

**AGRICULTURE & AGRI-
FOOD CANADA
SASKATOON RDC
CRYOBANK
DEHUMIDIFIER**

SASKATOON, SK

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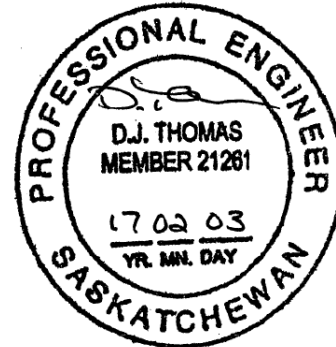


MECHANICAL ENGINEER:



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ELECTRICAL ENGINEER:



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STRUCTURAL

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E1.0 – ELECTRICAL – POWER AND SYSTEMS

PART 1 GENERAL

1.1 Section Includes

- .1 Title and description of Work.
- .2 Contract Method.
- .3 Work sequence.
- .4 Contractor use of premises.
- .5 Partial Owner occupancy.

1.2 Related Section/Documents

- .1 Instructions to Bidders.
- .2 Agreement and Definitions.
- .3 General Conditions.
- .4 Supplementary Conditions.
- .5 Division 1 - General Requirements: All Sections.

1.3 Trade Definitions

- .1 For convenience of reference only, the Specifications are separated into title Sections (see Table of Contents). Sections are identified by title and a six digit number system, and conform generally to "Trade Definitions" as published by the Saskatchewan Bid Depository Incorporated, as amended. It is understood that some differences may exist between the specifications and the "Trade Definitions". In the event of differences or conflicts, Specifications govern. The General Contractor shall be responsible for deciding who supplies and installs specified materials and equipment. Extras will not be considered on grounds of differences of interpretations of Specifications as to which Trade does what work.

1.4 Work Covered By Contract Documents

- .1 Renovation to existing cryobank ventilation system including installation of new dehumidification unit, remote condensers, ductwork, electrical, controls, etc. Existing exhaust fan 'ACRY-EF1' is to be removed once new dehumidification unit is installed (see phasing plan on drawing M6.2). Existing VAV box 'VAV-134' controls and air flow to be modified.

1.5 Contract Method – Stipulated Price Contract

- .1 Provide subtrade work under a single stipulated price contract.

1.6 Work Schedule

- .1 To be provided by General Contractor within each sub-trade tender package.

1.7 Sub-Contractor Use of Premises

- .1 The sub-contractor shall limit the use of premises for Work, storage and access to allow:
 - .1 Owner occupancy throughout.
 - .2 Coordinate use of premises under direction of the General Contractor.
 - .3 Assume full responsibility for protection and safekeeping of products under this Contract.
 - .4 Obtain and pay for the use of additional storage or work areas needed for operations under this Contract.

END OF SECTION

PART I GENERAL

1.1 Requirements Included

- .1 Coordinate Work with other Sub Contractors under administration of General Contractor.

1.2 Description

- .1 Coordination progress schedules, submittals, use of site, temporary utilities, construction facilities, and construction work, with progress of work of other contractors, under instructions of G.C.

1.3 Construction Organization and Start-Up

- .1 Comply with General Contractor's allocation of mobilization areas of site; for field offices and sheds, for, access, traffic, and parking facilities.
- .2 During construction co-ordinate use of site and facilities through General Contractor's procedures for intra-project communications: Submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.
- .3 Comply with instructions of General Contractor for used of temporary utilities and construction facilities.
- .4 Co-ordinate field engineering and layout work with General Contractor

1.4 Schedules

- .1 Submit preliminary construction progress schedule in accordance with Section 01310 to General Contractor co-ordinated with General Contractor's project schedule.
- .2 After review, revise and resubmit schedule to comply with revised project schedule.
- .3 During progress of work revise and resubmit as directed by General Contractor.

1.5 Submittals to General Contractor

- .1 Submit preliminary shop drawings, product data and samples in accordance with Section 013300 for review for compliance with Contract Documents; for field dimensions and clearances, for relation to available space, and for relation to work of other contracts. After review, revise and resubmit for transmittal to Consultant.
- .2 Submit requests for payment for review, and for transmittal to Consultant.
- .3 Submit requests for interpretation of Contract Documents, and obtain instructions through General Contractor.
- .4 Process substitutions and change orders through General Contractor.
- .2 Deliver closeout submittals for review and preliminary inspections, for transmittal to Consultant.

1.6 Coordination Drawings

- .1 Provide information required by General Contractor for preparation of coordination drawings.
- .2 Review and approve revised drawings for General Contractor's submittal to Consultant.

1.7 Close-Out Procedures

- .1 Notify General Contractor when Work is considered ready for Substantial Performance.
- .2 Accompany General Contractor on preliminary inspection to determine items listed for completion or correction.
- .3 Comply with General Contractor's instructions for correction of items of work listed in executed certificate of Substantial Performance.
- .4 Notify General Contractor for instructions for completion of items of work determined in Consultant's final inspection

END OF SECTION

PART 1 GENERAL

1.1 Requirements Included

- .1 Requirements and limitations for cutting and patching the Work.
- .2 Existing slab cutting and patching.
- .3 Existing roofing cutting and patching.

1.2 Related Requirements

- .1 Section 016000 - Material and Equipment.
- .2 Individual Sections: Cutting and patching incidental to work of the section. Advance notification to other sections required.

1.3 Submittals

- .1 Submit written request in advance of cutting or alteration which affects;
 - .1 Structural integrity of any element of Project.
 - .2 Integrity of weather exposed or moisture resistant elements.
 - .3 Efficiency, maintenance, or safety of any operational element.
 - .4 Visual qualities of sight exposed elements.
- .2 Include in request:
 - .1 Identification of Project.
 - .2 Location and description of affected work.
 - .3 Statement on necessity for cutting or alteration.
 - .4 Description of proposed work, and products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Date and time work will be executed.

PART 2 PRODUCTS

2.1 Materials

- .1 Required for original installation.
- .2 Change in materials: Submit request for substitution under provisions of Section 01600.

PART 3 EXECUTION

3.1 General

- .1 Execute cutting, fitting, and patching to complete the Work.
- .2 Fit the several parts together, to integrate with other work.
- .3 Uncover work to install ill-timed work.
- .4 Remove and replace defective and non-conforming work.
- .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical work.

3.2 Inspection

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of work.

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

3.3 Preparation

- .1 Provide supports to assure structural integrity of surroundings; devices and methods to protect other portions of project from damage.
- .2 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

3.4 Performance

- .1 Execute work by methods to avoid damage to other work, and which will provide proper surfaces to receive patching and finishing.
- .2 Employ original installer to perform cutting and patching for weather exposed and moisture resistant elements, and sight exposed surfaces.
- .3 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed without prior approval.
- .4 Restore work with new products in accordance with requirements of Contract Documents.
- .5 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .6 At penetration of fire-rated wall, ceiling, or floor construction, completely seal voids with fire resistant material, full thickness of the construction element.
- .7 Refinish surfaces to match adjacent finishes. For continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

END OF SECTION

PART 1 GENERAL

Abbreviations may be used on the drawings and in the Project manual. Refer to this Section for interpretations.

AFF	Above Finished Floor	DIAM	Diameter
AD	Access Door	DIM	Dimension
AP	Access Panel	DPR	Dispenser
ACFL	Access Floor	DS	Downspout
ADJT	Adjustable	DWG	Drawing
ALT	Alternate	DF	Drinking Fountain
AL	Aluminum	EF	Each Face
ANOD	Anodized	ELEC	Electrical
ASPH	Asphalt	EL	Elevation
AUTO	Automatic	ELEV	Elevator
A/VR	Air/Vapour Retarder	EQ	Equal
BSMT	Basement	EXST	Existing
BRCG	Bracing	EXT	Exterior
BIT	Bituminous	FB	Face Brick
BLKG	Blocking	FOC	Face of Concrete
BS	Both Sides	FOF	Face of Finish
BOT	Bottom	FOM	Face of Masonry
BRK	Brick	FOS	Face of Studs
BLDG	Building	FSTNR	Fastener
BBD	Bulletin Board	FBRBD	Fibreboard
BUR	Built-up Roofing	FBRGL	Fiberglass
CAB	Cabinet	FIN	Finish
CARP	Carpet	FFE	Finished Floor Elevation
CB	Catch Basin	FEC	Fire Extinguisher Cabinet
CLG	Ceiling	FHC	Fire Hose Cabinet
CEM	Cement	FPRF	Fireproofing
CPL	Cement Plaster	FLG	Flashing
CT	Ceramic Tile	FLR	Floor
CLR	Clear	FD	Floor Drain
COL	Column	FTG	Footing
CONC	Concrete	FDN	Foundation
CCB	Concrete Block	FUR	Furring
CONST	Construction	GALV	Galvanized
CONT	Continuous	GL	Glass Glazing
CJT	Control Joint	GLB	Glass Block
CG	Corner Guard	GB	Grab Bar
CORR	Corrugated	GR	Grade
CNTR	Counter	GVEL	Gravel
CFLG	Counter Flashing	GWB	Gypsum Wallboard
CSE	Course	HDWD	Hardwood
DP	Dampproofing	HGT	Height
DMT	Demountable	HC	Hollow Core
DIAG	Diagonal	HM	Hollow Metal
INSUL	Insulation	HORIZ	Horizontal
INTR	Interior	REINF	Reinforce
LAM	Laminate	RESIL	Resilient
LTL	Lintel	REV	Revision
MH	Man Hole	RD	Roof Drain

MFR	Manufacture	RFH	Roof Hatch
MSNRY	Masonry	RO	Rough Opening
MO	Masonry Opening	RB	Rubber Base
MAX	Maximum	SNT	Sealant
MECH	Mechanical	SECT	Section
MC	Medicine Cabinet	SHTHG	Sheathing
MEMB	Membrane	SIM	Similar
MET	Metal	SC	Solid Core
MTFR	Metal Furring	SD	Soap Dispenser
MIN	Minimum	SND	Sanitary Napkin Dispenser
MIR	Mirror	SNR	Sanitary Napkin Receptor
MISC	Miscellaneous	SPEC	Specification
MOD	Modular	SST	Stainless Steel
NOM	Nominal	STD	Standard
NIC	Not in Contract	STRL	Structural
NTS	Not to Scale	SUSP	Suspended
OC	On Centre	TKBD	Tackboard
OPG	Opening	TLE	Telephones
OPP	Opposite	TER	Terrazzo
OPH	Opposite Hand	THK	Thick
OD	Outside Diameter	THR	Threshold
OH	Overhead	TPH	Toilet Paper Holder
PNT	Paint	TPTN	Toilet Partition
PNL	Panel	TPD	Toilet Paper Dispenser
PTD	Paper Towel Dispenser	T&G	Tongue and Groove
PBD	Particleboard	TSL	Top of Slab
PTR	Paper Towel Receptor	TST	Top of Stair
PTN	Partition	TB	Towel Bar
PLAS	Plaster	TYP	Typical
PLAM	Plastic Laminate	UNFIN	Unfinished
PG	Plate Glass	VERT	Vertical
PLYWD	Plywood	VCT	Vinyl Composite Tile
PE	Porcelain Enamel	VIN	Vinyl
PCC	Precast Concrete	VF	Vinyl Fabric
PFN	Pre-finished	WPF	Waterproofing
PRF	Preformed	WDO	Window
QT	Quarry Tile	WGL	Wired Glass
		WPT	Working Point
		WM	Wire Mesh

END OF SECTION

PART 1 GENERAL

1.1 Requirements Included

- .1 Requirements and procedures for installation of permanent identification labels and markers on process, mechanical, and electrical equipment installations.

1.2 Related Requirements

- .1 Section 013300 - Submittals: Product data and samples.
- .2 Section 017839 - Contract Closeout: Project Record Documents.

1.3 Quality Assurance

- .1 Comply with CSA B53 project specifications for colours, designations, markings, sizes, and band widths.

1.4 Submittals

- .1 Submit typed copy of preliminary schedule of name plates, tag coding, and colour coding for review by Consultant prior to start of work.
- .2 Submit 2 additional final typed copies of schedules for nameplates and valve tags 15 days prior to inspection for Substantial Performance or 5 days prior to date scheduled for instruction of Owner's personnel, whichever is first.
- .3 Incorporate copies of final schedules for nameplates and valve tags into Record Documents, Section 01720.

1.5 Schedules

- .1 Nameplate schedules shall list: Pump, control, fire system, alarm system and electrical equipment nameplates.
- .2 Include nameplate designation, manufacturer's nameplate data, equipment and component parts; numbers, location of equipment, and switch location and normal operating position of switch.
- .3 Valve tag schedules shall list each tag by systems. Include reference number, valve location and usage, system identification, colour code, and function, size and valve manufacturer with model number, and normal operating position of valve.

1.6 Colour Identification Schedules

- .1 Refer to related systems technical specification.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Related Requirements

- .1 Section 013200 – Construction Schedule
- .2 Section 013530 – Safety Requirements

1.2 Access and Egress

- .1 Design, construct and maintain temporary "access to" and "egress from" Work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

1.3 Use of Site and Facilities

- .1 Execute Work with least possible interference or disturbance to normal use of premises. Make arrangements with Consultant to facilitate Work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by Work provide temporary means to maintain security.
- .4 Consultant will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .5 Use only stairwells and elevator existing in building for moving workers and material.
 - .1 Protect walls of passenger elevators, to approval of Consultant prior to use.
 - .2 Accept liability for damage, safety of equipment and overloading of existing equipment.
- .6 Closures: protect Work temporarily until permanent enclosures are completed.

1.4 Existing Services

- .1 Notify Consultant and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Consultant 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of Work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
- .3 Provide for pedestrian and vehicular traffic.

1.5 Special Requirements

- .1 Carry out noise generating Work Monday to Friday from 18:00 to 07:00 hours and on Saturdays, and Sundays.

- .2 Submit schedule in accordance with Section 013200 - Construction Schedule.
- .3 Ensure all personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .4 Keep within limits of Work and avenues of ingress and egress.
- .5 Ensure Contractor's personnel employed on site are mindful of adjacent university zone.

END OF SECTION

PART 1 GENERAL

1.1 Requirements Included

- .1 Scheduled pre-construction and progress meetings.

1.2 Related Requirements

- .1 Section 016000 - Material and Equipment.

1.3 Administrative

- .1 Schedule and administer project meetings throughout the progress of the work at the call of the Consultant.
- .2 Prepare agenda for meetings and distribute the agenda and written notice of the meeting to the Owner, Consultants and required subtrades (5) days prior to the meeting.
- .3 Provide physical space and make arrangements for meetings or schedule teleconference meetings with AAFC arranging for teleconference facilities.
- .4 Preside at meetings.
- .5 Record the minutes. Include significant proceedings and decisions. Identify 'action' by parties.
- .6 Reproduce and distribute copies of minutes within (3) days after each meeting and transmit to meeting participants, affected parties not in attendance, the Consultant, and the Owner.
- .7 Representative of Contractor, Subcontractor and suppliers attending meetings shall be qualified and authorized to act on behalf of the party each represents.

1.4 Pre-Construction Meetings

- .1 Within (15) days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Senior representatives of the Owner, Consultant, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum five (5) days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include the following:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work, progress scheduling (Section 013200).
 - .3 Schedule of submissions of shop drawings, samples, colour chips, (Section 013300).

- .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences (Section 015000).
- .5 Delivery schedule of specified equipment (Section 013200).
- .6 Site Security (Section 015000).
- .7 Contemplated change notices, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
- .8 Record drawings (Section 017839).
- .9 Maintenance manuals (Section 017839).
- .10 Take-over procedures, acceptance, warranties (Section 017000).
- .11 Monthly progress claims, administrative procedures, photographs, holdbacks.
- .12 Appointment of inspection and testing agencies or firms (Section 014000).
- .13 Insurance, transcripts of policies (GC11.1).

1.5 Progress Meetings

- .1 During the course of Work and (2) weeks prior to project completion, schedule bi-weekly progress meetings.
- .2 Contractor, major Subcontractors involved in Work, and AAFC representatives are to be in attendance, and the Consultant is to be present at the request of AAFC.
- .3 Notify parties minimum (5) days prior to meetings.
- .4 Record cumulative minutes of meetings and circulate to attending parties and affected parties not in attendance within (3) days after meeting.
- .5 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measuring and procedures to regain project schedule.
 - .7 Revision to construction schedule.
 - .8 Progress, schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.

- .11 Pending changes and substitutions.
- .12 Review proposed changes for effect on construction schedule and on completion date.
- .13 Other business.

END OF SECTION

PART 1 GENERAL

1.1 Requirements Included

- .1 Schedule, form, and content.
- .2 Scheduled revisions

1.2 Related Requirements

- .1 Review AAFC requirements

1.3 Schedules Required

- .1 Submit the following schedules:
 - .1 Construction Progress Schedule
 - .2 Submittal Schedule for Shop Drawings and Product Data
 - .3 Submittal Schedules for Samples
 - .4 Product Delivery Schedule.

1.4 Format

- .1 Prepare schedule in the form of a horizontal bar chart.
- .2 Provide a separate bar for each trade or operation.
- .3 Provide horizontal time scale identifying the first work day of each week.
- .4 Format for listings: The chronological order of the start of each item of work.
- .5 Identification of listings: By systems description.

1.5 Submission

- .1 Submit initial schedules within fifteen (15) days after award of Contract.
- .2 Submit one (1) opaque reproduction, plus two (2) copies to be retained by the Consultant.
- .3 Consultant will review schedule and return review copy.
- .4 Resubmit finalized schedule within 7 days after return of review copy.
- .5 Submit revised progress schedule with each application for payment.
- .6 Distribute copies of the revised schedule to:

- .1 Job site office
 - .2 Subcontractors
 - .3 Other concerned parties.
- .7 Instruct recipients to report to the Contractor within 10 days, any problems anticipated by the timetable shown in the schedule.

1.6 Construction Progress Schedule

- .1 Include the complete sequence of construction activities.
- .2 Include the dates for the commencement and completion of each major elements of construction, but not limited to the following:
 - .1 Site clearing
 - .2 Site utilities
 - .3 Foundation Work
 - .4 Structural framing
 - .5 Special subcontractor work
 - .6 Equipment Installations (if any within the scope of Base Building work).
 - .7 Finishes (Exterior)
 - .8 Mechanical
 - .9 Electrical
- .3 Show projected percentage of completion of each item as of the first day of the month.
- .4 Indicate progress of each activity to date of submission schedule.
- .5 Show changes occurring since previous submission of schedule:
 - .1 Major changes in scope.
 - .2 Activities modified since previous submission.
 - .3 Revised projections of progress and completion.
 - .4 Other identifiable changes.
- .6 Provide a narrative report to define:
 - .1 Problem areas, anticipated delays, and the impact on the schedule.
 - .2 Corrective action recommended and its effect.
 - .3 The effect of changes on schedules of other prime contractors.

1.7 Submittals Schedule

- .1 Include schedule for submitting shop drawings, product data, samples.
- .2 Indicate dates for submitting, review time, resubmission time, float time, last date for meeting fabrication schedule.
- .3 Includes dates when delivery will be required for Owner furnished products.
- .4 Include dates when review submittals will be required by the Consultant.

END OF SECTION

PART 1 GENERAL

1.1 Requirements Included

- .1 Shop drawings and product data
- .2 Record drawings
- .3 Certificates and transcripts

1.2 Related Requirements

- .1 Section 014000 - Quality Control: Submission of test and mix design mill tests.
- .2 Section 017839 - Project Record Documents: Submission of contract closeout documents.

1.3 Administrative

- .1 Submit to Departmental Representative submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Work affected by the submittal shall not proceed until review is complete.
- .3 Review, and sign submittals prior to submission to the Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified as to the specific project will be returned without being examined and shall be considered rejected.
- .4 Verify field measurements and affected adjacent Work is coordinated with shop drawings and General Contractor. Advise consultant of conflicts prior to final approval of shop drawings.
- .5 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative review of submittals.
- .6 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .7 Keep one reviewed copy of each submission on site. Distribute copies of reviewed submissions to all persons involved in that item of work.

1.4 Shop Drawings and Product Data

- .1 The term "shop drawings" means drawings, diagrams, illustration, schedules, performance charts, brochures and other data which are to be provided by the Contractor to illustrate details of a portion of the Work.
- .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of the Section under which the adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

- .3 Adjustments made on shop drawings by the Departmental Representative are not intended to change the Contract Price. If adjustments affect the value of Work, state such in writing to the Departmental Representative prior to proceeding with the Work.
- .4 Make changes in shop drawings as the Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify the Departmental Representative in writing of any revisions other than those requested.
- .5 Submit six (6) prints of shop drawings for each requirement requested in specification Sections and as the Departmental Representative may reasonably request.
- .6 Submit six (6) copies of product data sheets or brochures for requirements requested in specification Sections and as the Departmental Representative may reasonably request where shop drawings will not be prepared due to standardized manufacture of product.
- .7 If upon review by the Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, the transparency will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through the same procedure indicated above, shall be performed before fabrication and installation of work may proceed.

1.5 Record Drawings

- .1 After award of Contract the Departmental Representative may provide two (2) sets of drawing prints for the purpose of maintaining record drawings. Accurately and neatly record deviations from Contract Documents caused by site conditions and changes ordered by the Departmental Representative.
- .2 Record locations of concealed components of mechanical and electrical services.
- .3 Depth of various elements of foundation in relation to floor level.
- .4 Horizontal and vertical location of underground utilities and appurtenances concealed in construction, referenced to permanent surface features.
- .5 Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
- .6 Field changes of dimension and detail.
- .7 Changes made by Change Order or Change Directive.
- .8 Locations and elevations of permanent benchmarks.
- .9 Identify drawings as "Project Record Copy". All changes must be noted on this Project Record copy as the work proceeds and in chronological order of events. Maintain in new condition and make available for inspection on site by Departmental Representative.
- .10 On completion of Work and prior to final inspection, neatly transfer "as-built" notations to the second set and submit both sets to the Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

- .1 This section specifies general requirements and procedures for contractors submissions of shop drawings, product data, samples and mock-ups to Departmental Representative for review. Additional specific requirements for submissions are specified in individual sections of Divisions 2 through 32.
- .2 Do not proceed with work until relevant submissions are reviewed by Departmental Representative.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submissions.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative's review of submission, unless Departmental Representative gives written acceptance of specific deviations.
- .8 Make any changes in submissions which Departmental Representative may require consistent with Contract Documents and re-submit as directed by Departmental Representative.
- .9 Notify Departmental Representative, in writing, when re-submitting, of any revisions other than those requested by Departmental Representative.

1.2 Submission Requirements

- .1 Coordinate each submission with requirements of work and Contract Documents. Individual submissions will not be reviewed until all related information is available.
- .2 Allow 10 days for Departmental Representative review of each submission.
- .3 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shopdrawing, product date and sample.

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- .5 Other pertinent data.
- .4 Submissions shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractors authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .5 After Departmental Representative's review, distribute copies.

1.3 Shop Drawings

- .1 Original drawings, or modified standard drawings provided by Contractor, to illustrate details of portions of work, which are specific to project requirements.
- .2 Maximum sheet size: 850 x 1050 mm.
- .3 Submit shop drawings as follows:
 - .1 Submit (8) copies of shop drawings.
- .4 Cross-reference shopdrawing information to applicable portions of Contract Documents.

1.4 Product Data

- .1 Product Data: Manufacturers catalogue sheets brochures, literature, performance charts and diagrams, used to illustrate standard manufactured products.
- .2 Submit 3 copies of product data.
- .3 Sheet size: 215 x 280 mm, maximum of 3 modules.
- .4 Delete information not applicable to project.
- .5 Supplement standard information to provide details applicable to project.
- .6 Cross-reference product data information to applicable portions of Contract Documents.

1.5 Samples

- .1 Samples: Examples of materials, equipment, quality, finishes, workmanship.
- .2 Where colour, pattern or texture is criterion, submit full range of samples.
- .3 Reviewed and accepted samples will become standard of workmanship and material against which installed work will be verified.

1.6 Shop Drawings Review

- .1 The review of shop drawings is for the sole purpose of ascertaining conformance with the general concept. This review shall not mean approval of the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the construction and Contract Documents. Without restricting the generality of the foregoing, 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 of all sub-trades, and for coordination of the work.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Applicable Codes

- .1 Execute work in accordance with National Building Code of Canada (NBCC) and Supplements, the Uniform Building Standards and Accessibility Act of the Province of Saskatchewan, AAFC, and all codes and standards specified within the text of this specification.
- .2 Conform to the latest issue of codes and standards specified, as amended and revised on date for receipt of bids.
- .3 All personnel associated with the Project shall observe the smoking regulations as set by Agriculture and Agri-Food Canada (AAFC) and the University of Saskatchewan. There shall be no smoking allowed, inside the building. Smoking shall be permitted outside the building in designated areas only.

.2 Construction Safety Guidelines

- .1 Observe construction safety measures of National Building Code of Canada, applicable Worker's Compensation Board and Occupational Health and Safety Regulations requirements, and comply with all acts, regulations, bylaws and authorities having jurisdiction.
- .2 In case of conflict or discrepancy, the more stringent requirements shall apply.

.3 WHMIS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding handling, storage, use and disposal of hazardous materials, regarding labelling and provision of material safety data sheets acceptable to Labour Canada and Health and Welfare Canada.

.4 Interior and Exterior Fire Protection and Alarm Systems

- .1 Fire protection and alarm systems shall not be:
 - .1 Obstructed
 - .2 Shut-off, or
 - .3 Left inactive at the end of a working day or shift
- .2 Fire hydrants, standpipes, and hose systems shall not be used for other than firefighting purposes.

.5 Fire Extinguishers

- .1 Supply fire extinguishers, necessary to protect the work in progress and the contractor's physical plant on site.

.6 Rubbish and Waste Material

- .1 Rubbish and waste material are to be kept to a minimum.
- .2 The burning of rubbish on site is prohibited.
- .3 Do not bury rubbish and waste material on site.
- .4 Do not dispose of waste or volatile material, such as mineral spirits, oil, or paint thinner into waterways, storm, or sanitary sewers.

.7 Flammable and Combustible Liquids

- .1 The handling, storage, and use of flammable and combustible liquids are to be governed by the National Fire Code of Canada.

.8 Hazardous Substances

- .1 Work entailing the use of toxic or hazardous material, chemicals and/or explosives, which otherwise creates a hazard to life, safety or health, shall be in accordance with the National Fire Code of Canada.
- .2 When work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers, equipped with sufficient fire extinguishers.
- .3 When flammable liquids, such as lacquers or urethanes are to be used, provide proper ventilation and all sources of ignition are to be eliminated.

