PUBLIC WORKS GARAGE
2373 CHISWICK LINE, CHISHOLM, ON
PROJECT NO. 6487
JUNE 2022

Piotrowski Consultants Ltd.
1820 Bond Street
North Bay, ON P1B 4V6

I N D E X

PART 1- GENERAL

1.1. GENERAL

1. This section covers items common to all sections of Division 15 and is supplementary to requirements of Division 1.

2. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

3. Coordinate all requirements with General Contractor.

1.2. CODE OF STANDARDS

1. Do complete installation in compliance with latest editions and all amendments of the following Codes and Standards. Where conflicts in requirements occur, the higher standard shall apply:

    1. ASHRAE

    2. SMACNA

    3. CSA

    4. Ontario Building Code

    5. All governing municipal requirements

    6. ULC

    7. LEED Canada for New Construction and Major Renovations 2009.

1.3. DEFINITIONS

1. “Provide” means supply and install.

2. “Approved” means approved in writing by Consultant.

3. “Consultant” means designated qualified professional engineer acting as representative of Owner for monitoring of work.

4. “Manual” means Operations and Maintenance manual.

1.4. CARE, OPERATION, START-UP AND INSTRUCTION TO OWNERS

1. Provide certified personnel to instruct Owner of operation mechanical equipment. Provide maintenance specialist personnel to instruct on maintenance and adjustment of mechanical equipment and any changes or modification equipment must be under terms of guarantee.

2. Provide instruction during regular work hours prior to acceptance and turn over to Owner's staff for regular operation.

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 all aspects of its care and operation.

4. Use operation and maintenance data manual for instruction purposes. On completion of instruction, turn three manuals over to the Owner.

5. Operation and maintenance manual to be approved by and final copies deposited with Consultant before final inspection.

6. Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

1.5. PERMITS, CERTIFICATES, FEES AND INSPECTIONS

1. Submit to the Building Department the necessary number of drawings and specifications for examination prior to commencement of work to obtain a building/plumbing permit. Obtain and pay for all building/plumbing permits. Include all costs in the tender price.

2. Submit Notice of Project to Ministry of Labour.

3. Contractor shall be responsible to pay associated fees.

4. Notify Consultant of changes required by Building Department prior to making changes.

5. Notify Consultant upon completion of work.

1.6. COORDINATION WITH EXISTING UTILITIES

1. Before commencing any Work, the Contractor shall determine the locations of all underground utilities and structures indicated in or inferable from the Contract Documents, or that are inferable from an inspection of the Place of the Work.

2. All existing utilities are to be maintained and protected for the length of construction.

3. Contractor to notify consultant if any conflicts arise and allow for minimum 48 hours for consultants review.

1.7. EQUIPMENT REQUIREMENTS AND INSTALLATION

1. Permit equipment maintenance and disassembly by use of unions or flanges to minimize disturbance to connecting piping and duct systems and without interference from building structure or other equipment.

2. Provide accessible means for lubricating equipment including permanent lubricated "lifetime" bearings.

3. Pipe drain lines to drains.

4. Line-up equipment, rectangular cleanouts and similar items with building walls wherever possible.

5. Provide equipment commissioning and preliminary balancing and confirm the proper operation of all equipment and related systems.

1.8. RESPONSIBILITY FOR TRIAL USAGE

1. Obtain written permission to start and test permanent equipment and systems prior to acceptance by Consultant.

2. Consultant may use ventilating equipment and systems for testing.

3. Protect equipment and systems' openings from dirt, dust and other foreign materials during test usage.

1.9. ELECTRICAL

1. Division 15 shall supply and install motors, controls and control wiring, supply starters, switches and relays, for all motor driven equipment under Division 15. Starters, switches and relays shall be handed over to Division 16 for installation and wiring.

2. Electrical equipment not supplied by Division 15 is listed on the drawings or elsewhere in the Specification for quality of material and workmanship.

3. Safety disconnect switches shall be supplied for each rotating equipment unless within viewing distance for motor control but max 6 m (20') supplied by Division 15 and installed by Division 16.

4. Wiring and controls for connections below 50 V, which are related to control systems are the responsibility of Division 15. Refer to Division 16 for quality of materials and workmanship.

    1. Control cables, type LVT, soft annealed copper conductors with thermoplastic insulation and colour coding. Installation in EMT conduit.

    2. Two conductors parallel with an overall thermoplastic jacket; three or more conductors twisted with an overall thermoplastic jacket.

    3. Cable to be installed in EMT conduit or to be plenum rated FT6 type.

1.10. THERMOSTATS AND SENSORS

1. All thermostats, sensors etc to be mounted at 1200mm (47”) above finished floor to centre line of device. Any interference with other devices such as switches, etc to be coordinated with Consultant.

1.11. MOTORS

1. Provide motors for mechanical equipment as specified.

2. If delivery of specified motor will delay delivery of installation of any equipment, install an acceptable motor for temporary use. Final acceptance of equipment will not occur until specified motor is installed.

3. Motors under 373 W (1/2 HP) speed as indicated, continuous duty high efficiency, built in overload protection, resilient mount, single phase, 120 V unless otherwise specified or indicated.

4. Motors 373 W (1/2 HP) to 150 kW (200 HP) T frame, to or exceeding the current Ontario Hydro Motor Efficiency Levels and be listed in the current Ontario Hydro Motor Efficiency Levels Guide as tested to CSA C390M 1985 or IEEE 112B and approved under the Canadian Safety Code, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C (72°F), 3 phase, 208 V or 600 V unless otherwise specified or indicated.

5. Provide a suitable manual or magnetic starter for each piece of equipment supplied under this Division.

6. Provide safety disconnect switches for the above equipment.

7. Division 16 will install all starters, disconnects and line voltage control devices and perform all wiring under supervision of this Division.

1.12. PIPE HANGERS AND SUPPORTS

1. See Section 15140 – Hangers and Supports.

1.13. BELT DRIVES

1. Fit reinforced belts in sheaves matched to drive. Multiple belts to be matched set.

2. Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.

