide for following output signal types and ranges:
    - .1 4 - 20 mA.
    - .2 0 - 10 V DC.
  - .3 Meet IEEE C37.90.1 surge withstand capability.
- .6 DI interface equipment:

.1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
.2 Meet IEEE C37.90.1 surge withstand capability.
.3 Accept pulsed inputs up to 2 kHz.

.7 DO interface equipment:
.1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
.2 Switch up to 5 amps at 220 V AC using optional interface relay.

.4 Controllers and associated hardware and software: operate in conditions of -10 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.

.5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike lockable door.
.1 Provide for conduit entrance from top, bottom or sides of panel.
.2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
.3 Mounting details as approved by Consultant for ceiling mounting.

.6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.

.7 Provide surge and low voltage protection for interconnecting wiring connections.

2 Products

2.1 Master Control Unit (MCU)

.1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.

.2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
.1 MCU must support BACnet.

.3 MCU local I/O capacity as follows:
.1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.
.2 LCUs may be added to support system functions.

.4 Central Processing Unit (CPU).
.1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.
.2 CPU idle time to be more than 30 % when system configured to maximum input and output with worst case program use.
.3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:

.1 Non-volatile memory to contain operating system, executive, application, sub-routine, other configurations definition software, schedules, application parameters, operating data, etc.

.4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second.

.5 Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

.1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Consultant.

.2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.

.3 Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems..

.4 Functions to include, but not be limited to, following:

.1 Start and stop points.
.2 Modify setpoints.
.3 Modify PID loop parameters.
.4 Override PID control.
.5 Change time/date.
.6 Add/modify/start/stop weekly scheduling.
.7 Add/modify setpoint weekly scheduling.
.8 Enter temporary override schedules.
.9 Define holiday schedules.
.10 View analog limits.
.11 Enter/modify analog warning limits.
.12 Enter/modify analog alarm limits.
.13 Enter/modify analog differentials.

.5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.

.6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.

.7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.

.8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

2.2 Local Control Unit (LCU)

.1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.

.2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.

.3 Points integral to one Building System to be resident on only one controller.

.4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
- .1 Include minimum 2 interface ports for connection of local computer terminal.
- .2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.
- .3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.
- .4 Include power supplies for operation of LCU and associated field equipment.
- .5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.
- .6 Provide conveniently located screw type or spade lug terminals for field wiring.

2.3 Terminal/Equipment Control Unit (TCU/ECU)

.1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
- .1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook (2011) section 47.

.2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.

.3 VAV Terminal Controller.
- .1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.
- .2 Controller to support point definition; in accordance with Section 25 05 01 - EMCS: General Requirements.
- .3 Controller to operate independent of network in case of communication failure.
- .4 Controller to include damper actuator and terminations for input and output sensors and devices.

2.4 Software

.1 General.
- .1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.
- .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.
- .3 Include initial programming of Controllers, for entire system.

.2 Program and data storage.

.1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.
.2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.

.3 Programming languages.
.1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.
.2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required.

.4 Operator Terminal interface.
.1 Operating and control functions include:
.1 Multi-level password access protection to allow user/manager to limit workstation control.
.2 Alarm management: processing and messages.
.3 Operator commands.
.4 Reports.
.5 Displays.
.6 Point identification.

.5 Pseudo or calculated points.
.1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
.2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).

.6 Control Description Logic (CDL):
.1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
.2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.
.3 Perform changes to CDL on-line.
.4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.
.5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.
.6 MCU to be able to perform following pre-tested control algorithms:
.1 Two position control.

.2 Proportional Integral and Derivative (PID) control.

.7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.

.8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

.9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.

.7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.

.8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.

.1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:

.1 Time of day scheduling.
.2 Calendar based scheduling.
.3 Holiday scheduling.
.4 Temporary schedule overrides.
.5 Optimal start stop.
.6 Night setback control.
.7 Enthalpy (economizer) switchover.
.8 Peak demand limiting.
.9 Temperature compensated load rolling.
.10 Fan speed/flow rate control.
.11 Hot water reset.
.12 Chilled water reset.
.13 Condenser water reset.
.14 Chiller sequencing.

.2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.

.3 Apply programs to equipment and systems as specified.

.9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.

.1 MCUs to accumulate and store automatically run-time for binary input and output points.
.2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
.3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
.4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
.5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWH, litres, tonnes, etc.).
.6 Store event totalization records with minimum of 9,999,999 events before reset.
.7 User to be able to define warning limit and generate user-specified messages when limit reached.

2.5 Levels of Address

.1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.
.1 Display analog values digitally to 1 decimal place with negative sign as required.
.2 Update displayed analog values and status when new values received.
.3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
.4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

2.6 Point Name Support

.1 Controllers (MCU, LCU) to support PWGSC point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

3 Execution

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Location

.1 Location of Controllers to be shown on shop drawings submitted for review by Consultant.

3.3 Installation

.1 Install Controllers in lockable enclosures.

.2 Provide necessary power from local 120 V branch circuit panel for equipment.

.3 Install tamper locks on breakers of circuit breaker panel.

.4 Use uninterruptible Power Supply (UPS) and emergency power where shown.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 01 73 00 - Execution Requirements.
.2 Section 21 05 01 – Common Work Results - Mechanical.
.3 Section 23 33 15 - Dampers - Operating.
.4 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
.5 Section 25 05 01 - EMCS: General Requirements.
.6 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
.7 Section 25 05 54 - EMCS: Identification.
.8 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
.9 Section 26 05 00 - Common Work Results - Electrical.

1.2 References

.1 American National Standards Institute (ANSI).
  .1 ANSI C12.7-1993 (R1999), Requirements for Watt-hour Meter Sockets.
  .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.

.2 American Society for Testing and Materials International, (ASTM).
  .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.

.3 National Electrical Manufacturer's Association (NEMA).
  .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 Air Movement and Control Association, Inc. (AMCA).
  .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers for Rating.

.5 Canadian Standards Association (CSA International).
  .1 CSA-C22.1-12, Canadian Electrical Code, Safety Standard for Electrical Installations.

.6 Nova Scotia Department of Labour and Workforce Development
  .1 Electrical Bulletin 2012-02

1.3 Submittals

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures, Section 21 05 01 – Common Work Results, Mechanical, and Section 25 05 02 - EMCS: Submittals and Review Process.

2 Products

2.1 General

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in ■■■ watertight / shockproof / vibration-proof / heat resistant ■■■ assembly.

.3 Operating conditions: -10 to 44 degrees C with 10 to 90 % RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

.8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

.9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

.10 Cutting and Patching: in accordance with Section 01 73 00 - Execution Requirements supplemented as specified herein.

2.2 Temperature Sensors

.1 General: except for room sensors to be resistance or thermocouple type to following requirements:

- .1 Thermocouples: limit to temperature range of 200 degrees C and over.
- .2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
- .3 Sensing element: hermetically sealed.
- .4 Stem and tip construction: copper or type 304 stainless steel.
- .5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
- .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length ■■■ 100 / 150 mm ■■■ as necessary.
- .7 ■■■Room temperature sensors not to display name of manufacturer or control company without prior permission. ■■■ SPEC NOTE: NS DTIR REQUIREMENT ■■■

.2 Room temperature sensors and display wall modules.
  .1 Temperature sensing and display wall module.
    .1 LCD display to show space temperature and temperature setpoint.
    .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
    .3 Jack connection for plugging in laptop personal computer for access to zone bus.
    .4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
    .5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
    .6 Stability 0.02 degrees C drift per year.
    .7 Separate mounting base for ease of installation.
  .2 Room temperature sensors.
    .1 Wall mounting, in slotted type covers having ■■■ brushed aluminum / brushed stainless steel ■■■ finish, with guard as indicated.
    .2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.
    .3 Where sensors are mounted on surface mounted boxes use cover with rounded corners and edges that do not project beyond the box.

.3 Duct temperature sensors:
  .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm or as indicated.
  .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.

.4 Outdoor air temperature sensors:
  .1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.

2.3 Temperature Transmitters

.1 Requirements:
  .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
  .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.
  .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
  .4 Input and output short circuit and open circuit protection.
  .5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
  .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
  .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
  .8 Integral zero and span adjustments.
  .9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50 degrees C.

.10 Long term output drift: not to exceed 0.25 % of full scale/ 6 months.
.11 Transmitter ranges: select narrowest range to suit application from following:
.1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.
.2 0 to 100 degrees C, plus or minus 0.5 degrees C.
.3 0 to 50 degrees C, plus or minus 0.25 degrees C.
.4 0 to 25 degrees C, plus or minus 0.1 degrees C.
.5 10 to 35 degrees C, plus or minus 0.25 degrees C.

2.4 Humidity Sensors

.1 Room and Duct Requirements:
.1 Range: 5 - 90 % RH minimum.
.2 Operating temperature range: 0 - 60 degrees C.
.3 Absolute accuracy:
.1 Duct sensors: plus or minus 3 %.
.2 Room sensors: plus or minus 2 %.
.4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
.5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
.6 Room sensors: locate in air stream near RA grille wall mounted as indicated.
.7 Duct mounted sensors: locate so that sensing element is in air flow in duct.

.2 Outdoor Humidity Requirements:
.1 Range: 0 - 100 % RH minimum.
.2 Operating temperature range: -40 - 50 degrees C.
.3 Absolute accuracy: plus or minus 2%.
.4 Temperature coefficient: plus or minus 0.03%RH/ degrees C over 0 to 50 degrees C.
.5 Must be unaffected by condensation or 100% saturation.
.6 No routine maintenance or calibration is required.
.7 Provide UV Stablized PVC waterproof housing.

2.5 Humidity Transmitters

.1 Requirements:
.1 Input signal: from RH sensor.
.2 Output signal: 4 -20 mA onto 500 ohm maximum load.
.3 Input and output short circuit and open circuit protection.
.4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.
.5 Output linearity error: plus or minus 1.0% maximum of full scale output.
.6 Integral zero and span adjustment.
.7 Temperature effect: plus or minus 1.0% full scale/ 6 months.
.8 Long term output drift: not to exceed 0.25% of full scale output/ 6 months.

2.6 Combination Relative Humidity / Temperature Sensor

.1 Where there is a requirements for the monitoring of both relative humidity and temperature at the same location, the BMS Contractor has the option to provide a

combination relative humidity sensor and temperature sensor. The individual sensors must each meet the specification details above.

2.7 Pressure Transducers

.1 Requirements:
- .1 Combined sensor and transmitter measuring pressure.
  - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
- .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10%.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
- .5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
- .6 Over-pressure input protection to at least twice rated input pressure.
- .7 Output short circuit and open circuit protection.
- .8 Accuracy: plus or minus 1% of Full Scale.

2.8 Differential Pressure Transmitters

.1 Requirements:
- .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
- .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
- .5 Integral zero and span adjustment.
- .6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
- .7 Over-pressure input protection to at least twice rated input pressure.
- .8 Output short circuit and open circuit protection.
- .9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.9 Static Pressure Sensors – Duct Mounted

.1 Provide duct mounted static pressure sensors as indicated within the field termination schedules and/or control diagrams. Static pressure sensors shall meet, at minimum, the following requirements:
- .1 Input range shall be appropriate for the application. Select range such that it covers from zero duct static pressure relative to the exterior of the duct up to a static pressure of between 20% and 50% in excess of the maximum static pressure that could be encountered in the duct relative to the duct exterior. Typically, for low pressure commercial duct consider using a range of 0 to 500 Pa, for medium pressure duct use a range of 0 to 6" W.G. and for high pressure duct use a range of 0 to 10" W.G.
- .2 4 - 20 mA, 0-5 or 0-10V DC output proportional to pressure input range compatible with BMS system.
- .3 1% full scale output accuracy.

.4 Operating temperature range of 0°C to 60°C.
.5 Easily accessible, integral non-interacting zero adjustment.
.6 Minimum over pressure input protection of two times rated input or 1 psig whichever is greater.

2.10 Static Pressure Transmitters

.1 Requirements:
- .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
- .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
- .3 Accuracy: 0.4 % of span.
- .4 Repeatability: within 0.5 % of output.
- .5 Linearity: within 1.5 % of span.
- .6 Deadband or hysteresis: 0.1% of span.
- .7 External exposed zero and span adjustment.
- .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

2.11 Velocity Pressure Sensors

.1 Requirements:
- .1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.
- .2 Maximum pressure loss: 37 Pa at 1000 m/s.
- .3 Accuracy: plus or minus 1 % of actual duct velocity.

2.12 Velocity Pressure Transmitters

.1 Requirements:
- .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
- .2 Calibrated span: not to exceed 125 % of duct velocity pressure at maximum flow.
- .3 Accuracy: 0.4 % of span.
- .4 Repeatability: within 0.1 % of output.
- .5 Linearity: within 0.5 % of span.
- .6 Deadband or hysteresis: 0.1% of span.
- .7 External exposed zero and span adjustment.
- .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.13 Liquid And Steam Flow Meters

.1 Requirements:
- .1 Pressure rating: as specified in I/O summaries.
- .2 Temperature rating: as specified in I/O summaries.
- .3 Repeatability: plus or minus 0.2 %.
- .4 Accuracy and linearity: plus or minus 1.0 %.
- .5 Flow rangability: at least 10:1.
- .6 Body material: to suite pipe and service
- .7 Ends:
  - .1 NPS 2 and under: screwed.
  - .2 NPS 2.1/2 and over: flanged.

2.14 Pressure And Differential Pressure Switches

.1 Requirements:
- .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.
- .2 Adjustable setpoint and differential.
- .3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.
- .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
- .5 Accuracy: within 2% repetitive switching.
- .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.
- .7 Switches on steam and high temperature hot water service: provide pigtail syphon.

2.15 Temperature Switches

.1 Requirements:
- .1 Operate automatically. Reset automatically, except as follows:
  - .1 Low temperature detection: manual reset.
  - .2 High temperature detection: manual reset.
- .2 Adjustable setpoint and differential.
- .3 Accuracy: plus or minus 1 degrees C.
- .4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.
- .5 Type as follows:
  - .1 Room: for wall mounting on standard electrical box with or without protective guard as described in Section 3 below.
  - .2 Duct, general purpose: insertion length : 460 mm.
  - .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
  - .4 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
  - .5 Strap-on: with helical screw stainless steel clamp.

2.16 Tank Level Switches

.1 Requirements:
- .1 Indicate high/low water level and to alarm.
- .2 For mounting on top of tank.
- .3 Maximum operating temperature: 120 degrees C.
- .4 Snap action contacts rated 15 amp at 120 V.
- .5 Adjustable setpoint and differential.

2.17 Sump Level Switches

.1 Requirements:
- .1 Liquid level activated switch sealed in waterproof and shockproof enclosure.
- .2 Complete with float, flexible cord, weight. Instrument casing to be suitable for immersion in measured liquid.

.3 N.O./N.C. Contacts rated at 15 amps at 120V AC. CSA approval for up to 250 volt 10 amps AC.

2.18 Electric / Pneumatic (E/P) Transducers

.1 Requirements:
- .1 Input range: 4 to 20 mA.
- .2 Output range: proportional 20-104 kPa or 20-186 kPa as applicable.
- .3 Housing: dustproof or panel mounted.
- .4 Internal materials: suitable for continuous contact with industrial standard instrument air.
- .5 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 2 % of full scale over entire range.
- .6 Integral zero and span adjustment.
- .7 Temperature effect: plus or minus 2.0 % of full scale/ 50 degrees C or less.
- .8 Regulated supply pressure: 206 kPa maximum.
- .9 Air consumption: 16.5 ml/s maximum.
- .10 Integral gauge manifold c/w gauge (0-206 kPa).

2.19 Electromechanical Relays

.1 Requirements:
- .1 Double voltage, DPDT, plug-in type with termination base.
- .2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.
- .3 Contacts: rated at 5 amps at 120 V AC.
- .4 Relay to have visual status indication

2.20 Solid State Relays

.1 General:
- .1 Relays to be socket or rail mounted.
- .2 Relays to have LED Indicator
- .3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
- .4 Operating temperature range to be -20 degrees C to 70 degrees C.
- .5 Relays to be CSA Certified.
- .6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.
- .7 Operational frequency range, 45 to 65 HZ.

.2 Input:
- .1 Control voltage, 3 to 32 VDC.
- .2 Drop out voltage, 1.2 VDC.
- .3 Maximum input current to match AO (Analog Output) board.

.3 Output.
- .1 AC or DC Output Model to suit application.

2.21 Current Transducers

.1 Requirements:

.2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:

.1 4-20 mA DC.
.2 0-1 volt DC.
.3 0-10 volts DC.
.4 0-20 volts DC.

.3 Frequency insensitive from 10 - 80 hz.

.4 Accuracy to 0.5% full scale.

.5 Zero and span adjustments. Field adjustable range to suit motor applications.

.6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.22 Current Sensing Relays

.1 Requirements:
.1 Suitable to detect belt loss or motor failure.
.2 Trip point adjustment, output status LED.
.3 Split core for easy mounting.
.4 Induced sensor power.
.5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
.6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
.7 Adjustable latch level.

2.23 Control Dampers

.1 See Section 23 33 15 – Dampers - Operating

2.24 Electronic Control Damper Actuators

.1 Requirements:
.1 Direct mount proportional type as indicated.
.2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
.3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
.4 Power requirements: 5 VA maximum at 24 V AC.
.5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
.6 For VAV box applications floating control type actuators may be used.
.7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.25 Control Valves

.1 Body: globe style.
.1 Flow characteristic as indicated on control valve schedule.
.2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
.3 Normally open or Normally closed, as indicated.
.4 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
.5 Packing easily replaceable.
.6 Stem, Type 316 stainless steel.

.7 Plug and seat: brass unless noted otherwise..
.8 Disc, replaceable, material to suit application.
.9 Minimum shut-off pressure equals maximum circulating pump shut-off pressure
.10 NPS 2 and under:
.1 Screwed National Pipe Thread (NPT) tapered female connections.
.2 Valves to ANSI Class 250, valves to bear ANSI mark.
.3 Rangeability 50:1minimum.
.11 NPS 2½ and larger:
.1 Flanged connections.
.2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.
.3 Rangeability 100:1 minimum.

.2 Butterfly Valves NPS 2 and larger:
.1 Body: for chilled water ANSI Class 150 cast iron lugged body and wafer body installed in locations as indicated. For steam and heating water ANSI Class 150 carbon steel lugged body and wafer body.
.2 End connections to suit flanges that are ANSI Class 150.
.3 Extended stem neck to provide adequate clearance for flanges and insulation.
.4 Pressure limit: bubble tight sealing to 170 kilopascals.
.5 Disc/vane: aluminum bronze to ASTM B148.
.6 Seat: for service on chilled water EPDM . For service on heating water PTFE.
.7 Stem: 316 stainless steel.
.8 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
.9 Flow characteristic linear.
.10 Maximum flow requirement as indicated on control valve schedule.
.11 Maximum pressure drop as indicated on control valve schedule: pressure drop not to exceed one half of inlet pressure.
.12 Normally open or Normally closed, as indicated.
.13 Valves are to be provided complete with mounting plate for installation of actuators.

2.26 Electronic / Electric Valve Actuators

.1 Requirements:
.1 Construction: steel, cast iron, aluminum.
.2 Control signal: 0-10V DC or 4-20 mA DC.
.3 Positioning time: to suit application. 90 sec maximum.
.4 Fail to normal position as indicated.
.5 Scale or dial indication of actual control valve position.
.6 Size actuator to meet requirements and performance of control valve specifications.
.7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.
.8 Minimum shut-off pressure: refer to control valve schedule.

2.27 Watt-Hour Meters And Current Transformers

.1 Requirements:

.1 Include three phases, test and terminal blocks for watt-hour meter connections and connections for monitoring of current. Provide two transformers for 600 V 3 wire systems for watt-hour meter use. Accuracy: plus or minus 0.25 % of full scale. For chiller applications: to have instantaneous indicator with analog or digital display.
.2 Watt-hour meter sockets: to ANSI C12.7.
.3 Potential and current transformers: to ANSI/IEEE C57.13.
.4 Potential transformers: provide two primary fuses.
.5 Demand meters: configure to measure demand at 15 minute intervals.

2.28 Surface Water Detectors

.1 Requirements:
.1 Provide alarm on presence of water on floor.
.2 Expendable cartridge sensor.
.3 Internal waterproof switch.
.4 One set of dry contacts 2 amps at 24 V.
.5 Unaffected by moisture in air.
.6 Self-powered.

2.29 Panels

.1 Wall or bracket mounted enamelled steel cabinets with hinged and key-locked front door.

.2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity.

.3 Panels to be lockable with same key.

2.30 Wiring

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical and Nova Scotia Department of Labour and Workforce Development Bulletin 2012-02.

.2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.

.3 Wiring must be continuous without joints.

.4 Sizes:
.1 Field wiring to digital device: #18 AWG copper.
.2 Analog input and output: shielded #18 minimum copper.

2.31 Terminal Unit Controller Differential Pressure Sensors

.1 Provide as part of the terminal unit controller, a differential pressure transducer for the monitoring of the terminal unit air flow rate. The differential pressure transducer shall meet, at minimum, the following requirements:
.1 It shall monitor the differential pressures generated by a multi-point averaging device, such as a cross flow sensor located in the primary air duct or at the discharge of the terminal unit. The terminal unit manufacturer shall provide the multi-point averaging sensors. Co-ordinate with the terminal unit manufacturer for range of pressure differential.

.2 The pressure differential transducers shall be a compatible component of the terminal unit unitary controller (or supplied by the BMS Contractor). The terminal unit manufacturer as part of the factory installation shall provide tubing from these sensors to the multi-point averaging devices.

.3 The differential pressure sensor shall be mounted in the terminal unit enclosure of on the terminal unit, depending on space availability. The differential transducer shall monitor the flow rates with an accuracy of ±5% in the flow range of 300 to 3000 ft./min.

.4 Provide a one-micron filter on the pressure differential sensor if it monitors a moving air stream.

.5 The output from the differential pressure transducer shall be compatible with the unitary controller. The unitary controller must convert the analog signal using the square root extraction formula to output the velocity.

2.32 Carbon Dioxide (Co_2) Sensors

.1 Provide a space or duct carbon dioxide gas detection sensor as indicated within the field termination schedules and/or control diagrams. Carbon dioxide detection sensors shall meet, at minimum, the following requirements:

.1 Setup to be fully microprocessor based via plug and play LCD.

.2 4-20 mA, 0-10 or 0-5V DC output compatible with BMS proportional to 0 to 2000 ppm (adjustable to 10,000 ppm in 500 ppm increments) of carbon dioxide concentration.

.3 Power supply to be 20-30V AC/DC @ 80 mA maximum for 24V AC and 36 mA average @ 24V DC.

.4 No maintenance or period sensor replacement needed, The sensor shall have a five (5) year calibration interval, utilizing the Automatic Calibration Logic Program (ACLP).

.5 Standard accuracy to be 3% of reading or 75 ppm, whichever is greater.

.6 Operating temperature of 0°C to 50°C (32°F to 122°F).

2.33 Low Limit Temperature Cutout

.1 Minimum 6000 mm vapour pressure type sensing element.

.2 Two circuit type with SPST switch action for each circuit.

.3 One circuit to fan shutdown. Other circuit to DDC system.

.4 Manual reset.

.5 Minimum contact rating of 15 amps at 120V AC.

2.34 Damper End Switches

.1 Activated by damper blade movement and mounted securely on damper frame.

.2 Rotary action steel slotted lever with plastic roller.

.3 Two electrically isolated single pole changeover micro switches.

.4 Contact rating of 10 amperes at 120V AC.

.5 CSA approved and bear a ULC label.

2.35 Control Transformers

.1 Indoor type MC enclosed style, single phase 50 VA - 5000 VA.

.2 Features:

.1 Rugged split side covers provide easy access to wiring compartments and allow installation with either solid or flexible conduit.
.2 Attractive aluminum side supports enhance heat dissipation capability.
.3 Many multi-voltage primary and secondary models increase range of applications per unit.
.4 Solidly fixed terminals with standard combination screw connections facilitate wiring.
.5 All terminals clearly identified with additive polarity markings.
.6 Every coil bobbin wound for greater efficiency and superior heat evacuation capability.
.7 All models built with heat-proof insulation for compact size and long life.
.8 Standard electrical knockouts and double “D” fuse knockouts are provided on all units.
.9 All units can be mounted either vertically or horizontally.
.10 All units CSA certified.

.2 Engineering Specifications:

.1 Input voltages: 600, 480, 416, 380, 347, 277, 240, 208, 120.
.2 Output voltages: 240, 120, 32, 24, 16, 12.
.3 Output VA range: 50-5000.
.4 Operating frequency: 57-63 Hz.
.5 Insulation systems: 130°C (50-1000VA), 155°C (1500-5000VA).
.6 Sound level: Less than 35 db.
.7 Polarity: Additive.

.3 Acceptable Materials: Marcus, Hammond.

2.36 Air Flow Monitoring Stations (AFMS)

.1 Pitot tube, static pressure; averaging airflow monitoring station with integral flow straighteners to eliminate the effects of turbulence. Multi-port pitot array featuring hemispherically tipped static sensors, spaced as per ASHRAE traversing guidelines, complete with flow sensor.

.2 Rectangular duct configuration, standard 12" flange-to-flange dimension.

.3 Accuracy: ±2%.

.4 Repeatability: ±0.5%.

.5 Minimum/Maximum velocity: 400/6000 FPM.

.6 Unrecovered Pressure Loss: approximately 30% of measured differential pressure.

.7 Standard 16 gauge galvanized steel casing complete with aluminum 3/8" honeycomb hexcell flow straightener design, hard copper pitot tubes (Hi/Lo) di-electrically isolated from the galvanized steel casing.

.8 Duct flanges shall be gasketted complete with bolts.

.9 AFMS's shall be supported independently from the new insulated outside air ducting.

.10 Leak test all fittings and joints as per the manufacturer's recommendations.

.11 See drawing for size of AFMS's. The Controls Contractor shall provide a differential pressure transmitter/transducer to interface with the building EMCS.

.12 Maximum duct air operating conditions: 6.0" WG; 200 deg.C.

.13 Maximum pressure drop: 0.15" WG.

.14 Acceptable Materials: Ruskin, Ultratech Industries Inc. (a Hamlin Company); Air Monitor Corporation; Sensocon; Ebtron; Dwyer; Tek-Air; Kele; Greenheck Fan Corporation; Paragon Controls Incorporated;

2.37 Pressure / Current Transmitters

.1 Requirements:
- .1 Range: to suit application. Operating point ideally at mid span of range.
  - .1 Pressure sensing elements: bourdon tube, bellows or diaphragm type.
  - .2 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
- .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .3 Output variations: less than 0.2% full scale for supply voltage variations of plus or minus 10%.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5% of full scale output over entire range.
- .5 Integral zero and span adjustment.
- .6 Temperature effects: not to exceed plus or minus 1.5% full scale/ 50°C.
- .7 Over-pressure input protection to at least twice rated input pressure.
- .8 Output short circuit and open circuit protection.
- .9 Accuracy: plus or minus 1% of Full Scale.

2.38 Fan System Pressure Sensors

.1 Requirements:
- .1 Multipoint element with self-averaging manifold.
  - .1 Maximum pressure loss: 0.025" W.G. at 2000 fpm (Air stream manifold).
- .2 Accuracy: plus or minus 1% of actual duct static pressure.

2.39 Fan System Static Pressure Transmitters

.1 Requirements:

.1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
.2 Calibrated span: not to exceed 150% of duct static pressure at maximum flow.
.3 Accuracy: 0.4% of span.
.4 Repeatability: within 0.5% of output.
.5 Linearity: within 1.5% of span.
.6 Deadband or hysteresis: 0.1% of span.
.7 External exposed zero and span adjustment.
.8 The unit to have a ½" N.P.T. conduit connection. The enclosure shall be an integral part of the unit.

2.40 Turbine Flow Water Meters

.1 Requirements:
.1 Size as indicated.
.2 Pressure rating: 150 psig (gauge) at 38°C.
.3 Temperature rating: 73 to 260°C.
.4 Repeatability: plus or minus 0.1%.
.5 Accuracy and linearity: plus or minus 0.5%.
.6 Flow rangability: at least 10:1.
.7 Output voltage: 30 to 300 mV peak-to-peak into 10 Kohm load.
.8 Body material: bronze or stainless steel.
.9 Ends: Screwed or Flanged

2.41 Frequency To DC Transmitters For Turbine Meters

.1 Requirements:
.1 Input: greater than 5000 ohm.
.1 Range: greater than 100 mV less than 20V peak-to-peak, 200 through 400 Hz.
.2 Span adjustment: fully adjustable.
.3 Zero adjustment: 0 to 10% of output.
.4 Output: 4 to 20 mA into 500 ohm load.
.5 Load effect: plus or minus 0.1% of span zero to maximum load resistance.
.6 Linearity and repeatability: plus or minus 0.05% of span.
.7 Power input: 24V DC plus or minus 10%.
.8 Input, output and power input transformer isolated.
.9 Enclosure: general purpose NEMA 1.

2.42 Pressure And Differential Sensors And Switches

.1 Requirements:
.1 Range: to suit application. Operation point ideally at mid span of range.
.1 Pressure sensing elements: bourdon tube, bellows or diaphragm type.
.2 Adjustable setpoint and differential.
.3 Switch: SPDT snap action type, rated at 120V, 15 amps AC or 24V DC.
.4 Sensor assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
.5 Accuracy: within 2% repetitive switching.
.6 Provide sensor pressure and accuracy ratings:

.1 Chilled water: 125 psig.
.2 Glycol and Hot water: 125 psig.
.3 Low pressure steam and compressed air: 15 psig. Range: 0 to 30 psig. Accuracy: plus or minus 0.45 psig.
.4 High pressure steam and compressed air: 100 psig. Range: 0 to 200 psig. Accuracy: plus or minus 2 psig.
.5 For fan operation: Range: 0 to 12" W.G. Adjustable differential: 0.04" to 1.2" W.G.