.9 Safety Guidelines

- .1 The Construction Manager and Trade Contractor acknowledge and agree that the maintenance, well being and health and safety of all personnel at the Place of Work is or paramount importance, and is a mutual responsibility of each and to the end, each will provide support and contribution as set out below:
 - .1 The Trade Contractor shall comply with “The Occupational Health and Safety Act, 1993” and “The Occupational Health and Safety Regulations, 1996”, and all other applicable acts, regulations, standards, and codes of practice, etc.
 - .1 In addition to all other requirements of this act and regulations, the Trade Contractor shall comply with Sections 13 and 15 of “The Occupational Health and Safety Act, 1993” and Sections 22, 38, 41, and 48 of “The Occupational Health and Safety Regulations, 1996”.
 - .2 The Trade Contractor shall provide a copy of Trade Contractor’s Corporate Safety Program Manual for review by the Construction Manager. The Trade Contractor’s Corporate Safety Program implementation shall comply with the following policy.
 - .1 The Trade Contractor shall provide documentation confirming the Trade Contractor’s Corporate Safety Program includes all Trade Subcontractors, Suppliers, individuals or firms providing a service to the Trade Contractor.
 - .2 Trade Contractors that do not normally operate in the province of Saskatchewan shall request the Saskatchewan Construction Safety Association (SCSA) certify that they have an equivalent certification from the province in which their head office is located. In addition, the Construction Manager strongly suggests that companies complete all of the necessary seminars and have at least one accredited “construction safety officer: on staff. For additional information contact the SCSA office in Saskatoon at 1-800-817-2081.
 - .3 The Trade Contractor shall ensure that it only utilizes qualified and competent supervisors and workers. The Trade Contractor shall submit resumes of all proposed site supervision personnel that provides evidence they are competent, qualified, and reliable to supervise and monitor the safe and competent performance of all Work.
 - .4 The Trade Contractor shall conduct weekly documented safety meetings with all workers, Trade Subcontractors, Suppliers, and any other site personnel. These safety meetings shall deal with safety training and education and any other safety concerns or matters. Minutes of these

meetings shall clearly indicate measures the Trade Contractor will take to mitigate any existing or potential risks associated with the Work that any employee may encounter. A copy of the minutes shall be sent to the Construction Manager.

- .5 The Trade Contractor shall conduct documented weekly safety inspections of the Place of the Work that identify potential or existing hazards. The documentation shall include rectification measures, dates for completion and the assignment of the person responsible. A copy of the weekly safety inspections shall be sent to the Construction Manager.
- .6 The Trade Contractor shall send, to the Construction Manager, a copy of any Notice of Contravention or Compliance Assurance Notice issued directly to the Trade Contractor by Saskatchewan Labour.
- .7 The Construction Manager reserves the right to conduct a safety audit on the Trade Contractor, Trade Subcontractors or Suppliers at any time to ensure safety compliance is maintained. The Construction Manager also reserves the right to conduct formal inspections of all hired or contracted work to ensure, as far as is reasonably practicable to do so, that the health and safety programs and the applicable provincial Health Safety Act and Regulations are complied with, as well as any other applicable acts, regulations, standards, and codes of practice, etc.
- .8 The Construction Manager reserves the right to stop the performance of any Work at any time that it feels, and in its sole opinion, the Work or any manner in which Work is performed is creating unacceptable risks to any parties on the University of Saskatchewan worksites. The Construction Manager also reserves the right to terminate any contract with any service provider for poor safety performance or failure to adhere to any of the provisions of this specification. The Owner shall not be liable for any loss (financial or otherwise) incurred by the Trade Contractor, Trade Subcontractors, or Supplier as a result of such Work stoppages or termination of the Contract. The Owner reserves the right to let the remainder of the Contract to another suitable party.

.10 Compliance with Construction Manager's Safety Guidelines

- .1 In addition to the foregoing, proceed with the work in accordance with all Construction Manager's Safe Work Practices, Procedures, and Policies.
 - .2 In the case of conflict or discrepancy, the most stringent requirement shall govern.
 - .3 A copy of the Construction Manager's Company Safety Manual is available at the office and/or site of the Construction Manager for viewing.
 - .4 All personnel will be required to attend a Construction Manager's site specific safety orientation.
 - .5 It is mandatory that both the Trade Contractor's Superintendent and Project Manager sign and return the acknowledgement form in the Project Safety Plan, confirming their understanding of its requirements, prior to beginning any work on-site.
- .11 All costs for orientation shall be included in the bid.

END OF SECTION

PART 1 GENERAL

1.1 Requirements Included

- .1 Testing, administrative and enforcement requirements.
- .2 Testing and mix designs.

1.2 Inspections

- .1 Refer to AAFC general procedures and standards.
- .2 The Owner and the Departmental Representative shall have access to the Work. If parts of the Work are in preparation at locations other than the Place of the Work, access shall be given to such work whenever it is in progress.
- .3 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or the law of the Place of the Work.
- .4 If the Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have the inspections or tests satisfactory completed and make such good Work.
- .5 The Departmental Representative may order any part of the Work to be examined if the Work is suspected to be not in accordance with the Contract Documents. If, upon examination such work is found not in accordance with the Contract Documents, correct such work and pay the cost of examination and correction. If such Work is found in accordance with the Contract Documents, the Owner shall pay the cost of examination and replacement.
- .6 The Contractor shall furnish promptly two (2) copies of certificates and inspection reports relating to the Work.

1.3 Independent Inspection Agencies

- .1 The Contractor will appoint and will pay for the services outlined below.
 - .1 Inspection and testing required by construction documents, law, ordinances, rules, regulations or orders of public authorities.
 - .2 Inspection and testing performed exclusively for Contractor's convenience.
 - .3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
 - .4 Mill tests and certificates of compliance.
 - .5 Tests specified to be carried out by Contractor under the supervision of the Departmental Representative.
 - .6 Additional tests may be required for rejected work.
- .2 Provide equipment required for executing inspection and testing by the appointed agencies.
- .3 Employment of inspection/testing agencies do not relax the responsibility to perform Work in accordance with the Contract Documents.
- .4 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to the Owner. Pay costs for re-testing and re-inspection.

1.4 Access to Work

- .1 Allow inspection/testing agencies access to the Work, off site manufacturing and fabrication plants.
- .2 Owner to provide reasonable facilities for such access.

1.5 Procedures

- .1 Notify the appropriate agency and Departmental Representative in advance of the requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with responsible promptness and in an orderly sequence so as not to cause delay in the Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.6 Rejected Work

- .1 Refer to PWGSC and/or AAFC General Procedures and Standards.
- .2 Remove defective Work, whether the result of poor workmanship, use of defective products or damage and whether incorporated in the Work or not, which has been rejected by the Departmental Representative as failing to conform to the Contract Documents. Replace or re-execute in accordance with the Contract Documents.
- .3 Make good other Contractor's work damaged by such removals or replacement promptly.
- .4 If in the opinion of the Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, the Owner may deduct from the Contract Price the difference in value between the Work performed and that called for by the Contract Documents, the amount of which shall be determined by the Departmental Representative.

1.7 Reports

- .1 Submit four (4) copies of test reports to the Departmental Representative.

1.8 Tests and Mix Designs

- .1 Furnish tests results and mix design as may be requested. An appointed Testing Agency is to review supplier's mix design and provide approval and recommendations to the Departmental Representative
- .2 The costs of tests and mix designs beyond those called for in the Contract Documents or beyond those required by the law of the Place of Work shall be appraised by the Departmental Representative and may be authorized as recoverable.

END OF SECTION

PART 1 GENERAL

- 1.1 Refer to PWGSC General Procedures and Standards.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 Barriers

- .1 Provide barricades and covered walkways required by governing authorities for public rights-of-way and for access to building.
- .2 Provide barriers around trees and plants designated to remain. Protect from damage.

3.2 Guard Rails and Barricades

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.

3.3 Weather Enclosures

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings;

3.4 Dust Tight Screens

- .1 Provide dust tight screens or partitions to localize dust generating activities, and for the protection of workers, finished areas of Work.
- .2 Maintain and relocate protection until such Work is complete.

3.5 Scaffolding

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

3.6 Hoisting

- .1 Provide, operate and maintain hoists and cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.
- .2 Hoist and cranes shall be operated by qualified operators.

3.7 Dewatering

- .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

3.8 Site Storage/Loading

- .1 Refer to PWGSC General Procedures and Standards.

3.9 Access to Site

- .1 Refer to PWGSC General Procedures and Standards.

3.10 Construction Parking

- .1 Parking will be permitted on site provided it does not disrupt the performance of Work.

3.11 Sanitary Facilities

- .1 Provide sufficient sanitary facilities for workers and maintain in clean condition.

3.12 Water Supply

- .1 Available adjacent to site.

3.13 Temporary Heating (if required)

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside the building must be vented to the outside or be non-flame type. Solid fuel salamanders not permitted.
- .3 Maintain temperatures of minimum ten (10) degrees C in areas where construction is in progress, unless indicated otherwise in specifications.
- .4 Ventilated heated areas keep building free of exhaust or combustion gases.
- .5 The permanent heating system of the building, or portions thereof, may be used upon receiving written permission from the Departmental Representative. Equipment warranty period to commence at time of substantial completion.
- .6 Pay costs for maintaining temporary heat.
- .7 Be responsible for damage to the Work due to failure in providing adequate heat and protection during construction.

3.14 Temporary Power and Light

- .1 Arrange for connection with appropriate utility company. Pay all costs for installation, maintenance and removal.
- .2 Temporary power for electric cranes and other equipment requiring in access of above is the responsibility of the contractor.
- .3 Provide and maintain temporary lighting throughout the project. The level of illumination on all floors and stairs shall not be less than 15 foot candles 162 Lx.

3.15 Protection for Off-Site and Property

- .1 Protect surrounding property from damage during performance Work.
- .2 Be responsible for damage incurred.

3.16 Fire Protection

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction and governing codes, regulations and bylaws.
- .2 Open and burning rubbish are not permitted on the site.

3.17 Protection of Building Finishes and Equipment

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screen, covers, and hoarding as required.
- .3 Be responsible for damage incurred due to lack of or improper protection.
- .4 The Contractor is responsible for all water penetrations and leakage into the building and the ensuing costs of replacement of damaged finishes and contents, during the execution of the work.

3.18 Security

- .1 Refer to PWGSC General Procedures and Standards.

3.19 Offices

- .1 Provide and maintain in clean condition during progress of Work, adequately lighted, heated and ventilated Contractor's office with space for filing and layout of Contract Documents and Contractor's normal site office staff.
- .2 Provide adequate required aid facilities.
- .3 Subcontractors may provide their own offices as necessary. Direct the location of these offices.

3.20 Equipment/Tool/Materials Storage

- .1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause the least interference with work activities.

3.21 Project Cleanliness

- .1 Refer to PWGSC General Procedures and Standards.

3.22 Installation/Removal

- .1 Provide construction facilities and temporary controls in order to execute the work expeditiously.
- .2 Remove from site all such work after use.

END OF SECTION

PART 1 GENERAL

- 1.1 Requirements Included
 - .1 Reference standards
 - .2 Product quality, availability, storage, handling, protection, transportation
 - .3 Manufacturer's instructions.
 - .4 Workmanship, co-ordination, cutting, fastenings.
 - .5 Existing facilities.
- 1.2 Related Requirements
 - .1 Section 014000-Quality Control: Quality control and inspection of Work.

PART 2 PRODUCTS

- 2.1 Material and Product Reference Standards
 - .1 Within the text of specifications, reference may be made to the following standards:

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASTM	American Society of Testing and Materials
CEC	Canadian Electrical Code (published by CSA)
CEMA	Canadian Electrical Manufacturer's Association
CAN1	Standards Council of Canada designation for CGA
CAN2	Standards Council of Canada designation for CGSB
CAN3	Standards Council of Canada designation for CSA
CAN4	Standards Council of Canada designation for ULC
CGA	Canadian Gas Association
CGSB	Canadian General Standards Board
CISC	Canadian Institute of Steel Construction
CLA	Canadian Lumberman's Association
CPCA	Canadian Painting Contractors' Association
CPCI	Canadian Prestressed Concrete Institute
CRCA	Canadian Roofing Construction Association
CSA	Canadian Standards Association
FM	Factory Mutual Engineering Corporation
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
NAAMM	National Association of Architectural Metal Manufacturers
NBC	National Building Code
NEMA	National Electrical Manufacturers' Association
TTMAC	Terrazzo, Tile and Marble Association of Canada
ULC	Underwriters' Laboratories of Canada
 - .2 Conform to these standards, in whole or part, as specifically requested in the specifications.
 - .3 If there is question as to whether any product or system is in conformance with applicable standards, the Departmental Representative reserves the right to have such products or

- systems tested to prove or disapprove conformance.
- .4 The cost for such testing will be born by the Owner in the event of conformance with Contract Documents or by the Contractor in the event of non conformance.
 - .5 Conform to latest date of issue of referenced standards in effect on date of submission of bids, except where a specific date or issue is specifically noted.

2.2 Quality

- .1 Refer to PWGSC General Procedures and Standards.

2.3 Availability

- .1 Immediately upon signing Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of Products are foreseeable, notify the Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In the event of failure to notify the Departmental Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Consultant reserves the right to substitute more readily available products of similar character, at no increase in Contract Price.

2.4 Storage, Handling and Protection

- .1 Handle and store Products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's when applicable.
- .2 Store packaged or bundle Product in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in the Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in a heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged Products at own expense and to the satisfaction of the Departmental Representative.

2.5 Transportation

- .1 Pay costs of transportation of Products required in the performance of Work.
- .2 Transportation cost of Products supplied by the Owner will be paid for by the Owner. Unload, handle and store such Products.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

- .1 Unless otherwise indicated in the specifications, install or erect Products in accordance

with manufacturer's instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.

- .2 Notify the Departmental Representative in writing, of conflicts between the specifications and manufacturer's instructions, so that the Departmental Representative may establish the course of action.
- .3 Improper installation or erection of Products, due to failure in complying with these requirements, authorized the Departmental Representative require removal and re-installation at no increase in Contract Price.

3.2 Workmanship

- .1 Workmanship shall be the best quality, executed by the workers experienced and skilled in the respective duties for which they are employed. Immediately notify the Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ any unfit person or anyone unskilled in their required duties. The Departmental Representative reserves the right to require the dismissal from sites, workers deemed incompetent, careless, insubordinate or otherwise objectionable.
- .3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Departmental Representative, whose decision is final.

3.3 Coordination

- .1 Insure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for co-ordination and placement of openings, sleeves and accessories.

3.4 Concealment

- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform the Consultant if there is a contradictory situation. Install as directed by Departmental Representative.

3.5 Cutting and Remedial Work

- .1 Refer to PWGSC and/or AAFC general procedures and standards.

3.6 Location of Fixtures

- .1 Consider the location of fixtures, outlets, and mechanical and electrical as approximate.
- .2 Inform the Departmental Representative of a conflicting installation. Install as directed.

3.7 Fastenings

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in the affected specification Section.
- .4 Space anchors within their load or shear capacity and ensure they provide positive

- permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
 - .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

3.8 Protection of Work in Progress

- .1 Adequately protect Work completed or in progress. Work damaged due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Departmental Representative, at no increase in Contract Price.
- .2 Prevent overloading of any part of the building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Consultant.

3.9 Existing Utilities

- .1 When breaking into or connecting to existing services utilities, execute Work at times directed by local governing authorities, with a minimum of disturbance to Work, and/or building occupants, and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in a manner approved by authority having jurisdiction and stake otherwise record location of capped service.

END OF SECTION

PART 1 GENERAL

1.1 Substitution During Construction

- .1 The Contractor may propose substitutions on condition that either:
 - .1 Previously disclosed data or specified material cannot be provided or incorporated into the work in time allowed due to conditions beyond control of the Contractor, or
 - .2 Owner will benefit by reduced cost or improved project. Owner shall receive full benefit of any cost reduction.

- .2 Requests for substitutions shall include:
 - .1 Statement of cause for request with substantiating documents.
 - .2 Documentary proof of equal or superior quality, delivery time, and costs in form of certified quotation from supplier of both specified and proposed material.
 - .3 Change to Contract value in the form of an ADD or DEDUCT adjustment.

- .3 When requesting a substitution, Contractor shall:
 - .1 Include costs of additional consulting services and related costs required to incorporate the substitution into the work.
 - .2 Refer to PWGSC and/or AAFC general procedures and standards.

- .4 Requests for substitutions will be subject to approval by the Departmental Representative and acceptance by the Owner. Approved substitutions will be considered in accordance with AAFC Contract.

- .5 Until a decision is rendered on a proposed substitution, make no change in the execution of the specified work, unless written instructions to do so are issued by the Departmental Representative.

- .6 Substitutions indicated or implied on shop drawings, schedules, samples or proposed in ways other than in the manner heretofore described, and not approved by the Departmental Representative, will be cause for rejection of shop drawings, schedules, or samples. Work previously approved, then found to contain substitutions not accepted, may be rejected in accordance with the terms of the Contract.

1.2 Documentation of Approved Substitutes

- .1 Refer to PWGSC and/or AAFC general procedures and standards.

END OF SECTION

PART 1 GENERAL

- 1.1 Requirements Included
 - .1 Provide testing organization services under provisions specified in Section 01400.

- 1.2 Quality Assurance
 - .1 Testing organization: Current member in good standing of AABC certified to perform specified services.
 - .2 Comply with applicable procedures and standards of the certification sponsoring association.
 - .3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

- 1.3 Submittals
 - .1 Prior to start of Work, submit name of organization proposed to perform services. Designate who has managerial responsibilities for co-ordination of entire testing, adjusting and balancing.
 - .2 Submit documentation to confirm organization compliance with quality assurance provision.
 - .3 Submit (3) preliminary specimen copies of each of the report forms proposed for use.
 - .4 Fifteen days prior to Substantial Performance, submit (3) copies of final reports on applicable forms.

- 1.4 Procedures - General
 - .1 Comply with procedural standards of certifying association under whose standard services will be performed.
 - .2 Notify Departmental Representative (3) days prior to beginning of operations.
 - .3 Accurately record data for each step.
 - .4 Report to Departmental Representative any deficiencies or defects noted during performance of services.

- 1.5 Final Reports
 - .1 Organization having managerial responsibility shall make reports.
 - .2 Each form shall bear signature of recorder, and that of supervisor of reporting organization.
 - .3 Identify each instrument used, and latest date of calibration of each.

- 1.6 Contractor Responsibilities
 - .1 Prepare each system for testing.
 - .2 Cooperate with testing organization, provide access to equipment and systems.
 - .3 Provide personnel, operate systems at designation times, and under conditions required for proper testing, adjusting, and balancing.
 - .4 Notify testing organization (7) days prior to time project will be ready for testing.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

- 3.1 Preparation
 - .1 Provide instruments required for test.
 - .2 Make instruments available to Departmental Representative to facilitate spot checks during testing.
 - .3 Retain possession of instruments and remove at completion of services.

END OF SECTION

PART 1 GENERAL

1.1 Requirements Included

- .1 Final cleaning.
- .2 Systems demonstration.
- .3 Document submission.
- .4 Project commissioning.
- .5 Inspection and takeover procedures.

1.2 Related Requirements

- .1 General Conditions and Supplementary Conditions of the Contract: Fiscal provisions, legal submittals, and other administrative requirements.
- .2 Section 015000 - Construction Facilities and Temporary Controls.
- .3 Section 017839 - Project Record Documents.

1.3 Final Cleaning

- .1 Final clearing of the space will occur when the project area is substantially complete.
- .2 When the Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for the performance of the remaining Work.
- .3 Remove waste products and debris, and leave the Work clean and suitable for the occupancy by Owner.
- .4 When the Work is totally completed, remove surplus products, tools, construction machinery and equipment. Remove waste products and debris.
- .5 Remove waste materials from the site at regularly scheduled times or dispose of as directed by the Consultant. Do not burn waste materials on site, unless approved by the Consultant.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Leave the work clean and ready for occupancy before the inspection process commences.
- .8 Clean and polish mechanical and electrical fixtures.
- .9 Remove stains, spots, marks and dirt from electrical and mechanical fixtures, walls, floors, ceilings and all other surfaces.

- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .12 Broom clean and wash exterior walks, steps and surfaces.
- .13 Remove dirt and other disfiguration from exterior surfaces.
- .14 Clean and sweep roofs.
- .15 Clean equipment to a sanitary condition, clean or replace filters of mechanical equipment.
- .16 Clean roofs and drainage systems.

1.4 Project Commissioning

- .1 Expedite and complete deficiencies and defects identified by the Consultant within fifteen (15) days of written notice.
- .2 Review maintenance manual contents (operating, maintenance instructions, record "as-built" drawings, spare parts, materials) for completeness.
- .3 Review cash allowance in relation to Contract Price, change orders, holdbacks and other Contract Price adjustments.
- .4 Submit required documentation such as statutory declarations, Workers' Compensation Certificates, warranties, certificates of approval or acceptance from regulating bodies.
- .5 Attend and conduct 'end of work' testing and break in or start up demonstrations.
- .6 Review inspection and testing reports to verify conformance to the intent of the documents and that changes, repairs or replacements have been completed.
- .7 Meet with other Consultants, structural, mechanical, electrical to coordinate completion, testing approvals.
- .8 Review condition of equipment (dehumidification system, condensers, etc.) which have been used in the course of the work to ensure turning over at completion in "as new condition" with warranties, dated and certified from time of Substantial Performance of the Work.
- .9 Arrange and coordinate instruction of Owner's staff in care, maintenance and operation of building systems by suppliers or Subcontractors.
- .10 Coordinate Owner's Contractor's and Subcontractor's cleaning-up and completion activities all to suit Owner's work schedule and not disrupt Owner's productivity.
- .11 Provide on-going review, inspection and attendance to building callback, maintenance and repair problems during the Warranty periods.

1.5 Inspection/Takeover Procedures

- .1 Prior to application for certificate of Substantial Performance, carefully inspect the Work and ensure it is complete, that major and minor construction deficiencies are complete and/or corrected and the building is clean and in condition for occupancy. Notify the Consultant in writing, of satisfactory completion of the Work and request an inspection
- .2 During the Consultant inspection a list of deficiencies and defects will be tabulated. Correct same.
- .3 When the Consultant considers deficiencies and defects have been corrected and it appears requirements of the Contract have been performed, make application for certificate of Substantial Performance. Refer to General Conditions Article GC 5.2 for specifics to application.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

END OF SECTION

PART 1 GENERAL

1.1 Materials

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

1.2 Cleaning During Construction

- .1 Provide on-site metal containers for collection of waste materials, and debris.
- .2 Dispose of waste materials, and debris off site.
- .3 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 Project Cleanliness

- .1 Maintain the work in tidy condition, free from accumulation of waste products and debris, other than that caused by the Owner or other Contractors.
- .2 Remove waste material and debris from the site at the end of each working day.
- .3 Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

1.4 Final Cleaning

- .1 Remove grease, dust dirt, stains, labels, fingerprints, and other foreign materials, from interior and exterior finished surfaces including glass and other polished surfaces.
- .2 Clean lighting reflectors, lenses, and other lighting surfaces.
- .3 Remove snow and ice from access to building.
- .4 Remove waste materials from the site at regularly scheduled times or dispose of as directed by the Departmental Representative. Do not burn waste materials on site, unless approved by the Departmental Representative.
- .5 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .6 Leave the work broom clean before the inspection process commences.
- .7 Clean and polish glass, mirrors, hardware, mechanical and electrical fixtures. Replace broken scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, floors and ceilings.
- .9 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .10 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .11 Broom clean and wash exterior walks, steps, and surfaced areas.
- .12 Remove dirt and other disfiguration from exterior surfaces.
- .13 Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment and clean roofs, downspouts, and drainage systems.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

- .1 Waste goals.
- .2 Disposal of waste.

1.2 DEFINITIONS

- .1 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants, or similar materials.
- .2 Construction and Demolition Waste: Solid wastes typically including, but not limited to, building materials, packaging, trash, debris, and rubble resulting from construction, re-modelling, repair, and demolition operations.
- .3 Hazardous: Exhibiting the characteristics of hazardous substances including, but not limited to, ignitibility, corrosiveness, toxicity, or reactivity.
- .4 Non-hazardous: Exhibiting none of the characteristics of hazardous substances including, but not limited to, ignitibility, corrosiveness, toxicity, or reactivity.
- .5 Non-toxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- .6 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and re-manufactured into a new product for reuse by others.
- .7 Recycle: To remove a waste material from the Project site to another site for re-manufacture into a new product for reuse by others.
- .8 Recycling: The process of sorting, cleansing, treating, and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .9 Return: To give back reusable items or unused products to vendors for credit.
- .10 Reuse: To reuse a construction waste material in some manner on the Project site.
- .11 Salvage: To remove waste material from the Project site to another site for resale or reuse by others.
- .12 Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- .13 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- .14 Toxic: Poisonous to humans either immediately or after a long period of exposure.
- .15 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- .16 Volatile Organic Compounds (VOC's): Chemical compounds common in and emitted by many building products over time through outgassing:
 - .1 Solvents in paints and other coatings,
 - .2 Wood preservatives; strippers and household cleaners,
 - .3 Adhesives in particle board, fibreboard, and some plywood; and foam insulation,
 - .4 When released, VOC's can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.
- .17 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.
- .18 Waste Management Plan: A Project-related plan for the collection, transportation, and disposal of the waste generated at the construction site. The purpose of the plan is to ultimately reduce the amount of material being landfilled.

1.3 OWNER WASTE MANAGEMENT GOALS

- .1 Owner has established this Project is to generate the least amount of waste possible. This requires that the construction processes ensure as little waste as possible, either due to error, poor planning, breakage, mishandling, contamination, or other factors.
- .2 Owner recognizes that waste in any project is inevitable, but indicates that as much of the waste materials as economically feasible be reused, salvaged, or recycled as required.
- .3 Minimize waste disposal to landfills.

1.4 WASTE MANAGEMENT PLAN

- .1 Draft Waste Management Plan: prior to any waste removal, the Construction Manager will create a draft waste management plan.
- .2 Plan to contain the following:
 - .1 List of materials to include the following materials:
 - .1 Cardboard
 - .2 Clean dimensional wood
 - .3 Beverage containers
 - .4 Land clearing debris
 - .5 Concrete
 - .6 Brick
 - .7 Concrete Masonry Units (CMU)
 - .8 Asphalt
 - .9 Metals from building, steel stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet metal, stainless steel, aluminium, copper, zinc, lead, brass, and bronze
 - .10 Gypsum board
 - .11 Plastic buckets – waste reduce by using plastic lines cardboard dry packaged materials instead of premixed moist packaged materials where this option is available.
 - .12 Carpet and carpet pad trim
 - .13 Paint
 - .14 Plastic sheeting and packaging, where recycling programs are available
 - .15 Rigid plastic foam insulation, where recycling programs are available.
 - .2 Final Waste Management Plan: Once the recycling options addressed in the draft Waste Management Plan are selected, the Construction Manager is to create a Final Waste Management Plan, containing the following:
 - .1 Analysis of the proposed jobsite waste to be generated, including types and quantities.
 - .2 Landfill options: The name of the landfill site where trash will be disposed of.
 - .3 Alternatives to Landfill: A list of waste materials from the Project that will be separated for reuse, salvage, or recycling.
 - .4 Meetings: A description of regular meetings held to address waste management.
 - .5 Materials Handling Procedures: A description of the means any waste materials identified above will be protected from contamination, and a description of the means to be employed in recycling materials consistent with requirements for acceptance by designated facilities.