3. For motors up to 7.5 kW (10 HP) standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid position of range for specified r/min. Use fixed sheaves for motors 7.6 kW (10 HP) and over. Replace sheaves during balancing if required.

4. Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturers design requirements on prime mover shafts.

5. Motor slide rail adjustment plates to allow for centre line adjustment.

1.14. GUARDS

1. Provide guards for unprotected drives.

2. Guards for belt drives:

1. Expanded metal screen welded to steel frame.

2. Minimum 1.3 mm (18 GA) galvanized sheet metal tops and bottoms.

3. 40 mm (1 1/2") 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 permit movement of motors for adjusting belt tension.

1.15. BUILDING PERMIT

1. Prepare permit application and apply for building permit at local Building Department. Include all costs in tender price. Consultant will provide contract documents in PDF format, contractor responsible to produce hard copies.

1.16. DRAIN VALVES

1. Locate at low points and at section isolating valves unless otherwise specified.

2. Minimum NPS 3/4 unless otherwise specified: bronze, with hose end male thread and complete with cap and chain.

1.17. PENETRATIONS

1. Where pipes pass through fire rated walls, floors or partitions, maintain fire rating of assembly in compliance with OBC. Submit shop drawings and details on all products.

2. Provide pipe sleeves at penetrations where pipes pass through masonry or concrete, or where protection is required from galvanic action or physical abrasion.

    1. Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc-rich paint.

    2. Where sleeves pass through masonry or concrete: backfill space around sleeve with masonry or concrete.

    3. Where sleeves pass through walls or floors: caulk space between insulation and sleeve or between pipe and sleeve with waterproof fire retardant non-hardening mastic.

    4. In foundation walls and below grade floors: pipe sleeve to be 1.25x pipe outside diameter or minimum 50mm. Fill space between pipe and sleeve with soft foam insulation.

3. Ensure no contact between copper tube or pipe and ferrous material or sleeve.

4. Continue insulation through penetrations where pipe is required to be insulated.

5. Temporarily plug all openings during construction.

1.18. SLEEVES

1. Size:

    1. Provide 5 mm (1/4") clearance between sleeve and pipe or between sleeve and insulation.

    2. Where piping passes below footings, provide min clearance of 50 mm (2") between sleeve and pipe. Fill void with elastic, water proof material. Backfill up to underside of footing with concrete of same strength as footing.

2. Provide sleeves of minimum 1.0 mm (20 GA) galvanized sheet steel with lock seam joints or use PVC pipe in non rated walls.

3. Use cast iron or steel pipe sleeves with annular fin continuously welded at mid-point through foundation walls.

1.19. ESCUTCHEONS AND PLATES

1. Provide on pipes passing through finished walls, partitions, floors and ceilings.

2. Use split type chrome plated brass, with set screws for ceiling or wall mounting.

3. Inside diameter shall fit around finished pipe. Outside diameter shall cover opening or sleeve.

4. Where sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension.

5. Secure to pipe or finished surface but not insulation.

1.20. TESTS

1. Provide the following supplementary requirements to tests specified:

    1. Give 48 h notice of date when tests will be made.

    2. Do not insulate or conceal work until tested and approved.

    3. Conduct tests in presence of Consultant.

    4. Bear costs including retesting and make good.

    5. Pipe pressure:

        1. Hydraulically test water supply systems at 1-1/2 times system operating pressure or minimum 1050 kPa (150 psig).

2. Maintain test pressures without loss of 4 h unless otherwise specified.

3. Record pressure test results, indicating:

    1. Portion of piping tested.

    2. Test pressure.

    3. Test duration.

    4. Results/Comments.

    5. Type of pipe.

    6. Type of system.

    7. Size of pipe.

4. Submit results to Consultant.

1.21. PAINTING

1. Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals.

2. Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

1.22. SPECIAL TOOLS

1. Provide one set of special tools required to service equipment as recommended by manufacturers.

1.23. ACCESS DOORS

1. Supply access doors to concealed mechanical equipment for operating, inspecting, adjusting and servicing.

2. Flush mounted 600 mm x 600 mm for body entry and 300 mm x 300 mm for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.

3. Material:

    1. Special areas such as tiled or marble surfaces: use stainless steel with brushed satin or polished finish as directed by Consultant.

    2. Remaining areas: use prime coated steel.

4. Installation:

1. Locate so that concealed items are accessible.

2. Locate so that hand or body entry (as applicable) is achieved.

3. Installation is specified in applicable sections.

5. Acceptable Material: Nailor 0900 or approved equal.

1.24. DIELECTRIC COUPLINGS

1. Provide wherever pipes of dissimilar metals are joined.

2. Provide felt or rubber gaskets to prevent dissimilar metal contact.

1.25. CUTTING AND PATCHING

1. All cutting and patching shall be by Division 15. Coordinate with other trades. Notify Structural Engineer before cutting any structural members and obtain written permission.

1.26. CONCRETE WORK

1. Provide 100mm concrete housekeeping pads for all floor mounted equipment, including: boilers, air handlers, pumps, heat and energy ventilators, tanks and furnaces.

1.27. EXCAVATION AND BACKFILLING

1. This Division shall be responsible for coordination for bedding of lines or equipment and for backfilling and compaction to 98% Standard Proctor Density.

1.28. EXISTING SYSTEMS

1. Before submitting tender price verify on job site location of all accessible existing systems affecting execution of this contract. Difficulties arising during construction will not be considered as grounds for additional payment.

2. Where work involves breaking into or connecting to existing systems, carry out work at times directed by governing authorities, with minimum of disturbance to pedestrian traffic.

3. Submit schedule to and obtain approval from Consultant for any shut down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.

4. Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.

1.29. INSTRUCTIONS TO OWNERS

1. Provide certified personnel to instruct Owner of operation mechanical equipment. Provide

maintenance specialist personnel to instruct on maintenance and adjustment of mechanical equipment and any changes or modification equipment must be under terms of guarantee.