.7 Provide sensors with isolation valve and snubber between sensor and pressure source.
.8 Sensors on steam and medium temperature hot water service: provide pigtail syphon.
.9 Metal housing with conduit connection.

2.43 Liquid Level Switches

.1 Requirements:
.1 Liquid level activated switch sealed in waterproof and shockproof enclosure.
.2 Complete with float, flexible cord, weight. Instrument casing to be suitable for immersion in measured liquid.
.3 N.O./N.C. Contacts rated at 15 amps at 120V AC. CSA approval for up to 250 volt, 10 amps AC.

2.44 Current/Pneumatic (I/P) Transducers

.1 Requirements:
.1 Input range: 4 to 20 mA.
.2 Output range: proportional 2 - 15 psig or 2 - 30 psig as applicable.
.3 Housing: dustproof or panel mounted.
.4 Internal materials: suitable for continuous contact with industrial standard instrument air.
.5 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 2% of full scale over entire range.
.6 Integral zero and span adjustment.
.7 Temperature effect: plus or minus 2.0% full scale/ 50°C or less.
.8 Regulated supply pressure: 30 psig maximum.
.9 Air consumption: 0.035 cfm maximum.
.10 Integral gauge manifold c/w gauge (0 - 30 psig).

2.45 Air Pressure Gauges

.1 Diameter: 1½" minimum.

.2 Range: zero to two times operating pressure of measured pressure media to nearest standard range.

2.46 Electrical Relays

.1 Requirements:
.1 Double voltage, DPDT, plug-in type with termination base.
.2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.
.3 Contacts: rated at 5 amps at 120V AC.

.4 Relay to have visual status indication.

2.47 Current Transducers

.1 Requirements:

.1 Range: to suit application. Operating point ideally at mid span of range.

.2 Purpose: measure line current and produce proportional signal in one of following ranges:

.1 4-20 mA DC.
.2 0-1 volt DC.
.3 0-10 volts DC.
.4 0-20 volts DC.

.3 Frequency insensitive from 10 - 80 hz.

.4 Accuracy to 0.5% full scale.

.5 Zero and span adjustments. Field adjustable range to suit motor applications.

.6 Adjustable mounting bracket to allow for secure/safe mounting inside the MCC.

2.48 Current Sensing Relays

.1 Requirements:

.1 Complete with metering transformer ranged to match load, plug-in base and shorting shunt to protect current transformer when relay is removed from socket.
.2 Suitable for single or 3 phase metering into single relay.
.3 To have adjustable latch level, adjustable delay on latch and minimum differential of 10% of latch setting between latch level and release level.
.4 3-Phase application: provide for discrimination between phases.
.5 To have adjustable latch level to allow detection of worst case selection. To be powered from control circuit of motor starter being metered. Relay and base to be mounted in adjacent auxiliary cabinet only if control circuit power to be brought into auxiliary cabinet. Adjustments to be acceptable from auxiliary cabinet. Self-powered with no insertion loss; dust proof housing.
.6 Relay contacts: capable of handling 10 amps at 240V AC.
.7 Unit complete with LED indication of relay status.

2.49 Electronic VAV Terminal Control Box

.1 Terminal box shall be sized to deliver air quantities as per mechanical VAV Box Schedule.

.2 Box shall be complete with factory installed averaging air velocity sensor.

.1 Provide removable air flow sensor with minimum 4 point sensing with +/- 5% accuracy at 10 deg C to 35 deg C and 100 to 2000 cfm.

.3 Box shall include direct damper shaft mounted actuator, of the non stall, full linear with position feedback type. Actuator shall denergize when at desired position.

.4 Box shall be complete with power transformer and control wiring to damper actuator and termination terminals for room sensors and other specified sensors and auxiliary devices.

.5 Box shall include VAV Controller as described in Section 13842 with appropriate mounting plate and protective cover. VAV controllers by Controls Contractor, shipped to VAV box manufacturer's factory for assembly.

2.50 Control Valves with Electronic Actuators

.1 Two and Three Port Valves to NPS 2:

.1 Body to be two-way or three-way as indicated on the drawings or required for application.

.2 Screwed body style to be available in 125# or 250# class as required for hot water, chilled water or low pressure steam applications. Material to be bronze.

.3 Action: normally open or normally closed for fail-safe, or as indicated. Spring return or fail last position as required.

.4 Globe type valve body materials to include replaceable EMPT disc, bronze seat, stainless steel stem, and multiple EMPT V-ring packing. Ports are to be female NPT.

.5 Operating temperature to 250°F.

.6 Actuator to be spring-return for fail-safe operation or fail last position as indicated. Actuator to be powered with 24V AC controlled from two-position, proportional control signal (0-10V AC), 4-20 ma) or tri-state.

.7 Actuator must be UL listed, CSA certified.

.8 Manual crank for opening and manually positioning valve for service. Must lock actuator in place at any position. Position indication readable from ten feet away.

.9 NEMA 2 housing. Ambient temperature ratings -30°C to 50°C.

.2 Two and Three Port Valves NPS 2½ and Up:

.1 Body to be two-way or three-way as indicated on the drawings or required for application. Three-way valve body to be mixing or diverting as required.

.2 Flanged body style to be available in 125#, 250# or 300# class as required for hot water, chilled water or steam applications. Material to be cast iron.

.3 Action: normally open or normally closed for fail-safe, or as indicated. Spring return or fail last position to suit application.

.4 Globe type valve body materials to include bronze seat and plug stainless steel stem, and multiple Buna N or Teflon O-ring packing.

.5 Operating temperature to 121°C.

.6 Flow characteristics to be equal percentage or linear as indicated.

.7 Leakage for single seat type valves not to exceed 0.01% or maximum flow.

.8 Actuator to be spring-return for fail-safe operation or fail last position as indicated. Actuator to be powered with 24V AC controlled from two-position, proportional control signal (0-10V AC, 4-20 ma) or tri-state.

.9 Actuator must be UL listed, CSA certified.

.10 Manual crank for opening and manually positioning valve for service. Must lock actuator in place at any position. Position indication readable from 10 ft. away.

.11 NEMA 2 housing. Ambient temperature ratings -30°C to 50°C.

.3 District heat primary control valves shall conform to the following: The district heating control valve for each heat exchanger shall be located on the district heat return side and meet the following conditions:

.1 Valve is single seated, plug type-two way. The valve shall have an equal percentage characteristic. Minimum turn down - 35:1.

.2 Control valve to exceed heat exchanger pressure drop by 1 psig, but not greater than 10 psig for building heating or for DHW. Control valves are for temperature control and not intended as pressure reducers.

.3 The valve shall be ANSI Class IV shut off or better with maximum leakage factor of 0.01% of the rated CV. Valves shall close under a differential pressure of 85 psig without cavitation or excessive noise (>80db).

.4 Minimum inlet pressure and temperature for design of valve - 1724 kPa/121.1^{o}C. ANSI Class 250. Bronze body with screwed or union ends.

.5 Valve shall be bronze with a spring loaded Teflon V-ring or EPDM O-Ring stem packing. Stainless steel stem. Stainless steel seat. Stainless steel plug/disc.

.6 Valves, the valves shall fail in the “AS IS” position for heating and closed position for domestic hot water (requires backup battery or spring).

.7 Two valves shall be piped in parallel if a single valve exceeds 2½" diameter. The actuators should operate in sequence to satisfy the building heating demand. The valve first to open shall have a rating for 33% of the flow and the second valve rating for 67%.

.8 Valves shall have CRN registration and approval from the PEI Department of Labour Provincial Boiler Inspector. Acceptable valves include Powers Flowrite II Type S.S., Siemens Flowrite VF599, Invensys Siebe 7213.

2.51 Variable Frequency Drives (VFD’s)

.1 General:

.1 Scope:

.1 The Controls Contractor shall provide variable frequency drives (VFD’s) for systems as indicated on the drawings.

.2 Provide line and load reactors and filters for each VFD.

.3 Provide on-site commissioning (start-up) of the variable frequency drives by factory trained service personnel. Adequate time must be allowed to thoroughly and safely start, program and test run the VFD with the building management system. A separate site visit is to be provided for the training of operation and maintenance personnel.

.4 Provide rain shields for both VFDs and Line/Load reactors installed in Mechanical Rooms

.2 Submittals:

.1 All bid submittals must include the following:

.1 A detailed description of all components in the VFD package including line and load reactor impedance ratings and/or filter design type, VFD current, Hp, and voltage rating.

.2 Mechanical dimensional drawings.
.3 List of exceptions to this specification.
.4 Harmonic specification compliance calculations.

.2 Final approval submittals shall include a dimensional drawing and schematic wiring diagram. These submittals shall show all VFD package component connections and all digital and analog inputs and outputs to be connected to the control system.

.3 On completion of the installation, the supplier shall provide the following:
.1 Full commissioning report documenting all programmable settings, AC input voltage, DC bus voltage, current draw at maximum speed, and a description of ambient conditions.
.2 One operator's manual for the VFD installed.
.3 One 8½" x 11" wiring diagram for each VFD installed.

.3 VFD Standard Features:
.1 A minimum of five digital inputs programmable for function as well as normally open or normally closed operation.
.2 A minimum of two digital outputs programmable for run, frequency arrival or over torque, as well as normally open or normally closed operation.
.3 The VFD shall accept 0-5V DC, 0-10V DC and 4-20 mA analog speed reference inputs.
.4 Current or voltage speed reference inputs shall be selectable by a digital input.
.5 The VFD shall offer a 0-10V DC analog output programmable for frequency or current.
.6 The VFD shall include a set of normally open/normally closed alarm contacts.
.7 A minimum of seven programmable pre-set speeds shall be included.
.8 A minimum of three critical frequency reject points with programmable band width shall be included.
.9 The VFD shall provide DC injection braking capable of automatic initation prior to all start commands to brake a wind-milling fan.
.10 Acceleration and deceleration shall be programmable from 1 to 999 seconds.
.11 Acceleration and deceleration shall be programmable for linear, S-curve, U-cruve, or reverse U-curve options.
.12 The carrier frequency shall be programmable to a maximum of 16 kHz.
.13 The VFD shall provide an automatic energy saving feature which will optimize the output voltage to minimize the power consumption.
.14 The VFD shall be capable of an instantaneous power failure ride through of 15 milli-seconds.
.15 The VFD shall be programmable for constant or variable torque V/F curves to optimize energy consumption.
.16 The VFD shall be programmable to offer thermal overload protection for a single motor.
.17 Adjustable minimum speed setting from 0-100% and adjustable maximum speed setting from 0-100%.
.18 A fault log will record total number of faults and display details of the last three faults, including reason for fault, output frequency and current at time of fault, and DC bus voltage at time of fault.
.19 Fuzzy logic control of acceleration and deceleration time without trip.

.20 The keypad shall have the ability to enable or disable reverse and stop buttons.
.21 PID shall be programmable feature.
.22 Software settings shall be lockable by both software and digital input.
.23 A non-volatile memory shall be provided so that programming and fault log memory will not be lost in the event of a power failure.

.4 Protective Devices Feature and Digital Displays:
.1 The VFD shall have the following protective features and digital displays as a minimum:
.1 Instantaneous over-current protection.
.2 Electronic thermal overload protection.
.3 Over-voltage protection.
.4 Under-voltage protection.
.5 Ground fault protection.
.6 Phase loss protection.
.7 Current transformer fault.
.8 Instantaneous power failure protection.
.9 Unattended start protection.
.10 External trip input and display.
.11 CPU error.
.12 EEPROM error.
.13 Option board error.
.2 The VFD package shall provide the following protective devices as a minimum:
.1 All 575 volt systems shall be 3% impedance harmonically compensated line reactors rated to carry 150% total RMS current continuously.
.2 All 575 volt systems shall include standard output filters. The output filters shall consist of 5% impedance, harmonically compensated, IGBT rated load, reactor connected on the VFD output with a three phase delta connected capacitor module connected in parallel to the reactor output. The output filters shall be tuned to approximately 1 to 2 Khz and the VFD carier frequency must be set to 5 Khz or higher.
.3 Co-ordinate Electrical Contractor's responsibility with respect to the installation of the line reactors and the load filters.

.5 Environmental Ratings:
.1 The VFD shall operate within the following environmental ratings without derating:
.1 Ambient temperature of -10 to 40°C.
.2 Humidity of 20 to 90% non-condensing.
.3 Altitude of 4,000 feet.
.4 Vibration of 0.5G or less.
.6 Ensure that the VFD, load side wiring and motor combination are completely compatible.

.7 Wiring on the load side of VFD's shall be specifically rated for this application. Regular wiring is not acceptable.

.8 Output waveform tests shall be performed on all VFD's. Submit test results to the Consultant for review.

.9 Ensure all VFD's are properly ventilated. Provide galvanized steel unistrut support structure, frame and racking system.

.10 Provide circuitry to limit the total harmonic distortion (THD) on the line side of the VFD.

.11 Ensure that the VFD is rated for constant torque or variable torque loads as applicable.

.12 VFD Input Disconnect:

.1 Fusible disconnects shall be used for all installations that do not offer other means of short circuit protection for the VFD. Non-fusible disconnects may be used for installations that do provide other means of short circuit protection.

.1 Provide fusible disconnect with fuses, for all VFD installations. Fusible disconnect shall be integrally mounted and wired with VFD in a NEMA 1 enclosure.

.13 Four Line Digital Keypad:

.1 Provide for a four line digital keypad that employs words and numbers for each operator interface. Keypad shall be capable of monitoring, programming and operating the VFD.

.14 Overload Relay:

.1 Provide a separately mounted overload relay for each motor in a multi-motor application.

.15 Acceptable Materials: ABB, Siemens SED 2, Allen Bradley, Graham Company, Reliance, Toshiba, Trane, Mitsubishi, Siemens, Hitachi, AC Tech, MGI Technologies.

2.52 Quality Assurance

.1 Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of laboratory systems and shall be the manufacturer's latest standard design that complies with the specification requirements.

.2 Standard one year warranty period, starting on the date of Owner acceptance. Any materials or system performance problems within that one year period shall be corrected by the manufacturer at no cost to the Owner.

.3 Supplier shall have an in-place support facility within 500 kilometers of the site with technical staff, spare parts inventory, and all necessary test and diagnostic equipment.

.4 Installation, as well as the startup, checkout and commissioning shall be by full time employees of the control system manufacturer and shall be fully trained by the system manufacturer.

2.53 Room Occupancy Sensors

.1 The Electrical Contractor shall provide the room occupancy sensors. The Controls Contractor shall interface to the dry contact provided by Division 16 for each occupancy sensor. Provide all necessary devices, wiring, etc. to make operational.

3 Execution

3.1 Installation

.1 Install room temperature sensors and/or thermostats away (min. 6”) from other heat producing devices, such as Electrical dimming panels to avoid false readings.

.2 Room temperature / humidity sensors and/or thermostats / humidistats shall be wall-mounted, 1200 mm AFF.

.3 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.4 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.5 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.6 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.7 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 – Fire-stopping. Maintain fire rating integrity.

.8 Electrical:

.1 Complete installation in accordance with Section 26 05 00 - Common Work Results – Electrical and NS DOL Electrical Bulletin 2012-02.

.2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.

.3 Refer to electrical control schematics included as part of control design schematics [in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Consultant before beginning Work.

.4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

.5 Install communication wiring in conduit.

.1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).

.2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.3 Maximum conduit fill not to exceed 40%.

.4 Design drawings do not show conduit layout.

.6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Consultant to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

.9 Pneumatic: provide Pneumatic tubing, valves and fittings for field control devices in accordance with Section 23 09 43 - Pneumatic Control System for HVAC.

.10 Mechanical: supply and install in accordance with Section 23 09 43 - Pneumatic Control System for HVAC.

.1 Pipe Taps.

.2 Wells and Control Valves.

.3 Air flow stations, dampers, and other devices.

.11 VAV Terminal Units: supply, install and adjust as required.

.1 Air probe, actuator and associated vav controls.

.2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.

.3 Co-ordinate air flow adjustments with balancing trade.

.12 Repair surfaces damaged during execution of Work.

.13 Turn over to Owner existing materials removed from Work not identified for re-use.

3.2 Temperature And Humidity Sensors

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Outdoor installation:

.1 Protect from solar radiation and wind effects by non-corroding shields. Install in NEMA 4 enclosures.

.4 Indoor Installation

.1 Provide tamper guard for temperature sensors in corridors, vestibules, cafeterias, gymnasium, and where shown on plans.

.2 Screws securing ■■■ brushed aluminum / stainless steel ■■■ sensor plates to back boxes to be tamper proof and flush with sensor plate.

.5 Duct installations:

.1 Do not mount in dead air space.
.2 Locate within sensor vibration and velocity limits.
.3 Securely mount extended surface sensor used to sense average temperature.
.4 Thermally isolate elements from brackets and supports to respond to air temperature only.
.5 Support sensor element separately from coils, filter racks.

.6 Averaging duct type temperature sensors.

.1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
.2 Wire multiple sensors in series for low temperature protection applications.
.3 Wire multiple sensors separately for temperature measurement.
.4 Use software averaging algorithm to derive overall average for control purposes.

.7 Thermo-wells: install for piping installations.

.1 Locate well in elbow where pipe diameter is less than well insertion length.
.2 Thermo-well to restrict flow by less than 30%.
.3 Use thermal conducting paste inside wells.

3.3 Panels

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

3.4 Magnehelic Pressure Indicators

.1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor.

3.5 Pressure And Differential Pressure Switches And Sensors

.1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

.2 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor

3.6 I/P Transducers

.1 Install air pressure gauge on outlet.

3.7 Air Pressure Gauges

.1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.

.2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

3.8 Identification

.1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.9 Air Flow Measuring Stations

.1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.10 Testing And Commissioning

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION

1 General

1.1 Related Section

.1 Section 21 05 01 - Common Work Results – Mechanical.
.2 Section 25 05 01 - EMCS: General Requirements.

1.2 References

.1 Not Used.

1.3 Submittals

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.2 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.
  .1 Control Description Logic (CDL) for each system.
  .2 Input/Output Point Summary Tables for each system.
  .3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

1.4 Sequence Of Operation

.1 See Drawings

2 Products

NOT USED

3 Execution

NOT USED

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Summary

.1 Section Includes:

.1 General requirements that are common to NMS sections found in Division 26 - Electrical, 27 - Communications and 28 - Electronic Safety and Security.

.2 Related Sections:

.1 01 10 10 General Requirements
.2 01 21 00 Allowances
.3 01 31 13 Project Coordination
.4 01 32 00 Project Progress Documentation
.5 01 33 00 Submittals
.6 01 35 13 Special Project Requirements
.7 01 41 00 Regulatory Requirements
.8 01 42 13 Abbreviations
.9 01 45 00 Quality Control
.10 01 50 00 Temporary Facilities
.11 01 60 00 Product Requirements
.12 01 73 00 Execution Requirements
.13 01 74 00 Cleaning
.14 01 77 19 Project Closeout
.15 01 91 13 Commissioning
.16 26 05 01 Common Work Results - For Electrical
.17 26 05 20 Wire and Box Connectors 0-1000 V
.18 26 05 21 Wires and Cables (0-1000 V)
.19 26 05 28 Grounding - Secondary
.20 26 05 29 Hangers and Supports for Electrical Systems
.21 26 05 31 Junction, Pull Boxes and Cabinets
.22 26 05 32 Outlet Boxes, Conduit Boxes and Fittings
.23 26 05 34 Conduits, Conduit Fastenings and Conduit Fittings
.24 26 05 36 Cable Trays for Electrical Systems
.25 26 12 17 Dry Type Transformers Up To 600 V Primary
.26 26 24 17 Panelboards Breaker Type
.27 26 24 19 Motor Control Centres

.28 26 27 26 Wiring Devices
.29 26 28 14 Fuses - Low Voltage
.30 26 28 20 Ground Fault Circuit Interrupters - Class A
.31 26 28 21 Moulded Case Circuit Breakers
.32 26 28 23 Disconnect Switches - Fused and Non-Fused
.33 26 29 01 Contactors
.34 26 29 10 Motor Starters to 600 V
.35 26 50 00 Lighting
.36 26 52 01 Unit Equipment for Emergency Lighting
.37 26 53 00 Exit Signs
.38 26 99 99 Panel Schedules
.39 27 05 26 Grounding and Bonding for Communications Systems
.40 27 05 33 Pathways for Communications Systems
.41 27 10 05 Structural Cabling for Communications Systems
.42 28 31 00 Multiplex Fire Alarm System

1.3 References

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

.2 Abbreviations for electrical terms: to CSA Z85.

.3 CSA Electrical Bulletins in force at the time of tender submission, while not identified and specified by number in this division, are to be considered as forming part of the related CSA Part II standard and must be complied with..

.2 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.4 Contract Drawings

.1 No omissions in the drawings or specifications are intended and the Contractor shall give due consideration to this matter. Any work or material referred to in the drawings and not in the specifications, or vice versa, shall be furnished and performed as though fully covered in both. This shall apply particularly to the drawings where descriptions are sufficiently detailed so as to require little or no mention in the specifications. Items indicated on floor plans and not on riser diagrams, or vice versa, shall be considered fully covered by both.

.2 Runs of conduit and outlet locations indicated on the drawings are diagrammatic and exact locations must be determined by the Contractor as the work proceeds, with due regard to the structure and the work of other trades. The Engineer reserves the right to alter locations of conduit and outlets up to 10'-0" without extra cost, provided that the Contractor is advised prior to roughing in. The Contractor shall make any changes dictated by structural requirements, or conflicts with other trades, without charge to the Owner.

.3 Any error or omission shall be referred to the Engineer whose decision shall be final.

.4 Building dimensions shall not be scaled from the electrical drawings but shall be obtained from the Architectural and/or Structural drawings. Any discrepancy between the drawings and the building shall be questioned before proceeding with the installation.

1.5 Work Included

.1 The specifications complement the drawings in describing the supply and installation of the complete electrical systems. These systems shall include but not be limited to the following:

- .1 120/208V-3 phase-4 wire Light & Power Systems
- .2 347/600V-3 phase-4 wire Light & Power Systems
- .3 Emergency Power System
- .4 Communications system
- .5 Conduit and wiring for electronic access control system.
- .6 Conduit and wiring for intrusion alarm system.
- .7 Conduit and wiring and patch panels for CCTV surveillance system.

.2 This project will be commissioned by an independent Commissioning Agent. Provide support required by the Commissioning Agent. This support shall include but not be limited to the following:

- .1 Operating equipment.
- .2 Simulating alarm conditions.
- .3 Completing documentation.

1.6 Work Not Included

.1 The specifications and drawings do not include for the supply and/or installation of the following limited items.

- .1 Supply and installation of active telephone equipment.
- .2 Supply and installation of active data equipment.
- .3 Supply and installation of electronic access and control devices.
- .4 Supply and installation of intrusion alarm devices.
- .5 Supply and installation of CCTV surveillance cameras, monitoring equipment and recording equipment.

1.7 Design Requirements

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels for control items in English.

1.8 Submittals

.1 Submittals: in accordance with Section 01 33 00 - Submittals.

.2 Shop drawings:

.1 The Contractor shall prepare shop drawings showing in detail the design and construction of all equipment, panels, cabinets, lighting fixtures, etc. Six (6) copies of all such drawings shall be submitted to the Engineer for review, and the work shall not be executed until such review has been obtained.

.2 All shop drawings, other than standard manufacturers' dimensions and data sheets, shall bear the stamp of a registered professional Engineer who shall be fully responsible for the Engineering content of such drawings.

.3 Prior to submission the Contractor shall carefully check all shop drawings to ensure that they comply with the drawings and specifications in both intent and detail. No consideration will be given to shop drawings submitted without this approval and review from the Contractor. Appendix A at the end of this section must be completed and signed and must accompany all shop drawing submissions. Submissions not accompanied by Appendix A will be returned for re-submission.

.4 The Engineer’s review of these drawings is general and is not intended to serve as a check and shall not release the Contractor from responsibility for errors or from the necessity of checking the drawings himself, or of furnishing the materials and performing the work as required by the plans and specifications.

.5 High quality electronic “PDF” copies of shop drawings are acceptable.

.3 Quality Control:

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Permits and fees: in accordance with General Conditions of contract.

.5 Submit, upon completion of Work, load balance report as described in PART 3 - Load Balance.

.6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Consultant.

.4 Manufacturer's Field Reports: submit to Consultant manufacturer's written report, within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.9 Quality Assurance

.1 Qualifications: electrical Work to be carried out by qualified, licensed electricians or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

1.10 System Startup

.1 At the conclusion of the job, the Contractor shall review and demonstrate to the Owner, all electrical equipment and their respective functions and operation. Such demonstration shall be provided for such reasonable periods of time as the complexity of the job warrants, and as approved by the Engineer. Such review and demonstration shall be made by an authorized representative of the Contractor, who shall be fully knowledgeable of the project, its installation and operation. Three bound maintenance and operational manuals shall be reviewed and left with the Owner. These manuals shall be custom written for materials and systems supplied for this project. Generic information may accompany the manuals but must only be supplemental information. These manuals shall include, but not be limited to, training lists, final inspection report(s) from the authority having jurisdiction, approved copies of all shop drawings, guarantees, manufacturers maintenance instructions, diagrams, and parts lists, all packaging and installation instructions, and all operating instructions. Where manufacturers' literature is not available, or appropriate, the Contractor shall provide same in written form. This shall apply particularly to the general light, power and control system. Prior to final inspection, submit these manuals to the Engineer for review.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant will aspects of its care and operation.

1.11 Minimum Standards

.1 All work shall be performed in accordance with Canadian Electrical Code, National Building Code, and CAN/ULC-S524, as minimum standards. These standards together with all Local or Municipal Rules, Regulations, and Ordinances shall be considered as the Latest Approved Editions at the time of Tender Closing. In no instance, shall the standard established by the drawings and specifications, be reduced by any codes.

1.12 Permits, Fees and Inspection

.1 The Contractor shall obtain all inspections and permits required by all laws, ordinances, rules, and regulations by public authority having jurisdiction in this district, and shall obtain certificates of such inspections and shall pay all charges in connection therewith. The final certificate of inspection shall be obtained before final payment for work shall be considered due.

.2 In no instance shall the standard established by the drawings and specification be reduced by any codes, etc..

1.13 Supervision

.1 The Contractor shall provide supervision and sufficiently qualified foreman to ensure that the job proceeds in a proper and efficient manner. If in the opinion of the Engineer, such personnel are not competent to carry out their work, the Contractor shall replace these men immediately upon written request of the Engineer.

1.14 Other Trades

.1 The Contractor shall co-operate and investigate with other trades to make maximum use of the spaces and avoid conflict with pipes, ducts, equipment radiation, etc. Shop drawings shall be prepared by the Contractor indicating the route of main conduits and ducts which shall be submitted to the Engineer for review.

.2 The Contractor shall co-operate with other Contractors on the site and carry out the work, in such a way, as not to hinder or hold-up the work of other trades.

.3 The Contractor shall consult with other Contractors, where their respective installations conflict and shall re-route conduits, ducts, outlets, equipments, etc., as required, subject to the approval of the Engineer.

.4 The Contractor shall obtain from the mechanical and other trades complete detailed wiring diagrams of equipment requiring connections and shall be responsible for pointing out any discrepancies or the reason why they cannot be adhered to.

1.15 Fire Penetrations

.1 Where conduits and cables pass through fire separations and sound rated separations, including floors, walls, membranes, etc., provide a metallic sleeve, or core drill to 1" radius larger than the conduit or cable passing through the fire separation. Construct a ceramic fibre insulation dam, or dams as required, and fill the penetration with 3M PUTTY 303 or 3M CAULK CP25. A minimum depth of 2" of putty or caulk is required. As an alternate system, pack the space with ceramic fibre insulation to within 1 inch of each face of the separation, and fill the remaining voids with 1" of Electrovert AA 400 FLAMESEAL PUTTY, on each side. Either installation shall be in strict accordance with manufacturers

recommendations and to suit UL and/or ULC requirements. All such work shall be performed by personnel familiar and experienced with this type of work.

1.16 Guarantee

.1 The Contractor shall guarantee all work, under this Division, free from defects, for a period of one (1) year, after final acceptance of the entire project. The Contractor shall make good all defects, other than normal wear and tear, during the life of the guarantee. Notwithstanding the above, longer guarantees may be required for specific installations or equipments, as indicated in other sections of the specifications.

.2 Guarantees shall be submitted in writing, bound where more than one is required, and submitted to the Engineer for review. Each guarantee shall include:

.1 Project name and address.

.2 Guarantee time period (commencement date shall be the date as shown on the project final certificate of completion, unless otherwise indicated).

.3 Clear and concise definition of what is guaranteed.

.4 Signatures of company officers of the Contractor and/or manufacturers, as applicable.

1.17 Record Drawings

.1 One (1) set of white prints will be provided for record drawing purposes. Maintain project "as-built" record drawings and accurately record significant deviations from the Contract Documents, caused by site condition or Contract change. Mark changes on white prints in "RED".

.2 Identify each drawing in the lower right hand corner in letters at least 1/2" high as follows:

.1 "AS-BUILT DRAWINGS"

.2 (This drawing has been revised to show electrical systems as installed)

.3 (Signature of Contractor)

.4 (Date).

.3 Submit as-built drawings to Engineer for approval. Make all corrections as directed.