- .6 Transportation: A description of the means of transportation of recyclable materials whether materials will be site-separated and self-hauled to designated centres, or whether mixed materials will be collected by waste hauler and removed from site, and destination of materials.

1.5 THIRD PARTY RESPONSIBILITY

- .1 Cooperate with all parties on site to implement a Waste Reduction Plan.

1.6 STORAGE, HANDLING, AND PROTECTION

- .1 Store materials to be reused, recycled, and salvaged in locations so as to protect from deterioration.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect structural components not removed for demolition from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Consultant.
- .7 Protect surface drainage, storm sewers, sanitary sewers, and utility services from damage and blockage.

1.7 SCHEDULING

- .1 Coordinate work with other activities at site to ensure timely and orderly progress of the work.

Part 2 Products

- .1 Not Used.

Part 3 Execution

3.1 PREPARATION

- .1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 SITE VISIT

- .1 Pre-bid site visit: Walk-through of project site prior to completion of bid submittal.

3.3 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises.
 - .1 The Trade Contractor shall comply with "The Occupational Health and Safety Act, 1993" and "The Occupational Health and Safety Regulations, 1996", and all other applicable acts, regulations, standards, and codes of practice, etc.
 - .2 Provide temporary security measures.

3.4 WASTE MANAGEMENT PLAN IMPLEMENTATION

- .1 Manager: The Construction Manager will designate an on-site party responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for Project.

- .2 Distribution: The Construction Manager will distribute copies of the Waste Management Plan to the Job Site Foreman, each Subcontractor, the Owner, and the Consultant.
- .3 Instruction: The Construction Manager will provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by parties at appropriate stages of Project.
- .4 Separation Facilities: The Construction Manager will lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.
- .5 Hazardous wastes: Hazardous wastes shall be separated, stored, and disposed of according to local regulations.

3.5 DISPOSAL OF WASTE

- .1 Burying or rubbish and waste materials is prohibited.
- .2 Disposal of waste, volatile materials, mineral spirits, oil, paint thinner into waterways, storm, or sanitary sewers is prohibited.

3.6 CLEANING

- .1 Remove tools and waste materials on completion of work, leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.
- .3 Source separation materials to be reused/recycled into specified sort areas.

3.7 SPECIAL PROGRAMS

- .1 The Construction Manager will be responsible for final implementation of programs involving tax credits or rebates or similar incentives related to recycling, if applicable to the Project.
- .2 Revenues or other salvage obtained for recycling or returns accrue to Owner.
- .3 Obtain information packets relevant to all of the above listed programs prior to starting work on the Project, and confirm facility's ability to accept waste from Project.
- .4 Document work methods, recycled materials, alternate disposal methods that qualify for tax credits, rebates, and other savings under programs listed by authority having jurisdiction.

3.7 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

.1	<u>Province</u>	<u>Address</u>	<u>General Inquiries</u>	<u>Fax</u>
	Saskatchewan	Saskatchewan Environment and Resource Management 3211 Albert Street Regina, SK, S4S 5W6	(306) 787-2700	(306) 787-3941

END OF SECTION

PART I GENERAL

- 1.1 Related Requirements
 - .1 Section 013300 - Submittals: Shop drawings, photographs.
 - .2 Section 014000 - Quality Control: Test and inspect reports.
- 1.2 Quality Assurance
 - .1 Instructions and data to be prepared by personnel experienced in maintenance and operation of described products.

PART 2 PRODUCTS

- 2.1 Format
 - .1 Organize data in the form of an instructional manual. Refer to PWGSC and/or AAFC general procedures and standards.
- 2.2 Contents – Each Volume
 - .1 Table of Contents: Provide title of project; names, addresses, and telephone numbers of Departmental Representative and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
 - .2 Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- 2.3 Submission
 - .1 Refer to PWGSC and/or AAFC general procedures and standards.

PART 3 EXECUTION

- 3.1 Record Documents and Samples
 - .1 Maintain at the site for Contractor, Owner and Departmental Representative use, one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to the Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
 - .2 Label and file in accordance with Section number listings in Table of Contents of this Project Manual.
 - .3 Maintain Record Documents in a clean, dry and legible condition.
 - .4 Keep Record Documents and samples available for inspection by Consultant.
- 3.2 Recording As-Built Conditions
 - .1 Record information on a set of blue line opaque drawings, and in a copy of a Project

- Manual.
- .2 Provide felt tip marking pens, maintaining separate colors for each major system, for recording information.
 - .3 Record information concurrently with construction progress. Do not conceal work until required information is recorded.
 - .4 Contract Drawings and shop drawings: Legibly mark each item to record actual construction, including:
 - .1 Measure depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction and any field changes of dimension and detail.
 - .4 Changes made by addenda and change orders.
 - .5 Details not on original Contract Drawings.
 - .6 References to related shop drawings and modifications.
 - .5 Specifications: Legibly mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalog number of each project actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda, Change Orders and Field Orders.
 - .6 Other Documents: Maintain manufacturer's certifications, inspection certifications, field test records, and authority having jurisdiction certifications required by individual specifications sections.
- 3.3 Warranties and Bonds
- .1 Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing.
 - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten (10) days after completion of the applicable item of work.
 - .4 Date of beginning of time of warranty shall be determined after the Date of Substantial Performance is determined.
 - .5 Verify that documents are in proper form, contain full information, and are notarized.
 - .6 Co-execute submittals when required.
 - .7 Retain warranties and bonds until time specified for submittal.

END OF SECTION

PART 1 GENERAL

1.1 Requirements Included

- .1 Procedures for demonstration and instruction of equipment and systems to Owner's personnel.

1.2 Related Requirements

- .1 Section 016600-Testing, Adjusting, and Balancing of Systems.
- .2 Section 017839-Project Record Documents: Operation and Maintenance Data.
- .3 Individual Sections: Demonstrating systems and equipment.
- .4 Section 237413 – Dehumidification Unit.

1.3 Description

- .1 Demonstrate operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of final inspection.
- .2 Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed upon times.

1.4 Quality Control

- .1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.

1.5 Submittals

- .1 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Owner's approval.
- .2 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3 Give time and date of each demonstration, with a list of persons present.

1.6 Conditions for Demonstrations

- .1 Equipment has been inspected and put into operation in accordance with Section 01600.
- .2 Testing, adjust, and balance has been performed in accordance with Section 01660 and equipment and systems are fully operational.
- .3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

PART 2 PRODUCTS (Not Used).

PART 3 EXECUTION

3.1 Preparation

- .1 Verify that conditions for demonstration and instructions comply with requirements, and that designated personnel are present.

3.2 Demonstration and Instructions

- .1 Demonstrate start up, operation, control, adjustment, trouble shooting, servicing, and maintenance of each item of equipment at scheduled times, at the equipment designated location.
- .2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction, and review contents of manual in detail.
- .4 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

END OF SECTION

PART 1 GENERAL

1.1 Work Included

- .1 Structural steel framing members, beams, columns, structural steel support members and struts, complete with required bracing, welds, washers, nuts, shims, anchor plates and bolts.
- .2 Base plates, connectors and bearing plates, rivets, wall anchors, girts, purlins, attached accessories, shelf angles and brackets.
- .3 Field and shop welded composite studs shall be supplied and installed under this section.
- .4 Erection.
- .5 Painting of material supplied.

1.2 Related Work

- ~~.1 Concrete Form Work Section 031000.~~
- ~~.2 Cast in Place Concrete Section 033000.~~
- ~~.3 Pre Engineered Light Gauge Metal Building Section 051220~~
- .3 Metal Fabrications Section 055000.
- .4 Painting and Finishing Section 099120.

1.3 Work Supplied Only - Installed by Others

- .1 Anchor bolts.
- .2 Embedded plates and assemblies.

1.4 Quality Assurance

- .1 On date of tender and for duration of contract, fabricator shall be certified by the Canadian Welding Bureau to Division 1, or Division 2.1 of CSA W47.1-1983 "Certification of Companies for Fusion Welding of Steel Structures" and to CSA W55.3-1965 "Resistance Welding Qualification Code for Fabricators of Structural Members".
- .2 Design to strictly adhere to all codes and standards as enumerated under Section 1.5. - Reference Standards.
- .3 In the event of conflict between pertinent codes, standards and/or regulations, most stringent shall govern.

1.5 References

- .1 Canadian Standards Association, Latest Edition:
 - .1 CAN/CSA S16.1-94 Limit State Design of Steel Structures.
 - .2 CAN/CSA-G40-20: General Requirements for Rolled or Welded Structural Quality Steel.
 - .3 CAN/CSA-G40.21-M181: Structural Quality Steel.
 - .4 CAN/CSA-S16.1-94: Steel Structures for Buildings (Limited States Design).
 - .5 W47.1-1983: Certification of Companies for Fusion Welding or Steel Structures (25r).
 - .6 W48 Series: Electrodes.
 - .7 W55.3-M1989: Resistance Welding Qualifications Code for Fabricators of Structural Members used in Buildings.
 - .8 W59-M1989: Welded Steel Construction (Metal Arc Welding).
 - .9 ASTM Standard A325M: High Strength Bolts for Structural Steel Joints Including Suitable Nuts and Plane Hardened Washers.
 - .10 CSA Standard W59-M1984 Welded Steel Construction.
 - .11 CSA S136 Cold-Formed Steel Structural Members
 - .12 CSA 940.21 Structural Quality Steel
 - .13 ASTM A61 (ASTM A6M) Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Ring and Bars for Structural Use
- .2 Canadian Institute of Steel Construction/Canadian Paint Manufacturer's Association:

- .1 STD 2-75: A Quick Drying Primer for Use on Structural Steel.
- .3 Steel Structures Painting Council surface preparation specifications.
- .4 American Society for Testing Materials:
 - .1 A307-1976a: Carbon Steel Externally and Internally Threaded Standard Fasteners.
 - .2 A325-1976a: High Strength Bolts for Structural Steel Joints Including Suitable Nuts and Plain hardened Washers.

1.6 Submittals

- .1 Prior to commencement of work, submit shop and erection drawings in accordance with Section 01300, Submittals.
- .2 On shop drawings, show members supplied, material standards, welds, finishes, paint and details of anchors, fasteners and accessories. It is the responsibility of the steel fabricator to provide all structural steel connection designs with the shop drawings and detail all connections on the shop drawings. Shop drawings are to be sealed and signed by a Professional Engineer registered with the Association of Professional Engineers of the Province having jurisdiction within the structural steel contract work. Show the capacity of all connections including moment connections. Structural drawings may show schematically structural steel connections and are **not** to be used for fabrication.
- .3 Upon request by the Departmental Representative, submit mill test reports on steel materials supplied under this Section indicating physical and chemical properties.
- .4 Submit a record drawing survey of that work whose erection tolerance does not meet CAN3-S16.1
- .5 Show all welds, both shop and field, by the currently recommended symbols of the Canadian Welding Bureau.
- .6 Review of shop drawings shall be for size and arrangement of principal and auxiliary members only. Such review will not relieve the Contractor of responsibility for general and detail dimension and fit, or any errors or omissions.
- .7 Substitutions:
 - .1 If at any time after the Contract is let this Contractor wishes to make changes or substitutions for the material required on the drawings or in these specifications, he shall submit all such proposed changes to the General Contractor and to the Departmental Representative for approval before substitution is made.
- .8 At time of bidding /tendering of the work, the structural steel supplier/fabricator is to assess. Connection design requirements and connection configuration (may require input from structural steel fabricator , connection design engineer during tender period for size and configuration of connection details No extra costs will be permitted for connection design fabrication and installation after tender award.

1.7 Testing

- .1 The Departmental Representative, on behalf of the Owner, may retain the services of a material testing agency to inspect and test fabricated members in the shop or field. Cooperate with such agency in its performances of its duties.
- .2 Report failures of material to fit together properly to the Departmental Representative No corrective measures are permitted unless approved the by Departmental Representative in writing.

1.8 Design

- .1 Design system used in proportioning members is "Simple Construction" according to CSA CAN3 S16.1, unless noted.
- .2 Bolted Connections:
 - .1 Friction Type:
 - .1 Connections subject to stress reversals.
 - .2 As noted on drawings.

- .2 Bearing Type:
 - .1 All others.
- .3 Bolts:
 - .1 Minimum size - 20mm, unless noted.
 - .2 Minimum number - (2) unless noted.
- .4 Design connections and assume full responsibility for same.
- .5 Check field conditions to determine exact requirements and dimensions.

PART 2 PRODUCTS

2.1 Materials

- .1 Standard Rolled Sections: New material conforming to CAN3 G40.21-M81, Grade 350W and CAN/CSA-G40.21.
- .2 Hollow Structural Sections: New material conforming to CSA Standard G40.21-M81, Grade 350W, Class C.
- .3 Base and Cap Plates: New material conforming to CSA Standard G40.21-M81, Grade 300W.
- .4 Plates over 40mm: CAN/CSA-G40.21, 230G.
- .5 Beam End Plates: Ledger Angles and Miscellaneous Steel: New material conforming to CSA Standard G40.21-M81, Grade 300W.
- .6 Anchor Bolts: New material conforming to CAN 3 G40.21-M81, Grade 260W. ASTM A307, Grade A (ASTM 568 Property Class 4.6) Carbon Steel Hex-Head Bolts; and Carbon Steel Nuts and Washers.
- .7 High Strength Bolts, Nuts and Washers: ASTM A325 (ASTM A325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts and hardened carbon-steel washers.
 - .1 Finish: Plain, uncoated.
 - .2 Finish: Hot-dip zinc-coating, ASTM A153, Class C at exposed to weather conditions.
 - .3 Direct-Tension Indicators: ASTM F959, Type 325.
 - .1 Finish: Plain, uncoated.
 - .2 Finish: Mechanically deposited zinc-coating, ASTM B695, Class 50 at exposed to weather conditions.
- .8 Non-High Strength Bolts, Nuts and Washers: ASTM A307, Grade A (ASTM F568, Property Class 4.6); carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.
- .9 Pipe: ASTM A53, Grade B.
- .10 Electrodes: CSA W48 Series.
- .11 Shop and Field Studs: Shall be Nelson headed anchors to ASTM A108-58T or approved equal. Sizes as detailed on drawings.

2.2 Primer

- .1 Primer: Fast-curing, lead and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements of FS TT-P-664.
- .2 Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds and repair painting galvanized steel, with dry film containing not less than 93% zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

2.3 Fabrication

- .1 Fabricate structural steel members in accordance with building design drawings and all requirements of CAN/CSA S16.1-94 and CSA/CAN3, S16.1. Welding to conform to CSA W59-M1989 "Welded Steel Construction". Verify all dimensions prior to fabrication.
- .2 No cutting or openings in structural members except as shown on structural drawings. Reinforce openings to maintain required design strength.
- .3 Provide 20mm grout weep hole in base plates near centre.
- .4 Provide column base plate assembly with end moment capacity equal to capacity generated by

- anchor bolts.
- .5 Provide full end plates for skew connections.
- .6 Accurately cut and mill column ends to assure full contact of bearing surfaces.
- .7 Camber horizontal members as specified on drawings. Mill camber up where not specifically detailed.
- .8 All bolted connections to be slip-resistant (friction type) connections.
- .9 All structural members to be connected for loads shown on drawings or half the depth of the connected member, whichever is greater.
- .10 Tolerances of all structural steel shall be maintained strictly in accordance with CAN/CSA S16.1-94.

2.4 Painting

- .1 Clean members, remove loose mill scale, rust, oil, dirt and other foreign matter. Prepare surfaces according to SSPC Standard SP2 "Hand Tool Cleaning", and SSPC-SP3 "Power Tool Cleaning".
- .2 Apply one coat of prime paint in the shop to steel surfaces, except:
 - .1 Surfaces to be encased in concrete or mortar: Extend priming of partially embedded members to a depth of 2" (50 mm).
 - .2 Surfaces to receive field installed stud shear connectors.
 - .3 Surfaces and edges to be field welded.
 - .4 Faying surfaces of friction type connections.
 - .5 Surfaces to be high-strength bolted with slip-critical connections.
 - .6 Surfaces to receive sprayed-on fire-proofing.
 - .7 Galvanized surfaces.
 - .8 Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at a rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges and exposed surfaces.
 - .1 Stripe paint corners, crevices, bolts, welds and sharp edges.
 - .2 Apply 2 coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.
 - .9 Painting: Apply a one-coat, non-asphaltic primer complying with SSPC's "Painting System Guide No. 7.00" to provide a dry film thickness of not less than 1.5 mils (0.038 mm).
- .3 All steel exposed ledgers, lintels and connections shall be prepared and painted as follows:
 - .1 Blast clean steel to SSPC Standard SP6 "Commercial Blast Cleaning". Apply one coat of General Paint 06-154-Q.D. Shop Primer.
 - .2 Apply one coat of General Paint 16-Line Q.D. industrial enamel. Color selection by Departmental Representative
- .4 All other structural steel shall be prepared in accordance with SSPC Standard SP2 "Hand Tool Cleaning" and have one coat of specified shop applied primer.
- .5 Apply paint under cover, on dry surfaces only and when surface and air temperatures are above 5° C.
- .6 Maintain dry condition and 5° C minimum temperatures until paint is thoroughly dry.

PART 3 EXECUTION

3.1 Examination

- .1 Prior to commencement of erection, examine bearing and anchors provided or installed under other sections upon which work of this section is dependent. Promptly report to the Engineer errors or omissions that may affect the work.
- .2 Protect survey reference points during construction.

3.2 Erection

- .1 Erect structural steel in accordance with CSA/CAN3 S16.1-94. Assume full responsibility for

- corrective work to trades resulting from work which does not meet erection tolerances of this Section. Minimum erection tolerances of structural steel within CSA S16.1/CSA S136.
- .2 Set column base plates to proper elevations. Shim where necessary. Set all base plates which are shop welded to columns to proper elevation on steel shims. Maximum tolerance from stated elevations to be ± 2 mm. Wooden wedges shall not be used.
 - .3 After base plates are grouted, tighten anchor bolts to full capacity.
 - .1 Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 - .2 Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
 - .4 Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in a permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - .1 Level and plumb individual members of structure.
 - .2 Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
 - .5 Make adequate provision for all erection loads and for sufficient temporary bracing to maintain structure safe, plumb and in true alignment until completion of erection. Leave such bracing in place as long as required for safety.
 - .6 Provide temporary cross-bracing to safety support structural steel elements until completion of permanent bracing elements.
 - .7 Splice members only where indicated.
 - .8 As erection progresses, securely bolt work to take care of full design loads.
 - .9 Field Connections:
 - .1 Use high tensile bolts for field connections unless otherwise noted on building design drawings.
 - .2 Install and tighten high-strength bolts according to CSA S16.1/CSA S136.
 - .1 Connection type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.
 - .3 Weld Connections: Comply with CSA W59 for procedures, appearance and quality of welds, and methods used in correcting welding work.
 - .1 Comply with CSA S16.1/CSA S136 specifications referenced in this Section for bearing, adequacy of temporary connections, alignment and removal of paint on surfaces adjacent to field welds.
 - .2 Verify that weld sizes, fabrication sequence and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of backside welding on exposed steel surfaces. Grind smooth exposed fillet welds $\frac{1}{2}$ " and larger. Grind flush butt welds. Dress exposed welds.
 - .10 Reinforce and/or replace existing structural steel elements as shown on the drawings.
 - .11 After erection, field prime welds, nuts, bolts, washers and touch up abrasions or damage to shop primed surfaces.
 - .12 Remove erection bolts on welded, architecturally exposed structural steel. Fill holes with plug welds and grind smooth at exposed surfaces. Do not use thermal cutting during erection. Finish sections thermally cut during erection equal to a sheared appearance. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.
 - .13 Install shear connectors to beams and girders as shown, either in the shop or in the field.
 - .14 All studs to be installed in strict conformance with the requirements of Clause 5.5.6. of CSA Standard W59 "Welded Steel Construction".
 - .15 Obtain written permission of Departmental Representative prior to altering or field-welding of structural members.

- .16 When the base metal temperature is below 0° C, pre-heat the base metal to at least 10° C and maintain this temperature during welding.
- .17 Use only light drifting to draw parts together. Enlarge holes for bolted connections with reamers or twist drill only. Do not burn to form holes, enlarge holes or match unfair holes.
- .18 Make adequate provision for erecting stresses and for sufficient temporary bracing to keep the structural steel frame plumb and in true alignment until completion of erection.
- .19 Prior to field erection, examine the existing work of all other contractors on which this work is in any way dependent and report to the General Contractor any errors or discrepancies that may affect this work.
- .20 Seats may be used where required for web connections not permitted where they interfere with architectural clearance.
- .21 Columns: Where detailed, unless otherwise noted, all column base plates shall be welded to columns. Supply all necessary bolts for anchoring bases and fastening adjacent structure.
- .22 This Contractor shall inspect elevation of trowel surfaces to receive column base plates to ensure setting of steel to a ± 2 mm (1/8"). In accepting these trowelled surfaces, this Contractor shall assume responsibility for vertical leveling of all steel work.

3.3 **Field Quality Control**

- .1 The Owner will engage in independent testing agency to perform field inspections and tests and to prepare test reports. The Testing Agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- .2 Correct deficiencies or remove and replace structural steel that inspections and test reports indicated do not comply with specified requirements.
- .3 Additional testing at the Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.
- .4 Field-bolted connections will be tested and inspected according to CSA S16.1/CSA S136.

3.4 **Cleaning**

- .1 Touch-up Painting: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils (0.038 mm).
- .2 Galvanized Surfaces: Clean field welds, bolted connections and abraded areas and apply galvanizing repair paint according to ASTM A780.

END OF SECTION

PART I GENERAL

1.1 Section Includes

- .1 Shop fabricated ferrous metal items, galvanized and prime painted.

1.2 Related Sections

- .1 Examine drawings thoroughly to determine items and quantities required, and for purposes of distinction, read this Section in conjunction with structural steel drawings and specifications under Section 051200.
- .2 Section 099120 - Painting: Paint finish.

1.3 References

- .1 ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.
- .2 ASTM A325 - High Strength Bolts for Structural Steel Joints.
- .3 ASTM B177 - Chromium Electroplating on Steel for Engineering Use.
- .4 CAN/CGSB-7.1M - Cold Formed Steel Framing.
- .5 CAN/CSA-G40.20M - General Requirements for Rolled or Welded Structural Quality Steel.
- .6 CAN/CSA-G40.21M - Structural Quality Steels.
- .7 CAN/CSA-S136M - Cold Formed Steel Structural Members.
- .8 CGSB 85-GP-0M - Shop Painting Structural Steel.
- .9 CGSB 85-GP-16M -Painting Galvanized Steel.
- .10 CSA G164M - Hot Dip Galvanizing of Irregularly Shaped Articles.
- .11 CSA W47.1 - Certification of Companies for Fusion Welding of Steel Structures.
- .12 CSA W47.2 -Aluminum Welding Qualification Code.
- .13 CSA W55.3 - Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .14 CSA W59 - Welded Steel Construction (Metal-Arc Welding).
- .15 CSSBI - Canadian Sheet Steel Building Institute.
- .16 SSPC - Steel Structures Painting Council.

1.4 Submittals

- .1 Submit shop drawings to requirements of Section 013300.
- .2 Indicate on shop drawings, profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Shop drawings to bear stamp and signature of professional engineer registered in the province of the work.
- .3 Indicate welded connections using standard CSA W59 welding symbols. Indicate net weld lengths.

1.5 Quality Assurance

- .1 Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project with a record of successful in-service performance and with sufficient production capacity to produce required units without delaying the Work.
- .2 Perform Work in accordance with CSA W47.1, CSA W47.2M, CSA W55.3, CSA W59.2 and CSA W59.

1.6 Field Measurements

- .1 Check actual locations of walls and other construction to which metal fabrications must fit by accurate field measurements before fabrication. Show recorded measurements on final shop

drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 PRODUCTS

2.1 Ferrous Materials

Note: See drawings for locations, i.e. grates/miscellaneous angles, etc.

- .2 Metal Surfaces: For metal fabrications exposed to view in the completed Work, provide materials selected for their surface flatness, smoothness and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names or roughness.
- .2 Steel Plates, Shapes and Bars: CAN/CSA G40.21-M.
- .3 Rolled Steel Floor Plates: ASTM A786 (ASTM A786M).
- .4 Steel Tubing: Product type (manufacturing method) as follows:
 - .1 Cold-Formed Steel Tubing: ASTM A500.
 - .2 Hot-Formed Steel Tubing: ASTM A501.
- .5 Steel Pipe: ASTM A53, standard weight (schedule 40), unless otherwise indicated or another weight required by structural loads.
 - .1 Black finish unless otherwise indicated.
 - .2 Galvanized finish for exterior installations and where indicated.
- .6 Gray Iron Castings: ASTM A48, Class 30.
- .7 Malleable-Iron Castings: ASTM A47, Grade 32510 (ASTM A47M, Grade 22010).
- .8 Cast-In-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing as per ASTM E488, conducted by a qualified independent testing agency.
- .9 Formed Members: CAN/CGSB-7.1M, CAN/CSA-S136M.
- .10 Bolts, Nuts, and Washers: ASTM, A325, A307, galvanized to CSA G164M for galvanized fabrications.
- .11 Welding Materials: W59; type required for materials being welded.
- .12 Shop and Touch-Up Primer: CGSB 85-GP-10M, Red oxide type.
- .13 Touch-Up Primer for Galvanized Surfaces: CGSB 85-GP-16M, Zinc rich type.
- .14 Stainless steel shall be gauges as indicated, Type 304, with #3 finish.

2.2 Paint (see also Section 099120)

- .1 Shop Primer for Ferrous Metal: Fast-curing, lead and chromate-free, universal modified-alkyd primer complying with performance requirements of CGSB 1-GP-40M, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied top coats despite prolonged exposure.
- .2 Zinc Chromate Primer: To CGSB 1-GP-132M.
- .3 Zinc Rich Galvanized Primer: High zinc dust content paint for re-galvanizing welds in galvanized steel with dry film containing not less than 94% zinc dust by weight, to CGSB 1-GP-181M.