2. Training plans to be submitted prior to the execution of the training. At a minimum, training plans to include the list of systems and equipment which are to be trained on. Instructor's name and qualifications and allotted time for training. Training plans to be reviewed and approved by Owner and Consultant prior to commencement of training.

3. Provide instruction during regular work hours prior to acceptance and turn over to Owner's staff for regular operation.

4. Use operation and maintenance data manual for instruction purposes. On completion of instruction, turn three manuals over to the Owner.

5. Operation and maintenance manual to be approved by and final copies deposited with Consultant before final inspection.

1.30. OPERATION & MAINTENANCE MANUALS

1. Provide one (1) paper copy and one "PDF" format on USB stick of Mechanical Operation and Maintenance Manuals complete with As-built Drawings, in accordance to the following and Section 01300 - Submittals.

2. Mechanical Operation and Maintenance Manuals to be delivered to the Engineer's office in accordance with Section 01300 - Submittals.

3. Manuals to be bound in hard cover neatly labeled: "OPERATING AND MAINTENANCE INSTRUCTIONS".

4. The Operation and Maintenance Manuals shall be divided into sections with neatly labeled and tabbed dividers between each section. The sections to be included in the manual are:

    1. Section I – General

    2. Section II – Piping and Pump Systems

    3. Section III – Heating, Air Conditioning and Ventilation

    4. Section IV – Automatic Controls

    5. Section V – Sprinkler System

    6. Section VI – Air and Hydronic Balancing Report

5. The following information shall be contained within the sections:

    1. SECTION I: A list giving name, address and telephone number of the Consultant, Engineers, Construction Manager, Mechanical Trade and Controls Trade. Written guarantees for the Mechanical Systems. A copy of the Valve directory giving number, valve location, normal valve position, and purpose of valve. A framed copy of valve directory to be hung in Mechanical Room. Equipment lists and certificates shall be provided. Certificates shall be signed and sealed by the appropriate

suppliers. All major equipment including but not limited to boilers, cooling towers, chillers, air handling units, isolators, silencers, pumps and humidifiers are to be inspected by the manufacturer to ensure the equipment has been installed in accordance with their recommendations.

2. SECTION II, III and IV: A copy of all pressure tests and operational tests for pumping system. A copy of Gas Operational Tests for gas fired equipment. A list giving name, address and telephone number of all suppliers. A copy of all approved Shop Drawings. Copies of warranties.

3. SECTION IV: Complete Control Diagrams, Wiring Diagrams and description of Control system and the functioning of the system. A copy of all shop drawings and all calibration certificates. Shop drawings shall be the updated record drawings.

4. SECTION V: A copy of all shop drawings. Copies of all warranties. Maintenance information.

5. SECTION VI: Provide complete air balance report including pump and fan curves, measured values and floor plans showing location of all traverse readings and grille measurements. Provide copies of all pressure tests completed on the systems.

6. MAINTENANCE MATRIX

1. A maintenance matrix is to be provided in the Operation and Maintenance Manuals. The matrix shall indicate each piece of equipment and the required maintenance tasks and the frequency at which they are to be carried out.

1.31. OWNER OCCUPANCY SCHEDULE

1. The existing building will remain occupied during normal occupancy hours.

2. Provide temporary protection for all finishes, appliances or equipment in the existing building.

3. Protect and maintain existing boiler room and electrical room operations during the work.

1.32. AS-BUILT DRAWINGS

1. Site records:

1. One set to be kept on site and all changes to be recorded on daily basis. At the completion of the project, all changes shall be transferred to clean set, signed and passed to the Consultant. Provide “PDF” format of As-Built Drawings on USB stick with Maintenance Manuals at completion of project.

2. Make these drawings available for reference purposes and to inspection at all times.

2. Submit 2 copies of as-built marked up prints with final TAB report.

3. As-built drawings must be delivered before system acceptance.

1.33. BUILDING SERVICE CONNECTIONS

1. Make arrangements with all Utilities for building service connections and include all costs in tender price.

1.34. SPARE PARTS

1. One (1) set of belts from any motor driven mechanical components.

2. Leave spare parts on site. Coordinate storage location with the Owner.

1.35. TRAINING

1. Provide minimum of one 4 hour training sessions on systems.

END OF SECTION 15010

PART 1 - GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. REFERENCES

1. ASME B31.1-2012, (SI), Power Piping, (SI Edition).
2. MSS-SP-58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1. Submit shop drawings and product data in accordance with Section 01300 - Submittals.
2. Indicate on manufacturer's catalogue literature the following:
    1. Upper attachment.
    2. Middle attachment.
    3. Pipe attachment.
    4. Riser clamps.
    5. Shields and saddles.
    6. Sway braces.

1.4. MAINTENANCE DATA

1. Provide maintenance data for incorporation into manual specified in Section 01300 - Submittals.

PART 2- PRODUCTS

2.1. GENERAL

1. Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP-58.
2. Support from structural members. Where structural bearing does not exist or inserts are not

in suitable locations, provide supplementary structural steel members.