.4 Prior to start of testing, balancing and adjusting, finalize production of as-built drawings.

.5 Testing, balancing and adjusting to be performed using as-built drawings.

.6 Turn over the as built drawings to the owner at the completion of the project.

Part 2 Products

2.1 Materials and Equipment

.1 Contract materials shall be new and C.S.A. approved for their specific use..

.2 For the purposes of uniformity similar materials shall be of one manufacturer (i.e. all panels and switchgear; all motor control equipment; all light fixtures in as much as is possible; etc.)

.3 To avoid the possibility of the work being delayed, the Contractor shall order all materials as soon as possible, and he shall report at once to the Engineer any delays in the delivery of materials which would hold up the completion of the job.

.4 "Approved Manufacturers" catalogue designations are included in portions of this specification and also on the drawings. Manufacturers and equipments not listed, are not acceptable. Requests for approval of alternatives to the equipment specified, may be submitted to the Engineer for consideration ten (10) days prior to Tender closing. Where such approvals are granted, the Contractor shall assume full responsibility for the use of alternates with respect to conformance with the specifications, and physical limitations incurred

2.2 Electric Motors, Equipment and Controls

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.2 All power and control wiring associated with the mechanical systems of this project shall be performed by the electrical contractor but only to the limits of what is actually shown on the electrical drawings.

.3 The Contractor shall obtain from the mechanical and other trades complete detailed wiring diagrams of equipment requiring connections and shall be responsible for pointing out any discrepancies or the reason why they cannot be adhered to.

.4 Prior to rough in of electrical services, co-ordinate location of all mechanical equipment with the mechanical contractor.

2.3 Warning Signs

.1 Warning Signs: As specified and in accordance with requirements of Electrical Inspection Department and Consultant.

.2 Decal signs, minimum size 7” x 10”.

2.4 Wiring Terminations

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.5 Equipment Identification

.1 All switchboards, panels, disconnect switches, receptacles, voice/data and cable T.V. outlets, MCC's, transformers, control panels, magnetic starters, TOL's, etc. are to be provided with "lamicoid" nameplates as further described herein. Care is to be taken to ensure that all plates are affixed true and level, and plumb in all instances.

.2 Nameplates are to be affixed to all "metal" surfaces with steel type "pop-rivets". Care shall be taken to ensure that rivets do not interfere with the operation of the equipment.

.3 Nameplates are to be affixed to other types of surfaces with contact type cement.

.4 Nameplates are to be affixed to building "exterior" surfaces with nylon inserts and self tapping screws unless specifically indicated otherwise.

.5 Contact type cement is to be applied (buttered) to complete rear side of plate, as opposed to several locations or areas on same

.6 Lamicoid nameplates installed on distribution panelboards, motor control centres, splitter troughs, transformers, etc. shall indicate the following:

.1 Designated name of equipment.
.2 Amperage of overcurrent protection device.
.3 Voltages, number of phases and wires.
.4 Designation of power source
.1 Example:

PANEL 101 – 150AMPS
120/208V–3PH–4W
FED FROM MAIN SWITCHBOARD

.7 Lamicoid nameplates installed on combination starters, magnetic starters, manual starters, and all various system controls, control panels, disconnect switches, etc. shall contain the following information.

.1 Designated name of equipment.
.2 Designated name of power source.
.3 Branch circuit breaker number(s) where possible.
.4 Voltage(s).
.1 Examples:

EXHAUST FAN NO. 1
PANEL H – 120V
CCT. NO.17

SUPPLY FAN NO. 1
M.C.C. NO.1
600V–3PH

.8 Lamicoid nameplates installed on fusible type disconnect switches are to also indicate maximum designated/designed fuse size.

.9 Lamicoid nameplates are to be installed on all junction and/or pull boxes sized 6" x 6" and larger indicating name of system, designated panel name and electrical characteristics where applicable.

.10 Lamicoid nameplates are to be installed adjacent to each overcurrent devices located in switchboards, CDP panels, etc.. They need only indicate designated name and/or number of equipment they feed. Unused O.C. devices are to be identified as spare(s).

.11 Lamicoid nameplates installed on “main” service entrance switches, or “main” entrance switchboards to indicate the following information on minimum size 6" x 2plate complete with two lines of 1/2” high lettering. (Size #8 nameplate.)

.1 Example:.

MAIN BREAKER 1000 AMPS
347/600V-3PH-4W

.12 Install an additional “lamicoid” nameplate on all, or any piece of electrical equipment, or apparatus (i.e.: main switchboard, CDP panels, panelboards, motor control centres, etc.) that may contain overcurrent devices, i.e. circuit breakers and/or fuses, that have been designed for, and incorporate interrupting capacity sized “larger” than 10 kaIC.

.1 Example:.

Minimum interrupting capacity of breakers installed in this panel to be not less than 20 kaIC.

Minimum interrupting capacity of fuses installed in this MCC to be not less than 20 kaIC.

.13 Lamicoid nameplates are to be installed above all types of receptacles and abutted directly to tops of their respective device plates. Identification is to indicate respective panel source complete with associated circuit breaker number(s).

.1 1/16" thick x 1/2” high complete with 1/4” black letters on white face, directly above all flush receptacles. (Plate to be identical width as finish device plate)

.1 Example:.

PANEL 101-20

.14 General purpose receptacles located in rooms or areas containing additional receptacles intended for computer, electronic or other sensitive types of electronic equipment, etc. are to be identified as per the following:

.1 1/16" thick x 3/4” high complete with 1/4” black letters on white face, directly above all flush receptacles. (Identical width as finish device plate).

.1 Example:.

General Purpose Only
PANEL 101-24

.15 Lamicoid nameplate(s) for Cable T.V. and voice/data outlets are to be installed above the outlets and abutted directly to tops of their respective coverplates. Coordinate naming conventions with engineer and owner's representative.

.16 Allow for an “average” of forty letters for each lamicoid nameplate.

.1 Lamicoid 1/8” thick plastic engraving sheet, black letters, white face, for all electrical systems except fire alarm systems which shall have white letters on red face.

.2 1/16" thick nameplates above receptacles as previously indicated, with top left and right corners to be rounded off.

.3 Lettering on lamicoid nameplates shall not “start” or “end” nearer than 3/8” from either, or both ends of said plates. Size of lettering, including overall lengths of various plates shall be as indicated in the following chart.

.4 Sizes as follows:

NAMEPLATE SIZES

Size 1	[3/8" x 2"]{10 mm x 50 mm}	1 line	[3/16"]{5 mm} high letters
Size 2	[½" x 3"]{13 mm x 75 mm}	1 line	[1/4"]{6 mm} high letters
Size 3	[5/8" x 3"]{16 mm x 75 mm}	2 lines	[3/16"]{5 mm} high letters
Size 4	[3/4" x 3½"]{19 mm x 90 mm}	1 line	[3/8"]{10 mm} high letters
Size 5	[1½" x 3½"]{37½ mm x 90 mm}	2 lines	[½"]{13 mm} high letters
Size 6	[1" x 4"]{25 mm x 100 mm}	1 line	[½"]{13 mm} high letters

NAMEPLATE SIZES

Size 7	[1½" x 4"]{37½ mm x 100 mm}	2 lines	[1/4"]{6 mm} high letters
Size 8	[2" x 6"]{50 mm x 150 mm}	2 lines	[½"]{13 mm] high letters

.17 Labelling of all branch circuit phase and neutral conductors to be done on both ends of all circuit conductors plus in "all" junction and/or pull boxes located in between. Use write-on, self-laminating labels sized as necessary. To be installed in a "flagged" manner around individual conductor(s).

.18 Coverplates for junction and/or pull boxes located above finish ceilings housing branch circuits are to have each branch circuit number neatly identified on coverplate. Felt marker-pen may be used for this purpose..

.19 All of the following conductors are to have their insulation colours identified as indicated:

Phase A	Red
Phase B	Black
Phase C	Blue
Neutral	White/Grey
Bond	Green
Ground	Green
Isolated Ground	Green c/w Yellow Strip

.1 Colour code conductor insulation and others as per the following:

.1 All sizes of phase conductors up to and including #2 AWG.

.2 All sizes of neutral, bond and/or ground conductors, up to and including #3/0 AWG.

.2 Approved coloured tapes in lieu of insulation colouring may be used to identify conductors that exceed sizes as indicated in items .19.1.1 and .19.1.2 above, and is to take place on both ends of runs for a minimum of 12" from where terminations take place.

.20 Some examples of electrical apparatus that could have (identical types) of removable covers, and will require to have their lamicoid nameplates installed on wall(s) adjacent to control, rather than directly to their covers are the following.

.1 Magnetic starters.

.2 Manual TOL switches

.3 Magnetic contactors.

.4 Relays.

.21 Lamicoid nameplates shall be provided and installed on, or adjacent to, all various systems' control panels and/or cabinets, etc. complete with information as indicated. Plates are to reflect system's assigned name, and where applicable, shall also indicate both, designated panel name and associated branch circuit breaker number(s).

.1 Fire alarm panels.

.2 Security (intrusion) panels.

.3 Energy management panels.

.4 Communication panels.

.22 Control Transformers:

.1 Concealed control transformers located within ceiling spaces are to have lamicoid nameplates installed adjacent to same indicating their identified system, primary power source including designated panel name, and associated branch circuit breaker number(s).

.2 A second plate with identical information is to be installed on underside of room grid system or access opening frame so as to identify concealed location of same control transformer.

.3 All control transformers installed in control cabinets, and/or on walls adjacent to same, are to be identified with lamicoid nameplates containing information as previously indicated.

.23 Where fire alarm devices (duct type smoke detectors, relays, zone modules, etc.) are located above finished ceiling systems a lamiciod nameplate shall be located directly below the device indicating type and address.

FA: Relay Module
ADD: 0105

.24 All various pieces of mechanical equipment are to be identified with identical information as indicated on electrical equipment nameplate feeding same mechanical equipment.

.25 Both plates are to be supplied and installed by the electrical contractor in the absence of any mechanical trade identification.

.26 Bonding conductors require labelling on both ends of runs where they are “dedicated” solely to the designated branch circuit they accompany. Identify with same number(s) being used to identify accompanying branch circuit phase and neutral conductor.

.27 Schedules shall be installed on the back of each door for panels, neatly arranged and mounted in frame under transparent cover. Schedules shall show system voltage, which outlets are on each circuit and any special information necessary. Schedules shall be typewritten and of a permanent nature.

2.6 Wiring Identification

.1 Identify wiring on both ends of phase conductors of feeders and branch circuit wiring by circuit number at all panelboards, pull and junction boxes, outlet and equipment connections, and all devices. Labels shall be Panduit PLD-1 or PLD-2 as required. Labels to be installed in such a manner as to present white area with information in "flagged" position. Wrap around conductor in "U" fashion and have it adhere to itself. Identify neutrals and bond wires indicating which circuits with which they are used.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 The individual conductors and conductor pairs used in the various communications cables shall be colour coded. Maintain the colour coding scheme for each system throughout.

2.7 Colour Coding of Electrical Boxes

.1 All various systems junction and/or pull boxes, condulet fittings, etc., complete with their respective coverplates shall be colour coded as per the following. Boxes shall be painted inside and out where one colour is required, with the coverplate painted completely. Boxes shall be painted inside where two colours are required, with the coverplate painted diagonally with both colours.

System	Primary Colour	Secondary Colour
51 volts to 240 volts	Yellow	-
Above 240 volts	Orange	-
Fire Alarm	Red	-
Telephone	Black	-
P/A and Intercom	Blue	-
Security	Brown	-
Ground or Bond	Green	-
DC	Yellow	Black
CATV	Yellow	White
Energy Management	Red	White
Data	Blue	White

.2 All various systems junction and/or pull boxes, condulet fittings, etc., where located above suspended ceilings, shall have location identified on the underside or room side of T-bar spline, with 3/4" or 1/4" self-adhering colour coded discs affixed directly to spline in close proximity to where the concealed box is located. The same type of discs shall be installed on ceiling or wall access coverplates.

3/4" discs are to be primary colour.
1/4" discs are to be the secondary colour, affixed to the centre of the 3/4" disc.

.3 All various systems junction and/or pull boxes, condulet fittings, etc. where not concealed, shall have discs affixed to the outside of the box when architectural painting is complete.

2.8 Finishes

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint outdoor electrical equipment [equipment green finish to EEMAC Y1-1-1955.

.2 Paint indoor switchgear and distribution enclosures - light grey to EEMAC 2Y-1-1958.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

2.9 Access Doors

.1 Supply access doors for furred ceilings or spaces for servicing equipment and accessories or for inspection of safety, operating or fire devices for installation under section erecting the walls or ceilings.

.2 Access doors shall be flush mounted 24" x 24" for body entry and 12" x 12" for hand entry, unless otherwise noted. Doors shall open 180 degrees, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. Doors shall be of approved manufacturer with published literature. Access doors shall be minimum 14 gauge thick.

.1 General: Prime coated steel.

.2 Special areas such as tiled or marble surfaces: stainless steel.

2.10 Sprinkler Protection

.1 All equipment such as panelboards, transformers, switchboard, relay cabinets, control cabinets, etc., installed in areas equipped with sprinkler protection, shall be fitted with sprinkler hoods and shall comply with the intent of C.E.C. Sections 26-008 and Appendix B-26-008.

2.11 Housekeeping Pads

.1 Supply and installation of concrete housekeeping pads for transformers and motor control centres will be by the general contractor. The electrical contractor shall provide final dimensions and locations of concrete pads.

.2 Housekeeping pads shall be 4” thick, complete with 10M dowels at 18” c/c around the perimeter, drilled and grouted into the existing slab (minimum embedment 4”). Concrete shall be 3000 psi in accordance with CAN3-A23.1-M90. Reinforce with one layer of 6 x 6 WWF. Pads shall be nominally 6” larger in all dimensions than the equipment being supported, and have chamfered edges.

Part 3 Execution

3.1 Installation

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 Nameplates and Labels

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 Conduit and Cable Installation

.1 Install conduit and sleeves prior to the pouring of concrete, laying of concrete block, and the installation of drywall partitions.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

3.4 Location of Outlets

.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum 10” horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 10’-0", and information is given before installation.

.4 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical rooms on latch side of door.

3.5 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 Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 48”.
.2 Wall receptacles:
.1 General: 12”.
.2 Above top of counters or counter splash backs: 6”.
.3 Panelboards: 72” to top as required by Code or as indicated.
.4 Telephone and interphone outlets: 12”.
.5 Wall mounted telephone and interphone outlets: 48”.
.6 Fire alarm stations: 48”.
.7 Fire alarm signalling devices: 90”.

.8 Television outlets: 12".

.9 Door bell pushbuttons: 48".

3.6 Motor and Equipment Connections

.1 Provide final connections to all motors, equipments, controls, etc. indicated on the drawing. These motors, equipment, controls, etc. shall include those supplied under other sections of this specification, as well as Owner supplied items. Ensure that equipment will operate properly (e.g. proper rotation) and report any instance of defective equipment to the Engineer.

3.7 Co-ordination of Protective Devices

.1 This contractor shall provide a fault study with suggested over current (phase and ground fault) settings in accordance to IEEE standards. The study shall be prepared and submitted to the consultant for review. All costs associated with the study shall be included in the tender price.

.2 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.8 Cutting and Patching

.1 Should Division 26 be late or negligent in the placing of conduits, boxes, etc. during the rough-in period, then any patching or cutting required to accommodate the equipment shall be done by the General Contractor, but the cost for the same shall be the responsibility of, and be borne by, Division 26.

.2 Make every effort to minimize cutting and patching by providing dimensions, locations and other data for bases, sleeves, boxes, etc., to be built in as construction proceeds. Set sleeves and mark openings in concrete forms and masonry before placing concrete and masonry.

3.9 Field Quality Control

.1 Load Balance:

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment. Such adjustments shall be made under normal load conditions.

.3 Provide upon completion of work, load balance report as directed in PART 1 - Submittals: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests:

.1 Power distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and its control.

.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Systems: fire alarm system, communications.

.6 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 Test all wiring included in the Contract, to ensure there are no shorts or grounded conductors and that insulation values are as required by the Canadian Electrical Code

.5 The Engineer reserves the right to use any piece of electrical equipment, device, or material installed under this Contract for such reasonable lengths of time and at such times as he may require to make a complete and thorough test of the same, before the final completion and acceptance of the work

.6 The following wiring methods detailed below are designed to enhance the ability to perform capacitive leakage tests; these methods are to be strictly followed and tests performed under this Contract

.1 All circuit conductors are to be individually tie wrapped to their corresponding labelled neutral conductor in all panelboards, pull boxes and junction boxes. Enough slack conductor length should be left to enable the ability to clamp the ground detector around the individually tie wrapped circuit conductor and its corresponding labelled neutral. This wiring method is to be neat and of good workmanship quality

.2 The tie wrapping of the neutral with its respective phase conductors is to be made at the closest point of entry into panelboards, pull boxes and junction boxes.

.3 CDP's, panelboards, MCC's, etc. are to have their respective feeder phase and neutral conductors tie wrapped together and enough slack conductor length to enable the ability to clamp the ground detector around each set of feeders. This wiring method is to be neat and of good workmanship quality.

.4 After all electrical wiring has been completed by the Electrical Sub-Contractor, he is to test the grounded electrical distribution system to ensure there are not ground shorts, and capacitive leakage in the system is within acceptable limits

.5 All feeders or branch circuits, which do not have neutral conductors, are to have their respective phase conductors tie wrapped together in accordance with the methods described previously.

.7 Submit properly prepared and bound reports of all tests indicating:

.1 The date and time of the test.

.2 The name or names of those who conducted the test.

.3 The purpose of the test.

.4 The results of the test.

.5 Any applicable code limits or bounds.

.8 Such tests shall not be construed as evidence of acceptance of any part of the Contract, and it is agreed and understood that no claim for damage will be made for any injury or breakage to any part or parts of the above, due to the aforementioned tests, where caused by weakness or inaccuracy of parts, or by defective materials or workmanship of any kind whatsoever.

.9 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.10 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.

3.10 Cleaning

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

.3 Luminaires shall be protected from dust and debris during construction. Reflectors, housings and lenses shall be protected from fingerprints during installation and adjustment. Cleaning of lenses and reflectors shall be carried our as per the manufacturer's recommended practices.

.4 On completion of this project, the Contractor shall remove all debris and leave the site neat and tidy. Equipment shall be checked for proper fitting and alignment, adjusted, cleaned, repainted where necessary, and left in first class condition.

END OF SECTION

APPENDIX A ONSA Job Number: 13-288

Shop Drawing Submittal Form

General Contractor:	
Phone Number:	Fax No:

Electrical Contractor:	
Phone Number:	Fax No:

Electrical Contractor Project Representative:	
Phone Number:	Fax No:

Shop Drawing Items:
Number of Shop Drawing Copies:
Supplier of Shop Drawings:
Manufacturer of Shop Drawings:
Specification Section and Items:

Drawing Reference:

Specified Options Indicated ☐ ***Yes*** ☐ ***No***

Items are in Conformance with Plans and Specifications Confirmed by Contractor.

(If No, explain):

Contractor's Signature:

Date:

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Section Includes

.1 Materials and installation for wire and box connectors.

1.3 References

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2No.18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2No.65-93 (R1999), Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

1.4 Waste Management and Disposal

.1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

.3 Divert unused wiring materials from landfill to metal recycling facility as approved by Consultant.

Part 2 Products

2.1 Materials

.1 For branch circuit wiring #10 AWG and smaller, use spring type pressure wire connectors with current carrying parts of copper, or copper alloy, and insulating cap, all to fit copper conductors as required. Standard of acceptable quality: Ideal "wing nuts".

.2 Joints for all other wiring shall be made using T & B colour keyed compression type connectors, 54000 series, and T & B series compression tools. Insulation

shall consist of a first layer of compound type tape followed by a layer of Scotch #33 vinyl tape.

.1 Burndy and Panduit compression connectors shall be considered an equal to the T&B compression connectors.

Part 3 Execution

3.1 Installation

.1 Remove insulation carefully from ends of conductors and:

.1 Install spring type wire connectors for branch circuit and control wiring #10 AWG and smaller. Plier tighten all wire nut joints and connections.

.2 Install pressure type wire connectors for branch circuit wiring larger than #10 AWG. Insulating tapes to overlap successive wraps by a minimum of 50%.

.3 The splicing of feeders conductors is not acceptable.

.2 All connections shall be made electrically and mechanically secure. The sizes of connectors shall be according to manufacturer's recommendations for each wire size and combination of wires.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Related Sections

.1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

1.3 References

.1 CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.

1.4 Product Data

.1 Submit product data in accordance with Section 01 33 00 - Submittals.

1.5 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 General

.1 Wire and cable shall conform fully to the latest specifications of the Canadian Standards Association (C.S.A.), Electrical and Electronic Manufacturers Association Of Canada (EEMAC), the Insulated Power Cable Engineers Association (IPCEA), and the American Society of Testing Materials (ASTM).

2.2 Building Wires

.1 Wiring on circuits exceeding 50 volts to ground shall be of soft drawn stranded copper of 98% conductivity and of full size and AWG gauge. Insulation shall be cross-linked polyethylene RW-90 rated 600 volts. Wiring shall be continuously colour coded as follows:

.1 Phase A Red
.2 Phase B Black
.3 Phase C Blue
.4 Neutral – White/Grey

.5 Ground Green

.6 Where extra colours are required for three way switches, etc., they shall be yellow.

.2 Conductors pertaining to the wiring of thermostats, motorized valves, damper actuators, and electric pneumatic relays shall be stranded copper conductor of 95% conductivity and of full size and AWG gauge. Insulation shall be thermoplastic "TW" rated 600 volts. Colour code shall be orange and brown. Minimum size shall be No. 18 AWG.

.3 Colour coding shall be by insulation colour as follows: Phase conductors on sizes up to and including No. 2 AWG. Neutral, ground and bond conductors on sizes up to and including No. 3/0 AWG. Approved coloured tape, in lieu of coloured insulation, may be used for phase conductors sized No. 1 AWG and larger, neutral, ground and bond conductors sized No. 4/0 AWG and larger.

.4 The use of aluminum or aluminum alloy conductors is not acceptable.

2.3 Armoured Cables

.1 AC-90 cables shall be soft drawn solid copper of 98% conductivity and of full size and AWG gauge. Insulation shall be cross-linked polyethylene rated 600 volts. Outer armour shall be of interlocking aluminum. Colour coding of AC-90 cable shall be as follows:

.1 Phase Conductors Black or Red

.2 Neutral Conductor White

.3 Ground Conductor - Bare

.4 Dedicated / Isolated Bond Conductor - Green

2.4 Control Cables

.1 Type LVT: Soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket.

Part 3 Execution

3.1 General

.1 The Contractor shall run all circuits so that the voltage drop, in no case exceeds 3% of the line volts. The neutral wire, wherever it is run shall be continuous with no fuses, switches, or breaks of any kind.

.2 The installation of more than 3 conductors in a run of conduit is permissible provided C.E.C. Section 4-004(1) is adhered to with respect to the derating of the conductors.

.3 The minimum conductor size for all 15-amp and 20-amp branch circuits are to be #12 AWG. For 15 amp and 20-amp 120 volt branch circuits, the following table shall be followed:

Branch Circuit One-Way Length from Panel to Load (Including Vertical Drops)	Phase Wire Size	Dedicated Neutral Wire Size	Shared Neutral Wire Size	Bond Wire Size
Up to (80'-0") (24.38 m)	#12 AWG	#12 AWG	#10 AWG	#12 AWG
(81'-0" to 125'-0") (24.68 m to 38.1 m)	#10 AWG	#10 AWG	#8 AWG	#12 AWG
(126'-0" to 185'-0") (38.4 m to 56.38 m)	#8 AWG	#8 AWG	#6 AWG	#10 AWG

.4 The requirements for accommodating larger common or "shared" branch circuit neutral conductors where the application might warrant such, could restrict the use of some types of AC-90 cables. In certain instances however, the installation of AC-90 cable (where permissible), and the use of "oversized" neutral conductors where required, is more than acceptable.

.5 Oversized #10 AWG branch circuit wiring conductors to be extended to outlet box of device they feed. Oversized #8 or #6 AWG branch circuit wiring conductors to be extended from panelboard to junction box located on wall or in ceiling space directly above outlet or device they feed. A #8 or #6 AWG wire can be reduced to #10 AWG for vertical portion of drop only.

.6 All "stranded" conductors are to be "twisted together" prior to any types of terminations taking place, but not necessarily limited to, some of the following areas:

.1 Receptacles.
.2 Light switches.
.3 Neutral terminal strips.
.4 Bonding terminal strips.
.5 Circuit breakers.
.6 Disconnect switches.
.7 Magnetic and manual starters.
.8 Magnetic contactors.
.9 Relays.
.10 Terminating lugs, etc.

3.2 Installation of Building Wires

.1 Where pulling wires and cables, the use of an approved lubricant only will be permitted. No wires or cables shall be pulled in conduits until such conduits are

free from moisture and in no case shall wires be pulled until approval of the Engineer is obtained.

.2 All various types of cables are to be installed parallel or perpendicular to building lines and shall be adequately secured to the building structure at not more than 60" intervals or as otherwise indicated, in such a manner as to ensure they are protected from potential types of mechanical damage occurring. Install independent supports for cabling in ceiling spaces, and do not use those of other trades. Do not secure cables to mechanical systems piping or ducts, suspended ceiling support wires, etc. unless specifically noted on the drawings. The laying of "unsupported" cables of any types whatsoever directly atop ceiling grid system is strictly prohibited.

.3 Install and secure surface cables directly to underside of metal decking and/or ceiling slab where installed in any concealed ceiling spaces.

.4 Cables are "always" to be installed as high as possible to underside of structure.

.1 Where cables are installed in same direction as steel joists, they are also to be secured as high as possible to underside of metal decking and/or structure. Do not install cables in the upper portions of any Q-Decking.

.5 The grouping together of cables to form a "bundle" for securing purposes, is acceptable provided that the following procedures are adhered to.

.1 In addition to securing cables at 60" intervals to structure, multiple or bundled groups of cables (including low voltage types), shall be tye-wrapped together at mid-point between each structure support, or every 30". Secure to structure at 60" intervals, and secure together (between structure supports) at 60" intervals.

.6 After all wiring devices have been installed, the Contractor shall test all systems to make sure there are no grounds, leaks, or shorts. Such tests shall be performed to the satisfaction of both the inspection authority having jurisdiction and the Engineer.

3.3 Installation of Armoured Cables

.1 AC-90 is permitted for use as indicated in paragraphs 3.3.6 and 3.3.7 below. All AC-90 cable shall be run parallel to building lines, secured in accordance with C.E.C. 12-618 and shall be adequately clamped and "ty-rapped" to the building structure in such a manner that they are protected from mechanical damage. This contractor shall install his own supports for cabling in ceiling spaces and he shall not use those of other trades or secure cabling to pipes, ducts, suspended ceiling support wires, etc.. The laying of cables directly atop ceiling grids is strictly prohibited. The incoming (Panel Side) grounding conductor shall be secured to the grounding screw of each outlet box, before connecting to the other grounding conductors. Twist all grounding conductors to the back of the outlet box, such that the grounding conductors obstruct as little room as possible.

.2 All flexible conduit or AC-90 fixture feeds shall originate from the side of the outlet box and not from the box cover. Where 3 or 4 drops extend from one outlet box, the box shall be a minimum 4¾" square. There shall be no more than 4 drops from any one box. All flex or AC-90 cables used for fixture drops are to be secured within 12" of the junction box.

.3 Grouping of AC-90 cables shall be limited to a maximum of eight current carrying conductors, including associated oversized neutral conductors where phase sharing occurs.

.4 The following examples incorporate uses of both common and dedicated (separate) branch circuit neutral conductors:

.1 Maximum of two runs of #12/4 conductor cables, including common (oversized) branch circuit neutral in each.

.2 Maximum of two runs of #12/3 conductor cables, including (oversized) branch circuit neutrals (if not 3 phase, 3 wire), plus one run of #12/2 cable.

.3 Maximum of four runs of #12/2 conductor cables, each including a separate, dedicated branch circuit neutral conductor.

.5 Where dedicated or separate branch circuit neutral conductors are non phase sharing, they need not be sized larger than phase conductors they accompany unless specifically indicated otherwise.

.6 AC90 may be utilized as a fixture drop. A fixture drop is defined as that portion of AC-90 cable or flexible conduit being used to make final connection between "accessible" type junction or outlet box located in ceiling space (above T-bar ceiling) and its respective light fixture.

.7 AC90 may be utilized as a wiring device drop. A wiring device drop (drop to receptacle and light switches) is defined as that portion of AC-90 cable being used to make final connection between "accessible" type junction or outlet box located in ceiling space (above T-bar ceiling) and its respective wiring device.

.1 There shall be not more than four drops from any one box regardless of size. All AC-90 cables used for fixture drops are to be secured within 12" of the junction box. Each fixture is to be complete with its own separate fixture drop originating from junction box located within same room.

.2 Provide 20 amp O.C. protection for "all" lighting branch circuits, unless specifically indicated otherwise.

.3 No. 12 AWG and No. 14 AWG Type AC-90 cables may be used where total fixture drop "loads" do not exceed the following:

.1 Maximum of 1800 watts at 120 volts using #12 AWG drop.

.2 Maximum of 1300 watts at 120 volts using #14 AWG drop.

.8 Separate pig-tail type leads shall be provided in each light fixture junction/outlet box for "final" connections to fixture drops. These pig-tail leads are to be "only" connected to light fixture "returns" and associated "neutral" conductors.