2.3 Fasteners

- .1 General: Provide plated fasteners complying with ASTM B633, Class Fe/Zn 25 for electro-deposited zinc coating for exterior use, or where built into exterior walls. Select fasteners for the type, grade and class required.

- .2 Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568, Property Class 4.6), with hex nuts.
- .3 Machine Screws: ANSI B18.6.3 (ANSI B18.6.7M).
- .4 Lag Bolts: ANSI B18.2.1 (ANSI B18.2.3.8M).
- .5 Wood Screws: Flat head, carbon steel, ANSI B18.6.1.
- .6 Plain Washers: Round, carbon steel, ANSI B18.22.1 (ANSI B18.22M).
- .7 Lock Washers: Helical, spring type, carbon steel, ANSI B18.21.1.
- .8 Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below, with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete, as determined by testing as per ASTM E488, conducted by a qualified independent testing agency.
- .9 Toggle Bolts: FS FF-B-588, tumble-wing type; class and style as required.

2.4 Grout

- .1 Non-Shrink Metallic Grout: Factory-packaged, ferrous-aggregate grout, complying with ASTM C1107, specifically recommended by manufacturer for heavy duty loading applications.
- .2 Non-Shrink Non-Metallic Grout: Factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C1107. Provide grout specifically recommended by the manufacturer for interior and exterior applications.

2.5 Concrete Fill

- .1 Concrete Materials and Properties: Comply with requirements of Division 3, Section 03300 "Cast-In-Place Concrete" for normal weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 Psi (20 Mpa), unless higher strengths are indicated.

2.6 Fabrication

- .1 Fabricate components in shop where possible, to details shown on drawings and in accordance with approved shop drawings. Accurately fit joints and intersecting members in true planes, with adequate fastening. Verify dimensions on site prior to proceeding with shop fabrication.
- .2 Fit and shop assemble in largest practical sections for delivery to site.
- .3 Build work square, true, straight and accurate to required size, with joints closely fitted and properly secured. Ensure shapes and sizes are true with clean lines and distortion-free surfaces.
- .4 Ease exposed edges to a radius of approximately 1/32" (1 mm), unless otherwise indicated. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- .5 Weld permanent connections wherever possible.
- .6 Provide anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- .7 Fabricate items from steel unless otherwise noted.
- .8 Use self-tapping, shake-proof, countersunk, flat headed screws on items requiring assembly by screws or as indicated. When used, countersink bolted connections in accordance with the Engineer's instructions. Nick threads to prevent loosening. Cut, reinforce, drill and tap metal fabrications as indicated to receive finish hardware, screws and similar items.
- .9 Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of jointed pieces. Clearly mark units for re-assembly and coordinated installation.
- .10 Where possible, fit and shop assemble work, ready for erection.
- .11 Exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

- .12 Indicate bolted connections on shop drawings.
- .13 Drill or punch holes for bolted connections.

2.6 Finishes

- .1 Prepare surfaces to be primed in accordance with SSPC SP 2.
- .2 Do not prime surfaces in direct contact with concrete or where field welding is required.
- .3 Prime paint items with one coat.
- .4 Galvanize structural steel members in accordance with CSA G164M to minimum 380g/sq m galvanized coating.
- .5 Insulate contact surfaces to prevent electrolysis due to metal to metal contact or contact between metal and masonry or concrete. Use bituminous paint, butyl tape, building paper or other accepted means.
- .6 Thoroughly de-scale steel work for which galvanizing is not specified before delivery to project site. Remove roughness and irregularities, clean with a wire brush, remove oil and grease, and prime with one shop coat of primer to 0.04 to 0.05 mm (1.5 to 2 mil) thickness.
- .7 Steel items located on the exterior or unheated side of air/vapour barrier of the building, or where items are likely to be in contact with moisture, shall be hot dipped galvanized.
- .8 Do not prime the following surfaces:
 - .1 Steel to be encased in concrete.
 - .2 Non-ferrous metals.
 - .3 Surfaces and edges to be field-welded. If painted, remove paint for field-welding for a distance of at least 50 mm (2") on sides of the joint.
- .9 Steel and Iron Finishes
 - .1 Galvanizing: For those items indicated for galvanizing, apply zinc-coating by the hot-dip process complying with the following requirements:
 - .1 ASTM A153 for galvanizing iron and steel hardware.
 - .2 ASTM A123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated, rolled, pressed, and forged shapes, plates, bars and strip 0.0299" (0.76mm) thick or thicker.
 - .2 Preparation for shop Priming: Prepare un-coated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications.
 - .1 Exteriors (SSPC Zone 1B): SSPC-SP 6 "Commercial Blast Cleaning".
 - .2 Interiors: (SSPC Zone 1A): SSPC-SP 3 "Power Tool Cleaning".
 - .3 Apply shop primer to un-coated surfaces of metal fabrications, except those with galvanized finishes or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC-PA 1 "Paint Application Specification No. 1" for shop painting. Stripe paint corners, crevices, bolts, welds and sharp edges.

PART 3 EXECUTION

3.1 Examination

- .3 Verify that field conditions are acceptable and are ready to receive work.
- .4 Beginning of installation means erector accepts existing conditions.

3.2 Workmanship

- .1 Fabrication, erection and workmanship: Conform to the requirements of CSA Standard S16.1, Steel Structures for Buildings and S136 Cold Formed Steel Structural Members.

3.3 Preparation

- .1 Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installing anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the project site.
- .2 Set sleeves in concrete with tops flush with finish surface elevations. Protect sleeves from water and concrete entry.
- .3 Clean and strip primed steel items to bare metal where site welding is required.
- .4 Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.

3.4 Installation

- .1 Install items plumb and level, accurately fitted, free from distortion or defects.
- .2 Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors, as required.
- .3 Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop-welded because of shipping size limitations. Do not weld, cut or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.
- .4 Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- .5 Field weld components indicated on shop drawings.
- .6 Perform field welding in accordance with W59. Comply with the following requirements.
 - .1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - .2 Obtain fusion without undercut or overlap.
 - .3 Remove welding flux immediately.
 - .4 At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.
- .7 Cutting, Fitting and Placement: Obtain Departmental Representative approval prior to site cutting or making adjustments not scheduled. Perform cutting, drilling and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment and elevation, with edges and surfaces level, plumb, true and free of rack, and measured from established lines and levels.

3.5 Setting Loose Plates

- .1 Clean concrete bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
- .2 Set loose levelling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 Erection Tolerances

- .1 Maximum variation from plumb: 6 mm per storey, non-cumulative.
- .2 Maximum offset from true alignment: 6 mm.

3.7 Schedule

- .1 The Schedule is a list of principal items only. Refer to drawing details for items not specifically scheduled.
- .2 Bollards (if any – coordinate with drawings)
 - .1 Steel pipe, concrete filled, crowned cap, as detailed; prime paint, enamelled finish.
 - .2 Fabricate pipe bollards from Schedule 80 Steel Pipe.
 - .3 Anchor bollards in concrete as detailed on plans.
 - .4 Fill bollards solidly with concrete, mounding top surface.
- .3 Ledge and shelf angles, channels and plates not attached to structural framing: For support of metal decking, masonry; prime paint finish. Provide loose bearing and levelling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists and of the required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.
- .4 Loose Steel Lintels:
 - .1 As detailed; prime paint finish.
 - .2 Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
 - .3 Size loose lintels for equal bearing of 12"/ft. (85 mm/m) of clear span but not less than 8" (200mm) bearing at each side of openings, unless otherwise indicated.
 - .4 Galvanize loose steel lintels located in exterior walls.
- .5 Rough Hardware
 - .1 Furnish bent or otherwise custom-fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items as specified in Division 6.
 - .2 Fabricate items to sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts that bear on wood structural connections and furnish steel washers elsewhere.
- .6 Miscellaneous Framing and Supports
 - .1 General: Provide steel framing and supports for applications indicated that are not a part of structural steel framework as required to complete the work.
 - .2 Fabricate units to sizes, shapes and profiles indicated and required to receive other adjacent construction retained by framing and supports. Fabricate from structural steel shapes, plates and steel bards of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware, hangers and similar items.
 - .3 Galvanize miscellaneous framing and supports in exterior locations.
- .7 Steel Ladders (if any – coordinate with drawings)
 - .1 Fabricate ladders for the location shown with dimensions, spacings, details and anchorages as indicated. Comply with requirements of ANSI A14.3.
 - .2 Side Rails: Continuous, steel 1/2" x 2-1/2" (12mm x 64mm) flat bars with eased edges spaced 18" (460mm) apart.
 - .1 Bar Rungs: 3/4" (19mm) diameter steel bars, spaced 12" (300mm) o.c. Fit rungs in centreline of side rails; plug weld and grind smooth on outer rail faces.
 - .2 Support each ladder at top and bottom and at intermediate points spaced not more than 60" (1500mm) o.c. with welded or bolted steel brackets. Size brackets to support design dead and live loads indicated and to hold centreline of ladder rungs clear of the wall surface by not less than 5" (127mm).

- .3 Steel Plate Stair: ¼” thick steel checkerplate treads, 1-1/4”x1-1/4”x3/16” angle support 10” channel stringers.

3.8 Identification of Parts for Erection

- .1 Identify individual pieces in accordance with identification schedule used on shop and erection drawings to clearly indicate their positions in the work for erection purposes. Apply identification marks, clear and legible, by using paint, stamping or other suitable means which will not become obliterated during shipment and handling.

3.9 Adjusting and Cleaning

- .1 After erection field prime welds, nuts, bolts, washers and touch up abrasions or damage to shop primed surfaces.
- .2 Touch-up Painting: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA1 requirements for touching up shop-painted surfaces. Apply by brush or spray to provide a 2.0 mil (0.05mm) minimum dry film thickness.
- .3 For galvanized surfaces, clean welds, bolted connections and abraded areas, and apply galvanizing repair paint to comply with ASTM A780.

3.10 Erection

- .1 Erect metal work square, plumb, straight and true, accurately fitted, with tight joints and intersections.
- .2 Provide suitable and acceptable means of anchorage, such as dowels, anchor clips, bar anchors, expansion bolts, shields and toggles.
- .3 Make field connections with high tensile bolts of weld to CSA S16 (Latest Edition) and CSA S16S1 (Latest Edition).
- .4 Hand items over for casting into concrete to appropriate trades together with setting templates.
- .5 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection.
- .6 Touch-up galvanized surfaces with zinc primer where burned by field welding.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes (Where Indicated on Drawings)

- .1 Batt insulation in cavity space of exterior wall (other than provided under Section 051220).
- .2 Batt and/or blow-in insulation for roof or truss perimeter edge (not included in Section 051220).
- .3 Batt and blow-in insulation or spray foam insulation for filling perimeter window and door shim spaces crevices in exterior wall and roof.
- .4 Acoustic batt insulation for interior demising walls.

1.2 Related Sections

1. Section 072500 - Vapour and Air Barrier: Continuing vapour and air barrier materials to adjacent construction.

1.3 References

- .1 CAN/CGSB-51.33M - Vapour Barrier, Sheet, for Use in Building Construction.
- .2 CSA A101M - Thermal Insulation, Mineral Fibre, for Buildings.

1.4 Performance Requirements

- .1 Materials of this Section shall provide continuity of thermal barrier at building enclosure elements.

1.5 Submittals

- .1 Submit product data to requirements of Section 013300.
- .2 Provide product data on product characteristics, performance criteria, limitations.

1.6 Coordination

- .1 Coordinate the work of Section 07250 for installation of vapour and air barrier seals

PART 2 INSULATION MATERIALS

2.1 Acceptable Manufacturers - Insulation Materials

- .1 Fibreglass Canada Inc. Model Fibreglass Friction Fit Batt Insulation.

2.2 Materials

- .1 Batt Insulation: CSA A101M; pre-formed fibre batt; friction fit, Fibreglass Friction Fit manufactured by Fibreglass Canada Inc. Minimum R20 walls and R40 roof – batt or blow-in insulation. See drawings for insulation thickness.
- .2 Mineral Fibre Insulation: To CSA A101-M1977, Type 1A, RSI indicated.
- .3 Vapour Barrier Film:
 - .1 Fibreglass Batt Insulation, CSA A101-M1983.
 - .2 Insulation: Proper installation of the vapour barrier is critical. Installation is to be done according to the National Building Code, 2005 edition, Subsection 9.26.5, part of which is reproduced below for reference:
 - .1 Every vapour barrier shall be installed to protect the entire insulated wall surface, except that the vapour barrier need not extend across the framing members provided the interior finish consists of panel-type material attached to all framing members with a continuous bead of adhesive in addition to the nails.
 - .2 Insulation shall be protected by a vapour barrier so that all joints are sealed or are lapped at least 100 mm and occur at framing members, furring or blocking.
 - .3 Where an interior frame wall meets an exterior wall required to have vapour barrier protection, the vapour barrier protection shall extend between the exterior

- and interior walls to form continuous protections at the wall intersection.
- .4 Where an interior frame wall meets a ceiling required to have vapour barrier protection, the vapour barrier protection shall extend over the top of the wall or beneath the top wall plate to form continuous vapour protection for the ceiling.
 - .5 Holes through vapour barrier, such as those cut for the installation of electrical wiring, electrical boxes, piping or ductwork, shall be sealed to maintain the integrity of the vapour barrier over the entire surface.
- .4 Accessories
- .1 Insulation clips: impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.
 - .2 Nails: Galvanized steel, length to suit insulation plus 25 mm to CSA B111-1974, Table 12.
 - .3 Staples: 12 mm minimum length.
 - .4 Sealant: To CGSB 19-GP-21M.
- .5 For light gauge metal buildings, provide R-28, 3' wide blanket type glass fibre insulation having 1 lb density and 8" foil skim Kraft insulation, minimum R-28 R-value.

PART 3 EXECUTION

3.1 Insulation Installation

- .1 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .2 Install insulation with vapour barrier facing warm side of building spaces and vapour permeable membrane facing cold side. Lap ends and side flanges of membrane over framing members. Retain in position with staples. Tape seal butt ends and lapped side flanges. Do not tear or cut vapour barrier.
- .3 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .4 Do not compress insulation to fit into spaces.

3.2 Vapour Barrier Installation

- .1 Place polyethylene on warm side of insulation and tight to insulation.
- .2 Staple vapour barrier to framing members. Lap joints 150 mm minimum. Ensure joints occur over framing members. Caulk all lap joints.
- .3 Tape seal areas where nails or staples penetrate vapour barrier.
- .4 Extend vapour barrier tight to perimeter of windows, door frames and other items interrupting continuity of membrane. Seal with sealant.
- .5 Seal vapour barrier at points of penetration.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

- .1 Sheet and sealant materials to provide a continuous vapour and air barrier throughout the building envelope and to seal wall vapour and air barrier to window, door and frame openings.

1.2 Related Sections

- .1 Section 079200 - Joint Sealers: Sealants.

1.3 References

- .1 CAN/CGSB-19.13M -Sealing Compound, One Component, Elastomeric, Chemical Curing.
- .2 CAN/CGSB-19.24M - Sealing Compound, Multi-Component, Chemical Curing.
- .3 CGSB 19-GP-14M - Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
- .4 CGSB 19-GP-18M - Sealing Compound, One Component, Silicone Base, Solvent Curing.
- .5 Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification.
- .6 CAN/GSB 51.34 – M86 (Balcon Vapour Barrier).

1.4 Performance Requirements

- .1 Materials of this Section shall provide continuity of building enclosure vapour and air barrier:
 - .1 In conjunction with materials described in Section 07212, 07213, 07214, 07900.
 - .2 To seal gaps between building enclosure components and wall and roof opening frame.

1.5 Quality Assurance

- .1 Perform Work in accordance with Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification requirements for materials and installation.
- .2 Maintain one copy of document on site.

1.6 Qualifications

- .1 Applicator: Company specializing in performing the work of this Section with minimum 3 years documented experience approved by manufacture.

1.7 Environmental Requirements

- .1 Do not install solvent curing sealants in enclosed building spaces without ventilation.
- .2 Maintain temperature and humidity recommended by the materials manufacturers before, during, and after installation.

1.8 Sequencing

- .1 Sequence Work to permit installation of materials in conjunction with other retardant materials and seals.

1.9 Coordination

- .1 Coordinate the work of this Section with all Sections referencing this Section.

PART 2 PRODUCTS

2.1 Sheet Materials

- .1 Sheet Air/Vapour Barrier: Type 1 used on masonry walls and masonry veneer walls, etc. Self adhering, cold applied composite sheet membrane comprised of rubberized asphalt integrally bonded to a film of high density cross laminated polyethylene, maintaining a minimum thickness of 1 mm; Blueskin as manufactured by Bakor or CCW705 Carlisle BY Wallace Construction specialties; Type 2; see 3.4.1.

- .2 Sheet Barrier Type 2: Self-adhering, cold-applied composite sheet membrane, comprised of 0.9 mm rubberized asphalt integrally bonded to a 0.1 mm film of high density, cross-laminated “embossed” polyethylene, for a minimum thickness of 1 mm. Ice and Water Shield manufactured by W.R. Grace; Betaguard AG manufactured by Bakor; Lastobond 195 by Soprema.
- .3 Sheet Barrier Waterproofing Type 3: Self adhering 1.5 mm water proofing membrane composed of cross laminated polyethylene and rubberized asphalt, Bituthene 3000 manufactured by W. R. Grace, WP200 manufactured by Bakor and CCW 861 Carlisle by Wallace Construction Specialties.
- .4 Sheet Air Barrier Type 4: Spunbonded olefin fibres interwoven in sheet form, forming an air retarder. Perm rating -1723 ng/Pa.s.sq.m. Tyvek, manufactured by E.I. du Pont de Nemours & Co.
- .5 Sheet Vapour Barrier Type 5: CGSB 51.34M86, 6 mil polyethylene – walls.

2.2 Sealants

- .1 Polyurethane Sealant: Single component, 100 percent solids in content; type recommended by manufacturer; Sunborne NPI by Wallace Construction.
- .2 Primer: Type recommended by manufacturer.
- .3 Acoustical sealant at overlap joints in poly ethylene vapour barrier.
- .4 Cleaner: Non-corrosive type recommended by manufacturer.

2.3 Adhesives

- .1 Adhesive: Type recommended by manufacturer.

2.4 Accessories

- .1 Thinner and Cleaner for Sheet: As recommended by sheet material manufacturer.
- .2 Tape: Minimum thickness of 0.8 mm; type recommended by manufacturer.
- .3 Wall Flashing: Sheet Barrier Type 1; Self-adhering membrane; Perma-A-Barrier Wall Flashing Membrane manufactured by W.R.Grace or Sopraseal, Colphene 1000 GSA manufactured by Soprema or Blueskin SA manufactured by Bakor, Carlisle CCW705LT by Carlisle.
- .4 Silicone: Anti mildew silicone Dow Corning tub and file sealant for countertop, plumbing, etc.

PART 3 EXECUTION

3.1 Examination

- .1 Verify that surfaces and conditions are ready to accept the Work.

3.2 Preparation

- .1 Remove loose or foreign matter which might impair adhesion.
- .2 Clean and prime substrate surfaces in accordance with manufacturers' instructions.

3.3 Installation - Exterior Walls

- .1 Install sheet materials in accordance with manufacturer's instructions
- .2 Install sealant in accordance with manufacturer's instructions.
- .3 Apply sheet barrier Type 1 to primed exterior GWB sheathing. Fit membrane tightly around all penetrations through it and seal.
- .4 Lap Sheet Barrier Type 1 into all openings in the wall area, windows, doors, etc. and terminate at a point that will ensure that it will not be visible from the interior.
- .5 Tie membrane into and make continuous with all framed openings.
- .6 Coordinate installation of membrane with roofing trade to ensure continuity of the air /vapour barrier.

- .7 At the end of each working day, and assuming a wall area has been only partially covered, seal along the top edge of the membrane at its termination to prevent the vertical drainage of precipitation from running in behind the membrane.
- .8 Before covering the membrane with the cavity insulation, inspect and repair any punctures, damaged areas or inadequately lapped seams.
- .9 Install membrane within recommended application temperature ranges.

3.4 Installation - Roof

See drawings for roof type and locations.

- .1 Install sheet barrier Type 2 onto primed roof surfaces. Lap seal in accordance with manufacturer's instructions, i.e. Carlisle CCW401 membrane, peel and stick self adhesive air vapour barrier by Wallace Construction Specialties Lastobond 195 by Soprema or in accordance to other approved roof membrane manufacturer/supplier.

3.5 Vapour Barrier Film Installation

- .1 Staple vapour barrier to framing members. Lap joints 150 mm minimum and tape seal. Ensure joints occur over framing members.
- .2 Tape seal areas where nails or staples penetrate vapour barrier.
- .3 Extend vapour barrier tight to perimeter of windows, door frames and other items interrupting continuity of membrane. Tape seal.
- .4 Seal vapour barrier at points of penetration.

3.6 Protection of Finished Work

- .1 Protect finished Work under provisions of Section 015000.
- .2 Do not permit adjacent Work to damage work of this Section.

3.7 Schedule

- .1 Wall and Roof Junction: Lap sheet barrier Type 1 from wall vapour barrier with 150 mm of contact over firm bearing to roof vapour barrier with 100 mm of contact. Peel and stick air/vapour system of wall to lap minimum 2" with peel and stick air/vapour barrier system with roof.
- .2 Sheet Metal Roofing: Lap sheet barrier Type 3 at eave protection, all valley, ridge and corner joints as indicated at eaves, Type 3 to extend minimum 2' within interior space.

END OF SECTION

PART 1 GENERAL

1.1 Scope of Work

- .1 Requirements of the Conditions of the Contract and of Division 1 of these Specifications apply to all work in this Section.

1.2 Extent of Work

- .1 Provide roof curbs for all duct penetrations.

1.3 Submittals

- .1 Submit 5 copies of manufacturer's literature and complete shop drawings of fabrication and installation of items of this Section to the Engineer prior to installation.

PART 2 PRODUCTS

2.1 Roof Curbs

- .1 General: Provide roof curbs capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Coordinate dimensions with rough-in information or shop drawings of equipment to be supported.
- .2 Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 14 ga. (.0747" thick), structural quality, hot dip galvanized or aluminum zinc alloy coated steel sheet; factory primed and prepared for painting with welded or sealed mechanical corner joints.
- .3 Use curbs with height to extend 12" above the top of finished roofing surface. Consider and compensate for presence and thickness of roof insulation when ordering.
- .4 Provide curbs with 1-1/2" insulation, #3 density on exterior curb face, extending full height from bottom to top of curb.

PART 3 EXECUTION

3.1 Installation of Curbs

- .1 Install curbs per shop drawings and manufacturer's recommendations.
- .2 Verify all locations with HVAC drawings and actual locations of roof joists.
- .3 Install gaskets on the same day the roof mounted units are set on curbs.

END OF SECTION

PART 1 GENERAL

1.1 Work Included

- .1 Preparing sealant substrate surfaces.
- .2 Sealant and backing at all locations where different materials come in contact, and where called out in the drawings.

1.2 Related Work

- .1 Section 072500 - Vapor and Air Barriers: Sealants used in conjunction with vapor and air barrier continuity

1.3 References

- .1 ASTM D1565 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers Open Cell Foam, CAN2-19.13M - Sealing Compound, One Component, Elastomeric, Chemical Curing.
- .2 CAN2-19.24M - Sealing Compound, Multi-Component, Chemical Curing.
- .3 CGSB 19-GP-2M - Glazing Compound, Non-hardening, Modified Oil Type.
- .4 CGSB 19-GP-5M - Sealing Compound, One Component, Acrylic Base, Solvent Curing.
- .5 CGSB 19-GP-14M - Sealing Compound, (1) Component, Butyl Polyisobutylene Polymer Base, Solvent Curing, CGSB 19-GP-17M- Sealing Compound, (1) Component, Acrylic Emulsion Base.
- .6 CGSB 19-GP-18M - Sealing Compound, One Component, Silicone Base, Solvent Curing.
- .7 CGSB 19-GP-21M - Sealing and Bedding Compound for Acoustical Purposes.
- .8 CGSB 19-GP-22M - Sealing Compound, Mildew Resistant, for Tubs and Tile.
- .9 CGSB 19-GP-23 - Guide to the Selection of Sealants on a Use Basis.
- .10 Sealant and Waterproofers Institute - Sealant and Caulking Guide Specification.

1.4 Quality Assurance

- .1 Manufacturer: Company specializing in manufacturing the products specified in this Section with three years documented experience.
- .2 Applicator: Company specializing in applying the work of this Section with three years documented experience.
- .3 Conform to Sealant and Waterproofers Institute requirements for installation & CGSB 19-GP-24.

1.5 Installation Instructions

- .1 Submit manufacturer's installation requirements of Section 016000.
- .2 Submit surface preparation instructions.

1.6 Environmental Requirements

- .1 Perform work to requirements of Section 015000.
- .2 Do not install solvent curing sealants in enclosed building spaces.
- .3 Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
- .4 Sealant and Substrate materials to be minimum 5°C

1.7 Coordination

- .1 Coordinate work with other trades.
- .2 Coordinate the work of this Section with all Sections referencing this Section.

1.8 Warranty

- .1 Provide a warranty under provisions of PWGSC General Procedures and Standards.
- .2 Warranty includes: Coverage of installed sealants and accessories which fail to achieve air tight

and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 Sealants

- .1 Acrylic Sealant Type A: CGSB 19-GP-5M, Single component, solvent curing, non-staining, non-bleeding, non-sagging, color as selected. Tremco 830
Elongation Capability 7.5 to 12%
Service Temperature Range -25 to 82° C
Shore A Hardness Range 25 to 50
- .2 Butyl Sealant Type B: CGSB 19-GP-14M, Single component, solvent release, non-skinning, non-sagging, butyl-polybutylene compound, black color, Tremco Butyl Sealant.
- .3 Acoustical Sealant Type C: CGSB 19-GP-21M, single component, non-skinning, high solids content, synthetic rubber, non-corrosive to metals or concrete, non-sagging, color as selected to match adjacent materials. Tremco Acoustical Sealant.
- .4 Polyurethane Sealant Type D: CGSB CAN 19. 13-M 87, Single component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging, self leveling type, color as selected. Dymonic manufactured by Tremco, Perma Pol RC-1 manufactured by P.R.C. Canada, NP1 manufactured by Sonneborn.
Elongation Capability 25%
Service Temperature Range -40 to 80° C
Shore A Hardness Range 20 to 35
- .5 Polyurethane Sealant Type E: CGSB CAN 2-19.24-M 80 Multi-component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging, self-leveling Type, color as selected. Dymeric manufactured by Tremco, Perma Pol RC-2 manufactured by P.R. C. Canada, NP2 manufactured by Sonneborn.
Elongation Capability 25%
Service Temperature Range -40 to 82° C
Shore A Hardness Range 20 to 35
- .6 High Density Polyurethane Foam combined with Latex Modified Asphalt Type F: Emseal Manufactured by Emseal Corporation.
- .7 Silicone Sealant Type G: CGSB 19-GP-18M, Single component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding, color as selected. 786 manufactured by Dow Corning; Proglaze manufactured by Tremco.
Elongation Capability 25%
Service Temperature Range -54 to 82° C
Shore A Hardness Range 15 to 35
- .8 Silicone Sealant Type H: CGSB 19-GP-22M, Single component, fungus resistant, chemical curing, non-sagging, non-staining, non-bleeding, color as selected. 796 manufactured by Dow Corning.
Elongation Capability 25%
Service Temperature Range -54 to 82° C
Shore A Hardness Range 15 to 35

2.2 Accessories

- .1 Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- .2 Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- .3 Joint Backing: ASTM D1056 D1565; round, open cell polyethylene foam rod; oversized 30 to

50% larger than joint width; Shore A hardness 10, tensile strength 140 to 100 KPa; Sof-Rod manufactured by Tremco.