2.2. UPPER ATTACHMENTS

1. Concrete:
    1. Anchors for existing concrete roof structure, heavy duty anchors Hilti HSL.
2. Steel beam (bottom flange):
    1. Cold piping NPS 2 and under: malleable iron C clamp to MSS-SP-58, type 19. ULC listed.
    2. Cold piping NPS 2-1/2 and larger and all hot piping: malleable iron beam clamp to MSS-SP-58, type 28 or 29. ULC listed.
3. Steel beam (top):
    1. Cold piping NPS 2 and under: malleable iron "top of beam" C clamp to MSS-SP-58, type 19. ULC listed.
    2. Cold piping NPS 2-1/2 and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer, to MSS-SP-58, type 25. ULC listed.
4. Steel joist:
    1. Cold piping NPS 2 and under: steel washer plate with double locking nuts.
    2. Cold piping NPS 2-1/2 and larger and all hot piping: steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.
5. Steel channel or angle (bottom):
    1. Cold piping NPS 2 and under; malleable iron C clamp to MSS-SP-58, type 23. ULC listed.
    2. Cold piping NPS 2-1/2 and larger and all hot piping; universal channel clamp. ULC listed.
6. Wood trusses and joists.
    1. Hold piping NPS2 and under. Secure angle iron 32 x 32 x 3 mm (1 1/2" x 1 1/2" x 3/16") on top of joist or bottom chord trusses. Space min. 2 joints. Use rod hanger with locking nut and clevis hanger.
    2. Cold piping NPS 2 1/2 and larger. Secure angle iron 50 x 50 x 4 mm on top of joists or bottom chord of trusses. Span min. 4 members. Use rod hangers with locking nut and clevis hanger.

2.3. MIDDLE ATTACHMENT (ROD)

1. Carbon steel threaded rod black finish.

2.4. PIPE ATTACHMENT

1. Cold piping, steel or cast iron: hot piping steel, with less than 25 mm, 1" horizontal movement; hot piping, steel, with more than 300 mm, 12" middle attachment rod length: adjustable clevis to MSS-SP-58, type 1. ULC listed.

2. Cold copper piping; hot copper piping with less than 25 mm, 1" horizontal movement; hot copper piping with more than 300 mm, 12" middle attachment rod length: adjustable clevis to MSS-SP-58, type 1. Copper plated.

3. Suspended hot piping, steel and copper, with horizontal movement in excess of 25 mm, 1"; hot steel piping with middle attachment rod 300 mm, 12" or less; pipe roller to MSS-SP-58, type 43.

4. Bottom supported hot piping, steel and copper: pipe roller stand to MSS-SP-58, type 45.

2.5. RISER CLAMPS

1. Steel or cast iron pipe: black carbon steel to MSS-SP-58, type 42. ULC listed.

2. Copper pipe: carbon steel copper finished to MSS-SP-58, type 42.

2.6. SADDLES AND SHIELDS

1. Hot and Cold piping NPS 1-1/4 and over: protection shield with high density insulation under shield with uninterrupted vapour barrier.

PART 3- EXECUTION

3.1. HANGER SPACING

1. Spacing and middle attachment rod diameter as specified in paragraphs below or as in table below, whichever is more stringent.

    1. Plumbing piping: most stringent requirements of Ontario Building Code, or authority having jurisdiction.

    2. Fire protection: to applicable fire code.

    3. Gas piping: up to NPS 1/2: every 6', 1.8 m

    4. Copper piping: up to NPS 1/2: every 5' 1.5 m

    5. Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

6. Within 12" of each horizontal elbow.

Pipe Size (Nominal)	Rod Diameter	Maximum Steel	Spacing Cooper
NPS 1/2	10 mm 3/8"	1.8m 6'	5' 1.5m
NPS 3/4, 1	10 mm 3/8"	2.1m 7'	6' 1.8m
NPS 1-1/4	10 mm 3/8"	2.1m 7'	8' 2.4m
NPS 1-1/2	10 mm 3/8"	2.7m 9'	8' 2.4m
NPS 2	10 mm 3/8"	3.0m 10'	9' 2.7m
NPS 2-1/2	10 mm 3/8"	3.0m 10'	10' 3.0m
NPS 3 to 4	10 mm 3/8"	4.6m 15'	12' 3.6m
NPS 6	19 mm 3/4"	5.1 m 17'	--

3.2. HANGER INSTALLATION

1. Offset hanger so that rod is vertical in operating position.

2. Adjust hangers to equalize load.

END OF SECTION 15140

PART 1- GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. REFERENCES

1. CGSB 1-GP-60M, Enamel, Interior, Gloss, Alkyd Type.
2. CGSB 24-GP-3a Identification and Classification of Piping Systems.

1.3. SAMPLES

1. Submit samples in accordance with Section 01300 - Submittals.
2. Submit samples and lists of proposed wording for approval before engraving.

PART 2– PRODUCTS

2.1. MANUFACTURERS NAMEPLATES

1. Provide metal nameplate on each piece of equipment, mechanically fastened complete with raised or recessed letters.
2. Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

2.2. SYSTEM NAMEPLATES

1. Colour:
    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, square corners, letters accurately aligned and machine engraved into core.
3. Sizes:

1. Conform to following table:

Size #	Dimensions (mm)	(in)	No. of Lines	Letter Height (mm)	(in)
1	10 x 50	3/8 x 2	1	3	1/8
2	13 x 75	1/2 x 3	1	5	1/4
3	13 x 75	1/2 x 3	2	3	1/8
4	20 x 100	3/4 x 4	1	8	3/8
5	20 x 200	3/4 x 8	1	8	3/8
6	20 x 100	3/4 x 4	2	5	1/4
7	25 x 125	1 x 5	1	12	1/2
8	25 x 125	1 x 5	2	8	3/8
9	35 x 200	1-1/4 x 8	1	20	3/4

2. Use average of 25 letters/numbers (maximum) per nameplate.

3. Use size #6 for terminal cabinets and control panels.

4. Use size #9 for equipment in mechanical rooms.

5. Facilities Inspection Program (FIP) identification:

1. General: use system of Main Identifier, Source Identifier, Destination Identifier.

2. Equipment and Mechanical Rooms: Main Identifier: size #9; Source and Destination Identifiers: size #5.

3. Elsewhere: Sizes as appropriate.

2.3. PIPING

1. General

1. To CGSB 24-GP-3a.

2. Identify medium by lettered legend, classification by primary and secondary colours, direction of flow by arrows.

2. Sizes:

1. Legend: block capitals to following table:

Outside Dia. of Pipe or Insulation mm	in	Size of Letters mm	in
30	1-1/4	13	1/2
50	2	19	3/4
150	6	32	1-1/4
250	7	63	2-1/2
Over 250	8	88	3