.9 AC90 may be not be utilized as a home run to any panel board.

3.4 Installation of Control Cables

.1 The installation of “surface” wiring on walls or in open (non-enclosed) type ceilings, shall be Type EMT conduit complete with associated steel type connectors and couplings.

.2 EMT conduit is to be extended to within 24" of “all” various control devices associated with the operation of any given piece of mechanical equipment.

.3 Unless specifically indicated otherwise, liquid tight, flexible metal type conduit complete with steel type connector and steel locknut may be used for the “final” 24" connection between the end of the EMT conduit and the applicable control device.

.4 EMT or PVC type conduit “wall stubs” complete with flush installed device box shall be installed in all masonry or concrete partitions where, and as may be required, where plenum rated cabling is used.

.5 EMT connectors complete with nylon insulated throat or threaded type bushing shall be installed on end of EMT stub above “finish” type ceilings, etc., where plenum rated cabling is used.

.6 All EMT conduit stubs are to be “bonded” to ground as per CEC.

.7 Ground control cable shield.

3.5 Stranded Conductors

.1 All stranded conductors prior to terminating under device bolts such as circuit breakers, switches, receptacles, etc., are to be twisted together so as to form a single conductor to ensure a reliable mechanical connection.

3.6 Capacitive Leakage Wiring Methods

.1 The following wiring methods detailed below are designed to enhance the ability of the Owner to perform capacitive leakage tests in the future:

.1 All circuit conductors are to be individually ty-wrapped to their corresponding labelled neutral conductor in all panelboards, pull boxes and junction boxes. Enough slack conductor length should be left to enable the ability to clamp the ground detector around the individually ty-wrapped circuit conductor and its corresponding labelled neutral. This wiring method is to be neat and of good workmanship quality.

.2 The ty-wrapping of the neutral with its respective phase conductors is to be made at the closest point of entry into panelboards, pull boxes and junction boxes.

.3 CDP's, panelboards, etc. are have their respective feeder phase and neutral conductors ty-wrapped together with enough slack conductor length to enable the ability to clamp the ground detector around each set of feeders. This wiring method is to be neat and of good workmanship quality. This ty-wrapping is to be located such that ease of clamping the ground detector can be accomplished without excessive exposure to live bussing.

.4 After all electrical wiring has been completed by the Electrical Sub-Contractor, he is to test the grounded electrical distribution system to ensure there are no ground shorts or grounds.

.5 All feeders or branch circuits which do not have neutral conductors are to have their respective phase conductors ty-wrapped together in accordance to the methods described previously.

3.7 Testing

.1 Test all feeders for continuity after they are installed and before they are terminated. At the load end of the conductors, jumper out Phase A to Phase B and jumper out Phase C to Neutral. Apply a meggar voltage to the pairs of conductors at the line end. A low reading (10 ohms or less) indicates continuity. A high reading (typically infinity) indicates a broken conductor; replace the conductor and repeat the test. Record the results.

.2 Test all feeders for insulation resistance after they are installed and before they are terminated. Connect one lead of the meggar to the building ground system and the other lead to the the line end of conductor to be tested and apply a meggar voltage. A high meggar reading of 50 megohms or more indicates that the insulation is acceptable. A low low meggar reading of less than 50 megohms indicates damaged or compromised insulation; replace the conductor and repeat the test. Record the results.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Related Sections

.1 Section 26 05 00 - Common Work Results - Electrical.

1.3 References

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837-1989(R1996), Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association, (CSA International)

1.4 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Equipment

.1 Grounding equipment shall be to CSA C22.2 No.41.

.2 Ground bus in electrical rooms shall be copper, 4" x 1/4" minimum, of length as per the drawings.

.3 Ground conductors to be to ASA-G7.1.

.4 Insulated ground conductors are to be RW90, green, for sizes up to and including #2. Insulated ground conductors #1 and larger to be TWH, green. All ground conductors to be copper without exception.

.5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Bonding jumpers, straps.

.5 Pressure wire connectors.

Part 3 Execution

3.1 Installation General

.1 All equipment and exposed non-current-carrying metal, conduits and parts shall be permanently and effectually grounded to meet minimum requirements of the C.E.C., and as indicated on the drawings and further specified. Standards set either by drawings or specifications which are above those covered by C.E.C. shall not be reduced under any circumstances.

.2 A complete grounding system shall be installed as indicated, which shall include but not be limited to the following:

.1 All panel board ground busses.

.2 The neutral point of all transformers.

.3 The wall mounted ground busses in all communications rooms.

.4 The metallic piping in storm and sanitary waste systems.

.5 The metallic piping in sprinkler systems.

.6 Structural steel.

.3 Generally, minimum grounding shall be provided by the metallic conduit/outlet box system and by the bond wire in cables. Additional insulated ground wires, sized as per the drawings, shall be provided as follows:

.1 In all EMT conduit feeders that supply panelboards, CDP panels, FDP panels, MCC's, and transformers - all sized as per C.E.C. Table 16.

.2 All non-metallic conduit systems (i.e., - PVC conduit).

.3 A separate green bond conductor sized as per Table 16 of the C.E.C. shall be installed in each EMT conduit run for branch circuit wiring.

.4 Where ground conductors terminate at ground buses in switchboards or panelboards, the connection shall be made with a compression lug, which shall be secured to the bus with nut, bolt and two Bellevelle washers. Size of bolts shall be to suit lug and shall be properly torqued and marked.

.5 A ground bus shall be supplied and installed in the electrical room and the communications room, all as indicated on the drawings. Connections to these busses shall be via two hole, compression lugs and compression fitting as indicated.

.4 Install connectors in accordance with manufacturer's instructions.

.5 Protect exposed grounding conductors from mechanical injury.

.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

.7 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.8 Connect building structural steel and metal siding to ground by welding copper to steel.

.9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.2 System and Circuit Grounding

.1 Install system and circuit grounding connections.

3.3 Equipment Grounding

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, distribution panels.

3.4 Communication Systems

.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

.1 Sound, fire alarm, intercommunication systems as indicated.

.2 Telecommunication rooms as indicated.

3.5 Field Quality Control

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Perform tests before energizing electrical system.

.3 Obtain the proper torque strength requirements from the lug manufacturer. Check the torque values at panelboard ground busses and wall-mounted ground busses. Record the results.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Related Sections

.1 Section 26 05 00 Common Work Results - For Electrical.

1.3 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Support Channels

.1 U shape, size 1½" x 1½" x 1/10" thick, surface mounted, suspended, set in poured concrete walls and ceilings.

.2 All strut to be galvanized.

.3 All threaded hanger rods to be minimum 3/8" diameter, larger if required, made from mild steel.

.4 In concrete use cast in threaded inserts wherever possible. Should additional inserts be required use a "red head" type of insert capable of carrying at least (500 lbs)(227 kg).

.5 Supports for all conduit work shall be one hole steel pipe straps; unistrut, or equal, with necessary fittings, approved for their respective use.

.6 All pull and junction boxes, wireways, and multiple conduits shall be supported by a steel channel support system with all components, hangers, wall supports, cable clamps, etc., specifically manufactured and approved for their application.

.7 Fastening devices for cabinets, boxes, supports etc., shall be nut and bolt, expansion shields, wedge anchors, or toggle bolts, size and number to suit the application or as detailed on the drawings. Toggle bolts may not be used in plasterboard construction.

.8 Fastening devices for outlet boxes shall be nut and bolt, expansion shields, wedge anchors or caddy clips, size and number to suit the application or as detailed on the drawings.

.9 Where outlet boxes are set in drywall construction, a piece of steel stud shall be secured to either side of the outlet box or use caddy quick-mount box supports, or caddy J-1-A for side box supports

Part 3 Execution

3.1 Installation

.1 Secure all equipment in a manner so as not to distort or cause undue stress on any components.

.2 Secure equipment to masonry, tile and plaster surfaces with lead anchors or nylon shields.

.3 Secure equipment to poured concrete with expandable inserts.

.4 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts. Toggle bolts shall not be used to secure equipment to plasterboard, drywall, or acoustic tile surfaces.

.5 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.6 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.7 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole steel straps to secure surface conduits and cables 2” and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 2”.
- .3 Beam clamps to secure conduit to exposed steel work.

.8 Suspended support systems.

- .1 Support individual cable or conduit runs with 3/8” dia threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 3/8” dia threaded rod hangers where direct fastening to building construction is impractical.

.9 For surface mounting of two or more conduits use channels at 5’-0" on centre spacing.

.10 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.11 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.12 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.13 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Consultant.

.14 Do not support any electrical conduits, wire or equipment from ceiling system support cables. Ceiling systems support cables may be utilized to marshal AC90 drops to fixtures.

.15 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.16 In addition to the C.E.C. conduit support requirements, all suspended conduit runs containing horizontal or vertical elbows shall have one additional support installed not greater than 12" from the midpoint of the 90° bend.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data for cabinets in accordance with Section 01 33 00 - Submittals.

1.3 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Junction and Pull Boxes

.1 Pull and junction boxes, where larger than standard boxes shall be the equivalent to Type "C" or "D" boxes sized according to C.E.C. Sections 12 3000 to 12 3038. Use Type "D" for boxes up to 12" x 12" and Type "C" for boxes 12” x 12" or larger.

.2 Pull boxes shall be of sheet metal construction with all welded steel corners and screw on flat covers for surface mounting.

.3 All flush installed boxes shall be Type “D”. Covers for flush mounted pull boxes shall extend a minimum of 1" all around.

.4 Concealed junction boxes (within ceiling space) shall not be smaller than 4" square.

2.2 Cabinets

.1 Cabinets shall be steel, fabricated to C.S.A. & EEMAC Standards with baked enamel finish. Cabinet shall be EEMAC Standard Types "C", "D", or "T" as indicated on the drawings. Type "T" cabinets shall be complete with hinged door, lock, two keys, and handle, and be lined with 3/4" plywood.

Part 3 Execution

3.1 Junction, Pull Boxes and Cabinets Installation

.1 Install pull boxes in inconspicuous but accessible locations and secure them adequately to the building structure. Pull boxes installed in the middle of conduit runs without backing are not acceptable.

.2 The location of junction and/or pull boxes in suspended ceiling spaces, i.e. - dry wall, T-Bar, etc., is not to be greater than 30" above the finished ceiling and must be easily accessible.

.3 All suspended junction, pull and outlet boxes shall be supported with minimum size 3/8" threaded rods, nuts and flat washers. Threaded rods shall be secured to boxes with one flat washer and nut installed on both sides of box. One rod required for all boxes sized up to and including 4¾" square. Two rods required for boxes larger than 4¾" square, up to and including 8" square. A minimum of four rods required for all boxes larger than 8" square.

.4 Mount cabinets with top not higher than 78” above finished floor.

.5 Install terminal block as indicated in Type T cabinets.

.6 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 100’ of conduit run between pull boxes.

3.2 Identification

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Install size 2 identification labels indicating system name, voltage and phase.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 References

.1 CSA C22.1-2012, Canadian Electrical Code, Part 1.

1.3 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Outlet and Conduit Boxes General

.1 Size boxes in accordance with CSA C22.1.

.2 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 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 3.1/2" x 2" x 1.1/2" or as indicated. 4” square outlet boxes when more than one conduit enters one side with extension and tile rings as required.

.2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 4" x 2.1/8" x 2".

.3 4" square or octagonal outlet boxes for lighting fixture outlets.

.4 4” square outlet boxes with extension and tile rings for flush mounting devices in finished walls.

.5 Surface outlet boxes installed below 8'-0" shall be hot dipped galvanized cast "FS", or "FD" series boxes with metal coverplates.

2.3 Conduit Boxes

.1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

2.4 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 1.1/4" and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 Installation

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using tile rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.5 At each local switch, convenience outlet, receptacle, ceiling or wall fixture, continuous row of fixtures, or system unit (i.e. fire alarm, etc.) provide and install a standard pressed steel outlet box unless specifically noted otherwise. All outlet boxes shall be galvanized inside and out and set flush with finished surfaces. They shall be rigidly and securely set. Boxes shall not be mounted back to back, but separated by a minimum of 12", to prevent noise transmission.

.6 In centering outlets, the Contractor is cautioned to allow for radiation, pipes, ducts, etc., and for the variation in arrangement and thickness of finishes, etc.. His failure to comply with this will not relieve him from the cost of necessary alterations.

.7 The Contractor shall allow for the relocation of an outlet up to 10'-0" from where shown, provided he has been notified so prior to rough-in of the same.

.8 No outlet or junction box may be installed more than 30" above a finished ceiling.

.9 All suspended boxes are to be supported with minimum size 3/8” threaded rod(s).

.10 All flexible conduit fixture feeds shall originate from the side of the outlet box and not from the box cover.

.11 Flush installed 4" square or a 4-11/16" square box being used as a junction or pull box that requires a blank metal coverplate, is to have an appropriate sized, one or two gang “tile ring” installed on same. This permits the use of a standard, one or two gang (blank) finish metal coverplate to be used, and avoids the necessity of acquiring an oversized, custom made coverplate.

.12 When installing flush boxes in metal drywall partitions, always screw a short piece of metal stud (same width as partition) to non-supported side of box.

.13 Concealed boxes installed above drywall ceilings or behind walls, are to have their locations identified on room sides of access opening frames with properly colour coded identification discs.

.14 Condulet fittings (LB, LL, LR, etc.) and their respective covers/plates are to be painted, and where concealed, have their locations identified with appropriate colour coded, 3/4”, self adhering discs, applied to T-bar splines and/or access opening frames, in similar manner as for concealed junction and/or pull boxes, etc..

.15 Tile type extension rings are not to be used on boxes that have not been “flush” installed. They are not intended, not acceptable for “surface” type application.

3.2 Identification

.1 All outlet boxes shall be colour coded as per the colour coding legend for conduits and cables. Refer to Specification Section 26 05 00. Outlet boxes are to be coloured only on the inside.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 References

.1 Canadian Standards Association (CSA)

.1 CAN/CSA C22.2 No. 18-98, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.

.2 CSA C22.2 No. 45-M1981 (R1992), Rigid Metal Conduit.

.3 CSA C22.2 No. 56-1977 (R1999), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.4 CSA C22.2 No. 83-M1985 (R1999), Electrical Metallic Tubing.

.5 CSA C22.2 No. 211.2-M1984 (R1999), Rigid PVC (Unplasticized) Conduit.

.6 CAN/CSA C22.2 No. 227.3-M91 (R1999), Flexible Nonmetallic Tubing.

1.3 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Conduits

.1 Thinwall Type "EMT" conduit shall conform to C.S.A. C22.2 No. 83 M1985 (R1992), galvanized, sized as indicated.

.2 Flexible galvanized steel liquid tight conduit shall conform to C.S.A. C22.2 No. 56 M1997(R1997), sized as indicated.

2.2 Conduit Fastenings

.1 One hole steel straps to secure surface conduits 2” and smaller. Two hole steel straps for conduits larger than 2”.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 60” on centers.

.4 Threaded rods, 3/8" diameter, 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 degree bends are required for 1" and larger conduits.

.3 Couplings for thinwall Type "EMT" shall be set screw type, zinc with matching locknuts.

.4 Connectors for thinwall Type "EMT" shall be set screw type, zinc with matching locknuts.

.1 Connectors 1¼" and larger shall be complete with threaded plastic bushings. Connectors less than 1¼" shall be complete with insulated throats.

.5 Connectors for flexible conduit, armoured cable shall be set screw galvanized steel. Units shall be equal to T&B #3110 series, steel, and be complete with case hardened locknuts.

.6 Connectors for liquid tight flexible conduit shall be watertight, compression type galvanized steel or aluminum. Locknuts shall be case hardened. Dry type connectors may be used in dry indoor areas not exposed to liquids or moisture, if approved for use.

2.4 Fish Cord

.1 Polypropylene.

Part 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.

.3 Thinwall Type "EMT" shall be used for all branch circuit wiring and all systems installed exposed on ceilings and walls unless noted otherwise. Bends, offsets, or elbows made on the job for steel conduits shall be made so that the conduit is not injured or flattened.

.4 All branch circuit wiring run in thinwall Type EMT conduit shall be complete with a No. 12 AWG minimum green insulated bonding conductor, increasing as required by Table 16 of the C.E.C..

.5 All concealed and exposed conduit shall be kept parallel to building lines and run "on the square". All conduits shall be installed to avoid proximity to steam and hot water pipes by 6". Conduits shall run through ceiling spaces and down in walls. No conduit shall run in or under floor slabs unless specifically indicated.

.6 All conduits shall be securely held in place by means of approved supports and in accordance with C.E.C. Sections 12-1010, 12-1114 and 12-1404. All EMT conduit straps shall be steel. Cast straps are not acceptable. EMT conduit shall be installed as a complete system and shall be securely fastened in place within 3'-0" of each outlet box, junction box, cabinet, couplings or fittings and the spacing between supports as follows:

.1 Less than 60" for 1/2" and 3/4" EMT;

.2 Less than 90" for 1" and 1.1/4" EMT;

.3 Less than 120" for 1.1/2" EMT or larger.

.7 No branch circuit wiring shall run in concrete slabs. Conduit stubs in concrete shall be protected from damage during construction. Conduit openings shall be sealed with plugs or caps to prevent entrance of foreign materials. Where conduits pass through a waterproof membrane an oversize sleeve shall be installed and caulking applied to maintain the waterproof properties of the membrane. A cold cure mastic shall then be applied between sleeve and conduit.

.8 Flexible conduit, not smaller than 3/8" I.D., or flexible armoured cable with separate grounding conductor, and complete with insulating anti shorts, shall be used between lighting fixtures and their respective junction boxes, and where rigid or "EMT" conduit cannot be used, such as in cabinet work.

.9 Liquid tight flexible conduit, not smaller than 3/8" I.D., shall be used for connections to all transformers, motors and equipments, in both wet and dry areas.

.10 Upon installation of all conduits, terminate in boxes, cabinets, and fittings, or install suitable plugs or caps, to prevent the entrance of foreign materials. Conduits shall be swabbed out using a drag, consisting of tight fitting rubber washers and shall be dry before conductors are pulled in.

.11 All conduit subject to corrosive elements shall be treated with corrosion resistant compounds.

.12 Conduit shall not pass through structural members without the permission of the Engineer.

.13 A sufficient number of fittings shall be used to permit easy pulling of wires. Conduits shall be continuous, and shall be made electrically and mechanically secure throughout.

.14 Conduits shall not run directly between outlets on the opposite sides of a common partition, in order to prevent sound transmission.

.15 It is strictly prohibited to install or otherwise “conceal” any types of rigid or flexible conduits, cables, etc. “within” the uppermost, or top portions of metal type Q-Deck “flutes”, regardless of their intended use(s).

.1 All or any types of wiring associated with metal type decking is to be “surface” installed on underside, or room side of same.

.16 Minimum conduit size for lighting and power circuits: 1/2".

.17 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.18 Mechanically bend steel conduit over ¾" diameter.

.19 Install fish cord in empty conduits.

.20 Run three 1" spare conduits up to ceiling space from each flush panel. Terminate these conduits in 6" x 6" x 4" junction boxes in ceiling space.

.21 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.22 Dry conduits out before installing wire.

3.2 Surface Conduits

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 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 3" parallel to steam or hot water lines with minimum of 1" at crossovers.

3.3 Concealed Conduits

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.4 Couplings and Connectors

.1 Thinwall Type "EMT" couplings shall be securely tightened.

.2 Connectors for thinwall Type "EMT", liquid tight and flexible conduit or cable shall terminate at boxes and cabinets with one case hardened locknut. Painted area shall be scraped clean, and locknut screwed tight to ensure ground continuity.

3.5 Conduit Fittings

.1 Install conduit fittings where required. Secure conduit in fittings and secure conduit to structure within 12" of fitting.

.2 Colour code coverplates, ceiling splines and access covers in accordance with Section 26 05 00.

END OF SECTION

Part 1 General

1.1 Related Sections

.1 Section 26 05 00 Common Work results - Electrical.

1.2 References

.1 Canadian Standards Association (CSA International):

.1 CAN/CSA C22.1 No.126.1-02, Metal Cable Tray Systems.

.2 National Electrical Manufacturers Association (NEMA):

.1 NEMA VE 1-2002, Metal Cable Tray Systems.

.2 NEMA VE 2-2001, Cable Tray Installation Guidelines.

1.3 Submittals

.1 Provide submittals in accordance with Section 01 33 00 - Submittals.

.2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.

.3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.

.4 Identify types of cabletroughs used.

.5 Show actual cabletrough installation details and suspension system.

1.4 Waste Management And Disposal

.1 Separate waste materials for recycling in accordance with Section 01 74 00 - Cleaning.

Part 2 Products

2.1 Cabletrough

.1 Cabletroughs and fittings: to NEMA VE 1 and CAN/CSA C22.1 No. 126.1.

.2 Wire mesh type.

.3 Trays: continuous, rigid, welded steel wire mesh, electro-galvanized, 12” wide by 4” deep.

.4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes filed fabricated from straight sections in accordance with manufacturer’s instructions.

.1 Radii on fittings: [300] [600] [900] mm minimum.

.5 Accessories: couplers, mounting brackets, bond connectors manufactured for cabletrough supplied.

.6 Acceptable Manufacturers: Legrand Cablofil CF105/300EZ, Cooper B-line Flextray and MP Husky Techtray.

2.2 Supports

.1 Provide splices, supports for a continuously grounded system as required.

Part 3 Execution

3.1 Installation

.1 Install complete cabletrough system in accordance with NEMA VE 2.

.2 Support cabletrough on both sides.

.3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 Cables In Cabletrough

.1 Install cables individually.

.2 Lay cables into cabletrough. Use rollers when necessary to pull cables.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Section Includes

.1 Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

1.3 Related Sections

.1 Section 01 33 00 - Submittals.

.2 Section 01 74 00 - Cleaning.

.3 Section 26 05 00 - Common Work Results - Electrical.

1.4 References

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.47-M90(R2007), Air-Cooled Transformers (Dry Type).

.2 CSA C9-M1981(R2007), Dry-Type Transformers.

.3 CAN/CSA-C802.2-06 Minimum Efficiency Values for Dry Type Transformers

.2 National Electrical Manufacturers Association (NEMA)

1.5 Product Data

.1 Submit product data in accordance with Section 01 33 00 - Submittals.

1.6 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 00 - Cleaning.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.3 Fold up metal banding, flatten and place in designated area for recycling.

1.7 Shop Drawings

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittals.

.2 Indicate on shop drawings:

.1 Dimensioned drawing showing enclosure, mounting devices, terminals, taps, internal and external component layout.
.2 KVA rating.
.3 Primary and secondary voltages.
.4 Frequency.
.5 Single or Three phase.
.6 Full load efficiency.
.7 Regulation at unity pf.
.8 Insulation type.
.9 Percent Impedance.
.10 Sound levels.
.11 'K' rating.

Part 2 Products

2.1 Transformers

.1 Transformers shall be of one manufacturer throughout the project.

.2 Dry type transformers: to CSA C9 02 Dry Type Transformers.

.3 Dry-type transformers: to CAN/CSA-C802.2 Minimum Efficiency Values for Dry Type Transformers.

.4 Bushings: to EEMAC GL1 3 1988.

.5 Design details

.1 Type: ANN - dry type, air cooled.
.2 Three phase with primary and secondary characteristics as noted.
.3 150 degree C temperature rise insulation system, class 'H'.
.4 Impedance levels shall not be less than those indicated on the drawings.
.5 Voltage taps: 2 x 2½% full capacity taps above neutral, and 2 x 2½% full capacity taps below neutral.
.6 Average sound levels: standard.
.7 Transformers shall be 'K' rated for harmonic content. 'K' factors shall be as indicated on the drawings.
.8 Basic Impulse Level (BIL): standard.
.9 Hipot: standard.
.10 Mounting: floor or wall as indicated

.6 Dry transformers to be equipped with dual spade transformer lugs, PET-4-250 type, secured to transformer chassis for grounding.

2.2 Enclosure

.1 Enclosures to be fabricated from sheet steel, complete with removable metal front panel. Enclosures and ventilation grills shall be drip proof in accordance with C.E.C. 26-008.

.2 Transformers shall be mounted on vibration isolators to reduce noise transmission. These isolators shall be located between the enclosure and the housekeeping pad and shall be in addition to isolators located between the core and coil assembly and the enclosure.

.3 Finishes to be light grey enamel in accordance with Section 26 05 00 - Common Work Results – Electrical

2.3 Windings

.1 Primary and secondary coils shall be of copper conductor. Taps are to be located at front of coils for ease of accessibility.

.2 Windings shall be of the three coil configuration, delta to wye connected unless indicated otherwise. "TEE" connected, 2 coil transformers, are not acceptable.

2.4 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Label size: 7.

.3 Nameplate wording: in accordance with Section 26 05 00 - Common Work Results - Electrical.

2.5 Manufacturers

.1 Standard of acceptability: Rex, Delta, and Hammond.

Part 3 Execution

3.1 Installation

.1 Locate, install and ground transformers in accordance with manufacturer's instructions. All transformers are to be floor mounted unless noted otherwise.

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections in accordance with wiring diagram.

.7 Energize transformers after installation is complete.

.8 Flexible connections to transformers shall be made using liquid tight flex conduit using the proper connectors in accordance with Section 26 05 34

.9 Adjust primary taps as necessary to produce rated secondary voltage at normal load.

3.2 Testing

.1 Measure input and output voltages. If the input voltage is more than 2-1/2% from the norm of 600 volts or 208 volts, investigate the line side further. If the high side voltage cannot be adjusted accordingly, adjust the tap connections to bring the output voltage as close to 208 volts as possible. Record the results.

.2 Measure the output currents to verify that they are within 10% of the average. Should any reading exceed the limit, re-balance the loads to achieve the desired limits. Record the results.

.3 Obtain the proper torque strength requirements from the transformer manufacturer. Check the torque values at the lugs for feeder terminations, neutral connection, and ground connections. Record the results.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Section Includes

.1 Materials and installation for standard and custom breaker type panelboards.

1.3 Related Sections

.1 Section 01 33 00 - Submittals.

.2 Section 06 10 00 - Rough Carpentry.

.3 Section 26 05 00 - Common Work Results - Electrical.

.4 Section 26 28 21 - Moulded Case Circuit Breakers.

1.4 References

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2No.29-M1989 (R2000), Panelboards and enclosed Panelboards.

1.5 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittals.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity, voltage and phase characteristics, and enclosure dimensions, as well as any special options called for on the drawings.

1.6 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Panelboards

.1 Panelboards: to CSA C22.2No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 120/208V panelboards: bus and breakers rated for 10,000 A (symmetrical) interrupting capacity minimum or as indicated.

.3 347/600v panelboards: bus and breakers rated for 14,000A (symmetrical) interrupting capacity minimum or as indicated.

.4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.6 Two keys for each panelboard and key panelboards alike.

.7 All bussing shall be aluminum, tin plated, with a full capacity neutral, with an ampere rating as per the drawings.

.8 Mains: suitable for bolt-on breakers.

.9 All panelboard trims and door finishes are to be baked grey enamel.

.10 All enclosures to be EEMAC 1, suitable for flush or surface mounting as indicated on the drawings. All surface mounted tubs to be sprinkler proof in accordance with C.E.C. 26-008.

.11 All panelboard tubs shall be minimum 14 gauge galvanized steel, minimum 20" wide.

2.2 CDP Panels

.1 CDP panels: to CSA C22.2 No.29.

.2 ALL CDP panels to be the product of the same manufacturer as other switchgear on the project.

.3 All CDP panels used on 347/600V systems shall have busses and breakers rated for 35,000 Amps (minimum, symmetrical) interrupting capacity or as indicated.

.4 All CDP panels used on 120/208V systems shall have busses and breakers rated for 18,000 Amps (minimum, symmetrical) interrupting capacity or as indicated.

.5 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification.

.6 CDP Panels: mains, number of circuits, and number and size of branch circuit breakers as indicated on the drawings.

.7 All bussing shall be aluminum, tin plated, with a full capacity neutral, with an ampere rating as per the drawings.

.8 All mains shall be suitable for bolt on breakers.

.9 All CDP panels trims are to be baked grey enamel.

.10 All enclosures to be EEMAC 1, suitable for surface mounting. All surface mounted tubs to be sprinkler proof in accordance with C.E.C. 26-008.

.11 All CDP panelboard tubs shall be 14 gauge galvanized steel with minimum dimensions of 24" wide x 11" deep - refer to drawings and panel schedules for minimum width required.

2.3 Breakers

.1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Lock-on devices installed as indicated on panel schedules.

2.4 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Nameplate for each panelboard size 4 engraved indicating:

.1 Panel number as per the drawings.
.2 Voltage and phase characteristics of panel.
.3 Amperage of panel.
.4 Where panel is fed from.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved.

.4 A typed directory under transparent cover shall be provided on the inside of each panel showing the location and load connected to each circuit.

2.5 Manufacturers

.1 Standard of acceptability:

.1 Panelboards: Cutler-Hammer "Pow-R-Line 1" Series.

.2 CDP panels: Cutler-Hammer "Pow-R-Line 4" Series.

.2 Other acceptable manufacturers: Siemens, Square D.

Part 3 Execution

3.1 Installation

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 00 - Rough Carpentry. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results - Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

.6 Emergency, exit, fire alarm, sprinkler excess pressure pump and bells, and night lighting, circuit breakers shall have locking devices on the handles to prevent unauthorized operation.

.7 Wiring in panelboards shall extend beyond the respective breakers, forming a 6" loop before returning to connect to the breaker terminals, so there will be flexibility for reconnecting within the panel. Wiring shall be secured with Ty-wraps or equivalent means to present a neat workmanlike appearance.