- .4 Bond Breaker: Pressure sensitive type recommended by sealant manufacturer.

PART 3 EXECUTION

3.1 Inspection

- .1 Verify that surfaces, joint openings are ready to receive work and field measurements are as shown on drawings and recommended by manufacturer.
.2 Beginning of installation means acceptance of substrate

3.2 Preparation

- .1 Clean and prime joints in accordance with manufacturer's instructions.
.2 Remove loose materials and foreign matter, which might impair adhesion of sealant.
.3 Verify that joint backing and release tapes are compatible with sealant.
.4 Prepare in accordance with ASTM C804 for solvent release and C790 for latex base sealants.
.5 Protect elements surrounding the work of this Section from damage or disfiguration.

3.3 Installation

- .1 Install sealant in accordance with manufacturer's instructions.
.2 Measure joint dimensions and size materials to achieve required width/depth ratios.
.3 Install joint backing to achieve a neck dimension no greater than 1/3 the joint width.
.4 Install bond breaker where joint backing is not used.
.5 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
.6 Install sealant free of air pockets, other embedded matter, ridges, & sags, & tool joints concave.

3.4 Cleaning and Repairing

- .1 Clean Work under provisions of 017000.
.2 Clean adjacent soiled surfaces.
.3 Repair or replace defaced or disfigured finishes caused by work of this Section.

3.5 Protection of Completed Work

- .1 Protect finished installation and adjacent work to requirements of Section 016000.
.2 Protect sealants until cured.

3.6 Schedule

	Location	Type	Colour
.1	Interior Demising Walls	A	to be determined
.2	Poly Vapor Retarder	A	to be determined

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

- .1 Surface preparation.
- .2 Surface finish (see drawings).

1.2 Related Sections

- .1 Section 051200 – Structural Steel: Shop primed items.

1.3 References

- .1 ASTM D2016 - Moisture Content of Wood.
- .2 CPCA (Canadian Painting Contractors Association) - Painting Manual.

1.4 Quality Assurance

- .1 Product Manufacturer: Company specializing in manufacturing quality paint and finish products with five (5) years experience.
- .2 Applicator: Company specializing in commercial painting and finishing with three (3) years documented experience, approved by product manufacturer.
- .3 Perform Work in accordance with Master Painters Institute's Architectural Painting and Specification Manual and the MPI Maintenance Repainting Manual.

1.5 Regulatory Requirements

- .1 Conform to applicable codes for flame/fuel/smoke rating requirements for finishes.

1.6 Certifications

- .1 Submit manufacturer's certificate to requirements of Section 016000 that products meet or exceed specified requirements.

1.7 Product Data

- .1 Submit product data to requirements of Section 013300.
- .2 Provide product data on all finish products.

1.8 Installation Instructions

- .1 Submit manufacturer's installation instructions to requirements of Section 016000.

1.9 Operation and Maintenance Data

- .1 Submit operation and maintenance data to requirements of Section 013300.
- .2 Include special cleaning instructions, and stain removal guidelines.

1.10 Delivery, Storage, and Handling

- .1 Deliver products to site to requirements of Section 016000.
- .2 Store and protect products to requirements of Section 016000.
- .3 Accept products on site in sealed and labelled containers and verify no damage.
- .4 Container labelling to include manufacturer's name, type of paint, brand name, colour designation and instructions for mixing and reducing.
- .5 Store paint materials at minimum ambient temperature of 7 degrees C, in well ventilated area.
- .6 Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.11 Protection of Surrounding Elements

- .1 Provide protection in accordance with Section 016000.
- .2 Protect elements surrounding the work of this section from damage.

1.1.2 Environmental Requirements

- .1 Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 7 degrees C for 24 hours before, during and 48 hours after application of finishes.
- .2 Provide minimum 270 lx of lighting surfaces to be finished.

1.1.3 Maintenance Materials

- .1 Provide maintenance materials to requirements of Section 017413.
- .2 Provide one container of each colour to Owner.
- .3 Label each container with colour, texture, and room locations.

PART 2 PRODUCTS

2.1 Acceptable Manufacturers - Paint

- .1 Benjamin-Moore.
- .2 General Paint.
- .3 Glidden Co. Ltd.
- .4 Sherwin Williams Company of Canada.

2.2 Acceptable Manufacturers -- Primers and Sealers

- .1 Benjamin-Moore.
- .2 General Paint.
- .3 Glidden Co. Ltd.
- .4 Sherwin Williams Company of Canada.

2.3 Materials (Note: not all materials listed may be used on this project).

- .1 Paints: Ready mixed except field catalysed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
- .2 Paints: Good flow and brushing properties; capable of drying or curing free of streaks or sags.
- .3 Paint Accessory Materials: Linseed oil, shellac, turpentine, and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

PART 3 EXECUTION

3.1 Inspection

- .1 Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.
- .2 Examine surfaces scheduled to be finished, prior to commencement of work. Report any condition that may potentially affect proper application.
- .2 Verify substrate surface temperature and ambient air temperature is above 5° C before applying finishes.
- .3 Minimum Application Temperatures for Latex Paints: Interiors 7° C. Exterior 50° F 10° C.
- .4 Minimum Application Temperature for Varnish and Finishes: 18° C.
- .5 Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture contents of surfaces are below the following maximums:
 - .1 Concrete Floors: 12 percent.
 - .2 Beginning of installation means acceptance of existing surfaces.

3.2 Preparation

- .1 Correct minor defects and deficiencies in surfaces, which affect work of this section.
- .2 Impervious Surfaces: Remove mildew by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- .3 Concrete Floors: Remove contamination and acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- .4 Gypsum Board Surfaces: Remove contamination and prime paint to identify minor defects. Prime paint after defects have been remedied.
- .5 Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- .6 Steel and Iron Surfaces: Remove grease, rust, scale, dirt, and rust. Where heavy coatings of scale are evident, removed by wire brushing, sandblasting.
- .7 Un-Primed Steel Surfaces: Clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts and nuts are similarly cleaned. Prime surfaces to identify defects. Prime paint after defects have been remedied.
- .8 Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

3.3 Application

- .1 Apply products in accordance with manufacturer's instructions. Workmanship to be in accordance with CPCA Architectural Planning Specification Manual. Colors as selected by the Owner, and materials to be new, in unopened containers. Apply one coat of primer and two finish coats.
- .2 Apply each coat to smooth consistency.
- .3 Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- .4 Sand lightly between coats to achieve required finish.
- .5 Do not apply finishes to surfaces that are not dry.
- .6 Allow applied coat to dry before next coat is applied.

3.4 Mechanical and Electrical Equipment

- .1 Refer to Divisions 22-23 - Mechanical and Division 26 - Electrical for schedule of painting and finishing requirements, colour coding, identification banding of equipment, ducting, piping, and conduit.
- .2 Remove finished louvers, grilles, covers, and access panels on mechanical and electrical components from location and paint separately. Finish paint primed equipment to colour as selected.
- .3 Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are pre-finished.
- .4 Replace identification markings on mechanical or electrical equipment when painted accidentally.
- .5 Paint interior surfaces of air ducts, convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvers, grilles, convector and baseboard cabinets to match face panels.
- .6 Paint exposed conduit and electrical equipment occurring in finished areas. Colour and texture to match adjacent surfaces.
- .7 Paint both sides and edges of plywood backboards for electrical equipment before installing equipment.
- .8 Colour code equipment, piping, conduit, and exposed ductwork in accordance with requirements indicated.
- .9 Replace electrical plates, hardware and fittings removed prior to painting.
- .10 Where exposed, painted structure is specified for interior floor and ceiling finishes, all piping,

ducting, wiring, HVAC diffusers, and conduit to be installed neatly and painted with ceiling color specified.

3.5 Protection

- .1 Protect other surfaces from paint or damage. Repair damage.
- .2 Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
- .3 Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.6 Cleaning

- .1 As work proceeds, promptly remove paint where spilled, splashed, or spattered.
- .2 During progress of work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials and debris.

3.7 Schedule Exterior Surfaces

- .1 Steel - unprimed
 - .1 One coat zinc chromate primer.
 - .2 Two coats alkyd enamel, semi-gloss.
- .2 Steel - shop primed
 - .1 Touch up with zinc chromate primer.
 - .2 Two coats alkyd enamel, semi-gloss.
- .3 Steel galvanized
 - .1 One coat zinc chromate primer.
 - .2 Two coats alkyd enamel, semi-gloss.

3.8 Schedule - Interior Surfaces

- .1 Steel unprimed
 - .1 One coat zinc chromate primer.
 - .2 Two coats alkyd enamel, semi-gloss.
- .2 Steel primed
 - .1 Touch up with zinc chromate primer.
 - .2 Two coats alkyd enamel, semi-gloss.
- .3 Steel galvanized
 - .1 One coat zinc chromate primer.
 - .2 Two coats alkyd enamel, semi-gloss.
- .4 Concrete floors (only if called out specifically in the drawings finish schedule)
 - .1 One coat floor enamel thinned 15 percent.
 - .2 Two coats alkyd floor enamel catalyzed epoxy enamel, gloss.
- .5 Plaster, Gypsum Board
 - .1 One coat latex primer sealer.
 - .2 Two coats latex eggshell.
- .6 Plaster, Gypsum Board
 - .1 One Coat Primer (by Contractor)
 - .2 Two Coats Alkyd Eggshell enamel. Benjamin Moore 264 Vol-Pro. (By Others)
- .7 Concrete Block (if any), Concrete
 - .1 One coat block filler.
 - .2 One coat latex sealer.
 - .3 Two coats latex eggshell.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in the Province of Work.
- .3 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .4 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .5 Closeout Submittals:
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Consultant before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.

- .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
 - .1 Submit 3 copies of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
 - .2 Make changes as required and re-submit as directed by Consultant.
- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
 - .1 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.
 - .2 Transfer information 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.
- .9 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Consultant for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 014000 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.3 MAINTENANCE
NOT USED.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

- .1 Construction/Demolition Waste Management and Disposal: separate waste materials in accordance with Section 017419-Construction/Demolition Waste Management and Disposal.

Part 2 Products

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
.2 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 014000 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
.2 Manufacturer's Field Services:
.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

- .1 Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
.2 Trial usage to apply to all equipment and systems.

- .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 drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.

3.5 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 The installation of drainage waste and vent piping.

.2 Related Sections:

.1 Section 017419 - Construction/Demolition Waste Management And Disposal.

.2 Section 013530 - Health and Safety Requirements.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM B32, Specification for Solder Metal.

.2 ASTM B306, Specification for Copper Drainage Tube (DWV).

.3 ASTM C564, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.2 Canadian Standards Association (CSA International).

.1 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.

.2 CAN/CSA-B12, Plumbing Fittings.

1.3 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.4 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:

.1 Separate and recycle waste materials in accordance with Section 017419 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 COPPER TUBE AND FITTINGS

.1 Above ground sanitary Type DWV to: ASTM B306.

.1 Fittings.

- .1 Cast brass: to CAN/CSA-B125.
- .2 Wrought copper: to CAN/CSA-B125.

- .2 Solder: lead free, tin 95:5.

2.3 CAST IRON PIPING AND FITTINGS

- .1 Above ground sanitary: to CAN/CSA-B70.

- .1 Joints.

- .1 Hub and spigot.

- .1 Caulking lead: to CSA B67.

- .2 Mechanical joints.

- .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

Part 3 Execution

3.1 INSTALLATION

- .1 In accordance with Section 230501 - Installation of Pipework.
- .2 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.

3.2 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.3 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 The installation of drainage waste and venting piping – plastic.

.2 Related Sections:

.1 Section 017419 – Construction/Demolition Waste Management And Disposal.

.2 Section 013530 – Health and Safety Requirements.

.3 Section 230501 – Installation of Pipework.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM D2235, Specification for Solvent Cement for Acrylonitrille-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

.2 ASTM D2564, Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.

.2 Canadian Standards Association (CSA International).

.1 CSA-Series B1800, Plastic Nonpressure Pipe Compendium.

.2 CSA-B181.2, PVC Drain, Waste and Vent Pipe and Pipe Fittings.

.3 CSA-B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.

1.3 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/ Demolition Waste Management And Disposal.

Part 2 Products

2.1 PIPING AND FITTINGS

.1 For buried and or above ground DWV piping to:

.1 CSA-B181.1.

.2 CSA-B181.2.

.3 CSA-B182.1.

2.2 JOINTS

- .1 Solvent weld for PVC: to ASTM D2564.
- .2 Solvent weld for ABS: to ASTM D2235.

Part 3 Execution

3.1 INSTALLATION

- .1 In accordance with Section 230501 - Installation of Pipework.

Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.

3.2 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.3 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
- .3 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .4 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, Consultant before final inspection.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .4 Maintenance data to include:

- .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
- .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 230593 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
 - .1 Submit 3 copies of draft Operation and Maintenance Manual Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
 - .2 Make changes as required and re-submit as directed by Consultant.
- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
 - .1 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.
 - .2 Transfer information 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.

- .9 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Consultant for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 014000 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.3 MAINTENANCE

- .1 Furnish spare parts as follows:
 - .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
 - .2 Provide one set of special tools required to service equipment as recommended by manufacturers.
 - .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Waste Management and Disposal: separate waste materials in accordance with Section 017419 - Waste Management and Disposal

Part 2 Products

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 014000 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

- .1 Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to all equipment and systems:
- .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 drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.

3.5 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Use of mechanical systems during construction.

1.2 USE OF SYSTEMS

.1 Use of new permanent heating and or ventilating systems for supplying temporary heat or ventilation is permitted only under following conditions:

- .1 Building has been closed in areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
- .2 There is no possibility of damage.
- .3 Supply ventilation systems are protected by 60% filters, inspected daily, changed every week 2 weeks or more frequently as required.
- .4 Return systems have approved filters over openings, inlets, outlets.
- .5 Systems will be:
 - .1 Operated as per manufacturer's recommendations and instructions.
 - .2 Operated by Contractor.
 - .3 Monitored continuously by Contractor.
- .6 Warranties and guarantees are not relaxed.
- .7 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense.
- .8 Refurbish entire system before static completion; clean internally and externally, restore to "as-new" condition, replace filters in air systems.

.2 Filters specified in this Section are over and above those specified in other Sections of this project.

.3 Exhaust systems are not included in approvals for temporary heating ventilation.

Part 2 Products

Part 3 Execution

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 017419 - Waste Management And Disposal.
- .2 Section 017413 - Cleaning.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 017419 - Waste Management And Disposal.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 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.

3.2 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.3 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.

- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

- .1 Install air vents at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.5 DIELECTRIC COUPLINGS

- .1 General: Compatible with system, to suit pressure rating of system.
- .2 Locations: Where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: Isolating flanges.

3.6 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape.
- .2 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 the 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.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

- .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 otherwise indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use ball valves at branch take-offs for isolating purposes except where otherwise specified.
- .15 Check Valves:
 - .1 Install silent check valves on discharge of pumps.
 - .2 Install swing check valves in horizontal lines on discharge of pumps.

3.7 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm 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 25 mm 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: Provide space for firestopping. 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.

3.8 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.9 PREPARATION FOR FIRESTOPPING

- .1 Uninsulated unheated pipes not subject to movement: No special preparation.
- .2 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .3 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.10 FLUSHING OUT OF PIPING SYSTEMS

- .1 Before start-up, clean interior of piping systems in accordance with requirements of Section 017413 – Cleaning.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Piping: Test as specified in relevant specification sections.
- .2 Maintain specified test pressure without loss for 2 hours minimum unless specified for longer period of time.
- .3 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .4 Pay costs for repairs or replacement, retesting, and making good.
- .5 Insulate or conceal work only after approval and certification of tests.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Electrical motors, drives and guards for mechanical equipment and systems.
 - .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
 - .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals

- .1 Provide maintenance data for motors, drives and guards for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Waste Management and Disposal: separate waste materials in accordance with Section 017419 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 373 W: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120V, 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, 575 V, unless otherwise indicated.

2.3 TEMPORARY MOTORS

- .1 If delivery of specified motor will delay completion or commissioning work, install motor 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 7.5 kW: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

- .4 For motors 7.5 kW 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.
- .8 Supply one set of spare belts for each set installed.

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 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm dia holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.-
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

3.3 FIELD QUALITY CONTROL

- .1 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.

3.4 CLEANING

- .1 Proceed in accordance with Section 017413 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
- .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
- .1 ANSI/ASME B31.1, Power Piping.
- .2 American Society for Testing and Materials International (ASTM)
- .1 ASTM A125, Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563, Specification for Carbon and Alloy Steel Nuts.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
- .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 ANSI/MSS SP69, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Underwriter's Laboratories of Canada (ULC)

1.3 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.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 013300 - Submittal Procedures.
- .2 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .3 Quality assurance submittals: submit following in accordance with Section 013300 – Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual.

1.5 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Waste Management and Disposal: separate waste materials in accordance with Section 017419 - Waste Management and Disposal.

Part 2 Products

2.1 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.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use electro-plating galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment to concrete:
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.
- .3 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies.
 - .2 Steel brackets.
- .4 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.
 - .3 Do not use 22 mm or 28 mm rod.
- .5 Pipe attachments: material to MSS SP58:
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.

- .6 Adjustable clevis: material to MSS SP69 UL listed, 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.
- .7 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .8 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated.
- .9 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.3 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

- .1 NOT USED.

2.5 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.9 PLATFORMS AND CATWALKS

- .1 To Section 05 50 00 - Metal Fabrications.

2.10 HOUSE-KEEPING PADS

- .1 NOT USED.

2.11 OTHER EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports from structural grade steel.
- .2 Submit structural calculations with shop drawings.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.

- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm or more,
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

- .1 Plumbing piping: to Canadian Plumbing Code, Provincial Code and authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS up to 1-1/4	Maximum Spacing Steel 2.1 m	Maximum Spacing Copper 1.8 m
1-1/2	2.7 m	2.4 m

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m
5	4.8 m	
6	5.1 m	
8	5.7 m	
10	6.6 m	
12	6.9 m	

.7 Pipework greater than NPS 12: to MSS SP69.

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:

- .1 Hammer jaw firmly against underside of beam.

3.7 FIELD QUALITY CONTROL

- .1 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Vibration isolation materials and components, seismic control measures and their installation.

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

.2 National Fire Protection Association (NFPA)

- .1 NFPA 13, Standard for the Installation of Sprinkler Systems.

.3 National Building Code of Canada (NBC).

1.3 SUBMITTALS

.1 Submittals: in accordance with Section 013300 - Submittal Procedures.

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

- .1 Submit of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 013300 - Submittal Procedures.

.2 Submit shop drawings in accordance with Section 013300 - Submittal Procedures.

.3 Quality assurance submittals: submit following in accordance with Section 013300 - Submittal Procedures.

- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .2 Instructions: submit manufacturer's installation instructions.

- .3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

- .1 Do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Waste Management and Disposal: separate waste materials in accordance with Section 017419 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 ELASTOMERIC PADS

- .1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.
- .2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
- .3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
- .4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 ELASTOMERIC MOUNTS

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 SPRINGS

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Cadmium plate for 100% relative humidity installations.

.4 Colour code springs.

2.5 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

2.6 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with pre-compression washer and nut with deflection indicator.

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.

2.8 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.

2.9 STRUCTURAL BASES

- .1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.
- .2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.
- .3 Bases to clear housekeeping pads by 25 mm minimum.

2.10 INERTIA BASE

- .1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gusseted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.
- .2 Pump bases: "T" shaped, where applicable, to provide support for elbows.

2.11 ROOF CURB ISOLATION RAILS

- .1 General: complete factory assembled.
- .2 Lower member: continuous rectangular steel tube or extruded aluminum channel.
- .3 Upper member: continuous rectangular steel tube or extruded aluminum channel to provide continuous support for equipment, complete with all-directional neoprene snubber bushings 6 mm thick to resist wind and seismic forces.
- .4 Springs: steel, adjustable, removable, selected for 25 mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.
- .5 High frequency isolation: 6 mm minimum thick continuous gasket on top and bottom of complete assembly or pads on top and bottom of each spring. Material: closed cell neoprene.
- .6 Weatherproofing: continuous flexible counterflashing to curb and providing access to springs. Material: neoprene.
- .7 Hardware: cadmium plated or galvanized.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 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 CLEANING

- .1 Proceed in accordance with Section 017413 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 REFERENCES

.1 Canadian Gas Association (CGA)

- .1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
- .2 CAN/CGSB-24.3, Identification of Piping Systems.

.3 National Fire Protection Association (NFPA)

- .1 NFPA 13, Standard for the Installation of Sprinkler Systems.

1.3 SUBMITTALS

.1 Product Data:

.2 Submittals: in accordance with Section 013300 - Submittal Procedures.

.3 Product data to include paint colour chips, other products specified in this section.

.4 Samples:

- .1 Submit samples in accordance with Section 013300 - Submittal Procedures.
- .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 013300 - Submittal Procedures.

.2 Health and Safety:

- .1 Do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Waste Management and Disposal: separate waste materials in accordance with Section 017419 - Waste Management and Disposal.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: use size # 5.

.2 Equipment in Mechanical Rooms: use size # 9.

.5 Identification:

.1 Use arrangement of Main identifier, Source identifier, Destination identifier.

.2 Equipment in Mechanical Room:

.1 Main identifier: size #9.

.2 Source and Destination identifiers: size #6.

.3 Terminal cabinets, control panels: size #5.

.3 Equipment elsewhere: sizes as appropriate.

2.3 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural gas: to CSA/CGA B149.1.

.2 Sprinklers: to NFPA 13.

2.4 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

- .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 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.
- .7 Colours and Legends:
 - .1 Where not listed, obtain direction from Consultant.
 - .2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

- .3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Waste water	Green	WASTE WATER
Sanitary	Green	SAN

2.5 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.6 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.7 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

- .1 Provide identification only after painting has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and or CSA registration plates as required by respective agency.
- .3 Identify systems.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.7 CLEANING

- .1 Proceed in accordance with Section 017413 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.
- .2 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .3 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .4 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .5 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .6 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 and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 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 for verification of TAB reports.

1.9 START OF TAB

- .1 Start TAB when building is essentially completed, including:
- .2 Installation of ceilings, doors, windows, other construction affecting TAB.
- .3 Application of weatherstripping, sealing, and caulking.

- .4 Pressure, leakage, other tests specified elsewhere Division 23.
- .5 Provisions for TAB installed and operational.
- .6 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.
 - .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5%, minus 5%.

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 TAB REPORT

- .1 Format in accordance with standard.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.

- .2 System schematics.
- .3 Submit 3 copies of TAB Report to Consultant for verification and approval, in English in D-ring binders, complete with index tabs.

1.14 SETTINGS

- .1 After TAB is completed, 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.

1.15 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Consultant.

1.16 AIR SYSTEMS

- .1 Standard: TAB to most stringent of TAB standards of AABC, NEBB or SMACNA.
- .2 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB qualified to standards of AABC or NEBB.
- .3 Quality assurance: perform TAB under direction of supervisor qualified 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).

1.17 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for air systems specified this section.
 - .2 Quality assurance: as for air systems specified this section.
- .2 Building pressure conditions:
 - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions during design conditions.

.3 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.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 013300 - Submittal Procedures.
- .2 Section 017419 - Waste Management And Disposal.
- .3 Section 230529 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C547, Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701, Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.3 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein.

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.5 SAMPLES

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.6 MANUFACTURERS' INSTRUCTIONS

.1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.

.2 Installation instructions to include procedures used, and installation standards achieved.

1.7 QUALIFICATIONS

.1 Installer: specialist in performing work of this section.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Protect from weather and construction traffic.

.3 Protect against damage from any source.

.4 Store at temperatures and conditions recommended by manufacturer.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 In accordance with Section 017419 - Waste Management And Disposal.

Part 2 Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102:
 - .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°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to ASTM C553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

- .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: Compatible with insulation.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.

- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .5 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .6 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .7 Contact adhesive: quick-setting
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation.
- .12 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of ductwork systems complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

- .6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses:
- .1 Supply and return air plenums of HVAC units – internal – 25mm
 - .2 Fresh air intakes – 50mm
 - .3 Exterior supply and return ductwork – 75mm with stucco embossed aluminum jacket
 - .4 Refrigerant piping – Armaflex – as per manufacturer’s specifications and requirements

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for copper tubing and fittings for refrigerant.
- .2 Related Sections:
 - .1 Section 013300 - Submittal Procedures.
 - .2 Section 013530 - Health and Safety Requirements.
 - .3 Section 017419 - Waste Management and Disposal.
 - .4 Section 230501 - Installation of Pipework.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .2 ASME B16.24, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .3 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5, Refrigeration Piping and Heat Transfer Components.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B52, Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
 - .1 EPS 1/RA/1, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
- .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 In accordance with Section 017419 - Waste Management and Disposal.

Part 2 Products

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B280.
 - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121 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 22 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 22 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.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 GENERAL

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 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 or hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Hot gas lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
 - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
 - .3 Provide inverted deep trap at top of risers.
 - .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified.
 - .2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

3.5 PRESSURE AND LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.

- .3 Test Procedure: build pressure up to 35 kPa 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 5Pa absolute and filled with dehydrated oil.
 - .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
 - .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
 - .1 Twice to 14 Pa absolute and hold for 4 h.
 - .2 Break vacuum with refrigerant to 14 kPa.
 - .3 Final to 5 Pa absolute and hold for at least 12 h.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .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 Make checks and measurements as per manufacturer's operation and maintenance instructions.

- .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.

3.7 DEMONSTRATION

- .1 Instructions:
 - .1 Post instructions in frame with glass cover in accordance with CSA B52.