2. Primary colour bands:

    1. At valves and fittings: 460 mm, 18" long.

    2. Elsewhere: 1.8 m, 42" long.

    3. Secondary colour bands: 50 mm, 2" wide, 75 mm, 3" in from one end of primary colour band.

3. Arrows:

    1. Outside diameter of pipe/insulation 75 mm and greater: 150 mm, 6" long x 50 mm, 2" high.

    2. Outside diameter of pipe/insulation less than 75 mm, 3": 100 mm, 4" long x 50 mm, 2" high.

    3. Use double headed arrows where flow is reversible.

3. Material:

    1. Paint: to CGSB 1-GP-60M.

    2. Legend markers, arrow colour bands: plastic coated cloth material with protective overcoating and waterproof contact adhesive undercoating, suitable for 100% RH and continuous operating temperature of 150°C (300°F). Apply to prepared surfaces. Wrap tape around pipe or pipe covering with ends overlapping one (1) pipe diameter.

    3. Waterproof and heat resistant plastic marker tags: for pipes and tubing 3/4" nominal and smaller.

    4. Acceptable material: Brady

4. Colours:

    1. Where not covered by table below, submit legend, primary and secondary classification colours to Consultant for approval.

5. Table:

    1. Pipe and valve identification.

Pipe Marker Legend	Valve Tag Legend	Primary Colour	Secondary Colour
Hot Water Htg Supply	H.W.H.S	Green	None
Hot Water Htg Return	H.W.H.R.	Green	None
Glycol Heating Supply	G.H.S.	Green	None

Glycol Heating Return	G.H.R.	Green	None
Gas Line	Gas	Green	None
Cold Water	C.W.	Green	None
Hot Water	H.W.	Green	None
Recirc. Hot Water	R.H.W.	Green	None

2. Legend and arrows:

    1. Black or white to contrast with primary colour.

    2. Fire protection: white on red background.

3. Fire protection system:

    1. Exposed piping identify only.

4. Natural gas:

    1. Paint entire system.

5. Low voltage control wiring installed by Division 15.

2.4. DUCTWORK

1. 2" high black stencilled letters and directional flow arrows 6" long x 2" high.

2.5. VALVES AND CONTROLLERS

1. Brass tags with 1/2" stamped code lettering and numbers filled with black paint.

2. Furnish Consultant with six identification flow diagrams of approved size for each system. Include valve tag schedule, designating number, service, function and location of each tagged item and normal operating position of valves.

2.6. CONTROLS IDENTIFICATION

1. Identify all systems, equipment, components, controls and sensors.

2. Inscription to identify function and fail-safe position.

PART 3- EXECUTION

3.1. GENERAL

1. Do identification work in accordance with CGSB 24-GP-3a except where specified otherwise.

2. Provide ULC and/or CSA registration plates, as required by respective agency.

3. Identify systems and equipment to conform to PWC, FIP.

3.2. LOCATION OF NAMEPLATES

1. In conspicuous location to facilitate easy reading from operating floor and to properly identify equipment and/or system.

2. Provide stand-offs for nameplates on hot surfaces and insulated surfaces.

3. Do not insulate or paint over plates.

3.3. PIPING

1. Locations:

    1. On long straight runs in open areas in boiler rooms, mechanical room, and tunnel so that at least one is clearly visible from any one viewpoint in operating areas or walking aisles and not at more than 15 m, 50' intervals.

    2. Adjacent to all changes in direction.

    3. At least once in each small room through which piping passes.

    4. On both sides of visual obstruction or where run is difficult to follow.

    5. On both sides of any separation such as walls, floors and partitions.

    6. Where piping is concealed in pipe chase, ceiling space, or other confined space, at entry and leaving points and adjacent to each access opening.

    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. Where this is not possible, place identification as close to valve as possible, preferably on upstream side.

    9. Legend to be easily and accurately readable from usual operating areas and all readily accessible points.

    10. Plane of legend to be approximately at right angles to most convenient line of sight with consideration of operating positions, lighting conditions, reduced visibility of colour or legends caused by dust and dirt and risk of physical damage.

3.4. DUCTWORK

1. Stencil over final finish only.

2. Locations of ductwork identification:

    1. On long straight runs in open areas in boiler rooms, equipment rooms, so that at least one is clearly visible from any one viewpoint in operating areas or walking isles and not at more than 15 m, 50' intervals.

    2. Adjacent to all changes in direction.

    3. At least once in each small room through which ductwork passes.

    4. On both sides of visual obstruction or where run is difficult to follow.

    5. On both sides of any separation such as walls, floors and partitions.

    6. Where ductwork is concealed in duct chase, or other confined space, at entry and leaving points and adjacent to each access opening.

    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 dampers. Where this is not possible, place identification as close to damper as possible, preferably on upstream side.

    9. Legend to be easily and accurately readable from usual operating areas and all readily accessible points.

    10. Plane of legend to be approximately at right angles to most convenient line of sight with consideration of operating positions, lighting conditions, reduced visibility of colour or legends caused by dust and dirt and risk of physical damage.

    11. Beside each access door.

3.5. VALVES AND CONTROLLERS

1. Secure tags with non-ferrous chains or closed "S" hooks for valves and operating controllers except at plumbing fixtures and radiation.

2. Install one copy of flow diagram and valve schedule mounted in frame with non-glare glass where directed by Consultant. Provide one copy in each operating and maintenance instruction manual.

3. Consecutively number valves system.

END OF SECTION 15190

PART 1– GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. REFERENCES

1. ASTM C411-11, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
2. CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.
3. ANSI/NFPA 90A-2012, Air Conditioning and Ventilating Systems, Installation of.
4. ANSI/NFPA 90B-2012, Warm Air Heating and Air Conditioning Systems.
5. CGSB 51-GP-10M-76, Thermal Insulation, Mineral Fibre, Block or Board, for Ducting, Machinery and Boilers.
6. CGSB 51-GP-11M-76, Thermal Insulation, Mineral Fibre, Blanket for Piping, Ducting, Machinery and Boilers.
7. CGSB 51-GP-52Ma-89, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

1.3. SHOP DRAWINGS

1. Submit shop drawings in accordance with Section 01300 - Submittals.
2. Submit for approval manufacturer's catalogue literature related to installation.