.8 Rigidly anchor floor mounted panels to the floor and wall.

.9 All recessed panelboards shall have two 1" empty EMT conduits stubbed up and out into accessible ceiling spaces above the panel (where such spaces exist), all for future use. Each pair of spare conduits to be terminated in one 6" x 6" x 4" Type 'D' box.

3.2 Testing

.1 Measure and balance load currents of distribution panels and branch circuit panels. Measure the load currents of the three phases with as much load as practical on. No reading should exceed plus or minus 10% from the average.

Should any reading exceed this limit, re-balance the loads until the desired limits are achieved. Record the results.

.2 Test all circuit breakers of distribution panels and branch circuit panels for manual operation. Move the breaker handle to the “OFF” position and confirm that there is no voltage reading on the load terminals. Record the results.

.3 Test all distribution panels and branch circuit panels for torque connections. Obtain the proper torque strength requirements from the panelboard manufacturer. Check for proper torque values for feeder terminations, branch circuit terminations, neutral connections, and ground connections. Record the results.

.4 Test 20% of branch circuits in branch circuit panels for continuity. Ensure that there is no load on a tested circuit – lighting circuits are to have all lights turned off and receptacle circuits are to have nothing plugged in. For lighting circuits, locate the last junction box in the circuit and jumper out the phase and neutral conductors. Move the circuit breaker to the “OFF” position and disconnect the neutral conductor in the panel. For receptacle circuits, locate the last receptacle in the circuit and jumper out the phase and neutral conductor. Move the circuit breaker to the “OFF” position and disconnect the neutral conductor in the panel. Connect the leads of a 500 volt meggar to the phase conductor and disconnected neutral conductor at the panel. A low reading (10 ohms or less) indicates continuity. A high reading (typically infinity) indicates a broken conductor; correct the problem and repeat the test. Record the results.

END OF SECTION

Panel:	"P-DP3201"	**Mounting:**	Surface
Location:	Electrical Room 129	**Feeder:**	See Single Line Diagram
Type:	Eaton P4L4A4-38	**Frame:**	FD, KD
Size:	73.5"H x 38"W x 12"D		
Rating:	400A 347/600 V 3Ph. 4W.		

No.	Brk.	Description	Load	Phase	Load	Description	Brk.	No.
1	***			A			***	2
3	225/3P	Transformer "P-TX3201"		B		MCC "P-MCC3M63"	250/3P	4
5	***			C			***	6
7	***			A			***	8
9	30/3P	Transformer "P-TX3M01"		B		Domestic Hot Water Heater "HWT4"	15/3P	10
11	***			C			***	12
13	***			A				14
15	70/3P	Transformer "P-TX3M02"		B				16
17	***			C				18
19				A				20
21				B				22
23				C				24
25				A				26
27				B				28
29				C				30
31				A				32
33				B				34
35				C				36
37				A				38
39				B				40
41				C				42
43				A				44
45				B				46
47				C				48
49				A				50
51				B				52
53				C				54
55				A				56
		Phase "A" Total kVA	0.00		0.00	**Phase "C" Total kVA**		
		Phase "B"		0.00	**Total kVA**			

Notes:

* -- Indicates Breaker To Be Complete With Handle Locking Device.

Panel:	"P-DP1201"	**Mounting:**	Surface
Location:	Electrical Room 129	**Feeder:**	See Single Line Diagram
Type:	Eaton P4L4A8-38	**Frame:**	FDB, JD
Size:	73.5"H x 38"W x 12"D		
Rating:	800A 120/208 V 3Ph. 4W.		

No.	Brk.	Description	Load	Phase	Load	Description	Brk.	No.
1	***			A			***	2
3	225/3P	Panel "P123" - Rm 140		B		Dimmer Rack "D1" - Rm 201	150/3P	4
5	***			C			***	6
7	***			A			***	8
9	100/3P	Panel "P125" - Rm 129		B		Dimmer Rack "D2" - Rm 201	150/3P	10
11	***			C		Cabinet #1	***	12
13	***			A			***	14
15	100/3P	Panel "1M03" - Rm 201		B		Dimmer Rack "D2" - Rm 201	150/3P	16
17	***			C		Cabinet #2	***	18
19	***			A			***	20
21	225/3P	Combi-Oven - Rm 140		B		Cam-Loks - Rm 145	100/3P	22
23	***	Shunt Trip		C			***	24
25	***			A			***	26
27	40/3P	Hoists - Rm 145		B		Cam-Loks - Rm 145	100/3P	28
29	***			C			***	30
31	***			A				32
33	250/3P	Dimmer Rack "D3" - Rm 145B		B				34
35	***			C				36
37				A				38
39				B				40
41				C				42
43				A				44
45				B				46
47				C				48
49				A				50
51				B				52
53				C				54
55				A				56

Phase "A" Total kVA	0.00		0.00	**Phase "C" Total kVA**
Phase "B"		0.00	**Total kVA**	

Notes:

* -- Indicates Breaker To Be Complete With Handle Locking Device.

Panel:	"P123"			**Mounting:**	Flush			
Location:	Kitchen 140			**Feeder:**	See Single Line Diagram			
Type:	Eaton P1aL4A2-72			**Frame:**	BAB			
Size:	60"H x 20"W x 5.75"D							
Rating:	225A 120/208V 3Ph. 4W.							

No.	Brk.	Description	Load	Phase	Load	Description	Brk.	No.	
1	***		4,990	A	1,560	Exhaust Fan EF6 - Roof	30/1P	2	
3	60/3P	Skillet (#16) - Rm 140	4,990	B	700	Exhaust Fan EF-P101 - Rm 139	15/1P	4	
5	***		4,990	C	865	Exhaust Fan EF-P102 - Rm 139	15/1P	6	
7		Shunt Trip	0	A	4,000	Coffee Maker (#37) - Rm 140	40/2P	8	
9	40/2P	Rinse Water Booster (#31) - Rm 140	3,000	B	4,000		***	10	
11	***		3,000	C	800	Ice Maker (#40) - Rm 140	15/2P	12	
13	***		5,760	A	800		***	14	
15	60/3P	Range (#18) - Rm 140	5,760	B	1,750	Cooler Compressor (#26B) - Roof	40/2P	16	*
17	***		5,760	C	1,750		***	18	*
19		Shunt Trip		A	1,180	Freezer Evaporator (#27A) - Rm 140	30/2P	20	*
21	15/1P	Spare	0	B	1,180		***	22	*
23	15/1P	Spare	0	C	2,030	Freezer Compressor (#27B) - Roof	40/2P	24	*
25	20/1P	Hot Cart (#13A) - Rm 140	1,440	A	2,030		***	26	*
27	20/1P	Hot Cart (#13B) - Rm 140	1,440	B	200	Cooler Lights (#26) - Rm 140	15/1P	28	*
29	20/1P	Hot Cart (#13C) - Rm 140	1,440	C	430	Cooler Evaporator (#26A) - Rm 140	15/1P	30	*
31	20/1P	Hot Cart (#13D) - Rm 133	0	A	500	Freezer Lights and Door Heater (#27)	15/1P	32	*
33	20/1P	Hot Cart (#13E) - Rm 133	0	B	1,440	Refrigerator (#2) - Rm 139	20/1P	34	*
35	20/1P	Hot Cart (#13F) - Rm 133	0	C	1,440	Refrigerator (#3A) - Rm 139	20/1P	36	*
37	20/1P	Hot Cart (#13G) - Rm 133	0	A	1,440	Refrigerator (#3B) - Rm 139	20/1P	38	*
39	15/1P	Exhaust Hoods (#17A/B) - Rm 140	200	B	400	Recept. Rm 136/37 - **GFCI Breaker**	20/1P	40	
41	30/1P	Dishwasher - (#33) - Rm 140	2,160	C	800	Recept. - Rm 135, 140	20/1P	42	
43	15/2P	Split Recept. - Rm 140	200	A	800	Recept. - Rm 135, 140, 141	20/1P	44	
45	***		200	B	800	Recept. - Rm 135, 139, 140	20/1P	46	
47	15/2P	Split Recept. - Rm 140	200	C	600	Recept. - Rm 134, 143	20/1P	48	
49	***	**GFCI Breaker**	200	A	50	Unit Heater - Rm 143	15/1P	50	*
51	20/1P	Lighting - Rm 140	1,620	B	6	Exit Signs - Rm 134, 135A, 145	15/1P	52	*
53	20/1P	Lighting - Rm 140	810	C	36	Exit Signs - Rm 125, 130, 133, 134	15/1P	54	*
55	20/1P	Lighting - Rm 135,136,137,139,141,145	858	A	10	Door Hold Opens - Door 130B, 134	15/1P	56	*
* 57	20/1P	Lighting - Rm 143	600	B	0	Spare	15/1P	58	
59	20/1P	Spare	0	C	0	Spare	15/1P	60	
61				A				62	
63				B				64	
65				C				66	
67				A				68	
69				B				70	
71				C				72	

Phase "A" Total kVA	25.82		27.11	**Phase "C" Total kVA**	
Phase "B"		28.29	**Total kVA**		

Notes:

* -- Indicates Breaker To Be Complete With Handle Locking Device.

Panel:	"P124"	**Mounting:**	Surface
Location:	Stage 145	**Feeder:**	See Single Line Diagram
Type:	Eaton P1aL4A2-42	**Frame:**	BAB
Size:	42"H x 20"W x 5.75"D		
Rating:	225A 120/208V 3Ph. 4W.		

No.	Brk.	Description	Load	Phase	Load	Description	Brk.	No.
1	20/1P	Audio equipment rack - Rm 145	1,000	A	5,760		***	2
3	20/1P	Audio equipment rack - Rm 145	1,000	B	5,760	Disconnect Switch - Stage Left	60/3P	4
5	20/1P	Audio equipment rack - Rm 145	1,000	C	5,760	Rm 145	***	6
7	20/1P	Receptacle beneath Panel "124"	200	A	5,760		***	8
9	20/1P	Receptacle beneath Panel "124"	200	B	5,760	Disconnect Switch - Stage Right	60/3P	10
11	20/1P	Receptacle beneath Panel "124"	200	C	5,760	Rm 145	***	12
13	20/1P	Receptacle beneath Panel "124"	200	A	240	Band receptacle - Rm 145	30/2P	14
15	20/1P	Receptacle beneath Panel "124"	200	B	240		***	16
17	15/1P	Receptacle - Rm 133	400	C	240	Band receptacle - Rm 145	50/2P	18
19	15/1P	Receptacles - Rm 145	800	A	240		***	20
21	15/1P	Receptacles - Rm 145	800	B	0	Spare	15/1P	22
23	15/1P	Receptacles - Rm 145	800	C	0	Spare	15/1P	24
25	15/1P	Receptacles - Rm 145	800	A	0	Spare	15/1P	26
27	20/1P	Receptacles - Rm 145	600	B	0	Spare	15/1P	28
29	20/1P	Receptacles - Rm 145	600	C	0	Spare	15/1P	30
31	15/1P	Receptacle - Rm 133	400	A	0	Spare	15/1P	32
33				B				34
35				C				36
37				A				38
39				B				40
41				C				42
		Phase "A" Total kVA	15.40		14.76	**Phase "C" Total kVA**		
		Phase "B"		14.56	**Total kVA**			

Notes:

* -- Indicates Breaker To Be Complete With Handle Locking Device.

Panel:	"P125"	**Mounting:**	Surface
Location:	Electrical Room 129	**Feeder:**	See Single Line Diagram
Type:	Eaton P1aL4A2-60	**Frame:**	BAB
Size:	54"H x 20"W x 5.75"D		
Rating:	225A 120/208V 3Ph. 4W.		

	No.	Brk.	Description	Load	Phase	Load	Description	Brk.	No.
	1	20/1P	Recept - Rm 133	800	A	540	Exhaust Fan EF1 - Rm 127	15/1P	2
	3	20/1P	Recept - Rm 133, 133A	800	B	540	Pump P-RC2 - Rm 128A	15/1P	4
	5	20/1P	Recept - Rm 133	600	C	50	Trap Primer - Rm 128A	15/1P	6
	7	20/1P	Recept - Rm 125, 131	800	A	50	Force Flow Heater - Rm 142	15/1P	8
	9	20/1P	Recept - Rm 125	800	B	600	Recept. Rm 127/28/28A - **GFCI Brkr**	15/1P	10
	11	20/1P	Recept - Rm 125, 130	800	C	500	Projector Receptacle - Rm 133	15/1P	12
	13	20/1P	Recept - Rm 125, 129	800	A	500	Projector Receptacle - Rm 133	15/1P	14
	15	20/1P	Recept - Rm 134, 142	800	B	500	Projector Receptacle - Rm 133	15/1P	16
	17	20/1P	Hand Dryer - Rm 127	1,500	C	600	Recept - Rm 133	15/1P	18
	19	20/1P	Hand Dryer - Rm 128	1,500	A	600	Recept - Rm 133	15/1P	20
	21	20/1P	Lighting - Rm 134	960	B	200	Recept - Rm 131	15/1P	22
*	23	20/1P	Lighting - Rm 142	600	C	50	Blind Receptacle - Rm 133	15/1P	24
	25	20/1P	Lighting - Rm 127,28,28A,29,30,31,33A	922	A	50	Blind Receptacles - Rm 125	15/1P	26
	27	20/1P	Spare	0	B	0	Spare	15/1P	28
	29	20/1P	Spare	0	C	0	Spare	15/1P	30
	31	20/1P	Spare	0	A	0	Spare	15/1P	32
	33	20/1P	Spare	0	B	0	Spare	15/1P	34
	35				C				36
	37				A				38
	39				B				40
	41				C				42
	43				A				44
	45				B				46
	47				C				48
	49				A				50
	51				B				52
	53				C				54
	55				A				56
	57				B				58
	59				C				60
			Phase "A" Total kVA	6.56		4.70	**Phase "C" Total kVA**		
			Phase "B"		5.20	**Total kVA**			

Notes:

* -- Indicates Breaker To Be Complete With Handle Locking Device.

Panel:	"1M03"				**Mounting:**	Surface			
Location:	Mechanical Mezzanine 201				**Feeder:**	See Single Line Diagram			
Type:	Eaton P1aL4A2-60				**Frame:**	BAB			
Size:	54"H x 20"W x 5.75"D								
Rating:	225A 120/208V 3Ph. 4W.								
	No.	**Brk.**	**Description**	**Load**	**Phase**	**Load**	**Description**	**Brk.**	**No.**
	1	20/1P	Lighting - Rm 201	1,140	A	1,690	DHW Heater (#41A)	20/2P	2
	3	20/1P	Lighting - Rm 201	1,080	B	1,690		***	4
	5	20/1P	Lighting - Rm 202, 203, 206, 207, 147	720	C	1,690	DHW Heater (#41B)	20/2P	6
*	7	20/1P	Rack "M1" - Rm 207	1,000	A	1,690		***	8
*	9	20/1P	Rack "M2" - Rm 207	1,000	B	1,690	DHW Heater (#41C) Top Element	20/2P	10
	11	20/1P	Recept. - Rm 207	200	C	1,690		***	12
	13	20/1P	Recept. - Rm 207	200	A	1,690	DHW Heater (#41C) Bottom Element	20/2P	14
	15	20/1P	Recept. - Rm 207	200	B	1,690		***	16
	17	20/1P	Recept. - Rm 207	200	C		Pump P-RC1 - Rm 203	15/1P	18
	19	20/1P	Recept. - Rm 201, 202, 03, 206	1,000	A	50	Trap Primer - Rm 201	15/1P	20
	21	20/1P	Recept. - Rm 201, 207	800	B	150	Unit Heaters - Rm 201	15/1P	22
	23	20/1P	Recept. Roof - **GFCI Breaker**	0	C	50	Humidifier HU1 - Rm 201	15/1P	24
	25	20/1P	Recept. Roof - **GFCI Breaker**	200	A	600	AHU11 Lighting - Rm 201	15/1P	26
*	27	15/1P	Intrusion alarm module - Rm 207	50	B	800	AHU12 Lighting - Rm 201	15/1P	28
*	29	15/1P	Access control module - Rm 207	50	C	0	AC-1 - **GFCI Breaker**	20/2P	30
	31	15/1P	Spare	0	A	0	Rm 201/207	***	32
	33	15/1P	Spare	0	B	0	Spare	15/1P	34
	35	15/1P	Spare	0	C	0	Spare	15/1P	36
	37				A				38
	39				B				40
	41				C				42
	43				A				44
	45				B				46
	47				C				48
	49				A				50
	51				B				52
	53				C				54
	55				A				56
	57				B				58
	59				C				60
			Phase "A" Total kVA	9.26		4.60	**Phase "C" Total kVA**		
			Phase "B"		9.15	**Total kVA**			

Notes:

* -- Indicates Breaker To Be Complete With Handle Locking Device.

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Related Work

.1 Section 26 05 00 – Common Work Results - Electrical.

.2 Section 26 29 10 – Motor Starters To 600V.

1.3 References

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-Q9000-92, Quality Management and Quality Assurance Standards - Guidelines for Selection and Use.

1.4 Product Data

.1 Submit product data in accordance with Section 01 33 00 - Submittals.

.2 Submit product data sheets for sills, busbars and compartments. Include product characteristics, physical size and finish.

.3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.5 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittals.

.2 Indicate:

.1 Outline dimensions
.2 Configuration of identified compartments.
.3 Floor anchoring method and dimensioned foundation template.
.4 Cable entry and exit locations.
.5 Dimensioned position and size of busbars and details of provision for future extension.
.6 Schematic and wiring diagrams.

1.6 Waste Management And Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 00 - Cleaning.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.3 Fold up metal banding, flatten and place in designated area for recycling.

1.7 Closeout Submittals

.1 Provide operation and maintenance data for motor control centre for incorporation into manual specified in Section 01 77 19 – Project Closeout.

.2 Include data for each type and style of starter.

1.8 Extra Materials

.1 Provide maintenance materials in accordance with Section 01 77 19 – Project Closeout.

Part 2 Products

2.1 Motor Control Centres

.1 The Contractor shall supply and install motor control centres as indicated on the drawings and specified as follows.

.2 Structures shall be enclosed, dead front, free standing, with solid non-accessible back for mounting against a wall. They shall be CEMA 1B and be 90” high, 20” wide and 20” deep, bolted together to form a rigid assembly and have provision at each end for future additions. They shall have zinc phosphate primer and spray painted with two coats of light grey air-dry enamel.

.3 Wiring shall be CEMA 1 Type "B" with wiring space at top and side.

.4 Wireway at top and wiring space at bottom shall be provided which will line up with adjacent units to form a convenient wiring space through the entire length of the M.C.C..

.5 Supply will be 347/600 volts 60 cycles, 3 phase, 4 wires. A continuous ground bus extending the full length of the motor control centre shall be supplied. Incoming cables will be as indicated on the drawings.

.6 Main horizontal bus shall be copper and rated not less than 450 amps and vertical bus rated 300 amps. Busses shall be copper and supported by non-tacking polyester insulators impervious to moisture, acid, and alkali; and braced to withstand fault currents of 20,000 RMS symmetrical amperes.

.7 Starters shall be of the combination breaker type, and breakers shall be magnetic only type Furnas, Cutler-Hammer, Allen Bradley, Siemens and Square “D”.

.8 Combination starters shall be equipped with moulded case magnetic only circuit breaker C.S.A. approved for the application, and with adjustable magnetic trip

settings. The operating handle of combination starters shall have provision for locking in the off position. Starters shall be provided in EEMAC I general-purpose enclosures unless specifically noted otherwise. Accessories shall be as noted on the drawings.

.9 Acceptable Product Manufacturers:

.1 Allan Bradley
.2 Square “D”
.3 Cutler-Hammer
.4 Furnas
.5 Siemens

.10 Control accessories such as light emitting diode pilot lights etc. as listed shall be supplied and mounted on a hinged panel attached to the wrapper unit and protruding through the door. One spare set of contacts and one holding coil for each type and size of motor starter shall be supplied.

.11 All components shall be mounted in a wrap around design, one piece enclosure, and be of the plug in type up to size 5 inclusive for FVNR motors.

.12 Plug in shall be provided by means of stab connection to the vertical bus and wiring from stabs to breaker or fusible switch to be included within the unit.

.13 Each combination starter shall have individual door with piano type hinges attached to the structure and each door cover, shall have rolled edges with round corners and neoprene gasket, to provide a semi-dust resistant MCC. Each unit shall be identified by a black lamicoid nameplate with white engraving.

2.2 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.1 Motor control centre main nameplate: size No. 7, engraved.
.2 Individual compartment nameplates: size No. 5, engraved as indicated.

2.3 Finishes

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Paint motor control centre exterior light gray and interiors white.

Part 3 Execution

3.1 Installation

.1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall, and set on housekeeping pads.

.2 Make field power and control connections as indicated.

.3 Adjust magnetic settings on circuit breakers to minimum setting consistent with normal motor starting requirements, in accordance with manufacturers recommendations.

.4 Obtain from the respective motor name plate data, the full load amperes; adjust over load devices in each starter unit.

3.2 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Ensure moving and working parts are lubricated where required.

.3 Operate starters to prove satisfactory performance of motor control centre during 8 hours period.

.4 Obtain the proper torque strength requirements from the motor control centre manufacturer. Check the torque values of feeder terminations, branch circuit terminations, and ground terminations. Record the results.

.5 Confirm that all branch circuit breakers operate manually and are labelled correctly. Measure the voltage at the load, first with the breaker handle in the “ON” position and then in the “OFF” position. Record the results.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Section Includes

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.3 Related Sections

.1 Section 01 33 00 - Submittals.

.2 Section 26 05 00 - Common Work Results - Electrical.

1.4 References

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No.42-99 (R2002), General Use Receptacles, Attachment Plugs and Similar Devices.

.2 CSA-C22.2 No.42.1-00, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).

.3 CSA-C22.2 No.55-M1986 (July 2001), Special Use Switches.

.4 CSA-C22.2 No.111-00, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

1.5 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittals.

1.6 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Switches

.1 Line voltage switches shall be specification grade, toggle type, flush mounted where possible, and C.S.A. approved as general purpose alternating current switches.

.2 Manually-operated general purpose AC switches with following features:

.1 Terminal holes approved for No. 10 AWG wire.
.2 Silver alloy contacts.
.3 Nylon or melamine moulding for parts subject to carbon tracking.
.4 Suitable for back and side wiring.
.5 White toggle.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

.5 Acceptable materials:

.1 120V - single pole:
.1 Hubbell Cat. No. 1221-W
.2 Pass & Seymour Cat. No. 20AC1W
.3 Leviton Cat. No. 1221-2W
.2 120V - three way
.1 Hubbell Cat. No. 1223-W
.2 Pass & Seymour Cat. No. 20AC3W
.3 Leviton Cat. No. 1223-2W
.3 120V - four way
.1 Hubbell Cat. No. 1224-W
.2 Pass & Seymour Cat. No. 20AC4W
.3 Leviton Cat. No. 1224-2W

.6 Other types of switches shall be as specifically indicated on the drawings.

2.2 Receptacles – 15A

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:

.1 Extra heavy duty compact design.
.2 Black nylon moulded housing for installation on black walls. White nylon moulded housing for installation on all other walls.
.3 Suitable for No. 10 AWG for back and side wiring.

.4 Break-off links for use as split receptacles.

.5 Eight back wired entrances, four side wiring screws.

.6 Triple wipe contacts and riveted grounding contacts.

.7 One piece brass grounding strap.

.8 Construction series receptacles will not be accepted.

.2 Receptacles of one manufacturer throughout project.

.3 Specified materials:

.1 Hubbell Cat. No. HBL5262-W and HBL5262-BK.

.4 Alternate materials:

.1 Pass & Seymour and Leviton.

2.3 Receptacles – 20A

.1 Duplex receptacles, CSA type 5-20 R, 125 V, 20 A, U ground, to: CSA-C22.2 No. 42 with following features:

.1 Extra heavy duty compact design.

.2 Black nylon moulded housing for installation on black walls. White nylon moulded housing for installation on all other walls.

.3 Suitable for No. 10 AWG for back and side wiring.

.4 Break-off links for use as split receptacles.

.5 Eight back wired entrances, four side wiring screws.

.6 Triple wipe contacts and riveted grounding contacts.

.7 One piece brass grounding strap.

.8 Construction series receptacles will not be accepted.

.2 Receptacles of one manufacturer throughout project.

.3 Specific materials:

.1 Hubbell Cat. No. HBL5362-W and HBL5362-BK.

.4 Alternate materials:

.1 Pass & Seymour and Leviton.

2.4 GFCI Receptacles – 15A

.1 GFCI duplex u-ground receptacles shall be heavy duty grade, A.C. rated 15 amperes at 125 volts, U ground, having parallel slots with double wiping contacts, ground terminal, and one piece body.

.2 GFCI receptacles shall be tamper resistant, complete with LED indication with coverplates as indicated below.

.3 Black nylon moulded housing for installation on black walls. White nylon moulded housing for installation on all other walls

.4 GFCI Receptacles shall be equal to Hubbell Circuit Guard Series Cat. No. GFTR15W and GFTR15BK.

.5 Other acceptable manufacturers: Bryant, Pass & Seymour.

2.5 GFCI Receptacles – 20A

.1 GFCI duplex u-ground receptacles shall be heavy duty grade, A.C. rated 20 amperes at 125 volts, U ground, having parallel slots with double wiping contacts, ground terminal, and one piece body.

.2 GFCI receptacles shall be tamper resistant, white complete with LED indication with coverplates as indicated below.

.3 Black nylon moulded housing for installation on black walls. White nylon moulded housing for installation on all other walls

.4 GFCI Receptacles shall be equal to Hubbell Circuit Guard Series Cat. No. GFTR20W and GFTR20BK.

.5 Other acceptable manufacturers: Bryant, Pass & Seymour.

2.6 Locking Receptacles – 20A

.1 Single receptacles, CSA type L5-20 R, 125 V, 20 A with following features:

.1 Heavy duty design.
.2 Glass-reinforced thermoplastic base and black nylon face.
.3 Suitable for No. 10 AWG for back and side wiring.
.4 One piece brass grounding strap.

.2 Receptacles of one manufacturer throughout project.

.3 Specified materials:

.1 Hubbell Cat. No. HBL2310.

.4 Acceptable alternates:

.1 Pass & Seymour and Leviton.

2.7 Special Receptacles

.1 Receptacles of specified amperage and voltage shall be supplied and installed where noted on the drawings. Where such units are noted they shall be best

quality, specification grade and conform to the noted rating and applicable C.S.A. configuration.

.2 See below for coverplates for all receptacles noted in .1. Receptacles shall be complete with lamicoid nameplates indicating voltage, amperage, & phase characteristic.

2.8 Coverplates

.1 Coverplates for wiring devices to: CSA-C22.2 No.42.1.

.2 Coverplates from one manufacturer throughout project.

.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.4 Type 302 stainless steel cover plates, for wiring devices mounted in flush-mounted outlet box, excluding wiring devices on black walls.

.5 Black nylon cover plates, for wiring devices mounted in flush-mounted outlet box, for wiring devices on black walls.

.6 Sheet metal utility style cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.7 Each 120 volt receptacle on the exterior of the building shall be complete with a weatherproof heavy duty cast aluminum “while in use” cover plate.

Part 3 Execution

3.1 Installation

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 All switches, and their wall plates, shall be installed plumb, with switch handle in the "up" position when switch is closed. Pigtail branch circuit conductors shall be used for connection to switches in multi-gang outlets. Do not use feed through features on switches. Twist stranded conductors and form under head of screw. Tighten terminal screw to specified torque. Use back wiring feature for conductor sizes #12 and #10.

.3 Install switches in gang type outlet box when more than one switch is required in one location.

.4 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.4 All receptacles, and their wall plates, shall be installed plumb, with long axis in the vertical position, U ground terminal on the top. Pigtail branch circuit conductors shall be used for connection to receptacles in cases where more than one phase conductor or neutral conductor exist in the outlet box. Do not use feed through features on receptacles. Twist stranded conductors and form under head of terminal screw. Tighten terminal screw to specified torque.

.5 Power and neutral conductor terminations shall be made using the back wiring feature on the receptacle for conductor sizes #12 and #10. Where voltage drop considerations require #8 AWG conductors to feed a receptacle, the #8 conductor shall be extended to a surface mounted junction box located in the ceiling space directly above the receptacle. The #8 AWG conductor shall be reduced to #10 AWG in the junction box before extending on down in the vertical drop to the receptacle.

.6 Install a green insulated bonding conductor, equal in ampacity to the receptacle ampacity, between the grounding terminal of the receptacle and the grounding screw or stud of the outlet box.

.7 Receptacles above counters shall be installed above the backsplash to a height as indicated on the drawings and coordinated on the site.

.8 All receptacles are to be polarity tested.

.9 All receptacles are to be identified with Lamicoid nameplates in accordance with Section 26 05 00 - Common Work Results - Electrical. The nameplate for each receptacle shall indicate the panel from which the receptacle is fed, as well as the branch breaker circuit number(s). In addition, a Ty-Rap Cat. No. TY5532M identifying tag shall be secured in the outlet box, marked with the same identification and arrange to be visible when the coverplate is removed, without removal of the receptacle.

.3 Coverplates:

.1 Protect all cover plates with paper or plastic film until painting and other work is finished.

.2 Install suitable common coverplates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.2 Testing

.1 Test every 5-15R and 5-20R receptacle for proper polarity tester with a Daniel Woodhead #1750 receptacle tester or equivalent. Use a suitable adapter for L5-

20R receptacles. Any receptacles that indicate improper wiring, make necessary corrections and repeat the test. Record the results.