3.8 CLEANING

- .1 Perform cleaning operations and in accordance with manufacturer's recommendations.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

.2 Related Sections:

- .1 Section 013300 - Submittal Procedures.
- .2 Section 013530 - Health and Safety Requirements.
- .3 Section 017419 - Waste Management and Disposal.
- .4 Section 230529 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials International, (ASTM).

- .1 ASTM A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
- .2 ASTM A635/A635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
- .3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

- .1 Material Safety Data Sheets (MSDS).

.4 National Fire Protection Association (NFPA).

- .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
- .2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.

.2 SMACNA HVAC Air Duct Leakage Test Manual.

.3 IAQ Guideline for Occupied Buildings Under Construction.

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 – Submittals, for the following:

.1 Sealants.

.2 Tape.

.3 Proprietary Joints.

.3 Co-ordinate submittal requirements and provide submittals.

.4 Submit Indoor Air Quality (IAQ) Management Plan.

1.4 QUALITY ASSURANCE

.1 Certification of Ratings:

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

.3 Indoor Air Quality (IAQ) Management Plan.

.1 Develop and implement an Indoor Air Quality (IAQ) Management Plan for construction and preoccupancy phases of building.

.2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

.2 Waste Management and Disposal:

- .1 In accordance with Section 014719 - Waste Management and Disposal.

Part 2 Products

2.1 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.

2.2 SEALANT

- .1 Sealant: water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.
- .1 Rectangular: Centreline radius: 1.5 times width of duct.
- .2 Round: Centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:

- .1 To 400 mm: with double thickness turning vanes.
- .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct.
 - .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 splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 Full radiused elbows.

2.6 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation.
- .2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.
- .4 Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.8 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Strap hangers: of same material as duct.
 - .1 Maximum size duct supported by strap hanger: 500.
 - .2 Hanger configuration: to SMACNA.

- .3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA and the following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .4 Upper hanger attachments:

- .1 For concrete: manufactured concrete inserts.
- .2 For steel joist: manufactured joist clamp.
- .3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct.
- .3 Support risers in accordance with SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA and as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Fresh air intake.

.2 Form bottom of horizontal duct without longitudinal seams.

.1 Solder joints of bottom and side sheets.

.2 Seal other joints with duct sealer.

3.4 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.

3.5 LEAKAGE TESTS

.1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.2 Do leakage tests in sections.

.3 Make trial leakage tests as instructed to demonstrate workmanship.

.4 Do not install additional ductwork until trial test has been passed.

.5 Complete test before performance insulation or concealment Work.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Materials and performance criteria for sound attenuation for mechanical systems.

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, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

- .2 ASTM C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

- .3 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

- .4 ASTM E477, Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

.4 National Building Code (NBC).

.5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.3 SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 In accordance with Section 017419 - Waste Management and Disposal.

Part 2 Products

2.1 ABSORPTION AND INSULATING MEDIA

- .1 Acoustic quality, glass fibre, bacteria and fungus resistant; free of corrosion causing or accelerating agents; packed to density to meet performance requirements; and meet NBC fire requirements or requirements of authority having jurisdiction for duct lining.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 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 Instrument test ports: install at inlet and outlet to permit measurement of insertion loss and pressure loss.
- .3 Suspension: to manufacturer's instructions.

3.3 CLEANING

- .1 Proceed in accordance with Section 017413 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

.2 Related Sections:

- .1 Section 013300 - Submittal Procedures.
- .2 Section 013530 - Health and Safety Requirements.
- .3 Section 014500 - Quality Control.
- .4 Section 017419 - Waste Management and Disposal.

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

- .1 Material Safety Data Sheets (MSDS).

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

- .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.3 SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:

- .1 Flexible connections.
- .2 Duct access doors.
- .3 Turning vanes.
- .4 Instrument test ports.

- .2 Submit WHMIS MSDS in accordance with Section 01 33 00 – Submittal Procedures. Indicate VOC's for adhesive and solvents during application and curing.

- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

- .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's Field Reports: manufacturer's field reports specified.
- .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting prior to beginning work of this.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 In accordance with Section 017419 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame 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/m².

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks.
 - .2 301 to 450 mm: four sash locks.
 - .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.

2.4 TURNING VANES

- .1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and 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 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

- .1 Ducting on sides of flexible connection to be in alignment.
- .2 Ensure slack material in flexible connection.

.2 Access Doors and Viewing Panels:

.1 Locations:

- .1 Fire and smoke dampers.
- .2 Control dampers.
- .3 Devices requiring maintenance.
- .4 Required by code.
- .5 Reheat coils.
- .6 Elsewhere as indicated.

- .3 Instrument Test Ports:
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 At inlet and outlet of coils.
 - .3 Downstream of junctions of two converging air streams of different temperatures.
 - .4 And as indicated.
- .4 Turning vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

- .1 Perform cleaning operations as specified and in accordance with manufacturer's recommendations.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)

- .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 013300 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

1.4 QUALITY ASSURANCE

.1 Health and Safety Requirements:

- .1 Do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

- .1 In accordance with Section 017419 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

- .2 Double thickness construction.
- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: piano hinge.
- .6 Folded leading edge.

2.3 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm.
- .4 Bearings: pin in bronze bushings.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible.
- .7 Corrections and adjustments conducted by Engineer.

3.3 CLEANING

- .1 Proceed in accordance with Section 017413 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Operating dampers for mechanical forced air ventilation and air conditioning systems.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

- .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

- .1 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 013300 - Submittal Procedures.

.2 Indicate the following:

- .1 Performance data.

.2 Quality assurance submittals: submit following in accordance with Section 013300 - Submittal Procedures.

- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Closeout Submittals

- .1 Provide maintenance data for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.
- .2 Certificates:
 - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 In accordance with Section 017419 - Waste Management and Disposal.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

- .1 Opposed and or parallel blade type as indicated.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Performance:
 - .1 Leakage: in closed position less than 2% of rated air flow at differential across damper.
- .6 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

2.2 DISC TYPE DAMPERS

- .1 Frame: brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A653/A653M.
- .2 Disc: spin formed, 1.6 mm thick, galvanized steel to ASTM A653/A653M.
- .3 Gasket: extruded neoprene, field replaceable, with 10 year warranty.

- .4 Bearings: roller self lubricated and sealed.
- .5 Operator: compatible with damper, linear stroke operator, actuator, zinc-aluminum foundry alloy casting cam follower.
- .6 Performance:
 - .1 Leakage: in closed position less than 0.001 % of rated air flow.

2.3 BACK DRAFT DAMPERS

- .1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, centre pivoted, spring assisted or counterweighted.

2.4 RELIEF DAMPER

- .1 Automatic multi-leaf aluminum dampers with ball bearing centre pivoted and counter-weights.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 233300 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

3.3 CLEANING

- .1 Proceed in accordance with Section 017413 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Fire and smoke dampers, and fire stop flaps.

1.2 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

- .1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

.3 Underwriters Laboratories of Canada (ULC)

- .1 CAN4-S112, Fire Test of Fire Damper Assemblies.
- .2 CAN4-S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
- .3 ULC-S505, Fusible Links for Fire Protection Service.

1.3 SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 013300 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

- .1 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 013300 - Submittal Procedures.

.2 Indicate the following:

- .1 Fire dampers.
- .2 Smoke dampers.
- .3 Fire stop flaps.
- .4 Operators.
- .5 Fusible links.
- .6 Design details of break-away joints.

- .2 Quality assurance submittals: submit following in accordance with Section 013300 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.
- .2 Certificates:
 - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials.
 - .2 Provide following:
 - .1 6 fusible links of each type.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 In accordance with Section 017419 - Waste Management and Disposal.

Part 2 Products

2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement Type A B C, listed and bear label of ULC UL - Warnock Hersey, meet requirements of provincial fire authority, ANSI/NFPA 90A and authorities having jurisdiction. Fire damper assemblies fire tested in accordance with CAN4-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
 - .1 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; roll door type; sized to maintain full duct cross section.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

2.2 SMOKE DAMPERS

- .1 Smoke Dampers: to be ULC or UL listed and labelled.
- .2 Normally closed reverse action smoke vent (S/D-RASV): folding blade type, opening by gravity upon detection of smoke, and/or from remote alarm signalling device actuated by an electro thermal link. Two flexible stainless steel blade edge seals to provide required constant sealing pressure.

- .3 Normally open smoke/seal (S/D-SSSD): folding blade type, closing when actuated by means of electro thermal link and/or from remote alarm signalling device. Blade edge seals of flexible stainless steel to provide required constant sealing pressure. Provide stainless steel negator springs with locking devices to ensure positive closure for units mounted horizontally in vertical ducts.
- .4 Motorized (S/D-M): folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.
- .5 Electro thermal link (S/D-ETL): dual responsive fusible link which melts when subjected to local heat of 74 degrees C and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.

2.3 COMBINATION FIRE AND SMOKE DAMPERS

- .1 Damper: similar to smoke dampers specified above.
- .2 Combined actuator: electrical control system actuated from smoke sensor or smoke detection system and from fusible link.

2.4 FIRE STOP FLAPS

- .1 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN4-S112.2.
- .2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
- .3 Flaps held open with fusible link conforming to ULC-S505 and close at 74 degrees C.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Co-ordinate with installer of firestopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

3.3 CLEANING

- .1 Proceed in accordance with Section 017413 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation of flexible ductwork, joints and accessories.

.2 Related Sections:

.1 Section 013300 - Submittal Procedures.

.2 Section 013530 - Health and Safety Requirements.

.3 Section 017419 - Waste Management and Disposal.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.3 National Fire Protection Association (NFPA).

.1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.

.4 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.

.2 SMACNA IAQ Guideline for Occupied Buildings under Construction.

.5 Underwriters' Laboratories Inc. (UL).

.1 UL 181, Standard for Factory-Made Air Ducts and Air Connectors.

.6 Underwriters' Laboratories of Canada (ULC).

.1 CAN/ULC-S110, Fire Tests for Air Ducts.

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS for the following:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.
- .3 Samples: submit samples with product data of different types of flexible duct being used in accordance with Section 013300 - Submittal Procedures.

1.4 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Waste Management and Disposal:
 - .1 In accordance with Section 017419 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 METALLIC - UNINSULATED

.1 Type 1: spiral wound flexible aluminum, stainless steel.

.2 Performance:

.1 Factory tested to 2.5 kPa without leakage.

.2 Maximum relative pressure drop coefficient: 3.

2.3 METALLIC - INSULATED

.1 Type 2: spiral wound flexible aluminum with factory applied, 37 mm thick flexible glass fibre thermal insulation with vapour barrier and vinyl jacket, as indicated.

.2 Performance:

.1 Factory tested to 2.5 kPa without leakage.

.2 Maximum relative pressure drop coefficient: 3.

2.4 NON-METALLIC - UNINSULATED

.1 Type 3: non-collapsible, coated mineral base fabric type, mechanically bonded to, and helically supported by, external steel wire, as indicated.

.2 Performance:

.1 Factory tested to 2.5 kPa without leakage.

.2 Maximum relative pressure drop coefficient: 3.

2.5 NON-METALLIC - INSULATED

.1 Type 4: non-collapsible, coated mineral base fabric type mechanically bonded to, and helically supported by, external steel wire with factory applied, 37 mm thick flexible mineral fibre thermal insulation with vapour barrier and vinyl jacket, as indicated.

.2 Performance:

.1 Factory tested to 2.5 kPa without leakage.

.2 Maximum relative pressure drop coefficient: 3.

2.6 METALLIC ACOUSTIC INSULATED - MEDIUM PRESSURE

.1 Type 5: Spiral wound, flexible perforated aluminum with factory applied 37 mm thick flexible mineral fibre thermal insulation and sleeved Type M vapour barrier, as indicated.

.2 Performance:

- .1 Factory tested to 2.5 kPa without leakage.
- .2 Maximum relative pressure drop coefficient: 3.

2.7 METALLIC - ACOUSTIC INSULATED - HIGH PRESSURE

.1 Type 6: Spiral wound, flexible perforated aluminum with factory applied 37 mm thick flexible mineral fibre thermal insulation and encased in spiral wound flexible aluminum jacket, as indicated.

.2 Performance:

- .1 Factory tested to 2.5 kPa without leakage.
- .2 Maximum relative pressure drop coefficient: 3.

2.8 NON-METALLIC - ACOUSTIC INSULATED

.1 Type 7: non-collapsible, coated mineral base perforated fabric type helically supported by and mechanically bonded to steel wire with factory applied flexible mineral fibre acoustic insulation and encased Type M vapour barrier.

.2 Performance:

- .1 Factory tested to 2.5 kPa without leakage.
- .2 Maximum relative pressure drop coefficient: 3.

Part 3 Execution

3.1 DUCT INSTALLATION

.1 Install in accordance with: CAN/ULC-S110 and SMACNA.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for acoustic duct lining.

1.2 RELATED SECTIONS

- .1 Section 013300 - Submittal Procedures.
- .2 Section 013530 - Health and Safety Requirements.
- .3 Section 017419 - Waste Management and Disposal.

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .2 ASTM C916, Standard Specification for Adhesives for Duct Thermal Insulation.
 - .3 ASTM C1071, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - .4 ASTM C1338, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
 - .5 ASTM G21, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Fire Protection Association (NFPA).
 - .1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - .2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- .4 North American Insulation Manufacturers Association (NAIMA).
 - .1 NAIMA AH116, Fibrous Glass Duct Construction Standards.

- .5 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
 - .1 SMACNA, HVAC DCS, HVAC, Duct Construction Standards, Metal and Flexible.
 - .2 SMACNA IAQ Guideline for Occupied Buildings.
- .6 Underwriter's Laboratories of Canada (ULC).
 - .1 CAN/ULC-S102, Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 013300 - Submittal Procedures.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets.
- .3 Submit Indoor Air Quality (IAQ) Management Plan.

1.5 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 In accordance with Section 017419 - Waste Management and Disposal.

1.8 SUSTAINABLE REQUIREMENTS

- .1 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

Part 2 Products

2.1 DUCT LINER

- .1 Mineral Fibre duct liner: air surface coated mat facing.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102 and NFPA 90A.
- .3 Recycled Content: EcoLogo certified.
- .4 Fungi resistance: to ASTM C1338.
- .5 Rigid:

- .1 Use on flat surfaces.
 - .2 25 mm thick, to ASTM C1071, Type 2, fibrous glass rigid board duct liner.
 - .3 Density: 48 kg/m³ minimum.
 - .4 Thermal resistance to be minimum 0.76 (m².degrees C)/W for 25 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.
 - .5 Maximum velocity on faced air side: 20.3 m/sec.
 - .6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C423.
 - .7 Recycled Content: EcoLogo certified.
- .6 Flexible:
- .1 Use on round or oval surfaces.
 - .2 25 mm thick, to ASTM C1071, Type 1, fibrous glass blanket duct liner.
 - .3 Density: 24 kg/m³ minimum.
 - .4 Thermal resistance to be minimum 0.37 (m².degrees C)/W for 12 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.
 - .5 Maximum velocity on coated air side: 25.4 m/sec.
 - .6 Minimum NRC of 0.65 at 25 mm thickness based on Type A mounting to ASTM C423.

2.2 ADHESIVE

- .1 Adhesive: to ASTM C916.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 degrees C to plus 93 degrees C.
- .3 Water-based fire retardant type.

2.3 FASTENERS

- .1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Nylon retaining clips, 32 mm square.

2.4 JOINT TAPE

- .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

2.5 SEALER

- .1 Meet requirements of NFPA 90A and NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with SMACNA HVAC DCS.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.

3.2 DUCT LINER

- .1 Install in accordance with manufacturer's recommendations, and as follows:
 - .1 Fasten to interior sheet metal surface with 90% coverage of adhesive to ASTM C916.
 - .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.
 - .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres to compress duct liner sufficiently to hold it firmly in place.
 - .1 Spacing of mechanical fasteners in accordance with SMAC HVAC DCS. In systems, where air velocities exceeds 20.3 m/sec, install galvanized sheet metal nosing to leading edges of duct liner.

3.3 JOINTS

- .1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
 - .1 Bed tape in sealer.
 - .2 Apply two coats of sealer over tape.
- .2 Replace damaged areas of liner.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Fans, motors, accessories and hardware for commercial use.

1.2 REFERENCES

.1 Air Conditioning and Mechanical Contractors (AMCA)

- .1 AMCA Publication 99, 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, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
- .2 Capacity: flow rate, total static pressure, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
- .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .4 Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.
- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 013300 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 013300 - Submittal Procedures.

.2 Shop Drawings:

.1 Submit shop drawings and product data in accordance with Section 013300 - Submittal Procedures.

.3 Provide:

.1 Fan performance curves showing point of operation, BHP and efficiency.

.2 Sound rating data at point of operation.

.4 Indicate:

.1 Motors, sheaves, bearings, shaft details.

.5 Quality assurance submittals: submit following in accordance with Section 013300 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.6 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.6 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials.
 - .1 Spare parts to include:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 In accordance with Section 017419 - Waste Management and Disposal.

Part 2 Products

2.1 FANS GENERAL

- .1 Motors:
 - .1 In accordance with Section 230513 - Common Motors Requirements for HVAC Equipment.
 - .2 For use with variable speed controllers.
 - .3 Sizes as specified.
 - .4 Two speed with two windings.
- .2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and or outlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment inlet, outlet dampers and vanes and as indicated.
- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Scroll casing drains: as indicated.
- .5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.6 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.7 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 CENTRIFUGAL FANS

.1 Fan wheels:

.1 Welded aluminum construction.

.2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.

.2 Bearings: heavy duty grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 hours.

.3 Housings:

.1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, 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 bolted airtight access doors with handles.

2.3 CABINET FANS - GENERAL PURPOSE

.1 Fan characteristics and construction: as centrifugal fans.

.2 Cabinet hung single or multiple wheel with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators and seismic control measures, motor, V-belt drive and guard inside or outside casing.

.3 Fabricate casing of zinc coated or phosphate treated steel reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to CAN/CGSB 1.181. Finish inside and out, over prime coat, with rust resistant enamel. Internally line cabinet with 50 mm thick rigid acoustic insulation, pinned and cemented, kg/m³ density, complete with perforated metal liner.

2.4 PROPELLER FANS

.1 Fabricate multibladed propellers of sheet steel or aluminum of airfoil shape within bell mouth entrance on integral mounts, with grease lubricated ball bearings, with extended lubrication fittings, suited for operating in any position, belt driven, complete with motor as indicated.

.2 Provide blade guards, bird screen and automatic back draft dampers on discharge, with gasketed edges.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 233300 - 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.

3.4 CLEANING

- .1 Proceed in accordance with Section 017413 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents, intakes and gooseneck hoods.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
 - .1 ANSI/NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.3 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.4 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .2 Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 In accordance with Section 017419 - Waste Management and Disposal.

Part 2 Products

2.1 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS

- .1 Factory manufactured aluminum.
 - .1 Complete with integral birdscreen of 2.7 mm diameter aluminum wire.
 - .2 Backdraft dampers.
 - .3 Maximum throat velocity: 3.3 m/s intake.
 - .4 Maximum loss through unit: 15 Pa exhaust static pressure.
 - .5 Maximum velocity through damper area: 1.5 m/s.
- .2 Birdscreens:
 - .1 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 12 mm mesh on exhaust 19 mm mesh on intake.

2.2 GOOSENECK HOODS

- .1 Thickness: to SMACNA.
- .2 Fabrication: to SMACNA.
- .3 Joints: to SMACNA.
- .4 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 12 mm mesh on exhaust 19 mm mesh on intake.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 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.

3.3 CLEANING

- .1 Proceed in accordance with Section 017413 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Filters and filter gauges for various types of mechanical air handling equipment.

1.2 REFERENCES

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA) ANSI/NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 52.1, Gravimetric And Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved).
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-115.10, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.14, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .3 CAN/CGSB-115.15, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
 - .4 CAN/CGSB-115.18, Filter, Air, Extended Area Panel Type, Medium Efficiency.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Underwriters' Laboratories of Canada ULC -S111, Standard Method of Fire Tests for Air Filter Units.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals
 - .1 Provide maintenance data for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 013530 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 In accordance with Section 017419 - Waste Management and Disposal.

1.6 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
 - .3 Spare filters: in addition to filters installed, supply 1 complete set of filters for each filter unit or filter bank.

Part 2 Products

2.1 GENERAL

- .1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 50 degrees C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.
- .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 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 each side.

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 Performance: minimum average synthetic dust weight arrestance 70%, to ASHRAE 52.1.

.4 Fire rated: to ULC -S111.

2.4 CARTRIDGE TYPE FILTERS, 80-85 % EFFICIENCY

.1 Media: deep pleated, disposable, high efficiency, to CAN/CGSB-115.14.

.2 Holding frame: galvanized steel with bracing.

.3 Media support: welded wire grid.

.4 Performance: average atmospheric dust spot efficiency 80-85% to ASHRAE 52.1.

.5 Fire rated: to ULC -S111.

2.5 CARTRIDGE TYPE FILTERS 95 % EFFICIENCY

.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.

2.6 FILTER GAUGES - DIAL TYPE

.1 Diaphragm actuated, direct reading.

.2 Range: 0 to 2 times initial pressure 0 to 250 Pa.

2.7 FILTER GAUGES - MANOMETER TYPE

.1 Inclined acrylic tube.

.2 Complete with levelling screws.

.3 Range: 0 to 2 times initial pressure 0 to 250 Pa.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION 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.

3.5 CLEANING

- .1 Proceed in accordance with Section 017413 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 General Unit Description.
- .2 Unit Casing.
- .3 Air filters
- .4 Electric Heaters.
- .5 Evaporator Coils.
- .6 Enthalpy Wheel.
- .7 Desiccant Wheel.
- .8 Internal Vibration Isolation
- .9 Drain Pan
- .10 Dampers
- .11 Controls
- .12 Unit Performance Requirements

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- .1 Controls and Instrumentation: Installation and wiring of thermostats and other control components.
- .2 Equipment Wiring Systems: Electrical connection of equipment.
- .3 Roof curb: Made on site with structural steel.

1.3 RELATED SECTIONS

- .1 Section 230500 – Common Work Results – Mechanical
- .2 Section 230554 - Mechanical Identification
- .3 Section 230593 - Testing, Adjusting and Balancing for HVAC
- .4 Section 230548 - Vibration and Seismic Controls for HVAC

.5 Section 230713 – Thermal Insulation for Ductwork

1.4 REFERENCES

- .1 ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- .2 AHRI 360 - Unitary Air-Conditioning Equipment.
- .3 ANSI/ASHRAE/IESNA 90.1-1999 - Energy Standard for New Buildings Except Low-Rise Residential Buildings.

1.5 SUBMITTALS

- .1 Submit drawings indicating components, dimensions, weights and loadings, required clearances, and location and size of field connections.
- .2 Submit product data indicating rated capacities, weights, accessories, service clearances and electrical requirements.
- .3 Submit manufacturer's installation instructions.

1.6 OPERATION AND MAINTENANCE DATA

- .1 Submit operation and maintenance data.
- .2 Include manufacturer's descriptive literature, start-up and operating instructions, installation instructions, and maintenance procedures.

1.7 HANDLING

- .1 Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- .2 Protect units from physical damage. Leave factory shipping covers in place until installation.

1.8 WARRANTY

- .1 Provide a full parts warranty for one year from start-up or 18 months from shipment, whichever occurs first

1.9 MAINTENANCE SERVICE

- .1 All work on units shall be accomplished by OEM factory trained and authorized servicing technicians
- .2 In conjunction with and supporting Factory warranty OEM shall furnish complete factory authorized service and maintenance of packaged rooftop units for (1) year from Date of Substantial Completion.

- .3 OEM shall provide quarterly, annual, and bi-annual maintenance in compliance with or exceeding ASHRAE Standard 180-2008.
- .4 Include maintenance items as outlined in manufacturer's operating and maintenance data.
- .5 Submit copy of service call work order or report to the Owner, and include description of work performed.

1.10 REGULATORY REQUIREMENTS

- .1 Unit shall conform to cULus for construction of packaged air conditioner and shall have cULus label affixed to rooftop package.
 - .1 In the event the unit is not cULus approved, the manufacturer shall, at his expense, provide for a field inspection by a cULus representative to verify conformance to cULus standards. If necessary, contractor shall perform required modifications to the unit to comply with cULus, as directed by the cULus representative, at no additional expense to the Owner.
- .2 Z21.47/Canadian Standards Association (CAN/CSA-2.3) for construction of packaged air conditioner.
 - .1 In the event the unit is not CSA approved, the manufacturer must, at his expense, provide for a field inspection by a CSA representative to verify conformance to CSA standards. If necessary, contractor shall perform modifications to the unit to comply with CSA, as directed by the CSA representative, at no additional expense to the Owner.
- .3 Gas-fired heating rooftop units shall conform to UL 795/Canadian Standards Association (CAN/CSA-3.2) for construction of packaged air conditioner.
 - .1 In the event the unit is not CSA approved, the manufacturer must, at his expense, provide for a field inspection by a CSA representative to verify conformance to CSA standards. If necessary, contractor shall perform modifications to the unit to comply with CSA, as directed by the CSA representative, at no additional expense to the Owner.

1.11 EXTRA MATERIALS

- .1 Provide one extra set of filters.

1.12 SUMMARY

- .1 The contractor shall furnish and install a 100% outdoor air dehumidification unit as shown and as scheduled on the contract documents. The unit shall be installed in accordance with this specification and perform at the conditions specified, scheduled or as shown on the contract drawings.

Part 2 Products

2.1 MANUFACTURERS

.1 General

- .1 Manufacturer of packaged dehumidification products shall have had a minimum of five years successful experience in the manufacture and service support of the dehumidification packages specified herein. Manufacturers with less than five years experience in the production of dehumidification units of the sizes and types specified shall not be acceptable.

2.2 GENERAL UNIT DESCRIPTION

- .1 Unit furnished and installed shall be electric packaged dehumidification unit as specified on the contract documents and within these specifications. Unit shall consist of insulated weathertight casing with enthalpy wheel, desiccant wheel, electric heater, evaporator coils, filters, supply, regen, and exhaust fan motors and drives, and unit controls.
- .2 Unit shall be single piece construction as manufactured at the factory. [Site assembled sub-assemblies will not be allowed.] Package units shall be constructed for installation on a roof curb providing full perimeter support under unit.
- .3 Unit shall be factory run tested to include the operation of all fans, enthalpy wheel, desiccant wheel, electric heater, evaporator coils, and control sequences.
- .4 Unit shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.

2.3 UNIT CASING

- .1 Cabinet: The casing shall be a 50mm metal wall constructed of 20 gauge G-90 galvanized steel exterior and 20 gauge galvanized steel interior. All joints shall be caulked airtight with a silicone sealant. The exterior of the unit shall be painted with a 2 part epoxy finish for indoor use and a UV top coat when unit will be installed in an outdoor environment.