1.4. DEFINITIONS

1. For purposes of this section:
    1. "CONCEALED" - insulated mechanical services and equipment in hung ceilings and non-accessible chases and furred spaces.
    2. "EXPOSED" - will mean "not concealed" as defined herein.

PART 2 - PRODUCTS

2.1. GENERAL

1. All components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN/ULC-S102.

2. Materials to be tested in accordance with ASTM C411.

2.2. D-2 MINERAL FIBER BLANKET WITH VAPOUR BARRIER MINUS 40 TO PLUS 150°F

1. Application: on round or oval ducting, either cold or dual temperature.

    1. Supply air conditioning ducting with exception of where exposed to conditioned space.

    2. Fresh air intake from louvre to HRV, ERV and A/H units.

    3. Exhaust and relief air ducting from HRV, ERV and A/H units to exhaust louvre or hood.

    4. Exhaust air from exhaust fan, hood.

    5. Or as indicated.

2. Material:

    1. CGSB 51-GP-11M, mineral fiber blanket; CGSB 51-GP-52M for vapour barrier.

    2. Acceptable material: Fibreglass MDS 103

3. Thickness: 25 mm, 1"

2.3. D-3 MINERAL FIBER BLANKET - ELEVATED TEMPERATURE TO 537°C (1000°F)

1. Application:

    1. Boiler breeching and boiler vent stack - round.

2. Material:

    1. CGSB 51-GP-11M inorganic glass fiber bonded by high temperature thermosetting resin.

3. Thickness: 50 mm (2").

2.4. D-4 MINERAL FIBER RIGID WITH VAPOUR BARRIER TO 65°C

1. Application: on cold or dual temperature rectangular ducting.

    1. Supply air conditioning ducting with exception of where exposed in conditioned space.

2. Fresh air intakes from louvre to HRV, ERV and A/H units.

3. Exhaust and relief air ducting from HRV, ERV and A/H units to exhaust louvre or hood.

4. Exhaust air from exhaust fan, hood.

5. Or as indicated.

2. Material:

1. CGSB 51-GP-10M, rigid mineral fiber board; CGSB 51-GP-52M vapour barrier, jacket and facing material.

2. Acceptable material: Fibreglass MDS 101

3. Thickness:

1. One 25 mm, 1" layer on: supply return and exhaust air ducts.

2. Two-1 1/2" layers on: intake ducts, supply and return ductwork installed on roof or outside.

2.5. FASTENINGS

1. Tape: self adhesive, 100 mm, 4" wide, aluminum, ULC labelled for less than 25 flame spread and less than 50 smoke developed.

2. Contact adhesive: quick-setting.

3. Lap seal adhesive: quick-setting for joints and lap sealing of vapour barriers.

4. For Canvas:

1. Washable adhesive for cementing canvas lagging cloth to duct insulation.

5. Pins.

1. Weld pins 4 mm, 3/16" diameter, with 40 mm, 1 1/2" diameter head for installation through the insulation. Length to suit thickness of insulation.

2.6. JACKET

1. Canvas.

1. Apply in exposed areas (boiler, mechanical, electrical, IT rooms and other areas as noted on drawings): ULC listed, fire rated, plain weave, cotton fabric at 220 g/m^2.

2. Acceptable material: Fatal Thermo Canvas

2. Aluminum Outer Jacket:

    1. Fabricated weather resistant coating, 24 gauge with rising seams.

    2. Apply to ductwork exposed to weather.

    3. Apply to breeching, chimney insulation.

PART 3– EXECUTION

3.1. APPLICATION

1. Apply insulation after required tests have been completed and approved by Consultant. Insulation and surfaces shall be clean and dry when installed and during application of any finish. Apply insulation materials, accessories and finishes to manufacturer's recommendations and as specified.

2. Vapour barriers and insulation to be unbroken over full length of duct or surface, without penetration for hangers, standing duct seams and without interruption at sleeves and supports.

3. Use stand-offs for all duct mounted control accessories.

4. Apply 1 mm. 20 ga galvanized sheet metal corners to all ductwork in mechanical rooms.

3.2. INSTALLATION

1. General:

    1. Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.

    2. Perform insulation work using qualified insulation applicators, in accordance with latest trade application methods and to the Consultant’s approval.

    3. Work to begin only when building is enclosed preventing insulation from getting wet due to elements such as rain, snow, construction, etc. All damaged or wet insulation to be replaced.

    4. All piping (Section 15260) and ductwork (Section 15270) insulation to be continuous except at fire barriers.

    5. Adhere and seal vapour barrier using vapour seal adhesives.

    6. Stagger longitudinal and horizontal joints, on multilayered insulation.

2. Mechanical fastenings:

    1. On rectangular ducts, use 50% coverage of insulating cement and weld pins at not

more than 200 mm, 8" centres, but not less than 2 rows per side and bottom.

END OF SECTION 15270

PART 1- GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. REFERENCES

1. ANSI/NFPA 10, Portable Fire Extinguishers.

2. CAN4-S508, Rating and Fire Testing of Fire Extinguishers.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1. Submit shop drawings and product data in accordance with Section 01300 - Submittals.

1.4. MAINTENANCE DATA

1. Provide maintenance data for incorporation into manual specified in Section 01300 - Submittals.

PART 2- PRODUCTS

2.1. MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS

1. Cartridge operated type or Stored pressure rechargeable type with hose and shut-off nozzle, ULC labelled for A, B and C class protection. Size 4.5 kg 4-A, 60-BC rated.