.2 Test 20% of 5-15R and 5-20R receptacles for blade retention strength wioth a Daniel Woodhead #1760 blade retention tester or equivalent. Replace any receptacle with a tension reading outside the range of 10-24 ounces. Record the results.

.3 Test 20% of 5-15R and 5-20R receptacles for voltage drop, with no two receptacles on the same circuit. The voltage should be between 114 and 126 volts. Plug a 1500 watt load into each receptacle for the test. Measure the voltage at the receptacle under no load and under load. Record the results.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Related Sections

.1 Section 26 05 00 - Common Work Results - Electrical.

1.3 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.2No.248.12-94 , Low Voltage Fuses Part 12: Class R (Bi-National Standard with, UL 248-12 (1st Edition).

1.4 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittals.

1.5 Waste Management and Disposal

.1 Place materials defined as hazardous or toxic waste in designated containers.

.2 Ensure emptied containers are sealed and stored safely for disposal away from children.

.3 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

1.6 Delivery and Storage

.1 Ship fuses in original containers.

.2 Do not ship fuses installed in switchboard.

.3 Store fuses in original containers in storage cabinet.

1.7 Maintenance Materials

.1 Provide maintenance materials in accordance with Section 01 77 19 – Project Closeout.

.2 Six spare fuses of each type and size installed.

Part 2 Products

2.1 Fuses General

.1 Fuses: product of one manufacturer for entire project.

.2 Fuses for protection of motors, transformers, and electric heating circuits and feeders:

.1 Shall be HRC, Form I, Class J, Type D (Time Delay), plated contacts, rated 600V, current limiting type, standard time delay - hold 500% of current rating for 10 seconds. Standard of acceptance: Mersen Type 'AJT' c/w spot indication.

.2 Other acceptable manufacturer: Littelfuse, Bussman

Part 3 Execution

3.1 Installation

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to physically matched mounting devices.

.3 Ensure correct fuses fitted to assigned electrical circuit.

.4 Fuse sizes shall be as indicated on the drawings. Six (6) spare fuses of each type and rating shall be provided.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Section Includes

.1 Materials for moulded-case circuit breakers, circuit breakers, and ground-fault circuit-interrupters.

1.3 Related Sections

.1 Section 01 33 00 - Submittals.

.2 Section 26 28 20 - Ground Fault Circuit Interrupters – Class “A”.

1.4 References

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.5 Submittals

.1 Submit product data in accordance with Section 01 33 00 - Submittals.

1.6 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Breakers General

.1 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters: to CSA C22.2 No. 5

.2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation having de-ionizing arc chambers, be trip free of operating handles on overloads with a definite indication when tripping has taken place, all

for manual and automatic operation with temperature compensation for 40°C ambient.

.3 Common-trip breakers: with single handle for multi-pole applications; tie handles will not be acceptable

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.5 Circuit breakers with interchangeable trips as indicated.

.6 Circuit breakers to have minimum 10000 A symmetrical RMS interrupting capacity rating.

2.2 Thermal Magnetic Breakers

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 Solid State Trip Breakers

.1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase, ground fault short circuit protection.

2.4 Optional Features

.1 Include:

.1 Shunt trip.
.2 On-off locking device.
.3 Handle mechanism to be supplied on all breakers 225amps and greater.
.4 Under-voltage release.
.5 Solid state trip unit.

2.5 Manufacturers

.1 Standard of acceptability:

.1 Pow-R-Line 1 panelboards:
.1 Cutler-Hammer 'BAB' Series.
.2 Pow-R-Line 4 panelboards (120/208V):
.1 Cutler-Hammer 'FDB'.
.3 Pow-R-Line 4 panelboards (347/600V):

.1 Cutler-Hammer ‘FD’ series

.2 Cutler-Hammer 'KD series c/w RMS 310 electronic LSI trip unit’, where noted in panel schedules and drawings.

Part 3 Execution

3.1 Installation

.1 Circuit breakers shall be securely mounted in panelboards and tightened down to the bussing as per the manufacturer's recommended torque levels.

.2 Install breakers in quantities as indicated.

.3 Supply and install blank sections in panelboards for all unused breaker spaces.

.4 Set trip units as per the fault and coordination study described in 26 05 00 Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Section Includes

.1 Equipment and installation for ground fault circuit interrupters (GFCI).

1.3 Related Sections

.1 Section 01 33 00 - Submittals.

.2 Section 01 45 00 - Quality Control.

.3 Section 26 05 00 - Common Work Results - Electrical.

1.4 References

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.144-M91(R2001), Ground Fault Circuit Interrupters.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA PG 2.2-1999, Application Guide for Ground Fault Protection Devices for Equipment.

1.5 Submittals

.1 Submittals in accordance with Section 01 33 00 - Submittals.

.2 Submit product data and shop drawings.

1.6 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Materials

.1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA-C22.2 No.144.

.2 Components comprising ground fault protective system to be of same manufacturer.

2.2 Breaker Type Ground Fault Interrupter

.1 Ground fault protection where required by circuit breakers in branch circuit panelboards shall be C.S.A. listed as Class "A" Group "1" with a sensitivity of 5 milliamps or greater. Breakers shall be of the thermal magnetic type incorporating a solid state ground fault sensing circuit and push to test push button. Breakers shall be of the bolt on design, and interchangeable with other panelboard breakers. Interrupting capacity shall be 10,000 amperes, R.M.S. symmetrical. Approved manufacturers, provided they comply, shall be Cutler-Hammer, Square D, Siemens.

2.3 Receptacle Type Ground Fault Interrupter

.1 Ground fault protection where required by receptacle devices, shall be C.S.A. listed as Class "A" Group "1" with a sensitivity of 5 milliamps or greater. Receptacle with built-in ground fault protection shall incorporate a solid state ground fault sensing circuit, auto testing circuitry, and physically fit in a standard single gang outlet box, and be complete with a push to test, and reset push buttons. Devices shall not include thermal magnetic protection in addition to the ground fault protection. Refer to wiring device Section 26 27 26 on specification of receptacle type ground fault circuit interrupter.

Part 3 Execution

3.1 Installation

.1 Install ground fault circuit breakers as specified in 26 28 21.

.2 Install ground fault receptacles in accordance with Section 26 27 26.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Section Includes

.1 Materials and installation for fused and non-fused disconnect switches.

1.3 Related Sections

.1 Section 01 33 00 - Submittals.

.2 Section 26 05 00 - Common Work Results - Electrical.

.3 Section 26 28 14 - Fuses - Low Voltage.

1.4 References

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches.

.2 CSA C22.2 No.39-M89 (R2003), Fuseholder Assemblies.

1.5 Submittals

.1 Submit product data in accordance with Section 01 33 00 - Submittals.

1.6 Shop Drawings

.1 Submit shop drawings and product data in accordance with 26 05 00 Common Work Results - For Electrical

.2 Indicate on shop drawings:

.1 Fuse clip arrangement/class.

.2 Overall length, height and depth of each type of switch.

.3 Number of poles, including neutrals where required, amperage rating, and voltage rating of each type of disconnect required.

1.7 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Disconnect Switches

.1 Fusible and non fusible disconnect switches in CSA rated enclosures, size as indicated, Type "A".

.2 Provision for padlocking in "ON" and "OFF" position.

.3 Mechanically interlocked door to prevent opening when handle in "ON" position.

.4 Fuses: size as indicated, in accordance with Section 26 28 14 - Fuses - Low Voltage.

.5 Fuseholders: suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

.8 Fuseholder assemblies to CSA C22.2 No. 39.

2.2 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

2.3 Manufacturers

.1 Standard of acceptability for Heavy Duty Disconnect Switch:

- .1 Fusible Disconnect Switch:
  - .1 Cutler-Hammer as detailed on drawing.
  - .2 Non-Fusible Disconnect Switch:
    - .1 Cutler-Hammer as detailed on drawing.
  - .3 Other acceptable manufacturers:
    - .1 Square 'D'
    - .2 Siemens.

Part 3 Execution

3.1 Installation

.1 Install disconnect switches complete with fuses if applicable.

.2 Supply all necessary mounting hardware and channel as required to mount switches.

3.2 Testing

.1 Check each disconnect switch for positive “make” and “break” operation with the switch door open. Visually confirm that there is a clear space between the switch blades and the female clamps when the switch is in the “OFF” position. Visually confirm that the switch blades are fully seated in the female clamps when the switch is in the “ON” position. Record the results.

.2 Check that the door interlock operates properly. De-energize the circuit that feeds the switch. With the switch in the “ON” position, confirm that the interlock prevents the door from opening. Record the results.

.3 Check that the door interlock voiding mechanism operates properly. De-energize the circuit that feeds the switch. With the switch in the “ON” position, activate the voiding mechanism and open the door. Close the door and confirm that it closes fully and that the mechanism reseats properly. Record the results.

.4 Obtain the proper torque strength requirements from the switch manufacturer. Check the torque values at the lugs of phase conductor terminations, neutral terminations, and ground terminations. Record the results.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Related Sections

.1 Section 26 05 01 - Common Work Results - Electrical.

1.3 Shop Drawings And Product Data

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittals.

.2 Indicate:

- .1 Mounting method and dimensions.
- .2 Starter size and type.
- .3 Layout of identified internal and front panel components.
- .4 Enclosure types.
- .5 Wiring diagram for each type of starter.
- .6 Interconnection diagrams.

1.4 Closeout Submittals

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 01 77 19 – Project Closeout.

.2 Include operation and maintenance data for each type and style of starter.

1.5 Extra Materials

.1 Provide maintenance materials in accordance with Section 01 77 19 – Project Closeout.

.2 Provide listed spare parts for each different size and type of starter:

- .1 3 contacts, stationary.
- .2 3 contacts, movable.
- .3 1 contacts, auxiliary.
- .4 1 control transformer[s].
- .5 1 operating coil.
- .6 2 fuses.
- .7 10% indicating lamp bulbs used.

1.6 Waste Management And Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 00 - Cleaning.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Manual Motor Starters

.1 Manual starters for single phase motors shall have toggle operating handle, quick make, quick break mechanism operating heavy sliding contacts. Overload devices of either eutectic alloy or bimetal construction shall be supplied and installed based on the motor name plate data. Starters for surface mounting shall be in general purpose EEMAC I enclosures, those for flush mounting complete with stainless steel cover plates. Starters shall be complete with locking tabs. Starters shall be surface or flush mounted as indicated on the drawings, or as dictated by the room finish schedule. Pilot lights shall be of the LED type and shall be included on all manual starters, unless specifically noted otherwise.

.2 Manual starters shall be complete with an adjustable knob that allows a 10%, plus or minus, adjustment of the nominal thermal overload rating.

.3 Standard of Acceptance: Siemens 3VA Series.

.4 Acceptable Alternate Manufacturers: Allen-Bradley, Furnas, Square 'D', Cutler-Hammer.

2.2 Full Voltage Solid State Magnetic Starters

.1 Solid state motor starters shall be electrically operated, electrically held, three-pole assemblies with arc extinguishing characteristics and shall have silver-to-silver renewable contacts. The overload protection shall consist of one current sensor located in each phase monitored by the microprocessor that yields a time current curve closely paralleling that of motor heating damage boundary, accurate to 2%. Running overload protection shall be DIP switch selectable for the specific motor full load amperes within the starter range. Provide DIP switch selectable overload trip class of 10, 20 and 30.

.2 Motor starters to monitor current in each phase to provide phase loss and phase unbalance protection.

.3 Motor starters to provide Class II ground fault protection.

.4 Motor starter microprocessor shall measure control circuit voltage and prevent closing of the coil on low-voltage and/or high voltage conditions which are outside of the coil ratings.

.5 Motor starter microprocessor shall apply voltage to the coil such that a guaranteed maximum of 2 milliseconds of main contact bounce occurs on contactor closure.

.6 Motor starter microprocessor shall continuously measure coil circuit voltage and current so as to maintain constant coil power at a level to maintain main contact closure and minimize coil power consumption.

.7 Motor starter control modules to perform the indicated input/output control functions shown on the drawings.

.8 Combination starters shall be equipped with moulded case magnetic only circuit breaker C.S.A. approved for the application, and with adjustable magnetic trip settings. The operating handle of combination starters shall have provision for locking in the off position. Starters shall be provided in EEMAC I general purpose enclosures unless specifically noted otherwise. Accessories shall be as noted on the drawings.

.9 Acceptable Product Manufacturers:

.1 Cutler-Hammer.
.2 Allen-Bradley
.3 Furnas
.4 Square 'D'
.5 Siemens

.10 2-N/O and 2-N/C spare auxiliary contacts unless otherwise indicated.

2.3 Control Transformer

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.4 Finishes

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results - Electrical.

2.5 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

.3 Magnetic starter designation label, white plate, black letters, size 4 engraved as indicated.

Part 3 Execution

3.1 Installation

.1 Manual and magnetic starters shall be provided for all motors, unless specifically noted otherwise.

.2 Mount all starters in a secure manner, easily accessible, and 4'-0" to centre, above the floor unless indicated otherwise.

.3 Obtain full load ampere ratings of respective motors and install thermal overloads of appropriate size.

.4 Adjust magnetic settings on circuit breakers to minimum setting consistent with normal motor starting requirements, in accordance with manufacturers recommendations.

.5 Ensure correct fuses and overload devices elements installed.

3.2 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical and manufacturer's instructions.

.2 Test the remote control sequence of manual starters. With the starter in the “ON” position and the motor not running, coordinate with the Division 25 Contractor to have ON and OFF signals sent from the DDC system. Confirm that the motor starts and stops. Record the results.

.3 Check the overload heaters of manual starters. Confirm that the overload heater matches the full load current on the motor nameplate. Record the results

.4 Test the remote control sequence of magnetic starters. With the H-O-A switch in the “AUTO” position and the motor not running, coordinate with the Division 25 Contractor to have ON and OFF signals sent from the DDC system. Confirm that the motor starts and stops. Record the results.

.5 Test the H-O-A switches of magnetic starters. Coordinate with the Division 25 Contractor to have an OFF signals sent from the DDC system and confirm that the motor is stopped. Move the H-O-A switch to the “ON” position and confirm that the motor starts. Move the H-O-A switch to the “OFF” position and confirm that the motor stops. Record the results.

.6 Check the overload settings of magnetic starters. Confirm that the overload relay setting matches the full load current on the motor nameplate. Record the results.

.7 Confirm the proper operation of the magnetic starter overload relays. Push the “TEST” button and confirm that the motor stops. Record the results.

.8 Operate switches, contactors to verify correct functioning.

3.3 Tests

.1 Perform tests in accordance with manufacturer's recommendations and instructions.

.2 Perform starting and stopping sequences of all contactors and relays.

.3 Check that the sequence of controls, interlocks with other separate related starters, equipment, control devices, etc., all operate as indicated.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 References

.1 American National Standards Institute (ANSI)

.1 ANSI C82.1-97, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.

.2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE C62.41-1991, Surge Voltages in Low-Voltage AC Power Circuits.

.3 American Society for Testing and Materials (ASTM)

.1 ASTM F1137-88(1993), Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

.4 United States of America, Federal Communications Commission (FCC)

.1 FCC (CFR47) EM and RF Interference Suppression.

1.3 Related Sections

.1 Section 01 33 00 - Submittals.

.2 Section 01 45 00 - Quality Control.

1.4 Shop Drawings and Product Data

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittals.

.2 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Consultant.

1.5 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Lamps

.1 On completion of the project provide a full set of best quality lamps for all lighting fixtures. Lamps shall be new and of a type suitable for the fixtures in which they are installed.

.2 T8 fluorescent lamps shall be Sylvania reduced mercury, 2725 initial lumens, 2562 mean lumens, 36,000 hour rated life, 3000K, and CRI minimum of 85. Lamps shall be designed to pass the federal TCLP test, and in effect at the time of manufacturing. Lamps shall be equivalent to Osram Sylvania Cat. No. FO28/830XPS/ECO. GE & Philips shall be listed as approved alternates.

.3 Incandescent lamps shall be general service, inside frosted, 120 volt, 1000 hour life except reflector lamps shall have 2000 hour life. Extended service 2500 hour life lamps shall be used where indicated. Special lamps shall be as specifically indicated.

.4 Incandescent lamps for theatrical luminaries shall be 575W, 120V, 12,360 initial lumens, 2000 hour life, 3050K, Ushio Cat. No. 1002283.

2.2 Ballasts

.1 All ballasts shall be supplied with a rated voltage matching the supply voltage indicated on the drawings and output current and voltage ratings of the lamp or lamps they are designed to operate.

.1 Fluorescent ballasts for 48" lamps shall qualify for the Efficiency Nova Scotia “Smart lighting choices” rebate and shall meet or exceed the following specifications:

.1 shall be electronic instant start and designed to operate both 28W and 32W T8 lamps.

.2 shall have an average input wattage of 55 watts when operating two non-enclosed FO32T8 instant start lamps; and 28 watts when operating one non-enclosed FO32T8 instant start lamp in ambients of 25℃.

.3 ballast factor of 88% minimum.

.4 power factor of 95% minimum.

.5 class “A” sound rating.

.6 thermally protected.

.7 rated for 60 Hz and voltage as indicated by circuit on the drawings.

.8 rated for operation from 10 degrees Celsius to 40 degrees Celsius.

.9 case temperatures shall not exceed 25 degrees Celsius over ambient temperature.

.10 operating frequency of 20 khz minimum. Ballast shall produce no visible lamp flicker.

.11 the total harmonic distortion shall not exceed 10%.

.12 crest factor of 1.7 maximum.

.13 shall contain no PCB's (polychlorinated biphenyls).

.14 shall withstand line transients and noise as defined in ANSI/IEEE Standard C62.41, Category A.

.15 lamp ignition time shall be 0.5 seconds minimum and shall be operated in accordance with ansi spec c82.1.

.16 EMI and RFI emission compliance with FCC (CFR47), Part 18, Sub-Part C, Class A, and FCC (CFR47) Part 15, Sub-Part B, Class B.

.17 ballasts shall be equivalent to Osram Sylvania Cat. No. QHE2X32T8/347-ISN-SC.

2.3 Finishes

.1 Baked enamel finish:

.1 Conditioning of metal before painting:

.1 For corrosion resistance conversion coating to ASTM F1137.

.2 For paint base, conversion coating to ASTM F1137.

.2 Metal surfaces of luminaire housing and reflectors finished with high gloss baked enamel or polyester powdercoat to give smooth, uniform appearance, free from pinholes or defects.

.3 Reflector and other inside surfaces finished as follows:

.1 White, minimum reflection factor 85%.

.2 Colour fastness: yellowness factor not above 0.02 and after 250 hours exposure in Atlas fade-ometer not to exceed 0.05.

.3 Film thickness, not less than 0.03mm average and in no areas less than 0.025mm.

.4 Gloss not less than 80 units as measured with Gardner 60° gloss meter.

.5 Flexibility: withstand bending over 1/2" mandrel without showing signs of cracking or flaking under 10 times magnification.

.6 Adhesion: 1" square lattice made of 1/8" squares cut through film to metal with sharp razor blade. Adhesive cellulose tape applied over lattice and pulled. Adhesion satisfactory if no coating removed.

.2 Alzak finish:

.1 Aluminium sheet fabricated from special aluminum alloys and chemically brightened, subsequently anodically treated to specifications established by Alcoa, to produce:

.1 Finish for mild commercial service, minimum density of coating 7.8 g/m^2, minimum reflectivity 83% for specular, 80.5% for semi-specular and 75% for diffuse.

.2 Finish for regular industrial service, minimum density of coating 14.8 g/m^2, minimum reflectivity 82% for specular and 73% for diffuse.

.3 Finish for heavy duty service, minimum density of coating 21.8 g/m^2, minimum reflectivity 85% for specular, 65% for diffuse.

2.4 Luminaires

.1 Refer to electrical drawings.

Part 3 Execution

3.1 Installation

.1 The Contractor shall supply, store and install all the light fixtures under this Contract in such a manner that their attachment to the ceiling shall be secure in all respects. In order to avoid any danger that the weight of the fixtures might distort hung ceilings (where such occur), approved type independent supports shall be provided by the Contractor to the satisfaction of the Engineer.

.2 Fixtures shall not be hung directly from plasterboard ceilings, but shall derive their support from channels independently mounted in the ceiling space.

.3 Any supporting angles, channels, unistrut, caddy clips, etc., required to adequately secure and support the fixtures shall be provided and installed by the Contractor. Exposed supporting system shall be painted white and blended in with the background colours.

.4 All lamps shall be new and burning at the time of take over. All fixtures shall be clean and in like new condition, at the time of takeover.

.5 This Division shall ensure the compatibility of the electronic ballast manufacturer and the fluorescent lamp manufacturer.

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 Section Includes

.1 Materials and installation for emergency lighting systems.

1.3 Related Sections

.1 Section 01 33 00 - Submittals.

.2 Section 26 05 21 - Wires and Cables (0-1000 V).

.3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.4 References

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.141-M1985(R1999), Unit Equipment of Emergency Lighting.

1.5 Submittals

.1 Submit product data in accordance with Section 01 33 00 - Submittals.

.2 Data to indicate system components, mounting method, source of power and special attachments.

1.6 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Type 1 battery units: Chrysler Canada Pavilion and Kenneth C Rowe Hall only

.1 Emergency lighting equipment: to CSA C22.2 No.141.

.2 Supply voltage: Universal 120V to 347 V, AC.

.3 Output voltage: 12V DC.

.4 Operating time: 30 min.

.5 Battery: sealed, maintenance free with ten year life warranty, wattage as indicated on drawings.

.6 Charger: solid state, three stage, self diagnostic circuitry, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations.

.7 Solid state transfer circuit.

.8 Low voltage disconnect: solid state, modular, operates at 87.5% battery nominal voltage.

.9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.

.10 Lamp heads: integral on unit, 345° horizontal and 180° vertical adjustment. Lamp type: MR16 LED, 6W.

.11 Cabinet: flush wall mounted with concealed heads.

.12 Finish: White.

.13 Auxiliary equipment:

.1 Test switch.
.2 Automated self diagnostic circuitry.

.14 Acceptable Product Manufacturers:

.1 Lumacell Cat. No. PH75/150LD10-AT.

.15 Approved alternates shall be:

.1 Aimlite.
.2 Dual-Lite.
.3 Emergi-Lite.
.4 Ready-Lite.
.5 Stanpro.

2.2 <u>Type 1 remote units: Chrysler Canada Pavilion and Kenneth C Rowe Hall only</u>

.1 Emergency lighting equipment: to CSA C22.2 No.141.

.2 Lamp heads: Lamp type: MR16 LED, 6W.

.3 Cabinet: flush wall mounted with concealed heads.

.4 Finish: White.

.5 Acceptable Product Manufacturers:

.1 Lumacell Cat. No. PHAR12VLD10.

.6 Approved alternates shall be:

.1 Aimlite.
.2 Dual-Lite.
.3 Emergi-Lite.
.4 Ready-Lite.
.5 Stanpro.

2.3 Type 2 Battery Units

.1 Emergency lighting equipment: to CSA C22.2 No.141.

.2 Supply voltage: Universal 120V to 347 V, AC.

.3 Output voltage: 12V DC.

.4 Operating time: 30 min.

.5 Battery: sealed, maintenance free with ten year life warranty, wattage as indicated on the drawings.

.6 Charger: solid state, three stage, self diagnostic circuitry, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations.

.7 Solid state transfer circuit.

.8 Low voltage disconnect: solid state, modular, operates at 87.5% battery nominal voltage.

.9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.

.10 Lamp heads: integral on unit, 345° horizontal and 180° vertical adjustment. Lamp type: MR16 LED, 6W.

.11 Cabinet: suitable for direct to wall mounting and c/w knockouts for conduit termination.

.12 Finish: White.

.13 Auxiliary equipment:

.1 Test switch.
.2 Battery disconnect device.

.3 AC input and DC output terminal blocks inside cabinet.

.4 Automated self diagnostic circuitry.

.14 Acceptable Product Manufacturers:

.1 Lumacell Cat. No. RG12S36/72/1442LD10-TMBB-AT.

.15 Approved alternates shall be:

.1 Aimlite.
.2 Dual-Lite.
.3 Emergi-Lite.
.4 Ready-Lite.
.5 Stanpro.

2.4 Type 2 Remote Units

.1 Emergency lighting equipment: to CSA C22.2 No.141.

.2 Lamp heads: lamp type: MR16 LED, 6W.

.3 Finish: White.

.4 Acceptable Product Manufacturers:

.1 Lumacell Cat. No. DR2130WH-MR16LD10.

.5 Approved alternates shall be:

.1 Aimlite.
.2 Dual-Lite.
.3 Emergi-Lite.
.4 Ready-Lite.
.5 Stanpro.

2.5 Wiring of Unit Equipment

.1 Conduit: Type EMT, to Section 26 05 34 Conduits, Conduit Fastenings and Conduit Fittings.

.2 Conductors: RW90 Type to Section 26 05 21 Wires and Cables 0 - 1000V, sized as indicated and in accordance with manufacturer's recommendations.

Part 3 Execution

3.1 Installation

.1 Install unit equipment and remote mounted fixtures.

.2 Direct heads on to egress path.

.3 Connect exit lights to unit equipment.

.4 Connect battery terminals.

3.2 Testing

.1 Test each battery pack for proper operation. Confirm the “FULL CHARGE” indicating light is lit. Turn off the circuit breaker and confirm that all emergency lamps remain illuminated for 30 minutes. Record the results.

.2 Test each battery pack and remote fixture for lamp burnout. Turn off the circuit breaker and confirm that all battery pack and remote fixture lamps are illuminated. Record the results.

.3 Test each battery pack for recharge time. Confirm the “FULL CHARGE” indicating light is lit. Turn off the circuit breaker and confirm that all emergency lamps remain illuminated for 30 minutes. Note the time and turn on the circuit breaker. After 24 hours, confirm that the “CHARGE” indication light is off and the “FULL CHARGE” indicating light is lit. Record the results

END OF SECTION

Part 1 General

1.1 General Requirements

.1 Division 1 and the General Conditions of the Contract between the Owner and the Contractor shall deem to apply and be part of this section.

1.2 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No.141- M1985(R1992) , Unit Equipment for Emergency Lighting.

.2 CSA C860- 01 , Performance of Internally-Lighted Exit Signs.

.2 National Fire Protection Association (NFPA) requirements.

1.3 Submittals

.1 Submit product data in accordance with Section 01 33 00 - Submittals.

.2 Submit product data sheets for exit lights. Include product characteristics, performance criteria, physical size, limitations and finish.

.3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.4 Waste Management and Disposal

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 Type 1: Chrysler Canada Pavilion and Kenneth C Rowe Hall only

.1 Exit lights: to CSA C22.2 No.141 and CSA C860, packaged in accordance with the Canadian Code for Preferred Packaging guidelines.

.2 Housing: extruded aluminum, brushed aluminum finish.

.3 Lamps: 2W LED (max) indirect illumination unit, 120 V to 347 V input.

.4 Operation: Designed for over 100,000 hours of continuous operation without re-lamping.

.5 Letters: 6" high by ¾" thick stroke, edge-lit, red on clear extruded acrylic face, reading "EXIT SORTIE".

.6 C860 Series and NRCAN listed.

.7 Supply voltage: 120 V to 347 V, AC.

.8 Operating time: 60 min.

.9 Battery: nickel-cadmium.

.10 Mounting: suitable for universal ceiling or wall mounting directly on junction box and c/w knockouts for conduit.

.11 Cabinet: finish: white baked enamel.

.12 Acceptable Product Manufacturer:

.1 Lumacell Cat. No. LER200ARCB6LC860SP.

.13 Approved alternates shall be:

.1 Aimlite.
.2 Dual-Lite.
.3 Emergi-Lite.
.4 Ready-Lite.
.5 Stanpro.

2.2 <u>Type 2</u>

.1 Exit lights: to CSA C22.2 No.141 and CSA C860, packaged in accordance with the Canadian Code for Preferred Packaging guidelines.

.2 Housing: extruded aluminum, white baked enamel finish.

.3 Lamps: 2W LED (max) indirect illumination unit, 120 V to 347 V input.

.4 Operation: Designed for over 100,000 hours of continuous operation without re-lamping.

.5 Letters: 6" high by ¾" thick stroke, red on white face, reading "EXIT SORTIE".

.6 C860 Series and NRCAN listed.

.7 Supply voltage: 120 V to 347 V, AC.

.8 Operating time: 60 min.

.9 Battery: nickel-cadmium.

.10 Mounting: suitable for universal ceiling or wall mounting directly on junction box and c/w knockouts for conduit.

.11 Cabinet: finish: white baked enamel.

.12 Acceptable Product Manufacturer:

.1 Lumacell Cat. No. LER450B6LC860SP.

.13 Approved alternates shall be:

.1 Aimlite.
.2 Dual-Lite.
.3 Emergi-Lite.
.4 Ready-Lite.
.5 Stanpro.

Part 3 Execution

3.1 Installation

.1 Install exit lights.

.2 Connect fixtures to exit light circuits.

.3 Ensure that exit light circuit breaker is locked in on position.

3.2 Testing

.1 Test the AC operation of each exit sign. Confirm that the circuit breaker is in the "ON" position and disconnect the battery from the appropriate battery pack. Visually inspect the exit sign and confirm that it is illuminated. Move the circuit breaker to the "OFF" position. Visually inspect the exit sign and confirm that it is not illuminated. Record the results.

.2 Test the DC operation of each exit sign. After the AC operation has been tested, move the circuit breaker to the "OFF" position. Visually inspect the exit sign and confirm that it is illuminated. Move the circuit breaker to the "ON" position. Visually inspect the exit sign and confirm that it is illuminated. Record the results

.3 Test the LEDs of each exit sign. Remove the face plate while the exit sign is energized and confirm that all of LEDs on the back plate are lit. Replace any plates with burned out LEDs and repeat the test. Record the results.