The floor decks of each section shall be lined with an underside sheathing of a minimum of 20 gauge G-90 galvanized steel. Insulation as previously specified shall be installed between the sheathing and top wearing floor surface. The top wearing surface on the floor shall be a minimum 16 gauge galvanized steel. This floor shall sustain the equipment loading and normal maintenance loading for the unit.

Closures around all components, such as coils, dampers and filters, shall be provided and made airtight. Closures shall be a minimum of 20 gauge galvanized steel and shall provide solid close-off inside of the unit housing walls. No air bypass or leakage around the components will be allowed.

- .2 Base Frame Construction: Units are to have a mechanically fastened galvanized steel base frame. All base frames to be suitably reinforced and braced to permit the loading, shipping, unloading and rigging to the unit. All base frames will also be constructed to allow for

general handling of the completed sections without damage to the external or internal components or misalignment of factory assembled components. Lifting lugs shall be provided as designated locations on the base frame for loading, unloading and installation of the unit.

- .3 Insulation: All wall and roof assemblies shall be insulated 50mm thick fiberglass insulation board to reduce heat transfer to the exterior environments.

2.4 AIR FILTERS

- .1 Air Filters: Filters shall be 50mm thick, pleated, disposable type filter MERV 8 high capacity filter. Air velocity through filter shall not exceed 2.54 m/s (500 fpm). Provision will be made to easily change filter by either access door or access panel.

2.5 FANS – SUPPLY, REGEN, AND EXHAUST

- .1 The regeneration, supply, and exhaust fans consist of a motor directly mounted to an impeller that draws in the desired airflow. The impeller is constructed out of corrosion resistant steel with painted finish and has backwards facing blades for adequate suction and appropriate discharge. The impeller is dynamically balanced to $G=2.5$ in accordance to DIN ISO 1940-1. To maintain impeller rigidity with the input shaft, the process impeller hub is constructed from aluminum or steel, depending on the application. The fan motors will have variable frequency drives (VFD) that are capable of modulating the speed and flowrate of the fan for the motors. The VFD will limit the current draw of the motor to the rated motor full load amperage to provide electrical and thermal protection for the motor.

2.6 ELECTRIC HEATERS

- .1 The electric heater shall be an electric resistor to air type that is constructed of a durable heat resistant/high temperature frame. The electric heater shall regulate its current from its corresponding power supply through an SCR controller to prevent any excessive heat transfer to the airstream.

2.7 EVAPORATOR COILS

- .1 The evaporators shall be of a fin-tube air-to-refrigerant type that is constructed of a galvanized steel frame. The evaporator coil(s) are to have a sufficient number of rows of copper tubes to aid heat transfer between the refrigerant and air. The tube design shall allow for one circuit per 6000 BTU/hr heat transfer to minimize pressure drop. To further aid the heat transfer between the refrigerant and air, aluminum fins with corrugated surfaces are incorporated with the construction of the coil. The fin spacing is set for the optimization of heat transfer versus cost.

The following requirements are applied to the refrigerant heat exchangers for this unit:

- 1) All coils are tested to 700 psig
- 2) All tubes are expanded at the tube collar
- 3) All fins have corrugated surface characteristics

- 4) All tubes are internally rifled to facilitate efficient heat exchange

2.8 ENTHALPY WHEEL

- .1 Wheel Media: The ECW or enthalpy wheel shall be constructed of corrugated synthetic fibrous media, with a desiccant intimately bound and uniformly and permanently dispersed throughout the matrix structure of the media. Rotors with desiccants coated, bonded, or synthesized onto the media are not acceptable due to delamination or erosion of the desiccant material. Media shall be synthetic to provide resistance to the corrosive effects from laboratory chemicals present in pharmaceutical and hospital environments as well as the corrosive effects from external outdoor air conditions. Coated aluminum is not acceptable. Face flatness of the wheel shall be maximized (+/- 0.032 in) in order to minimize wear on inner seal surfaces and to minimize cross leakage. Rotor shall be constructed of alternating layers of flat and corrugated media. Wheel layers should be uniform in construction forming uniform aperture sizes for air flow. Wheel construction shall be fluted or formed honeycomb geometry so as to eliminate internal wheel bypass. Wheel layers that can be separated or spread apart by air flow are unacceptable due to the possibility of channeling and performance degradation. The media shall be in accordance with NFPA or UL guidelines. The minimum acceptable performance shall be as specified in the drawings/submittal. The ECW or enthalpy wheel shall be AHRI certified in accordance with standard 1060 and carry the AHRI certification stamp.
- .2 Desiccant Material: The desiccant material shall be a molecular sieve, and specifically a 4A or smaller molecular sieve to minimize cross contamination
- .3 Wheel Media Support System: The wheel frames shall consist of evenly spaced steel spokes, galvanized steel outer band and rigid center hub. The wheel construction should allow for post fabrication wheel alignment.
- .4 Wheel Seals: The wheel seals shall be a contact brush seal on both the periphery of the wheel and the face. Seals should be easily adjustable.
- .5 Wheel Cassette: Where used, cassettes shall be fabricated of heavy duty reinforced galvanized steel or welded structural box tubing. Cassettes shall have a built in adjustable purge section minimizing cross contamination of supply air. Bearings shall be inboard, zero maintenance, permanently sealed roller bearings, or alternatively, external flanged bearings or pillow block. Drive systems shall consist of fractional horsepower A.C. drive motors with multilink drive belts. Cassette construction may be incorporated directly into unit in lieu of separate cassette.

2.9 DESICCANT WHEEL

- .1 Wheel Media: Wheels shall be constructed of corrugated synthetic media, with a desiccant intimately bound and uniformly and permanently dispersed throughout the matrix structure of the media. Rotors with desiccants coated, bonded, or synthesized onto the media are not acceptable due to delamination and/or erosion of the desiccant material over time. Media shall be synthetic to provide resistance to the corrosive effects from laboratory chemicals present in pharmaceutical and hospital environments as well as the corrosive effects from external outdoor air conditions. Coated aluminum is not acceptable. Face flatness of the wheel shall be maximized (+/- 0.032 in) in order to minimize wear on inner seal surfaces and

to prevent cross leakage. The minimum acceptable dehumidification performance shall be as specified in the drawings/submittal.

- .2 Desiccant Material: The desiccant material shall exhibit a type III isotherm to insure proper performance with low temperatures of regeneration. Lithium chloride, or lithium chloride containing desiccant shall not be used because of the deliquescent property of LiCL₂ during the adsorption process. The desiccant material shall be able to maintain a minimum of 90% of its adsorption capacity after 10 years of service life.
- .3 Wheel Media support system: The wheel frames shall consist of evenly spaced steel spokes, flanged aluminum outer band and rigid center hub. The wheel construction should allow for post fabrication wheel alignment.
- .4 Wheel Seals: The wheel face and peripheral seals shall be high temperature extruded contact seals which are easily adjustable, and which prevent leakage at up to 8" w.c. differential pressure. Face seal shall be Teflon coated to maximize wear resistance. Periphery seals will have Nomex felt attached to reduce seal drag.
- .5 Wheel cassette: Where used, cassettes shall be fabricated of heavy duty reinforced minimum 14 gauge galvanized steel. Bearings shall be inboard, zero maintenance, permanently sealed roller bearings or alternatively, sealed pillow block bearings for larger wheels. Drive systems shall consist of fractional horsepower A.C. drive gear motors. The drive mechanism shall be either a heavy duty chain and sprocket drive assemblies or belt with tension device. Cassette construction may be incorporated directly into unit in lieu of separate cassette.

2.10 INTERNAL VIBRATION ISOLATION

- .1 The fan assembly shall be mounted on a heavy duty steel frame support with vibration isolators that interrupt the transmission frequency of the assembly.
- .2 The fan assembly shall have a 2" flexible ducting at the inlet cone to maintain fan static pressure.

2.11 DRAIN PAN

- .1 The drain pan is to be constructed of welded 304 SS. The cooling coil drain pan shall cover the entire length of the coil and extend a minimum of 4 inches beyond the air leaving side of the coil.

2.12 DAMPERS

- .1 The unit will be equipped with dampers to control outdoor/return air to and from the unit. The dampers will have built in mechanisms for varying the position of blades for controlling airflow, either manually or actively with an actuator.

2.13 CONTROLS

- .1 The unit will have a microprocessor control capable of communication with the building management system using BACnet MS/TP protocol or digital input signals. Control options will include an economizer mode that shuts down the enthalpy wheel. The supply, exhaust,

and regeneration fans will have VFD speed controllers. The regeneration fan speed will be controlled by the microprocessor to control dehumidification. The unit will have appropriate temperature and humidity sensors to properly control the unit supply conditions.

2.14 UNIT PERFORMANCE REQUIREMENTS

- .1 As per drawings.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that roof is ready to receive work and opening dimensions are as verified.
- .2 Verify that proper power supply is available.

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Mount unit on site built roof mounting frame.

3.3 MANUFACTURER'S FIELD SERVICES

- .1 Package dehumidification manufacturers shall maintain service capabilities no more than 10 miles from the jobsite.
- .2 The manufacturer shall furnish an alternative price for:
 - .1 Extended warranty for 5 years.
 - .2 The manufacturer shall furnish complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

3.4 COMMISSIONING

- .1 Authorized service technician(s) (directly from manufacturer's factory) to travel to site and complete factory start-up of dehumidification unit upon completion of installation. Manufacturer technician to submit service start-up report to mechanical contractor.

Part 4 Sequence of Operations

4.1 PACKAGED ROOFTOP AIR CONDITIONING UNIT

- .1 As per drawings.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

- .1 Products Furnished But Not Installed Under This Section
- .2 Products Installed But Not Furnished Under This Section
- .3 Products Not Furnished or Installed But Integrated with the Work of this Section
- .4 Related Sections
- .5 Description
- .6 Approved Control System Contractor
- .7 Quality Assurance
- .8 Codes and Standards
- .9 System Performance
- .10 Submittals
- .11 Warranty
- .12 Ownership of Proprietary Material

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- .1 Refrigerant Piping:
 - .1 Pressure and Temperature Sensor Wells and Sockets
- .3 Ductwork Accessories:
 - .1 Automatic Dampers
 - .2 Airflow Stations
 - .3 Terminal Unit Controls

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- .1 Refrigeration Equipment:
 - .1 Refrigerant Leak Detectors
- .2 Dehumidification Equipment:

.1 Controllers

.2 Sensors

1.4 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION

.1 Dehumidification Equipment

.1 Discharge Air Temperature Control

.2 Air volume control

.3 Desiccant wheel control

.4 Enthalpy wheel control

.5 Relative Humidity Control

.2 Existing Oxygen Sensing Equipment and Alarms

.1 Electrical meters

1.5 RELATED SECTIONS

.1 The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of these Specifications and shall be used in conjunction with this Section as a part of the Contract Documents. Consult them for further instructions pertaining to this work. The Contractor is bound by the provisions of Division 0 and Division 1.

.2 The following constitute related work:

.1 Commissioning

.2 Basic Mechanical Requirements

.3 Air Distribution Materials and Methods

.4 Refrigeration Piping

.5 Valves, Fittings, and Piping Accessories

.6 Refrigeration Equipment

.7 Air Handling Equipment

.8 Air Distribution

.9 Test and Balance

- .10 Basic Electrical Requirements
- .11 Basic Electrical Materials
- .12 General Wiring
- .13 Equipment and Motor Wiring
- .14 Uninterruptible Power Supply
- .15 Emergency Systems
- .16 Fire Alarm Systems
- .17 Dehumidification Unit

1.6 DESCRIPTION

- .1 Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of systems defined for control on this project.
- .2 Existing Building Management System is a Johnson Controls Metasys Legacy 1st Generation system that communicates via N2 Bus
- .3 Controls Contractor shall provide a complete installation including additional compatible unitary control panels, field controllers (FAC), wiring, programming, colour graphics, and commissioning to control and monitor the dehumidification unit and related exhaust systems as per the Sequence of Operations specified on drawing M6.2.
- .4 The dehumidification system along with the existing exhaust system and oxygen sensing systems are to provide continuous general ventilation, heating, medium level ventilation and purge ventilation, relative humidity and space temperature control of the cryobank space.
- .5 The existing Building Management System programming is to be adjusted to include the operation of the dehumidification system.
- .6 Provide Johnson Controls field controllers (FAC) to integrate between new dehumidification system and existing Building Management System using existing N2 communication protocol BUS and MCM controllers.
- .7 The control system shall be designed such that each mechanical system will operate under stand-alone control. As such, in the event of a network communication failure, or the loss of other controllers, the control system shall continue to independently operate the unaffected equipment.

1.7 QUALITY ASSURANCE

- .1 System Installer Qualifications

- .1 The controls systems including all components, wiring, programming, etc are to be supplied and installed by the owners controls contractor. General contractor to carry costs for the supply and installation of the controls within the contract.
- .2 The general contractor is to employ either Pippin Automation or Johnson Controls for the controls scope of work.
- .3 The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.

1.8 CODES AND STANDARDS

- .1 Work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of local, state and federal authorities. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes:
 - .1 National Electric Code (NEC)
 - .2 International Building Code (IBC)
 - .3 International Mechanical Code (IMC)
 - .4 Underwriters Laboratories: Products shall be UL-916-PAZX listed.
 - .5 ANSI/ASHRAE Standard 135-2004 (BACnet).

1.9 SUBMITTALS

- .1 Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until the Engineer and Owner have reviewed submittals for conformity with the plan and specifications. Six (6) copies are required. All shop drawings shall be provided to the Owner electronically as .dwg or .dxf file formats.
- .2 Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the contractor from furnishing quantities required for completion.
- .3 Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.
- .4 Submit the following:
 - .1 A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.

- .2 A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
- .3 A schedule of all control dampers. This shall include the damper size, pressure drop, manufacturer and model number.
- .4 Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:
 - .1 Building Controllers
 - .2 Custom Application Controllers
 - .3 Application Specific Controllers
 - .4 Auxiliary Control Devices
 - .5 Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling
 - .6 Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled
 - .7 Points list showing all system objects, and the proposed English language object names
 - .8 Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project
 - .9 Color prints of proposed graphics with a list of points for display
- .5 Project Record Documents. Upon completion of installation submit three (3) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:
 - .1 Project Record Drawings. These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .DWG or .DXF drawing files shall also be provided.
 - .2 Testing and Commissioning Reports and Checklists.
 - .3 Operating and Maintenance (O & M) Manual. These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O & M manual shall include:
 - .1 Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
 - .2 Provide on-line help for documenting operator instructions
 - .3 A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided.

- .4 One set of electronic media containing files of all color-graphic screens created for the project.
 - .5 Complete original issue documentation, installation, and maintenance information for all third party hardware provided including computer equipment and sensors.
 - .6 Licenses and warranty documents for all equipment and systems.
 - .7 Recommended preventive maintenance procedures for all system components including a schedule of tasks, time between tasks, and task descriptions.
- .6 Training Materials: The Contractor shall provide a course outline and training material for all training classes at least six weeks prior to the first class. The Owner reserves the right to modify any or all of the training course outline and training materials. Review and approval by Owner and Engineer shall be completed at least 3 weeks prior to first class.

1.11 WARRANTY

- .1 Warrant all work as follows:
- .1 Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during customary business hours.
 - .2 At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of warranty.
 - .3 Operator workstation software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

- .1 All project-developed hardware and software shall become the property of the Owner. These items include but are not limited to:
- .1 Project graphic images
 - .2 Record drawings
 - .3 Project database
 - .4 Project-specific application programming code

.5 All documentation

PART 2 Products

2.1 SECTION INCLUDES

- .1 Materials
- .2 Communication
- .3 System Controllers
- .4 Custom Application Controllers
- .5 Application Specific Controllers
- .6 Input/Output Interface
- .7 Auxiliary Control Devices

2.2 MATERIALS

- .1 All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 1 year. The installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing. Spare parts shall be available for at least 5 years after completion of this contract.

2.3 COMMUNICATION

- .1 The controls Contractor shall provide all communication media, connectors, repeaters, network switches routers necessary for the DDC system network.

2.4 SYSTEM CONTROLLERS

- .1 General. Provide System Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
 - .1 The System Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - .2 The controller shall provide a USB communications port for connection to a PC
 - .3 The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 - .4 Controllers that perform scheduling shall have a real time clock.
 - .5 Data shall be shared between networked System Controllers.

- .6 The System Controller shall utilize industry recognized open standard protocols for communication to unit controllers.
- .7 The System Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - .1 Assume a predetermined failure mode.
 - .2 Generate an alarm notification.
 - .3 Create a retrievable file of the state of all applicable memory locations at the time of the failure.
 - .4 Automatically reset the System Controller to return to a normal operating mode.
- .2 Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at -40 C to 50 C (-40 F to 122 F).
- .4 Serviceability. Provide diagnostic LEDs for power, communications, and processor. The System Controller shall have a display on the main board that indicates the current operating mode of the controller. All wiring connections shall be made to field removable, modular terminal connectors. The System controller shall utilize standard DIN mounting methods for installation and replacement.
- .5 Memory. The System Controller shall maintain all BIOS and programming information indefinitely without power to the System controller
- .6 Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage

2.5 CUSTOM APPLICATION CONTROLLERS

- .1 General. Provide Custom Application Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
 - .1 The Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - .2 Controllers that perform scheduling shall have a real time clock.
 - .3 The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 - .4 The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode, and generate an alarm notification.
- .2 Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
 - .1 Controller used in conditioned ambient shall be mounted in IP 20 type enclosures, and shall be rated for operation at 0 C to 50 C (32 F to 120 F).

- .2 Controllers used outdoors and/or in wet ambient shall be mounted within IP 56 type waterproof enclosures, and shall be rated for operation at -40 C to 70 C (-40 F to 158 F).
- .3 Serviceability. Provide diagnostic LEDs for power, communications, and processor. All low voltage wiring connections shall be made such that the controller electronics can be removed and/or replaced without disconnection of field termination wiring.
- .4 Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- .5 Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

2.6 APPLICATION SPECIFIC CONTROLLERS

- .1 General. Application specific controllers (ASC) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.
 - .1 Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
 - .2 Each ASC will contain sufficient I/O capacity to control the target system.
- .2 Environment. The hardware shall be suitable for the anticipated ambient conditions.
 - .1 Controller used in conditioned ambient spaces shall be mounted in IP 20 type rated enclosures. Controllers located where not to be disturbed by System activity (such as above ceiling grid), may be provided with plenum-rated enclosures and non-enclosed wiring connections for plenum cabling. All controllers shall be rated for operation at 0 C to 50 C (32 F to 120 F).
 - .2 Controllers used outdoors and/or in wet ambient shall be mounted within IP 56 type waterproof enclosures, and shall be rated for operation at -40 C to 65 C (-40 F to 150 F).
- .3 Serviceability. Provide diagnostic LEDs for power and communications. All wiring connections shall be clearly labeled and made to be field removable.
- .4 Memory. The Application Specific Controller shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.
- .5 Immunity to Power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.
- .6 Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.

2.7 INPUT/OUTPUT INTERFACE

- .1 Hard-wired inputs and outputs may tie into the system through System, Custom, or Application Specific Controllers.
- .2 All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- .3 Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices.
- .4 Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 3 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.
- .5 Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.
- .6 Binary outputs shall provide for on/off operation. Terminal unit and zone control applications may use 2 outputs for drive-open, drive-close (tri-state) modulating control. Binary outputs on custom application controllers shall have 3-mode (on/off/auto) program override control from the panel with output status lights.
- .7 Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device. Analog outputs on custom application controllers shall have a 2-mode (auto/manual) program override control, with manual output adjustment over 0-100% of range.

2.8 AUXILIARY CONTROL DEVICES

- .1 Motorized dampers, unless otherwise specified elsewhere, shall be as follows:
 - .1 Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.
 - .2 Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.
 - .3 Damper shaft bearings shall be as recommended by manufacturer for application.
 - .4 All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
 - .5 All leakage testing and pressure ratings will be based on AMCA Publication 500.
 - .6 Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.

- .2 Control dampers shall be parallel or opposed blade types as scheduled on drawings.
- .3 Electric damper/valve actuators.
 - .1 The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
 - .2 Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
 - .3 All rotary spring return actuators shall be capable of both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
 - .4 Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
 - .5 All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
 - .6 Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
 - .7 Actuators shall be Underwriters Laboratories Standard 873 listed.
 - .8 Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.
- .4 Control Valves
 - .1 Control valves shall be two-way or three-way type for two-position or modulating service as scheduled or shown.
 - .2 Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
- .5 Binary Temperature Devices
 - .1 Low-Voltage Space Thermostats shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed set point adjustment, 13°C-30°C (55°F-85°F) set point range, 1°C (2°F) maximum differential, and vented cover.
 - .2 Line-Voltage Space Thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed set point adjustment, 13°C-30°C (55°F-85°F) set point range, 1°C (2°F) maximum differential, and vented cover.

- .3 Low-Limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.
- .6 Temperature Sensors
 - .1 Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.
 - .2 Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 1.5m [5 feet] in length.
 - .3 Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
 - .4 Space sensors shall be equipped with set-point adjustment, override switch, display, and/or communication port as shown on the drawings.
 - .5 Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.1 C [0.2 F].
 - .6 (Optional) The space temperature, set point, and override confirmation will be annunciated by a digital display for each zone sensor. The set point will be selectable utilizing buttons.
- .7 Humidity Sensors
 - .1 Duct and room sensors shall have a sensing range of 20% to 80% with accuracy of $\pm 5\%$ R.H.
 - .2 Duct sensors shall be provided with a sampling chamber.
 - .3 Outdoor air humidity sensors shall have a sensing range of 20% to 95% R.H. It shall be suitable for ambient conditions of -40 C to 75 C [-40 F to 170 F].
 - .4 Humidity sensor's drift shall not exceed 1% of full scale per year.
- .8 Static Pressure Sensors
 - .1 Sensor shall have linear output signal. Zero and span shall be field-adjustable.
 - .2 Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
 - .3 Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.

- .4 Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.
- .9 Low Limit Thermostats
 - .1 Safety low limit thermostats shall be vapor pressure type with an element 6m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
 - .2 Low limit shall be manual reset only.
- .10 Flow Switches
 - .1 Flow-proving switches shall be either paddle or differential pressure type, as shown.
 - .2 Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with IP 20 Type enclosure unless otherwise specified:
 - .3 Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), IP 20 Type enclosure, with scale range and differential suitable for intended application, or as specified.
 - .4 Current sensing relays may be used for flow sensing or terminal devices.
- .11 Relays
 - .1 Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
 - .2 Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide IP 20 Type enclosure when not installed in local control panel.
- .12 Transformers and Power Supplies
 - .1 Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.

- .2 Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 70.0 mV maximum Peak-to-Peak. Regulation shall be 5% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
 - .3 Unit shall operate between 0 C and 50 C.
 - .4 Unit shall be UL recognized.
- .13 Current Switches
- .1 Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

2.12 LOCAL CONTROL PANELS

- .1 All indoor control cabinets shall be fully enclosed IP 20 Type construction with hinged door, and removable sub-panels or electrical sub-assemblies.
- .2 Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
- .3 Provide on/off power switch with over-current protection for control power sources to each local panel.

PART 3 Execution

3.1 SECTION INCLUDES

- .1 Examination
- .2 Protection
- .3 General Workmanship
- .4 Field Quality Control
- .5 Wiring
- .6 Fiber Optic Cable
- .7 Installation of Sensors
- .8 Flow Switch Installation

- .9 Actuators
- .10 Warning Labels
- .11 Identification of Hardware and Wiring
- .12 Controllers
- .13 Programming
- .14 Cleaning
- .15 Training
- .16 Acceptance

3.2 EXAMINATION

- .1 The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.
- .2 The contractor shall inspect the site to verify that equipment is installable as shown, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.3 PROTECTION

- .1 The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.
- .2 The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.4 GENERAL WORKMANSHIP

- .1 Install equipment, piping, wiring/conduit parallel to System lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- .2 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- .3 Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.
- .4 Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

- .5 All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.5 FIELD QUALITY CONTROL

- .1 All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.
- .2 Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to System lines and properly supported.
- .3 Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.6 WIRING

- .1 All control and interlock wiring shall comply with the national and local electrical codes and the electrical portion of these specifications. Where the requirements of this section differ with those in the electrical section, the requirements of this section shall take precedence.
- .2 Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:
- .3 Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
- .4 All cables shall be UL listed for application, i.e., cables used in ceiling plenums shall be UL listed specifically for that purpose.
- .5 Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).
- .6 Where class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 3 m [10 ft] intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 1.5 m [5 ft] intervals or more often to achieve a neat and workmanlike result.
- .7 All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- .8 Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.

- .9 All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.
- .10 Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes.
- .11 Size of conduit and size and type of wire shall be the design responsibility of the Control System Contractor, in keeping with the manufacturer's recommendation and NEC.
- .12 Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.
- .13 Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.
- .14 Adhere to electrical section requirements for installation of raceway.
- .15 This Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- .16 Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

3.7 FIBER OPTIC CABLE SYSTEM

- .1 All cabling shall be installed in a neat and workmanlike manner. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.
- .2 Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post installation residual cable tension shall be within cable manufacture's specifications.
- .3 Fiber optic cabinets, hardware, and cable entering the cabinet shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

3.8 INSTALLATION OF SENSORS

- .1 Install sensors in accordance with the manufacturer's recommendations.
- .2 Mount sensors rigidly and adequate for the environment within which the sensor operates.
- .3 Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

- .4 All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
- .5 Install duct static pressure tap with tube end facing directly down-stream of air flow.
- .6 Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- .7 All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.
- .8 Wiring for space sensors shall be concealed in System walls. EMT conduit is acceptable within mechanical and service rooms.
- .9 Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

3.9 FLOW SWITCH INSTALLATION

- .1 Use correct paddle for pipe diameter.
- .2 Install and adjust flow switch in accordance with manufacturers' instructions.
- .3 Assure correct flow direction and alignment.
- .4 Mount in horizontal piping - flow switch on top of the pipe.

3.10 ACTUATORS

- .1 Mount and link control damper actuators per manufacturer's instructions.
 - .1 To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
 - .2 Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - .3 Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

3.11 WARNING LABELS

- .1 Affix labels on each starter and equipment automatically controlled through the DDC System. Warning label shall indicate the following:

CAUTION

This equipment is operating under automatic control and may start or stop at any time without warning.
Switch disconnect to “Off” position before servicing.

- .2 Affix labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects. Labels shall indicate the following:

CAUTION

This equipment is fed from more than one power source with separate disconnects.
Disconnect all power sources before servicing.

3.12 IDENTIFICATION OF HARDWARE AND WIRING

- .1 All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.
- .2 Permanently label or code each point of field terminal strips to show the instrument or item served.
- .3 Identify control panels with minimum 1-cm (1/2") letters on nameplates.
- .4 Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.13 CONTROLLERS

- .1 Provide a separate Controller for each major piece of HVAC equipment. A custom application controller may control more than one system provided that all points associated with that system are assigned to the same controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.
- .2 System Controllers and Custom Application Controllers shall be selected to provide a minimum of [15%] spare I/O point capacity for each point type found at each location. If input points are not universal, [15%] of each type is required. If outputs are not universal, [15%] of each type is required. A minimum of one spare is required for each type of point used.
 - .1 Future use of spare capacity shall require providing the field device, field wiring, points database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.14 PROGRAMMING

- .1 Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.

- .2 Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.
- .3 Software Programming
 - .1 Provide programming for the system as written in the specifications and adhere to the sequence strategies provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into any custom-written control programs sufficient comment statements or inherent flow diagrams to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.
- .2 Operators' Interface
 - .1 Standard Graphics. Provide graphics for each major piece of equipment and floor plan in the System. This includes each Chiller, Air Handler, VAV Terminal, Fan Coil, Boiler, and Cooling Tower. These standard graphics shall show all points dynamically as specified in the points list.
 - .2 The controls contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface database, and any third party software installation and integration required for successful operation of the operator interface.
 - .3 As part of this execution phase, the controls contractor will perform a complete test of the operator interface. Test duration shall be a minimum of [16] hours on-site. Tests shall be made in the presence of the Owner or Owner's representative.
- .3 Demonstration: A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall provide on-site dewith the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for on-line operation.

3.15 CLEANING

- .1 This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.
- .2 At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.
- .3 At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.16 TRAINING

- .1 Provide classroom training sessions as necessary, throughout the contract period for personnel designated by the Owner.
- .2 Train the designated staff of Owner's representative and Owner to enable them to proficiently operate the system; create, modify and delete programming; add, remove and modify physical points for the system, and perform routine diagnostic and troubleshooting procedures.
- .3 Additional training shall be available in courses designed to meet objectives as divided into three logical groupings; participants may attend one or more of these, depending on the level of knowledge required:
 - .1 Day-to-day Operators
 - .2 Advanced Operators
 - .3 System Managers/Administrators
- .4 Provide course outline and materials as per Part 1 of this Section. The instructor(s) shall provide one copy of training material per student.
- .5 The instructor(s) shall be factory-trained instructors experienced in presenting this material.
- .6 Classroom training shall be done using a network of working controllers representative of the installed hardware or at the customer's site.
- .7 This training shall be made available in addition to the interactive audio-visual tutorial, provided with the system.

3.17 ACCEPTANCE

- .1 The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

3.18 CONTROL VALVE INSTALLATION

- .1 Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.
- .2 All control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position.

- .3 Valves shall be installed in accordance with the manufacturer's recommendations.
- .4 Control valves shall be installed so that they are accessible and serviceable, and such that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
- .5 Isolation valves shall be installed such that control valve body may be serviced without draining the supply/return side piping system. {Note to designer: this must also be shown.} Unions shall be installed at all connections to screwed type control valves.
- .6 Provide tags for all control valves indicating service and number. Tags shall be brass, 1-1/2" in diameter, with 1/4" high letters. Securely fasten with chain and hook. Match identification numbers as shown on approved controls shop drawings.

3.19 CONTROL DAMPER INSTALLATION

- .1 Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
- .2 Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure 1/4" larger than damper dimensions and shall be square, straight, and level.
- .3 Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be equal $\pm 1/8"$.
- .4 Follow manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
- .5 Install extended shaft or jackshaft per manufacturer's instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)
- .6 Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to assure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
- .7 Provide a visible and accessible indication of damper position on the drive shaft end.
- .8 Support ductwork in area of damper when required to prevent sagging due to damper weight.
- .9 After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

3.20 COMMISSIONING

- .1 The controls contractor shall provide a detailed input/output points schedule.
- .2 Controls contractor to commission and verify operation of each input/output and provide commissioning report.
- .3 The controls contract shall follow the commissioning process outlined in AAFC general procedures and standards.

PART 4 Sequence of Operations

4.1 DEHUMIDIFICATION UNIT

- .1 Refer to drawing M6.2

END OF SECTION

PART 1 GENERAL

1 GENERAL

- .1 Include in electrical section, provision of labour, new materials, tools, transportation, services and facilities for a complete electrical installation. The installation shall be left complete in all respects and ready for operation to the complete satisfaction of the responsible Professional Engineer.

- .2 The electrical scope of work includes, but is not necessarily limited to the following provisions:
 - .1 Disconnect power supply to existing mechanical equipment being removed to allow for demolition of mechanical equipment.
 - .2 Revision and expansion of existing main distribution to accommodate the new automatic transfer switch and distribution equipment.
 - .3 Revision and expansion of existing emergency distribution to accommodate the new automatic transfer switch and distribution equipment.
 - .4 Provision, supply and install, wire and connect, automatic transfer switch and distribution to accommodate the new mechanical equipment.
 - .5 Provision of power supply to all mechanical equipment. Mechanical equipment to be supplied by others. Provide all line voltage control wiring. (See Motor Schedule and Mechanical drawings for details).

END OF SECTION

PART 1 GENERAL

1 CODE AND STANDARDS

- .1 Do complete installation in accordance with CSA C22.1-2015, except where specified otherwise.
- .2 Comply with CSA Electrical Bulletins in force at time of tender submission, while not identified and specified by number in this Division, are to be considered as forming part of related CSA Part II standard. Revision and expansion of existing main distribution to accommodate the new electric fire pump.
- .3 Do overhead and underground systems in accordance with CSA C22.3No.1-M1979 except where specified otherwise.
- .4 Do complete installation in accordance with latest Electrical Bulletins of the local inspection authority.
- .5 Abbreviations for electrical terms: to CSA Z85-1963.

2 PERMITS, FEES

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Architect will provide drawings at no cost.

3 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- .1 Submit shop drawings, product data and samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .3 Where applicable, include wiring, single line and schematic diagrams.
- .4 Include wiring drawings or diagrams showing interconnection with work of other Sections and Divisions.
- .5 Include shop drawings for all electrical items and equipment including wiring devices, motor starters, distribution equipment, luminaires, etc.

4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into maintenance manual specified in Section 01 78 00 - Closeout Submittals.

- .2 Include in operations and maintenance data:
 - .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
 - .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
 - .3 Wiring and schematic diagrams and performance curves.
 - .4 Names and addresses of local suppliers for items included in maintenance manuals.
- .3 O & M manuals to be provided in hard copy and electronic ".PDF" format.

5 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

6 CARE, OPERATION AND START-UP

- .1 Instruct operating personnel in the operation, care and maintenance of equipment.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .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 with aspects of its care and operation.

7 VOLTAGE RATINGS

- .1 Operating voltages: to CSA C235-1969(R1979).
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Where appliances such as stoves are supplied by other sections, advise the General Contractor in writing of the voltage at the outlet.

8 INSPECTIONS

- .1 Furnish a Certificate of Acceptance from Inspection Department on completion of work.

9 MATERIALS AND EQUIPMENTS

- .1 Shall be new and CSA approved.

- .2 Shall be manufactured in accordance with current CEMA, NEMA, or CSA standards.
- .3 Requests for approval of material and equipment, other than those specified on the drawings, shall be submitted not later than seven working days before the close of tender. Requests for approval shall be submitted with complete details of the construction and performance of the materials and equipment. Requests submitted without sufficient supporting information shall be rejected.
- .4 Materials and equipment of the same classification, type of function, shall be provided by the same manufacturer.

10 ELECTRICAL MOTORS, EQUIPMENT AND CONTROLS

- .1 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23 and shown on mechanical drawings.

11 FINISH

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, 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, prime and paint exposed hangers, racks, fastenings to prevent rusting.

12 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Lamacoid 5mm thick, red face 13 x 51mm.
- .2 Wording on nameplates to be approved prior to manufacture.
- .3 Allow for average of twenty-five (25) letters per nameplate.
- .4 Identification to be English.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify all electrical equipment such as motor starters, panelboards, distributions, distribution circuit breakers with nameplates.

13 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1-2015.
- .4 Use colour coded wires in communication cables, matched throughout system.
- .5 Identify all underground wiring with Brady Identoline underground warning tape. Installation to be as per manufacturers typical installation procedure.

14 CABLE AND CABLE IDENTIFICATION

- .1 Colour code conduits and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours to be 1 inch wide prime colour and 19mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	yellow	
up to 600 V	yellow	green
up to 5 kV	yellow	blue
up to 15 kV	yellow	red
Telephone	green	
Lighting	green	blue
Fire alarm	red	
Emergency voice	red	blue
Other systems	red	yellow

15 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

16 MANUFACTURERS AND CSA LABELS

- .1 Manufacturers nameplates and CSA labels to be visible and legible after equipment is installed.

17 WARNING SIGNS

- .1 Provide warning signs, as specified or to meet requirements of Inspection Department and Engineer.

18 LOCATIONS OF OUTLETS

- .1 Make all necessary adjustments after interior finishes are completed.
- .2 Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3m, and information is given before installation.
- .4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical rooms on latch side of door. Confirm direction of door swing on Architectural drawings prior to installation.

19 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 indicated verify before proceeding with installation.
- .3 Confirm luminaire locations with Architect prior to rough-in.
- .4 Install electrical equipment at the following heights unless indicated otherwise.
 - .1 Local switches: 1200mm.
 - .2 Wall receptacles:
 - .1 General: 300mm.
 - .2 Above top of continuous baseboard heater: 200mm.
 - .3 Above top of counters or splash back: 200mm.
 - .4 In mechanical rooms: 1400mm
 - .5 Panelboards: 1200mm or as required by Code.
 - .6 Telephone outlets: 300mm
 - .7 Wall mounted telephone outlets: 1400mm
 - .8 Fire alarm stations: 1200mm
 - .9 Fire alarm audible devices: 2000mm
 - .10 Television outlets: 300mm (unless wall mounted - refer to architectural)
 - .11 Wall mounted speakers: 2000mm
 - .12 Clocks: 200mm
 - .13 Door bell pushbuttons: 1400mm
 - .14 P. A. Station: 1400mm
 - .15 In accordance with accessibility guidelines.

20 PROTECTION

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage in English.

- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

21 LOAD BALANCE

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, a report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

22 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit, and sleeves, prior to pouring of concrete. Sleeves through concrete: metal, sized for free passage of conduit, and protruding 52mm.
- .2 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 All penetrations through exterior walls are to be made water and weatherproof.

23 FIRE PROOFING

- .1 Where cables or conduits pass through floors and fire rated walls, complete integrity of wall type to the satisfaction of the Chief Fire Inspector.
- .2 All emergency feeders and control wires to be 2 hour rated via use of mineral insulated cables or equivalent fireguard application by electrical section.

24 TESTS

- .1 Conduct and pay for tests of the following:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .4 Emergency power system including transfer switch.
- .2 Furnish manufacturer's, certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturers instructions.
- .3 Carry out tests in presence of Engineer.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Submit test results.

25 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.

26 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays, fuses, are installed to values and settings as indicated.

27 CLEANING

.1 Clean all outlets, cabinets, enclosures, tubs and similar electrical equipment of all construction dust and dirt.

.2 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt.

.3 Clean all coverplates and insure all paint is removed from wiring devices, panels, luminaires and other electrical equipment.

28 EXCAVATION AND BACKFILLING

.1 Ensure that excavation for underground electrical services is in location and at depth indicated. Electrical contractor to directly supervise excavation and backfilling.

.2 All work to be accordance with CSA22.1-2015 Section 12.

29 GUARANTEE

.1 The Electrical Contractor shall guarantee the satisfactory operation of all work and apparatus included and installed under this section of the specification.

.2 Replace forthwith at no additional material, or labour cost any part which may fail or prove defective within a period of twelve (12) calender months after the final acceptance of the complete building, provided that such failure is not due to improper usage, or ordinary wear and tear.

.3 No certificate given payment made, partial or entire use of the equipment by the Owner, shall be construed as acceptance of defective work.

.4 This general guarantee shall not act as a waiver of any specified guarantee for any greater length of time.

30 CUTTING AND PATCHING

- .1 Pay all costs for cutting and patching required for the installation of electrical work.
- .2 Assume full responsibility for laying out electrical work and for any damage caused by incorrectly located equipment or improper performance of this work.
- .3 Study the architectural plans and co-operate with other trades so that the elevation of all outlets shall not necessitate any unnecessary cutting of dados, mirrors, tiles or other construction material. If this is not done, the Electrical Contractor may be required by the Engineer to move these outlets at no additional cost to the Owner (including repair).

31 CO-OPERATION

- .1 Schedule execution of work with associated work specified in other Divisions. Check shop drawings of other sections prior to electrical rough-in to co-ordinate physical and electrical requirements. Adjust as required.

32 DRAWINGS

- .1 Carefully examine all drawings and specifications relating to the work to be certain that the work under this contract can be satisfactorily carried out and prior to submission of tender, examine the work of the other trades and report at once to the Engineer, any defect, discrepancy, omission or interference affecting the work of section or the warranty of same.
- .2 The drawings accompanying these specifications are intended to show the general arrangement and extent of the work to be done, but the exact location and arrangement of all parts shall be determined as the work progresses. The location of the outlets, equipment, etc. as given on the drawings are approximately correct but it shall be understood that they are subject to such modifications as may be found necessary or desirable at the time of installation to meet any structural, mechanical or architectural conditions. Such changes shall be made by the Electrical Contractor, as directed by the Engineer without additional charge.
- .3 At completion of project, provide a complete print of revisions, changes and conduit location as-built drawings to the satisfaction of the responsible Professional Engineer. Provide electronic AutoCAD ".dwg" format files of all changes, revisions, and conduit layouts suitable for printing drawing size reproductions of electrical drawings. Engineer will provide electronic copies of original electrical drawings.

END OF SECTION

PART 1 **GENERAL**

1 **RELATED WORK**

- .1 Wire and Cable: Section 26 05 21
- .2 Outlet Boxes: Section 26 05 32

PART 2 **PRODUCTS**

2 **MATERIALS**

- .1 Connectors complete with locking bushings for armoured cable.
- .2 Aluminum "wet" type or "dry" type for aluminum sheathed cable depending on application.
- .3 Wet type connectors for sealtite flexible conduit.
- .4 Hazardous areas shall have connectors matching Class and Division of area as identified.

PART 3 **EXECUTION**

3 **INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install connector in box.
 - .2 Install conductor in connector and tighten. Complete joints inside box using Marrette type connectors.

END OF SECTION

PART 1 GENERAL

1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Conduit: Section 26 05 34

PART 2 PRODUCTS

2 MATERIALS

- .1 Conductors: stranded for 8 AWG and larger.
- .2 Copper conductors sized as indicated with minimum size to be #12 AWG rated R90 : to CAN/CSA-C22.2 No. 0.3-M96.
- .3 Copper conductors with minimum size #18 AWG for fire alarm initiating circuits only.

3 ARMOURED CABLES

- .1 Insulated conductors copper, sizes as indicated.
- .2 Type AC90: toCSA C22.2 No.51-1968.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Minimum size: 12 AWG.

4 ALUMINUM SHEATHED CABLE

- .1 Conductors: copper sized as indicated.
- .2 Insulation: type RA90 rated 90 °C at 600 V.
- .3 Sheath: aluminum applied to form continuous corrugated seamed sheath.
- .4 Outer jacket of pvc applied over sheath for direct burial and wet locations.

5 FASTENINGS

- .1 Two hole aluminum straps to secure surface cables.
- .2 Channel type supports for two or more conductors.
- .3 6 mm diam threaded rods to support suspended channels.

PART 3 EXECUTION

6 INSTALLATION

- .1 In conduit systems in accordance with Section 26 05 34.
- .2 Armoured Cables shall be installed only where permitted in lieu of flexible conduit as indicated in Section 26 05 34.
- .3 Armoured cable shall not be surface run.
- .4 Home runs to panelboards shall not be armoured cable.
- .5 Group aluminum sheathed cables wherever possible on channels.
- .6 Terminate cables in accordance with manufacturers instructions and to the satisfaction of the local inspection authority.
- .7 Hazrdous area wiring shall match Class and Division identified.

END OF SECTION

PART 1 **GENERAL**

PART 2 **PRODUCTS**

1 **MATERIALS**

- .1 Grounding equipment to: CSA C22.2No.41 1950(R1967).
- .2 Copper grounding conductors to: ASA G7.1- 1964.

2 **EQUIPMENT**

- .1 Clamps for grounding of conductor, size as required to electrically conductive underground water pipe or ground rods as required by inspection authority.
- .2 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, size as required.
- .3 Insulated grounding conductors to Section. 26 05 21.
- .4 Non-corroding accessories necessary for grounding systems, type, size, material as required, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Thermit welded type conductor connectors.
 - .3 Bolted type conductor connectors.
 - .4 Bonding jumpers, straps.

3 **MANUFACTURERS**

- .1 Acceptable manufacturers: Burndy, Cadweld, T & B.

PART 3 **EXECUTION**

4 **INSTALLATION GENERAL**

- .1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, electrodes, conductors, connectors, accessories, as indicated, to conform to requirements of Engineer and local authority having jurisdiction over installation. Where EMT is used, run ground wire in conduit.
- .2 Install connectors to manufacturers instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.

- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install separate ground conductor, to outdoor lighting standards.
- .9 Ground secondary service pedestals.
- .10 Route all ground conductors back to existing main building ground.

5 ELECTRODES

- .1 Install rods as required by local inspection authority. Provide all grounding as per local inspection authority requirements.

6 TESTS

- .1 Perform tests in accordance with Section 260501.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END OF SECTION

PART 1 GENERAL

1 RELATED

General Provisions: Section 26 05 01.

PART 2 PRODUCTS

2 SUPPORTS CHANNELS

U shape, size 38mm x 38mm, 25mm thick, surface mounted, suspended, set in poured concrete walls and ceilings as required.

3 MANUFACTURERS

Acceptable manufacturers: Burndy, Electrovert, Unistrut.

4 FASTENINGS

- .1 Lead anchors or nylon shields to secure equipment and conduit straps.

PART 3 EXECUTION

5 INSTALLATION

- .1 Secure fastenings and supports as required for each type of equipment, cables and conduits and to manufacturers installation recommendations.

END OF SECTION

PART 1 **GENERAL**

1 **SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data for cabinets in accordance with Section 260501. Products.

PART 2 **PRODUCTS**

2 **SPLITTERS**

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters less than 400 A.
- .4 Where used as weatherproof transformer tap boxes, to be approved by Engineer prior to ordering. Manco, Celco or Ace type shall be used.

3 **JUNCTION AND PULL BOXES**

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Provide cast junction boxes for all exterior/weatherproof installations.
- .4 Explosion proof type boxes in hazardous locations matching Class and Division identified.

PART 3 **EXECUTION**

4 **SPLITTER INSTALLATION**

- .1 Install splitters as indicated and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.
- .3 Where required, shall be mounted on concrete base supplied by General Contractor complete with two piles.

5 **JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.

- .2 Mount cabinets with top not higher than 1830mm above finished floor.
- .3 Provide pull boxes so as not to exceed 30m of conduit run between pull boxes.

6 IDENTIFICATION

- .1 Install size 2 identification labels indicating system name voltage and phase in accordance with Section 260501.

END OF SECTION

PART 1 GENERAL

1 RELATED WORK

- .1 Box connectors: Section 260520

PART 2 PRODUCTS

2 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1-2015, Section 12.
- .2 100mm 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.

3 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 75mm x 50mm x 38mm or as required. 100mm square outlet boxes when more than one conduit enters one, side with extension and plaster rings as required.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 100mm x 50mm x 50mm.
- .3 100mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 100mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

4 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

5 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

6 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth 65mm for receptacles; 75mm for communication equipment.

7 CONDUIT BOXES

- .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle in exterior or wet or Class 1 areas.

8 FITTINGS – GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of foreign materials.
- .3 Conduit outlet bodies for conduit up to 32mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

9 OUTLET BOXES – EXPLOSION PROOF TYPE

- .1 In hazardous locations all boxes shall match Class and Division identified.

PART 3 EXECUTION

10 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not allowed.
- .5 Use of boxes with built-in connectors is not permitted.
- .6 Use of sectional boxes is not permitted.

END OF SECTION

PART 1 GENERAL

1 LOCATION OF CONDUIT

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.

PART 2 PRODUCTS

2 CONDUITS

- .1 Rigid galvanized steel threaded conduit: size as indicated or required; to CSA C22.2 No.45
- .2 Electrical metallic tubing (EMT), with couplings to CSA22.2 No.83
- .3 Rigid pvc conduit: size as indicated; to CSAC22.2 No.136
- .4 Flexible metal conduit and liquid-tight flexible metal conduit: size as indicated; to CSAC22.2 No. 56.

3 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50mm and smaller. Two hole steel straps for conduits larger than 50mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for multiple conduits.
- .4 6mm dia. threaded rods to support suspended channels.

4 CONDUIT FITTINGS

- .1 Fittings manufactured for use with conduit specified.
- .2 Factory "ells" where 90° bends are required for 25mm and larger conduits.

PART 3 EXECUTION

5 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas or as otherwise noted.

- .3 Use rigid galvanized steel threaded conduit in Class 1 Division 1 and 2 areas and where otherwise noted.
- .4 Use electrical metallic tubing (EMT) unless otherwise noted.
- .5 Use rigid pvc conduit underground, unless otherwise prohibited or noted.
- .6 Use flexible metal conduit or AC90 for connection to motors in dry areas, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures, work in movable metal partitions.
- .7 Use liquidtight flexible metal conduit for connection to motors in damp or wet locations.
- .8 Use explosion proof flexible connection for connection to explosion proof motors.
- .9 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .10 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .11 Mechanically bend steel conduit over 19mm dia.
- .12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .13 Install polypropylene fish cord in empty conduits.
- .14 Run 2-25mm spare conduits up to ceiling space and 2-25mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 150mm x 150mm x 100mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in a flush concrete surface type box.
- .15 Where conduits become blocked, remove and replace blocked section.
- .16 Dry conduits out before installing wire.
- .17 Minimum conduit size to be 19mm.

6 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Run conduits in flanged portion of structural steel.
- .3 Group conduits wherever possible on suspended surface channels.
- .4 Do not pass conduits through structural members except as indicated.

7 CONCEALED CONDUITS

- .1 Do not install horizontal runs in masonry walls.
- .2 Do not install conduits in terrazo or concrete toppings.

8 CONDUITS IN POURED CONCRETE

- .1 Locate to suit reinforcing steel. Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Where conduits pass through waterproof membrane provide oversized sleeve before membrane is installed. Use cold mastic between sleeve and conduit.
- .5 Encase conduits completely in concrete.
- .6 Co-ordinate electrical work and requirements in poured construction with General Contractor and insure installation is complete prior to pour.

9 CONDUITS IN POURED SLABS ON GRADE

- .1 Run conduits 25mm and larger below slab and encased in 75mm concrete envelope. Provide 50mm of sand over concrete envelope below floor slab.

10 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with a heavy coat of bituminous paint.

END OF SECTION

PART 1 **GENERAL**

1 **SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 26 05 01.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

2 **PLANT ASSEMBLY**

- .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.

PART 2 **PRODUCTS**

3 **PANELBOARDS**

- .1 Panelboards: to CSA C22.2No.29-1955.
- .2 Panelboards to be product of one manufacturer.
- .3 250 and 600 V panelboards: bus and breakers rated for available (symmetrical) interrupting capacity or as indicated.
- .4 Sequence phase bussing with breakers numbered as shown on drawings, with each breaker identified by permanent number identification as to circuit number.
- .5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with full size neutral.
- .8 Mains suitable for bolt-on breakers.
- .9 Finish trim and door baked grey enamel.
- .10 Sprinkler proof.

4 **CUSTOM BUILT PANELBOARDS**

- .1 Upstream circuit breaker on mains as indicated.
- .2 Double stack panels as indicated.

5 BREAKERS

- .1 Breakers to Section 26 28 21.
- .2 Breakers with thermal magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry.
- .4 Lock-on devices for receptacles, fire alarm, emergency, door supervisory, intercom, stairway, exit and night light circuits.

6 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

PART 3 EXECUTION

7 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on fireguard backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height given in Section 26 05 01 or as indicated.
- .4 Connect loads to circuits as indicated.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 For flush mounted panelboards, the general contractor is to provide adequate wall depth at no additional cost

END OF SECTION

PART 1 **GENERAL**

1 **PRODUCT DATA**

- .1 Submit product data in accordance with Section 26 05 01.

PART 2 **PRODUCTS**

2 **BREAKERS GENERAL**

- .1 Bolt-on moulded case circuit breaker, quick- make, quick-break type, for manual and automatic operation.
- .2 Common-trip breakers with single handle for multipole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting.
- .4 Instantaneous interrupting capacity to be co-ordinated with available fault current.
- .5 Moulded case circuit breakers: to CSA C22. No. 5 -1963.
- .6 Circuit breakers to be series rated

3 **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 under overload conditions and instantaneous magnetic tripping for short circuit protection.

4 **MANUFACTURERS**

- .1 Acceptable manufacturers: to match existing.

PART 3 **EXECUTION**

5 **INSTALLATION**

- .1 Install circuit breakers as indicated.
- .2 Provide short circuit fault study with shop drawings. Study shall bear the seal of Engineer.
- .3 Coordinate short circuit interrupting capacity with the utility. Provide written report and submit to engineer and power authorities.

END OF SECTION

PART 1 GENERAL

1 PRODUCT DATA

- .1 Submit product data in accordance with Section 26 05 01. products

PART 2 PRODUCTS

2 EQUIPMENT

- .1 Enclosed manual air break switches in non- hazardous locations: to CSA C22.2No.4-1974.
- .2 Fuseholder assemblies to CSA C22.2No.39-1972.
- .3 Fusible and non-fusible disconnect switch in CSA Enclosure 1 .
- .4 Fusible and non-fusible disconnect switch in CSA Enclosure 3 if located on exterior of building.
- .5 Provision for padlocking.
- .6 Mechanically interlocked door to prevent opening when handle in ON position.
- .7 Fuses as required where indicated.
- .8 Fuseholders in each switch suitable without adapters, for type of fuse as indicated.
- .9 Quick-make, quick-break action.
- .10 ON-OFF switch position indication on switch enclosure cover.
- .11 Match hazardous location Class and Division as identified.

3 EQUIPMENT IDENTIFICATION

- .1 Indicate name of load controlled on size 4 nameplate to Section 26 05 01.

4 MANUFACTURERS

- .1 Acceptable manufacturers: to match Section 26 28 21.

PART 3 EXECUTION

5 INSTALLATION

- .1 Install disconnect switches complete with fuses as indicated.

END OF SECTION