END OF SECTION

Part 1 General

1.1 Related Sections

.1 Section 26 05 00 Common Work Results - Electrical.

1.2 References

.1 American National Standards Institute:

.1 ANSI J-STD-607-A-2002, Joint Standard - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

.2 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA):

.1 TIA/EIA-606-2002, Administration Standard for the Commercial Telecommunications Infrastructure.

1.3 System Description

.1 Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.

.2 Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.

.3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

1.4 Delivery, Storage And Handling

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning.

Part 2 Products

2.1 Telecommunications Grounding Busbar (TGB)

.1 Predrilled copper busbar, electrotin plated with holes ¼" and 3/8" diameter for use with standard-sized lugs to: ANSI J-STD-607-A.

.2 Dimensions ¼" thick, 2" wide, 24" long to: ANSI J-STD-607-A.

.3 Panduit Cat. No. GB2B0514TPI-1.

2.2 Telecommunications Bonding Backbone (TBB)

.1 3/0 AWG copper conductor, green insulated to: ANSI J-STD-607-A.

2.3 Warning Labels

.1 Non-metallic warning labels in English and French to: ANSI J-STD-607-A.

.2 Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

Part 3 Execution

3.1 Telecommunications Grounding Busbar (TGB)

.1 Install TGB in Telecommunications Room 207.

3.2 Telecommunications Bonding Backbone (TBB)

.1 Install TBB to TGB as indicated.

.2 Use approved 2 hole compression lugs for connection to TGBs.

3.3 Bonding To TGB

.1 Bond metallic raceways in telecommunications room to TGB using 6 AWG green insulated copper conductor.

.2 For cables within telecommunications room having shield or metallic member, bond shield or metallic member to TGB using 6 AWG green insulated copper conductor.

.3 Bond equipment racks located in telecommunications room to TGB using 6 AWG green insulated copper conductor.

3.4 Labelling

.1 Apply warning labels to telecommunications bonding and grounding conductors.

.2 Apply additional administrative labels to: TIA/EIA-606.

END OF SECTION

Part 1 General

1.1_ System Description

.1 Telecommunications raceways system consists of outlet boxes, coverplates, conduits, cabletroughs, and pull boxes.

.2 Cabletrough distribution system.

Part 2 Products

2.1 Material

.1 Conduits: EMT type, to Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Cabletroughs: wire mesh type, to Section 26 05 36 - Cable Trays for Electrical Systems.

.3 Junction boxes, cabinets type E: to Section 26 05 31 - Splitters, Junction, Pull Boxes, and Cabinets.

.4 Flush outlet boxes 4" square with single gang tile ring: to Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.

.5 Surface outlet boxes: cast FS to Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.

.6 Pull boxes shall be Type C & D of minimum length eight times the internal diameter of the largest conduit: to Section 26 05 31 – Splitters, Junction, Pull Boxes, and Cabinets.

Part 3 Execution

3.1 Installation

.1 Install raceway system, including outlet boxes, pull boxes, coverplates, conduit, cabletroughs, miscellaneous and positioning material to constitute complete system.

.2 Conduits shall enter outlet boxes to either side of centre, to prevent cable damage by coverplate retaining screws.

.3 Install pull boxes in runs at 100' intervals, or lesser distances, as dictated by the number of bends.

.4 No more than two 90 degree bends between pull boxes are allowed. The use of "condulets" or "LB" type fittings is not allowed.

.5 Flexible conduits are not allowed. If it is necessary (upon consultation with the Engineer), to use a flexible conduit, the conduit shall be increased by one trade size.

END OF SECTION

Part 1 General

1.1 Related Sections

.1 Section 26 05 00 Common Work Results - Electrical.

1.2 References

.1 Canadian Standards Association (CSA International):

.1 CSA-C22.2 No. 214-02, Communications Cables (Bi-National standard with UL 444).

.2 CSA-C22.2 No. 232-M1988(R2004), Optical Fibre Cables.

.2 American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA):

.1 ANSI/TIA-568-C.0-(2009), Generic Telecommunications Cabling for Customer Premises.

.2 ANSI/TIA-568-C.1-(2009), Commercial Building Telecommunications Cabling Standard.

.3 ANSI/TIA-568-C.2-(2009), Balanced Twisted-Pair Cabling Components Standard.

.4 ANSI/TIA-568-C.3-(2009), Optical Fibre Cabling Components Standard.

.5 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.

.6 TIA-598-C-(2005), Optical Fibre Cable Colour Coding.

1.3 Definitions

.1 Refer to TIA/EIA-598-C, Annex A for definitions of terms: optical-fibre interconnect, distribution, and breakout cables.

1.4 System Description

.1 Structured telecommunications wiring system consist of unshielded-twisted-pair and optical fibre cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), data, and image.

.2 Installed in physical star configuration with separate horizontal and backbone sub-systems.

.1 Horizontal cables link work areas to telecommunications rooms.

.2 Telecommunications rooms linked to main terminal/equipment room (MT/ER) by backbone cables.

.3 MT/ER also linked to Entrance Room by backbone cables.

1.5 Submittals

.1 Provide submittals in accordance with Section 01 33 00 - Submittals.

1.6 Delivery, Storage And Handling

.1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning.

Part 2 Products

2.1 Four-Pair 100 Ω Balanced Twisted Pair Cable

.1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT4 or CMR to: CSA-C22.2 No. 214, Category 6A (Cat 6A) to: ANSI/TIA-568-C.2.

.2 Horizontal cables colour coded as follows:

.1 Blue for voice, Panduit Cat. No. PUC6A04BU-EG.

.2 White for data, Panduit Cat. No. PUC6A04WH-EG.

.3 Yellow for CCTV, Panduit Cat. No. PUC6A04YL-EG.

.3 Horizontal cable labels, Panduit Cat. No. S100X225YAJ.

2.2 Multi-Pair 100 Ω Balanced Twisted Pair Cable

.1 100 ohm, 50 pairs, sheath consists of thermoplastic jacket, Category 3 to: ANSI/TIA-568-C.2, flame test classification FT4 or CMG to: CSA-C22.2 No. 214.

.1 Panduit Cat. No. PUC3050WH-A.

2.3 Work Area Outlet

.1 Flush telecommunications outlets shall be up to four ports (refer to drawings for quantities of ports) and shall consist of:

.1 4” square by 2-1/8” deep box with single gang tile ring.

.2 Four port stainless steel cover plate, Panduit Cat. No. UICFP4S.

.3 Labels, Panduit Cat. No. UILJ1 and UILJ2.

.4 Category 6A jack(s), Panduit Cat. No. CJ6X88TGBU for voice, Panduit Cat. No. CJ6X88TGWH for data, Panduit Cat. No. CJ6X88TGYL for CCTV.

.5 Blank white module(s) for unused port(s), Panduit Cat. No. CMBWH-X.

.2 Surface telecommunications outlets shall be up to four ports (refer to drawings for quantities of ports) and shall consist of:

.1 Single gang cast FS box with metal 106 duplex cover plate.

.2 White four port 106 duplex module frame, Panduit Cat. No. CF1064WHY.

.3 Labels, Panduit Cat. No. UILJ1 and UILJ2.

.4 Category 6A jack(s), Panduit Cat. No. CJ6X88TGBU for voice, Panduit Cat. No. CJ6X88TGWH for data, Panduit Cat. No. CJ6X88TGYL for CCTV.

.5 Blank white module(s) for unused port(s), Panduit Cat. No. CMBWH-X.

2.4 Termination And Cross-Connection Hardware For UTP

.1 IDC Terminal strips, 25 pair, for terminating multi pair and 4 pair 100 Ω balanced twisted pair cables and supporting cross-connections using jumper wires or compatible plug-ended patch cords: Category 5e to: ANSI/TIA-568-C.2.

.2 Mount or block for housing 2 IDC terminal strips, mounted on wall, Panduit Cat. No. PXMT50.

.1 25 pair IDC terminal strip with 4-pair terminal markings, Panduit Cat. No. PXPCB4.

.2 Distribution rings or channels capable of externally mating with the above mount for managing cross-connection wires, Panduit Cat. No. PXDR.

.3 Category 5e patch panel, 1 rack units high, 24 ports unless noted otherwise:

.1 Each port equipped with factory installed "RJ-45" jacks, type T568A Category 5e to: ANSI/TIA-568-C.2:

.1 Panduit Cat. No. DPA245E88TGY angled patch panels in Room 207. Panduit Cat. No. DP245E88TGY flat patch panels in Room 223.

.2 Horizontal cable-management unit for every 24 port flat patch panel.

.1 Panduit Cat. No. CMPHF2.

.3 Component labels for patch panels.

.1 Panduit Cat. No. C379X030FJJ.

.4 Category 6A patch panel, 1 rack unit high, 24 ports and 2 rack units high, 48 ports:

.1 Each port equipped with factory installed "RJ-45" jacks, type T568A Category 6A to: ANSI/TIA-568-C.2.

.1 24 port angled, Panduit Cat. No. DPA246X88TGY.

.2 48 port angled, Panduit Cat. No. DPA486X88TGY.

.2 Component labels for patch panels.

.1 Panduit Cat. No. C379X030FJJ.

2.5 UTP Cross-Connect Wire

.1 Category 3, 1 pair to: ANSI/TIA-568-C.2.

2.6 UTP Patch Cords

.1 Length as required, with factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack Category 6A, 4 pairs to: ANSI/TIA-568-C.2.

.1 36" patch cords, Panduit Cat. No. UTP6ASD3.

.2 60" patch cords, Panduit Cat. No. UTP6ASD5.

.3 84" patch cords, Panduit Cat. No. UTP6ASD7.

.4 Label, Panduit Cat. No. S100X150YAJ.

2.7 UTP Work Area Cords

.1 10 FEET long, each end equipped with "RJ-45" plug Category 6A to: ANSI/TIA-568-C.2.

.1 Panduit Cat. No. UTP6ASD10.

.2 Label, Panduit Cat. No. S100X150YAJ.

2.8 Optical-Fibre Cable

.1 Distribution, without conductive members, multi-mode 50/125, laser-optimized OM3, 2000 MHz km capacity, 2 strands to: CSA-C22.2 No. 232 and ANSI/TIA-568-C.3, flame test classification FT4, each end terminated with duplex SC connectors.

.1 Panduit Cat. No. FODRX12Y.

.2 Label, Panduit Cat. No. S100X150YAJ.

2.9 Optical-Fibre Patch Panel

.1 Mounted in rack or cabinet 19" wide, 4 rack units, without lockable cover, capable of terminating 72 pairs of fibre, equipped with duplex LC compatible adapters.

.1 Rack mount fibre tray, Panduit Cat. No. FMT1.

.2 Fibre adapter patch panel, Panduit Cat. No. CFAPPBL1.

.3 Fibre adapter panel with 6 duplex SC connectors, Panduit Cat. No. FAP6WAQDSCZ.

.4 Horizontal cable management, Panduit Cat. No. NM2.

2.10 Optical-Fibre Patch Cords

.1 Interconnect cable, 2 strands, length as required, each end equipped with duplex LC connectors. Multi-Mode 50/125, laser-optimized, 2000 MHz km capacity to: ANSI/TIA-568-C.3.

.1 One metre patch cords, Panduit Cat. No. FXD3-3M1Y.

.2 Two metre patch cords, Panduit Cat. No. FXD3-3M2Y.

.3 Label, Panduit Cat. No. S100X220YAJ.

2.11 Equipment Racks

.1 Four post racks shall be Middle Atlantic Cat. No. R412-3830B, as follows:

.1 12 gauge welded mounting rails.

.2 Heavy duty welded base plates bolted to the floor.

.3 Holes tapped 10-32 at standard EIA spacing on front and rear of the uprights.

.4 Holes on sides of rack to gang together or mount cable management accessories.

.5 20” wide x 30” deep x 38 rack units high.

Part 3 Execution

3.1 Installation Of Termination And Cross-Connect Hardware

.1 Install termination and cross-connect hardware as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606-A.

3.2 Installation Of Horizontal Distribution Cables

.1 Install horizontal cables as indicated in conduits and cable trays from telecommunication rooms to individual work-area jacks. Identify and label as indicated to: TIA/EIA-606-A.

.2 Terminate horizontal cables in telecommunications room and at individual work-area jacks.

.1 Identify and label as indicated to: TIA/EIA-606-A.

.3 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.

3.3 Installation Of Backbone Cables

.1 Install backbone cables from each telecommunications room to main terminal/equipment room (MT/ER) in conduits and according to manufacturers' instructions.

.1 Identify and label as indicated to: TIA/EIA-606-A.

3.4 Implement Cross-Connections

.1 Implement cross-connections using jumper wires and patch cords as specified.

3.5 Equipment Racks

.1 Bolt all racks to the floor.

3.6 Field Quality Control

.1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as hard copy and electronic record on CD.

.1 Perform tests for Permanent Link on installed cables, including spares:

.1 Category 6A using certified level IV tester to: ANSI/TIA-568-C.2.

.2 Perform tests for Channel on 20% of cross-connected data horizontal cabling installed from each telecommunications room, including shortest and longest drops from each telecommunications room: should more than 5% of tested cables fail, test remaining cross-connected data cables.

.2 Test backbone UTP cables as specified below and correct deficiencies: provide record of results as hard copy and electronic record on CD.

.1 Perform Wire Map tests on multi-pair UTP cables to: ANSI/TIA-568-C.2.

.3 Test Optical-fibre strands for attenuation to: ANSI/TIA-568-C.3 and correct deficiencies: provide record of results as hard copy and electronic record on CD.

.1 Test backbone links in both directions. Backbone links:

.1 Test multi-mode fibre at both applicable wavelengths (850 nm and 1300 nm).

.2 Maximum attenuation: Cable attenuation + Connector loss + Splice loss.

.1 Multi-mode-fibre attenuation coefficients:

.1 3.5 db/km @ 850 nm; and

.2 1.5 db km @ 1300 nm

.2 Maximum connector insertion loss: 0.75 db per pair and maximum splice insertion loss: 0.3 db.

.4 Provide record of results as hard copy and electronic record on CD to: TIA/TSB-140.

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Section 26 05 00 Common Work Results - Electrical.

1.2 References

.1 Treasury Board of Canada Secretariat (TBS), Occupational Safety and Health (OSH)

.1 Fire Protection Standard-10.

.2 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S524-06, Standard for the Installation of Fire Alarm Systems.

.2 CAN/ULC-S526-07, Visible Signal Devices for Fire Alarm Systems, Including Accessories.

.3 CAN/ULC-S527-99, Standard for Control Units for Fire Alarm Systems.

.4 CAN/ULC-S528-05, Manual Stations for Fire Alarm Systems, Including Accessories.

.5 CAN/ULC-S529-09, Smoke Detectors for Fire Alarm Systems.

.6 CAN/ULC-S530-91(R1999), Heat Actuated Fire Detectors for Fire Alarm Systems.

.7 CAN/ULC-S531-02, Standard for Smoke Alarms.

.8 CAN/ULC-S537-04, Standard for the Verification of Fire Alarm Systems.

1.3 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 00 – Cleaning.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with the Waste Management Plan.

.3 Fold up metal banding, flatten and place in designated area for recycling.

1.4 Shop Drawings

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittals.

.2 Indicate on shop drawings details for devices.

Part 2 Products

2.1 Description

.1 The building has an existing Edwards EST2 fire alarm control panel, alarm initiating devices, supervisory devices, and audible signal devices. Make additions and modifications as indicated on the drawings.

2.2 Automatic Alarm Initiating Devices

.1 Bilingual addressable manual pull stations shall be Edwards Cat. No. SIGC-270B. Surface mount boxes shall be Edwards Cat. No. 27193-11, for locations where flush mounting is impossible.

.2 Addressable smoke detectors shall be Edwards Cat. No. SIGA-IPHS. Mounting base shall be Edwards Cat. No. SIGA-SB.

.3 Duct smoke detector housings shall be Edwards Cat. No. SIGA-DH. Air sampling inlet tubes shall be Edwards 6261 series, length to suit duct width.

.4 Addressable input modules shall be Edwards Cat. No. SIGA-CR.

2.3 Audible Signal Devices

.1 Vibrating 6” bells shall be Edwards Cat. No. 439D-6AWC.

.2 Vibrating 10” bells shall be Edwards Cat. No. 439D-10AWC.

2.4 Electromagnetic Door Hold-open Devices

.1 Semi-flush wall mounted devices shall be Edwards Cat. No. 1504-N5.

.2 Surface wall mounted devices shall be Edwards Cat. No. 1508-N5.

2.5 Wiring

.1 Twisted copper conductors: rated 300V.

.2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.

.3 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.

.4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.

Part 3 Execution

3.1 Installation

.1 Install systems in accordance with CAN/ULC-S524.

.2 All fire alarm system wiring is to be installed in conduit. Flexible metal conduit may be used for the final connection of devices located in suspended ceilings,

provided a junction box is installed within 1.5 metres of the device and a single flexible conduit is extended to the device box.

3.2 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical and CAN/ULC-S537.

.2 Fire alarm system:

.1 To ensure that all components are working properly, the Contractor shall engage a "Manufacturer's Representative" to check out the additions and modifications to the existing system and bear the cost of such inspection.

.2 The manufacturer of the fire alarm system shall make an inspection of the additions and modifications to the fire alarm system. The inspection shall comprise an examination of the system for the following:

.1 That the type of equipment installed is that designated by the Engineer's specification and is applicable for intended application.

.2 That the wiring connection to all equipment components are correct and meet ULC and CSA requirements.

.3 That equipment is installed in accordance with the Manufacturer's recommendations, and that all devices (where possible without destructive testing) have been operated and/or tested to verify their operation.

.4 That the supervisory wiring, of these items of equipment connected to a supervised circuit, is operating properly and that the Governmental Regulations, if any, concerning such supervisory wiring, have been met to the satisfaction of the Inspecting Officials.

.5 All such tests and inspections shall be in conformance with CAN/ULC-S537-97.

.6 The Manufacturer shall supply to the Contractor reasonable amounts of technical assistance with respect to any changes necessary to conform the work to paragraphs 1, 2, 3, 4, and 5 above. During the period of inspection by the Manufacturer, the Contractor shall make available to the Manufacturer, Electricians as designated by the Manufacturer.

.7 To assist the Electrical Contractor in preparing his Bid, the Manufacturer shall indicate the number of hours necessary to complete this inspection prior to closing of Electrical Trade Tenders.

.8 On completion of the inspection and tests, and when all of the above conditions have been complied with, including any necessary corrective measures, the Manufacturer shall issue, to the Contractor a copy of the inspection report, and a certificate of verification. The inspection report shall include a detailed list showing the location of each device and certifying the test result of each device. The certificate of verification shall confirm that the

inspection has been completed and is satisfactory. The Contractor shall include this documentation in the operation and maintenance manuals specified under Section 26 05 00.

.9 All costs involved in this inspection both from the Manufacturer and the Contractors work shall be included with the Contractors Total Tender Price.

END OF SECTION

CANADIAN MUSEUM OF IMMIGRATION AT PIER 21 EXPANSION
Tender Review : Project 1
Room Finish Schedule Legend

Issued: **13 June 2014**

Symb	Product	Notes
ACT	Suspended Acoutisc Tile	
AB	Wood Surface Acousit Panel	
AP	Acoustic Panel (Material Surface)	
AS - PT	Anti-Static Paint	
B-1	6" Rubber Base	6" high Colour 1 (White)
B-2	6" Rubber Base	6" high Colour 2 (Black)
B-3	Cove Base / Slip Resistant Flooring	
CB	Concrete Block	Painted
CONC	Exposed Poured Concrete (new)	Seal
CPT-E	Existing Carpet	
E	Existing	
FRP	Reinforced Fibreglass Panels	4' x 8' at 8' high
GWB	Gypsum Wall Board	
GWB-W	Water Resistant Gypsum Wall Board	
MWC	Metal Wall Covering	4' high
PLY	Plywood sheathing (interior wall assembly)	Painted
PT	Paint - Colour and Finish TBD	
RSF	Resilient Sheet Flooring + Cove	Colour: Charcoal
RUBRAILS	PVC Bumpers	At 36" and 6" AFF
SS	Stainless Steel Corner Guard	to 4' AFF
TEC	Suspended Tectum Accoustic Panels	
TL-1	Ceramic Tile	
TL-12	Ceramic Tile	
TL-2	Ceramic Tile	
WD	Exposed Wood Deck Ceiling	Cleaned and Clear Urethane
WP-1 / WP-2	Ash Veneer Wood Panel	For sizes refer to room elevations
WP-3	Acoustic Ash Veneer Wood Panel	For sizes refer to room elevations
WP-4	Acoustic Fabric Panel	For sizes refer to room elevations

CANADIAN MUSEUM OF IMMIGRATION AT PIER 21 EXPANSION
Project 1 Room Finish Schedule

Issued: **11 June2014**		FLOOR	BASE	WALLS				CEILING / BULKHEADS		CORNERS		NOTES	REV.
Room Numbers	**Room Names**			NORTH	EAST	SOUTH	WEST	HEIGHT (mm)	FINISHES	WALL TO 4'	WALL TO CEILING		
125	Chrysler Canada Pavillion	CONC -Existing Clear Seal	Refer to Elevations	Refer to Elevations	Refer to Elevations	Refer to Elevations	Refer to Elevations	13' 4" and 26'	High Ceiling Cleaned and Clear Urethane Low Ceiling TEC-PT Structural Steel, Ducts, electrical conduit, sprinkler pipes PT			**Refer to Elevations** Outlets with dedicated circuits Security Cameras Provide 4 Data access points for WIFI-- high up out of reach Provide Data access points at all outlets Painted Steel Chanels ALL WALLS - Refer to Elevations and Details	
127	Women's WC	CONC -Existing Clear Seal	B-1	PT TL-2	PT TL-1	PT TL-1	PT TL-1	10'	Suspended ACT PT			Change Table Exposed Steel Column PTD	
128	Men's WC	CONC -Existing Clear Seal	B-1	PT TL-2	PT TL-1	PT TL-1	PT TL-1	10'	Suspended ACT PT			Change Table Exposed Steel Column PTD	
128A	Janitor	CONC - Existing		PT TL-3	PT TL-3	PT TL-3	PT TL-3	10'	Suspended ACT PT				
129	Electrical Room	CONC - Existing	B-2	PLY to 8' PT	PLY to 8' PT	PLY to 8' PT	PLY to 8' PT	19'	WD Cleaned and Clear Urethane Steel PT				
130	Corridor	CONC - Existing	B-1	PT	PT	PT	PT	19'	WD Cleaned and Clear Urethane Steel PT				
131	Tech Storage	CONC - Existing		MWC to 4' PT	MWC to 4' PT	MWC to 4' PT	MWC to 4' PT	19'	WD Cleaned and Clear Urethane Steel PT				
133	Kenneth C Rowe Hall	CONC - Existing	Refer to Elevations	Refer to Elevations	Refer to Elevations	Refer to Elevations	Refer to Elevations	14' and 26'	High Ceiling Cleaned and Clear Urethane Low Ceiling TEC Structural Steel, Ducts, electrical conduit, sprinkler pipes PT	SS		**Refer to Elevations** Canada Flag Mosaic must be removed and saved for reinstall (provide backing and frame as required) Paint all exposed steel	
133A	Lift Storage	CONC - Existing		MWC to 4' PT	MWC to 4' PT	MWC to 4' PT	MWC to 4' PT	19'	Cleaned and Clear Urethane Steel PT				
133B	Chair Storage	CONC		MWC to 4' PT	MWC to 4' PT	MWC to 4' PT	MWC to 4' PT	19'	Cleaned and Clear Urethane Steel PT			Refer to door schedule for north wall	
134	South Cooridor B	CONC - Existing	B-2	PT	PT	PT	PT	19'	Cleaned and Clear Urethane Steel PT			1 hr Fire Rated Partition on East Wall	

CANADIAN MUSEUM OF IMMIGRATION AT PIER 21 EXPANSION
Project 1 Room Finish Schedule

Issued: 11 June2014		FLOOR	BASE	WALLS				CEILING / BULKHEADS		CORNERS		NOTES	REV.
Room Numbers	Room Names			NORTH	EAST	SOUTH	WEST	HEIGHT (mm)	FINISHES	WALL TO 4'	WALL TO CEILING		
135	Green Room	CONC - Existing	B-1	PT	PT	PT	PT	10'	ACT-PT				
135A	Green Room Cooridor	CONC - Existing	B-1	PT	PT	PT	PT	9'	Cleaned and Clear Urethane Steel PT				
136	Green Room WC	CONC - Existing	B-1	PT	PT TL-1	PT TL-1	PT TL-1	9'	ACT-PT				
137	Back of House WC	CONC SSF	B-1	PT TL-1	PT TL-1	PT	PT TL-1	9'	ACT-PT				
138	RESERVED												
139	Kitchen Storage	CONC - Existing RSF	B-3	PT	PT	PT	PT	18'	Cleaned and Clear Urethane Steel PT				
140	Kitchen	CONC - Existing RSF	B-3 RUBRAILS	FRP RUBRAILS PT	FRP RUBRAILS PT	FRP RUBRAILS PT	FRP RUBRAILS PT	14' and 26'	Cleaned and Clear Urethane Steel PT CONC	SS		Refer to elevations	
141	Storage	CONC - Existing		MWC to 4' PT	MWC to 4' PT	MWC to 4' PT	MWC to 4' PT	14' and 26'					
142	RESERVED												
143	RESERVED												
145	Stage	Painted Double Ply Floor	B-2	GWB PT	GWB PT	GWB PT	GWB PT	14' and 26'	Cleaned and Clear Urethane GWB - BULKHEAD - PT			Refer to Elevations	
145 B	Dimmer	Painted Double Ply Floor		PLY PT	PLY PT	PLY PT	PLY PT	ACT	9'			Grille as per elevations	
146	RESERVED												
147	South Stair (lower Level)	CONC - Existing	B-2	PT	PT	PT	PT		Unfished				
201	Mechanical Service Space	CONC - Existing	B-2	PT	PT	PT	PT	7-8'	Unfished				

CANADIAN MUSEUM OF IMMIGRATION AT PIER 21 EXPANSION
Project 1 Room Finish Schedule

Issued: **11 June2014**		FLOOR	BASE	WALLS				CEILING / BULKHEADS		CORNERS		NOTES	REV.
Room Numbers	**Room Names**			NORTH	EAST	SOUTH	WEST	HEIGHT (mm)	FINISHES	WALL TO 4'	WALL TO CEILING		
202	South Stair (Upper Level)	CONC - Existing	B-2	PT	PT	PT	PT	7-8'	Unfished				
203	Hot Water Tanks	CONC - Existing	B-2	PT	PT	PT	PT	7-8'	Unfished				
205	Corridor	CONC - Existing	B-2	PT	PT	PT	PT	7-8'	Unfished				
206	Corridor	CONC - Existing	B-2	PT	PT	PT	PT	7-8'	Unfished				
207	Comm Room	CONC - Existing		PLY	PLY	PLY	PLY	7-8'	Unfished				

APPENDIX

HAZARDOUS MATERIALS ABATEMENT

CANADIAN MUSEUM OF IMMIGRATION AT PIER 21 - WORK PLAN

Prepared for

Canadian Museum of Immigration
C/O
MHPM Project Leaders
1559 Brunswick Street, Suite 510
Halifax, NS
B3J 2G1

December 5, 2013

CMIP Project Number: 21MCIQ21 2013-8
Power Vac Belfor Project Number: 5158

INTRODUCTION

Power Vac Belfor is pleased to provide this project plan to the Canadian Museum of Immigration at Pier 21 (CMIP) c/o MHPM Project Managers for the asbestos and lead abatement required at the museum. Our project plan includes the periods of work, the projected work schedule within the work periods, abatement procedures and lay-out and protection of work areas.

PROJECT PLAN

Below is our proposed project plan, including scheduled work periods and our proposed work schedules.

WORK PERIODS

We purpose to conduct the majority of the required work over the two purposed closure periods. The first work period, occurring from December 14, 2013 to December 24, 2013, and the second work period occurring from January 2, 2014, to February 12, 2014. Outside of those two scheduled work periods, we purpose to work in non-public spaces of the museum once the two main phases of the work has been completed. These areas would include the mechanical mezzanine, the stairwells leading to the mechanical mezzanine, the north corridor and the storage spaced near the kitchen.

WORK SCHEDULE

December 14 – December 24, 2013

During this first schedules closure period, we purpose to conduct our work in the Heritage Hall and begin work in the Welcome Pavilion. During this phase of the work, our personnel will be working two 10-hour shifts. These shifts will run from 7:00am – 5:00pm and from 5:00pm – 3:00am. These shifts will run weekdays and weekends from the 14th to the 24th. If possible, we would like to deliver our equipment to the site on Friday December 13, 2013, this allows us begin with a full day's work on Saturday December 14, 2013. As required, all personnel and equipment will be removed from the Heritage Hall and the Welcome Pavilion by the end of day on December 24, 2013. We request, that we are able to store our equipment in the building over the week from December 25, 2013, to January 2, 2014.

Starting on January 2nd, 2014 to February 12th, 2014, we purpose to complete any outstanding work within the Welcome Pavilion which, will include the work over the escalader, and begin the work within the Pier 21 Museum and the theater storage area. We purpose to work two 10-hour shifts Monday to Saturday; we are available to work on Sunday's during this time period if necessary to complete the work. Our shifts will run from 7:00am – 5:00pm and from 5:00pm to 3:00am. As required, all work will be completed by the end of day on February 12, 2014. We plan to have all hazardous materials

abatement completed by the end of the night shift on February 5, 2014; however, we will likely continue to work within the museum space to complete the re-painting work and the removal of our equipment from February 5th to February 12th.

Any work that must occurring while the museum staff is removing or re-instating the exhibits will be safe and non-hazardous for the museum staff. Examples of this work would include laying plastic sheeting, installing scaffolding, etc.

Once the work in these areas has been completed, we will then move to working in the non-public spaces of the museum. We purpose to work in the mechanical mezzanine during the day shift 7:00am to 5:00pm, this will be quite work and will not disrupt the operation of the museum. We purpose to work during the night shift the kitchen storage areas as to no disrupt the museums daily schedule. At the end of each night shift, all kitchen storage spaces will be put back into working order. If time permits, these areas will be done during the scheduled closure periods. We will be able to provide a more detailed schedule once the project has started.

During the work periods, we purpose to begin with preparing the areas for work, once enough area has been prepared, we will proceed with applying the chemical strippers. Once the enough of the steel has been stripped, we will begin the repaint process.

REQUIREMENTS of CMIP

We will required that the lighting and the sound boards be removed from the stage area of Heritage Hall as it is not possible to access the structural steel above this equipment without them being removed. We will need this equipment removed as soon as possible. We also require that the flags within the Heritage Hall be removed. We also require that the majority of the exhibits be removed from the museum. In the effort of time and cost, these must be removed. We do not anticipate the need to remove any items within the Welcome Pavilion.

PROTECTION OF MUSEUM SURFACES

Surfaces within the museum will be protected from the work activities through the use of polyethylene sheeting on all surfaces around the work area including walls, ceilings, floors and any remaining exhibits. Areas that required extra protection, such as floors, will be protected with plywood in addition to the polyethylene sheeting. Because the work is generally minimally invasive, we do not anticipate any additional protection of surfaces to be required.

SCAFFOLDING AND AERIAL LIFTS

We purpose to use aerial man lifts in most areas of the building, we will require scaffolding to access the area above the stage in the Heritage Hall, above the escalader in the Welcome Pavilion, over the train exhibit and above the theater in the Pier 21 Museum.

ABATEMENT PROCEDURES

ASBESTOS ABATEMENT PROCEDURES

ASBESTOS PLASTER

We purpose to remove the asbestos containing plaster located behind the corridor door leading into the stairwell using modified Type II asbestos removal procedures. These procedures include containing the asbestos containing plaster, an area that measures approximately 10 square feet, through the use of polyethylene plastic sheeting to construct hoarding walls. The hoarding walls will create a “tent” in which the asbestos plaster will be removed.

Signage will be posted at the entrance to the work area to warn other personnel in the building of the asbestos hazardous within the work area. All work procedures for the removal of the asbestos plaster will be posted at the entrance to the work area along with the decontamination procedures for the workers. All access points into the work area will be sealed with polyethylene sheeting; these access points will include but not be limited to ventilation ducts and other mechanical opening. If possible, the ventilation system servicing this area of the building will be decommissioned during the abatement. The work area will be placed under negative pressure with a pressure differential of -0.02” on the water column. This negative air pressure will be achieved using HEPA filtered negative air machines places inside the work area and vented to the exterior of the building. The asbestos containing plaster will be removed using hand tools and wet techniques, whereby amended water is sprayed on to the plaster prior to removal. Once the plaster has been removed, all surfaces within the work area will be vacuumed using a certified HEPA vacuum or wet wiped. Once all cleaning has been completed, the work area will be sprayed with a slow drying asbestos lock down agent. Following a 24-hour drying period, the hoardings around the work area will be removed.

All work will be supervised by personnel training in both asbestos awareness and asbestos removal procedures. All other personnel on-site will be training in a minimum of asbestos awareness. At no time will asbestos removal occur on the site without a competent supervisor training in asbestos removal procedures present. All work will conform to the Nova Scotia Department of Labour and Advance Educations Code of Practice *Removal of Friable Asbestos Containing Materials*.

ASBESTOS CONTAINING TAR

We purpose to remove the tar located on the brick wall using Type I asbestos removal procedures. Because tar is generally considered to be non-friable, no containment of the area is considered to be necessary. The purposed work procedure will include the use of polyethylene plastic drop sheets under the work area to collect any fallen debris. The tar will be removed from the surface of the brick using hand tools and all workers will wear personal protective equipment. Because this material is approximately 3m off the floor, the removal will require the use of either scaffolding or aerial man lifts. All personnel working on aerial man lifts will be trained fall arrest procedures.

Once all asbestos containing materials have been removed from the work areas and the 24-hour time period for the sealer to dry has elapsed, all hoarding walls will be removed and disposed of as asbestos waste. All asbestos containing materials will be disposed of according to the Transportation of Dangerous Good Act. All asbestos waste will be placed in 6-mil polyethylene bags labeled with asbestos warnings; this bag will then be put into a second clean 6-mil bag labeled with asbestos warnings for disposal. The waste will all be shipped with the necessary waste shipping documents and placards. All asbestos waste will be disposed of at Arlington Heights C&D Disposal Facilities, which is an approved asbestos disposal site.

LEAD PAINT ABATEMENT

We purpose to remove the lead based paints from the steel surfaces in the museum using a chemical paint stripper call *Smart Strip*. This product will be applied to the steel using a combination of airless sprayers and brushes where it is not possible to use airless sprayers. The product will be allowed to sit on the painted steel surfaces for approximately 24-hours. Once the 24-hour dwell time has elapsed, workers will begin to scrape the paint from the steel. Scraping will be conducted using a combination of paint scrapers and wire metal brushes. We anticipate multiple coats of the chemical stripper will be required to remove the black lead based paint.

Appropriate personal protective equipment such as disposable clothing, gloves and respiratory protection shall be used where required. All leachable lead painted materials will be placed in appropriate containers for disposal.

We purpose to make use of aerial man-lifts throughout the Heritage Hall, kitchen storage, Welcome Pavilion, north corridor and the Pier 21 Museum where possible. In the area of the escalader and over the train and the theater within the Pier 21 Museum, we will need to erect scaffolding to allow access to all areas. Any remaining exhibits will be covered with polyethylene sheeting to protect them from falling lead paint chips.

All scaffolding will be erected by Sancton Access Inc. All personnel working on man lifts will be trained in fall arrest procedures. We purpose to apply the chemical stripping agent through the use of an airless sprayer to maximize time. Steel beams, columns, etc. will be sprayed 24-hours in advance of the scraping to maximize the effectiveness of the product. We anticipate a minimum of two coats will be required to remove the paint from the columns and beams.

Once the paint has been scraped from the beams and columns, all paint chips, contaminated polyethylene sheeting and personnel protective equipment will be disposed of as leachable lead waste. All waste will be bagged and packed into 45 gallon sealed steel drums and transported to Atlantic Industrial Services in Moncton where it will then be shipped for disposal at the Stablex Facility in Quebec.

LEAD DUST ABATEMENT

Surfaces throughout the mechanical mezzanine will be cleaned to remove the lead laden dust present. The lead laden dust will be removed from surfaces using a combination of HEPA vacuuming and wet wiping. Surfaces will first be HEPA vacuumed to remove the loose dust and then wiped using a detergent based solution to remove the lead residual left behind.

We trust that the above information is satisfactory, however, should you require any additional information, please don't hesitate to ask.

Regards,
Power Vac Belfor

Ashley Strong-Deveau, B.Sc in Agr

LVM | MARITIME TESTING

December 23, 2013

Mr. Craig Chisholm, PMP
Senior Project Manager
MHPM Project Managers Inc.
1559 Brunswick Street, Suite 501
Halifax, NS
B3J 2G1

Subject: Canadian Museum of Immigration at Pier 21
Lead Swab Sampling
Our ref: 17241

Mr. Chisholm:

LVM / Maritime Testing Limited (LVM) was retained by the Canadian Museum of Immigration at Pier 21 to collect lead swab samples on steel beams in the work area where lead paint was removed at the Canadian Museum of Immigration at Pier 21 (CMIP) located at 1055 Marginal Road, in Halifax, NS.

The samples were collected using a Ghost Wipe™, which is cloth-like material suitable for collecting swab samples from hard surfaces and dissolves during the digestion process of the laboratory analysis. Ghost wipes are typically used to analyze settled dust for metals content. At the sample location, the area wiped was measured in order to calculate lead loading. Samples were placed in individual clean plastic bottles. Samples were labeled with the sample ID and location. PPE was worn as required.

Two (2) swab samples were collected from various locations. The beams and columns were bare (i.e. were no longer painted), clean, and no dust was observed to be present in either of the two sampling locations.

Lead content analysis was subcontracted to AGAT Laboratories. Laboratory certificates are attached. Analytical results from the swab samples are provided in Table 1.

Table 1 Lead Swab

ID	SAMPLE LOCATION	SAMPLE DESCRIPTION	LAB RESULT (µg/100cm^2)	LAB RESULT (mg/m^2)
Sa. 1	Heritage Hall	Column C-31	238	23.8
Sa. 2	Heritage Hall	Column C-33	418	41.8

There is not currently a clearance criterion for lead in swab sampling following lead paint abatement in this setting. The paint on the beams had been removed and the sampling locations had been cleaned to what appeared visually to be bare metal with no visual dust.

The following might explain these data:

- The metal itself might contain a lead component.
- The stripper may have “dissolved” some of the lead during removal of the paint such that a non-visible surface residue was present that was then collected by the swab sampling.
- The paint may not have been completely removed (although it visually appeared to have been thoroughly removed).
- Dust from other abatement activities may have settled on the adequately-cleaned surface just prior to sampling (this was not obvious during the sampling, however).

It is my understanding that the contractor was required to remove the paint, which seems to have been done at these locations, and that no reference post-cleaning criterion was provided. I recommend, should these data not be suitable to allow acceptance of the work, that the following will be helpful.

Additional testing should be done under the following conditions:

1. Collect samples following “normal” abatement procedures and when areas appear to be free of paint. These data would be representative of those collected and reported here and would be representative of the current “post-abatement requirement” of conditions with the paint removed.
2. Collect samples following 1) above and also immediately following washing cleaned surfaces with a suitable lead dust removal detergent to remove all potential dust residues. In the absence of a final “clean” criterion, this concentration of dust could be used to represent a “best case” criterion if one is needed. Note that no such criterion was provided to the abatement contractor in advance of doing the work, however.

3. Collect sample following 1) above and following sanding of surface with fine-grit sandpaper to expose metal that had never been painted; this will determine if lead is present in exposed bare metal.

During our sampling program, we observed the paint to have been removed from the beams and columns. Overall, the abated area appeared clean and dust free and visually appeared to have satisfied the acceptance requirements.

We trust the enclosed to your satisfaction. If, however, additional information should be required, please communicate with the undersigned.

Yours very truly,

Ashley Zottarelli, P.Eng. Kim Strong, M.Sc.

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January 7, 2014

Craig Chisholm, PMP
MHPM PROJECT MANAGERS INC.
1559 Brunswick St, Suite 501
Halifax, NS
B3J 2G1

Subject: Canadian Museum of Immigration at Pier 21 – Phase I Progress Report

Mr. Chisholm,

Power Vac Belfor began work in the Heritage Hall on December 13, 2013. Work on this day included the loading in of our gear and equipment. On December 14, 2013, crews began preparing the area, this including covering the walls and floors of the Hall with polyethylene sheeting. Once the prep work was completed, crew began applying the chemical stripping product to the steel. The product was applied and the paint stripped from the steel between December 16, 2013 and December 22, 2013. Once the chemical stripping was completed, the steel was repainted on December 22 and 23, 2013. Once December 24, 2013, crews worked to tear down the polyethylene sheeting and touch up areas of the Hall that had become damaged during the abatement work. These areas included the paint on the stage and walls in the Hall.

During Phase I of the project the asbestos containing wall plaster from removed from the corridor. On December 23 – 24, 2013, the mechanical mezzanine was vacuumed and dusted to remove any residual lead dust from the steel beams.

Please contact me if you have any questions. I can be reached at 860-2425 or 225-5007.

Regards,

Ashley Strong-Deveau, B.Sc in Agr
Estimating

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Dartmouth, NS B3B 1T6
(902) 860-2425 Tel
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January 14, 2014

Craig Chisholm, PMP
MHPM PROJECT MANAGERS INC.
1559 Brunswick St, Suite 501
Halifax, NS
B3J 2G1

Subject: Canadian Museum of Immigration at Pier 21 – Phase II Progress Report, Week Ending January 11, 2014.

Mr. Chisholm,

The following is our progress report dating from January 2, 2014 to January 11, 2014.

January 2, 2014

Power Vac Belfor employees began preparing the Welcome Pavilion for abatement work. This work included covering walls, floors and other surfaces not included in the scope of work with polyethylene sheeting. Crews worked from 7:00am to 5:00pm and from 5:00pm to 3:00am. Our scaffolding contractor arrived on-site to begin scaffolding in the area above the escalator.

January 3, 2014

Power Vac Belfor employees continued prep work in the Welcome Pavilion. The day crew work from 7:00am – 12:00pm, at 12:00pm workers were dismissed for the day due to the worsening weather conditions. The night crew did not work due to the weather. Our scaffolding contractor worked from 7:00am – 12:00pm continuing to erect the scaffolding above the escalator. The scaffolding contractor also departed from the site on noon due to the weather.

January 4, 2014

Power Vac Belfor employees continued the prep work in the Welcome Pavilion and began the prep work in the museum. Crews worked from 7:00am – 5:00pm and from 5:00pm to 3:00am.

January 5, 2014

Power Vac Belfor employees continued prep work in the museum area and started the prep work in the Global Classroom. Two of the columns in the Global Classroom were enclosed and the chemical stripper applied. The day

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crew worked from 7:00am to 5:00pm and the night crew worked from 5:00pm to 6:30pm. The night crew did not work a full shift due to the bottleneck created by the scaffolding contractor not completing the scaffold above the escalator on January 3, 2014.

January 6, 2014

Power Vac Belfor employees continued prep work in the museum and the Global Classroom. Columns in the Global Classroom that were treated with the chemical stripper on January 5, where scraped. Our scaffolding contractor completed the work above the escalator and the night crew worked to finish prepping this area to enclose the work area from the main level below. Crews worked from 7:00am – 5:00pm and from 5:00pm – 3:00am.

January 7, 2014

Power Vac Belfor employees completed the prep work in the Welcome Pavilion and began to apply the chemical stripper to the beams. Crews worked to start prepping the storage rooms off the kitchen. Our scaffolding contractor began erecting the scaffolding above the train exhibit in the museum. Crews worked from 7:00am – 5:00pm and from 5:00pm – 3:00am.

January 8, 2014

Power Vac Belfor employees completed the application of the first coat of the chemical stripper to all areas of the Welcome Pavilion, completed the scraping of the lead paint in approximately three-quarters of the Welcome Pavilion and applied second coat of the paint stripper to areas as needed. Chemical stripper was applied to the beams in the storage area of the kitchen. Our scaffolding contractor continued work in the museum above the train. Crews worked from 7:00am – 5:00pm and from 5:00pm – 3:00am.

January 9, 2014

Power Vac Belfor employees completed chemical stripping in the storage room off the kitchen and continue to work in the Welcome Pavilion applying the paint stripper to areas as need. Primer and paint was applied to columns in the Global classroom. Our scaffolding contractor continued work in the museum starting the area above the theater. Crews worked from 7:00am – 5:00pm and from 5:00pm – 3:00am.

January 10, 2014

Power Vac Belfor employees primed and paint the storage room off the kitchen. Primer was applied to most areas within the Welcome Pavilion. Chemical stripper was applied to areas requiring an addition coat. Our scaffolding contractor continued work in the museum above the train. Crews worked from 7:00am – 5:00pm and from 5:00pm – 3:00am.

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January 11, 2014

Power Vac Belfor employees continued to prime the steel in the Welcome Pavilion and began the prep work above the train. Our scaffolding contractor did not work on Saturday. Crews worked from 7:00am – 5:00pm and from 5:00pm – 3:00am.

Please contact me if you have any questions. I can be reached at 860-2425 or 225-5007.

Regards,

Ashley Strong-Deveau, B.Sc in Agr
Estimating

LVM | MARITIME TESTING

January 17, 2014

Mr. Craig Chisholm, PMP
Senior Project Manager
MHPM Project Managers Inc.
1559 Brunswick Street, Suite 501
Halifax, NS
B3J 2G1

Subject: Canadian Museum of Immigration at Pier 21
Lead Swab Sampling
Our ref: 17241

Mr. Chisholm:

LVM / Maritime Testing Limited (LVM) was retained by the Canadian Museum of Immigration at Pier 21 to collect lead swab samples on steel columns in the work area where lead paint was removed at the Canadian Museum of Immigration at Pier 21 (CMIP) located at 1055 Marginal Road, in Halifax, NS.

The samples were collected using a Ghost Wipe™, which is cloth-like material suitable for collecting swab samples from hard surfaces and dissolves during the digestion process of the laboratory analysis. Ghost wipes are typically used to analyze settled dust for metals content. At the sample location, the area wiped was measured in order to calculate lead loading. Samples were placed in individual clean plastic bottles. Samples were labeled with the sample ID and location. PPE was worn as required.

Six (6) swab samples were collected in total from the two (2) columns in the current work area, as directed by you, on January 7, 2014. There is not currently a clearance criterion for lead in swab sampling following lead paint abatement in this setting.

Three (3) samples were collected from each column in question, under the following conditions:

1. Samples identified in Table 1 below as *Column# - Pb#a,* were collected following "normal" abatement procedures. The areas appeared to be free of paint. These data would be representative of the current "post-abatement requirement" of conditions with the paint removed.

2. Samples identified in Table 1 below as *Column# - Pb#b*, were collected immediately following washing cleaned surfaces with a suitable lead dust removal detergent to remove all potential dust

residues. The cleaner ledizolv™ was utilized prior to collecting these lead swab samples. This product is commonly used to clean lead dust. In the absence of a final "clean" criterion, this concentration of dust could be used to represent a "best case" criterion if one is needed. Note that no such criterion was provided to the abatement contractor in advance of doing the work, however.

3. Samples identified in Table 1 below as *Column# - Pb#c*, were collected following sanding of surface with fine-grit sandpaper to expose metal that had never been painted; this will determine if lead is present in exposed bare metal.

Lead content analysis was subcontracted to Maxxam Analytics. Laboratory certificates are attached. Analytical results from the swab samples collected from the current sampling program are provided in Table 1.

Table 1 : Current Lead Swab Sample Results

ID	SAMPLE LOCATION	SAMPLE DESCRIPTION	LAB RESULT ($\mu g/100cm^2$)	LAB RESULT (mg/m^2)
Column 1 – Pb1a	Lunchroom, 2nd Level	Following "normal" abatement procedures	56.2	5.62
Column 1 – Pb1b	Lunchroom, 2nd Level	Following cleaning with lead dust removal detergent	21.1	2.11
Column 1 – Pb1c	Lunchroom, 2nd Level	Following sanding to expose metal	4.14	0.414
Column 2 – Pb2a	Lunchroom, 2nd Level	Following "normal" abatement procedures	78.5	7.85
Column 2 – Pb2b	Lunchroom, 2nd Level	Following cleaning with lead dust removal detergent	18.5	1.85
Column 2 – Pb2c	Lunchroom, 2nd Level	Following sanding to expose metal	6.94	0.694

We trust the enclosed to your satisfaction. If, however, additional information should be required, please communicate with the undersigned.

Yours very truly,

Ashley Zottarelli, P.Eng.

Kim Strong, M.Sc.

Maxxam

Your Project #: 17241
Site Location: PIER 21
Your C.O.C. #: B 140551

Attention:Ashley Zottarelli

LVM Maritime Testing
97 Troop Ave
Dartmouth, NS
CANADA B3B 2A7

Report Date: 2014/01/08

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B401650
Received: 2014/01/07, 10:33

Sample Matrix: Swab
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Acid Extractable Metals in Swabs	6	2014/01/07	2014/01/08	ATL SOP-00058	Based on EPA6020A

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Mari Kenny, Project Manager
Email: MKenny@maxxam.ca
Phone# (902)420-0203 Ext:291

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Maxxam

Maxxam Job #: B401650
Report Date: 2014/01/08

LVM Maritime Testing
Client Project #: 17241
Site Location: PIER 21
Sampler Initials: AT

ELEMENTS BY ICP/MS (SWAB)

Maxxam ID		UL7284	UL7285	UL7286	UL7287	UL7288		
Sampling Date		2014/01/07	2014/01/07	2014/01/07	2014/01/07	2014/01/07		
COC Number		B 140551	B 140551	B 140551	B 140551	B 140551		
	Units	COLUMN1-PB1A	COLUMN1-PB1B	COLUMN1-PB1C	COLUMN2-PB2A	COLUMN2-PB2B	RDL	QC Batch
Metals								
Lead (Pb)	ug	56.2	21.1	4.14	78.5	18.5	0.125	3475114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		UL7289		
Sampling Date		2014/01/07		
COC Number		B 140551		
	Units	COLUMN2-PB2C	RDL	QC Batch
Metals				
Lead (Pb)	ug	6.94	0.125	3475114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam

Maxxam Job #: B401650
Report Date: 2014/01/08

LVM Maritime Testing
Client Project #: 17241
Site Location: PIER 21
Sampler Initials: AT

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	15.0°C

Samples were collected in a 10x10cm area

Results relate only to the items tested.

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Maxxam

Maxxam Job #: B401650
Report Date: 2014/01/08

LVM Maritime Testing
Client Project #: 17241
Site Location: PIER 21
Sampler Initials: AT

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
3475114	DLB	QC Standard	Lead (Pb)	2014/01/08		116	%	75 - 125
3475114	DLB	Spiked Blank	Lead (Pb)	2014/01/08		108	%	75 - 125
3475114	DLB	Method Blank	Lead (Pb)	2014/01/08	<0.125		ug	

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

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LVM | MARITIME TESTING

January 28, 2014

Mr. Craig Chisholm, PMP
Senior Project Manager
MHPM Project Managers Inc.
1559 Brunswick Street, Suite 501
Halifax, NS
B3J 2G1

Subject: Canadian Museum of Immigration at Pier 21
Lead Swab Sampling
Our ref: 17241

Mr. Chisholm:

LVM / Maritime Testing Limited (LVM) was retained by the Canadian Museum of Immigration at Pier 21 to collect lead swab samples on steel beams in the work area where lead paint was removed at the Canadian Museum of Immigration at Pier 21 (CMIP) located at 1055 Marginal Road, in Halifax, NS.

The samples were collected using a Ghost Wipe™, which is cloth-like material suitable for collecting swab samples from hard surfaces and dissolves during the digestion process of the laboratory analysis. Ghost wipes are typically used to analyze settled dust for metals content. At the sample location, the area wiped was measured in order to calculate lead loading. Samples were placed in individual clean plastic bottles. Samples were labeled with the sample ID and location. PPE was worn as required.

Two (2) swab samples were collected from various locations. The beams and columns were bare (i.e. were no longer painted), clean, and no dust was observed to be present in either of the two sampling locations. The laboratory reportedly lost the leach from the second sample preparation; therefore, one result is provided.

Lead content analysis was subcontracted to Maxxam Analytics. Laboratory certificates are attached. Analytical results from the swab samples are provided in Table 1.

Table 1 Lead Swab

ID	SAMPLE LOCATION	SAMPLE DESCRIPTION	LAB RESULT ($\mu g/100cm^2$)	LAB RESULT (mg/m^2)
L3	Exhibition Hall, 2nd Level	Following "normal" abatement procedures	19.8	1.98

There is not currently a clearance criterion for lead in swab sampling following lead paint abatement in this setting. The paint on the beams had been removed and the beams that were sampled had been cleaned to what appeared visually to be bare metal with no visual dust.

It should be noted that lead paint abatement was ongoing at the time the samples were collected in other areas of the enclosure.

We trust this is to your satisfaction. If, however, additional information should be required, please communicate with the undersigned.

Yours very truly,

Ashley Zottarelli, P.Eng.

Kim Strong, M.Sc.

Maxxam

Your Project #: 17241
Your C.O.C. #: B 078431

Attention:Ashley Zottarelli
LVM Maritime Testing
97 Troop Ave
Dartmouth, NS
CANADA B3B 2A7

Report Date: 2014/01/27
Report #: R2805957
Version: 1

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B411632
Received: 2014/01/23, 13:58

Sample Matrix: Swab
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Acid Extractable Metals in Swabs	1	2014/01/24	2014/01/27	ATL SOP-00058	Based on EPA6020A

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Mari Kenny, Project Manager
Email: MKenny@maxxam.ca
Phone# (902)420-0203 Ext:291

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Maxxam Job #: B411632
Report Date: 2014/01/27

LVM Maritime Testing
Client Project #: 17241
Sampler Initials: LL

ELEMENTS BY ICP/MS (SWAB)

Maxxam ID		UQ6587		
Sampling Date		2014/01/23		
COC Number		B 078431		
	Units	L3	RDL	QC Batch
Metals				
Lead (Pb)	ug	19.8	0.125	3492351

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam

Maxxam Job #: B411632
Report Date: 2014/01/27

LVM Maritime Testing
Client Project #: 17241
Sampler Initials: LL

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	16.3°C

Results relate only to the items tested.

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Maxxam

Maxxam Job #: B411632
Report Date: 2014/01/27

LVM Maritime Testing
Client Project #: 17241
Sampler Initials: LL

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
3492351	DLB	QC Standard	Lead (Pb)	2014/01/27		102	%	75 - 125
3492351	DLB	Spiked Blank	Lead (Pb)	2014/01/27		106	%	75 - 125
3492351	DLB	Method Blank	Lead (Pb)	2014/01/27	<0.125		ug	

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

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LVM | MARITIME TESTING

January 22, 2014

Mr. Craig Chisholm, PMP
Senior Project Manager
MHPM Project Managers Inc.
1559 Brunswick Street, Suite 501
Halifax, NS
B3J 2G1

Subject: Canadian Museum of Immigration at Pier 21
Lead Swab Sampling
Our ref: 17241

Mr. Chisholm:

LVM / Maritime Testing Limited (LVM) was retained by the Canadian Museum of Immigration at Pier 21 to collect lead swab samples on steel beams in the work area where lead paint was removed at the Canadian Museum of Immigration at Pier 21 (CMIP) located at 1055 Marginal Road, in Halifax, NS.

The samples were collected using a Ghost Wipe™, which is cloth-like material suitable for collecting swab samples from hard surfaces and dissolves during the digestion process of the laboratory analysis. Ghost wipes are typically used to analyze settled dust for metals content. At the sample location, the area wiped was measured in order to calculate lead loading. Samples were placed in individual clean plastic bottles. Samples were labeled with the sample ID and location. PPE was worn as required.

Two (2) swab samples were collected from various locations. The beams and columns were bare (i.e. were no longer painted), clean, and no dust was observed to be present in either of the two sampling locations.

Lead content analysis was subcontracted to AGAT Laboratories. Laboratory certificates are attached. Analytical results from the swab samples are provided in Table 1.

Table 1 Lead Swab

ID	SAMPLE LOCATION	SAMPLE DESCRIPTION	LAB RESULT ($\mu g/100cm^2$)	LAB RESULT (mg/m^2)
L1	Exhibition Hall, 2nd Level	Following "normal" abatement procedures	996	99.6
L2	Exhibition Hall, 2nd Level	Following "normal" abatement procedures	263	26.3

There is not currently a clearance criterion for lead in swab sampling following lead paint abatement in this setting. The paint on the beams had been removed and the beams that were sampled had been cleaned to what appeared visually to be bare metal with no visual dust.

It should be noted that lead paint abatement was ongoing at the time the samples were collected in other areas of the enclosure.

We trust this is to your satisfaction. If, however, additional information should be required, please communicate with the undersigned.

Yours very truly,

Ashley Zottarelli, P.Eng.

Kim Strong, M.Sc.

Maxxam

Your Project #: 17241
Your C.O.C. #: B 140495

Attention:Ashley Zottarelli

LVM Maritime Testing
97 Troop Ave
Dartmouth, NS
CANADA B3B 2A7

Report Date: 2014/01/21
Report #: R2785817
Version: 1

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B408513
Received: 2014/01/17, 14:45

Sample Matrix: Swab
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Acid Extractable Metals in Swabs	2	2014/01/20	2014/01/21	ATL SOP-00058	Based on EPA6020A

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Mari Kenny, Project Manager
Email: MKenny@maxxam.ca
Phone# (902)420-0203 Ext:291

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Maxxam

Maxxam Job #: B408513
Report Date: 2014/01/21

LVM Maritime Testing
Client Project #: 17241
Sampler Initials: L.L

ELEMENTS BY ICP/MS (SWAB)

Maxxam ID		UP0200	UP0201		
Sampling Date		2014/01/17	2014/01/17		
COC Number		B 140495	B 140495		
	Units	L1	L2	RDL	QC Batch
Metals					
Lead (Pb)	ug	996	263	0.125	3487384

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B408513
Report Date: 2014/01/21

LVM Maritime Testing
Client Project #: 17241
Sampler Initials: L.L

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	13.0°C

Results relate only to the items tested.

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Maxxam

Maxxam Job #: B408513
Report Date: 2014/01/21

LVM Maritime Testing
Client Project #: 17241
Sampler Initials: L.L

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
3487384	DLB	QC Standard	Lead (Pb)	2014/01/21		114	%	75 - 125
3487384	DLB	Spiked Blank	Lead (Pb)	2014/01/21		105	%	75 - 125
3487384	DLB	Method Blank	Lead (Pb)	2014/01/21	<0.125		ug	

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Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

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