2.2. EXTINGUISHER BRACKETS

1. Type recommended by extinguisher manufacturer.

2.3. IDENTIFICATION

1. Identify extinguishers in accordance with recommendations of ANSI/NFPA 10 CAN4-S508.

2. Attach bilingual tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

PART 3- EXECUTION

3.1. INSTALLATION

1. Install or mount extinguishers in cabinets or on brackets as indicated.

2. Install fire safety blankets as indicated.

END OF SECTION 15305

PART 1– GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. REFERENCES

1. ASME B16.5-2013, Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys.
2. ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
3. ASME B16.20-2012, Ring-Joint Gaskets and Grooves for Steel Pipe Flanges.
4. ASME B16.21-2011, Non-metallic Flat Gaskets for Pipe Flanges.
5. ASME B16.22-2013, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
6. ASME B18.2.1-2012, Square and Hex Bolts and Screws.
7. ASTM A47M/47M-99(2004), Specification for Ferritic Malleable Iron Castings.
8. ASTM A53/A53M-12, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
9. ASTM B32-08, Specification for Solder Metal.
10. ASTM B75/B75M-11, Specification for Seamless Copper Tube Metric.
11. CSA B149.1-10, Natural Gas Installation Code.
12. CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
13. LEED Canada for New Construction and Major Renovations 2009.

1.3. PRODUCT DATA

1. Submit product data in accordance with Section 01300 - Submittals.

1.4. MAINTENANCE DATA

1. Provide maintenance data for incorporation into manual specified in Section 01300 - Submittals.

PART 2 - PRODUCTS

2.1. PIPE

1. Steel pipe: to ASTM A120 ASTM A53, Schedule 40, seamless as follows:
    1. NPS 1/2 to 2, screwed.
    2. NPS 2 1/2 and over, plain end.
2. Copper tube: to ASTM B75M.

2.2. JOINTING MATERIAL

1. Screwed fittings: pulverized lead paste.
2. Welded fittings: to CSA W47.1.
3. Flange gaskets: to ANSI B16.21 or ANSI B16.20.
4. Soldered: to ASTM B32, tin antimony 95:5.

2.3. FITTINGS

1. Steel pipe fittings, screwed, flanged or welded:
    1. Malleable iron: screwed, banded, Class 150.
    2. Steel pipe flanges and flanged fittings: to ANSI B16.5.
    3. Steel butt-welding fittings.
    4. Unions: malleable iron, brass to iron, ground seat, to ASTM A47M.
    5. Bolts and nuts: to ANSI B18.2.1.
    6. Nipples: Schedule 40, to ASTM A53.
2. Copper pipe fittings, screwed, flanged or soldered:
    1. Cast copper fittings: to ANSI B16.18.
    2. Wrought copper fittings: to ANSI B16.22.

2.4. VALVES

1. Ball Valves - Up to 50mm (2").
    1. 1034 KPA (150psig) / 600WOG Rating.
    2. Brass and or Bronze body, Full port, TFE seats, Double O-Ring Design, or Teflon

packing, Chrome plated solid Bronze ball, 3.16 Rating, CGA/CSA Approved, Lever Handle, Threaded connection.

3. Acceptable Products:

1. Kits 58, Toyo 5044A, or approved equal.

2. Lubricated Plug Valve - 65mm (2 1/2") & Over.

1. Class 125, flanged to ANSI B16.1, Regular pattern, Regular port, Full bore lubricated plug valves.

2. Acceptable Products:

1. NH Canada 205m or approved equal.

PART 3– EXECUTION

3.1. PIPING

1. Install in accordance with applicable Provincial/Territorial Codes.

2. Install in accordance with CAN1-B149.1 CAN1-B149.2.

3. Assemble piping using fittings manufactured to ANSI standards.

4. Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

5. Slope piping down in direction of flow to low points.

6. Install drip points:

1. At all low points in piping system.

2. At each connection to equipment.

7. Use eccentric reducers at pipe size change installed to provide positive drainage.

8. Provide clearance for access and for maintenance.

9. Ream pipes, clean scale and dirt, inside and out.

10. Install piping to minimize pipe dismantling for equipment removal.

11. Paint all gas piping yellow unless otherwise directed. Where pipe is visible on exterior walls of building, paint to match building (colour by consultant) and provide yellow banding as per CAN/CSA B149.1.

3.2. VALVES

1. Install valves with stems upright or horizontal unless otherwise approved by Consultant.

2. Install valves at all branch take-offs to isolate each piece of equipment, and as indicated.

3.3. TESTING

1. Test system in accordance with CAN1-B149.1 CAN1-B149.2.

3.4. PURGING

1. Purge after pressure test in accordance with CAN1-B149.1 CAN1-B149.2.

END OF SECTION 15482

PART 1 - GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. REFERENCES

1. AMCA 99-10, Standards Handbook.
2. AMCA 210-07, Laboratory Methods of Testing Fans for Rating.
3. AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.
4. AMCA 301-06, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
5. CGSB 1-GP-181M, Coating, Zinc Rich, Organic, Ready Mixed.
6. ASHRAE Standard 51-2007 -- Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (ANSI/ASHRAE Approved) (ANSI/AMCA Standard 210-07)
7. LEED Canada for New Construction and Major Renovations 2009.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1. Submit shop drawings and product data in accordance with Section 01300 - Submittals.
2. Product data to include fan curves and sound rating data, showing point of operation.
3. Indicate the following: motors, wheels, bearings, shafts and enclosures.

1.4. OPERATION AND MAINTENANCE DATA

1. Provide operation and maintenance data for incorporation into manual specified in Section 01300 - Submittals.

1.5. MAINTENANCE MATERIALS

1. Provide maintenance materials in accordance with Section 01300 – Submittals.
    1. Spare parts to include:
        1. Matched sets of belts.
        2. Furnish list of individual manufacturer’s recommended spare parts for

equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.6. MANUFACTURED ITEMS

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

2. Provide confirmation of testing.

PART 2– PRODUCTS

2.1. FANS – GENERAL

1. Capacity, total static pressure, revolutions per minute, power, model, size, sound power data and as indicated.

2. Sound ratings: comply with AMCA (Air Moving and Conditioning Association) 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.

3. Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

4. Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 12" diameter.

5. Motors: for use with variable speed controllers where indicated.

6. Motors: sizes as indicated.

7. Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards, fan inlet outlet safety screens, outlet dampers and vanes as indicated.

8. Factory primed before assembly in colour standard to manufacturer.

9. Scroll casing drains: as indicated.

10. Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

11. Provide 18” high roof curbs for all roof mounted fans, unless otherwise specified.

12. Flexible connections: to Section 15911 - Duct Accessories.

13. Acceptable Product: Penn, Cook, Jenco, Greenheck, Broan, Nutone.

PART 3– EXECUTION

3.1. INSTALLATION

1. Install fans as indicated, complete with resilient mountings supplied by manufacturer.

2. Install fan restraining snubbers as indicated.

3. Install fan complete with vibration isolation, flexible electrical wiring, flexible duct connections to inlet and discharge air ductwork.

4. Flexible connections shall not be in tension during running.

5. Provide sheaves and belts required for final air balance.

END OF SECTION 15860

PART 1– GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. REFERENCE STANDARDS

1. Do work in accordance with:
    1. SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2005.
    2. SMACNA HVAC Duct Leakage Test Manual, 2012 Edition.
    3. ASHRAE Handbook, Fundamentals, and Systems Volumes.
    4. LEED Canada for New Construction and Major Renovations 2009.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1. Submit shop drawings and product data in accordance with Section 01300 - Submittals.
2. Indicate following:
    1. Sealants
    2. Tape
    3. Proprietary Joints

1.4. 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.

PART 2– PRODUCTS

2.1. CLASSIFICATION

1. Ductwork classification as follows:

Maximum Pressure		SMACNA Seal
Pa	" WG	Class

500	2	B
250	1	C
125	0.5	C

2.2. 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 or made air tight with gaskets, sealant tape or combination thereof. Longitudinal seams unsealed.

4. Unsealed seams and joints.

2.3. SEALANT

1. Sealant: water based polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C.

    1. Acceptable material: Duro-Dyne DWN/water based, 3M Fastbond 900.

2.4. TAPE

1. Tape: polyvinyl treated, open weave fiberglass tape, 50 mm (2") wide.

    1. Acceptable material: Duro-Dyne

2.5. DUCT LEAKAGE

1. In accordance with SMACNA HVAC Duct Leakage Test Manual, 2012 Edition.

2. In accordance with ASHRAE 90.1

2.6. FITTINGS

1. Fabrication: to SMACNA.

2. Radiused elbows: standard radius and or short radius with single thickness turning vanes.

3. Square elbows: to 460 mm (18") with single thickness turning vanes.

4. Square elbows: over 460 mm (18") with double thickness turning vanes.

5. Main supply duct branches with splitter damper.

6. Sub branch duct with 45° entry and balancing damper on branch or sub branch duct with square connection, volume extractor and branch duct balancing damper.

7. Transitions:

    1. Diverging: 20° maximum included angle.

    2. Converging: 30° maximum included angle.

8. Offsets: square elbows or full radiused elbows.

9. Obstruction deflectors: maintain full cross-sectional area. Maximum included angles as for transitions.

2.7. FIRESTOPPING

1. Retaining angles all around duct, on both sides of fire separation.

2. Firestopping material and installation must not distort duct.

2.8. GALVANIZED STEEL

1. Lock forming quality: to ASTM A525M-86, Z90 zinc coating.

2. Thickness: to ASHRAE and SMACNA.

3. Fabrication: to ASHRAE and SMACNA.

4. Joints: to ASHRAE and SMACNA or proprietary manufactured duct joint.

    1. Acceptable material: Duct-Mate

2.9. HANGERS AND SUPPORTS

1. Strap hangers: of same material as duct, but next sheet metal thickness heavier than duct.

2. Hanger configuration: to ASHRAE and SMACNA. Maximum size duct supported by strap hanger 20".

3. Hangers: galvanized steel angle with black steel rods to ASHRAE and SMACNA.

PART 3– EXECUTION

3.1. GENERAL

1. Install ducts in accordance with ASHRAE and SMACNA.

2. Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm (4") beyond insulated duct.

3. Support risers in accordance with ASHRAE and SMACNA.

4. Install breakaway joints in ductwork on each side of fire separation.

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 ASHRAE.

3.3. WATERTIGHT DUCT

1. Provide watertight duct for:

    1. Fresh air intake.

    2. Range hood exhaust.

    3. Dishwasher exhaust

    4. Shower areas.

    5. As indicated.

2. Form bottom of horizontal duct without longitudinal seams. Seal all other joints with duct sealer.

3. Slope horizontal branch ductwork down towards hoods served. Slope header ducts down toward risers.

4. Fit base of riser with 100 mm (4") deep drain sump and 1 1/4" drain connected, with deep seal trap and discharging to open funnel drain.

3.4. LEAKAGE TESTS

1. In accordance with SMACNA HVAC Duct Leakage Test Manual, 2012 Edition.

2. Make trial leak test to demonstrate workmanship.

3. Install no additional ductwork until trial test has been passed.

4. Test section minimum of 30 m (100') long with not less then 3 branch takeoffs and 2 90° elbows.

5. Conduct leak testing in accordance with Air Balance Council (AABC) recommended procedures – See Section 15990.

3.5. SEALING AND TAPING

1. Apply sealant to outside of joint to manufacturer's recommendations.

2. Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturer’s recommendations.

END OF SECTION 15891

PART 1– GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. REFERENCES

1. ASTM A525M-87, Specification for General Requirements for Steel and Extruded Aluminum frame.
2. American Society for Testing and Materials International (ASTM)
    1. ASTM A 653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
3. Health Canada/Workplace Hazardous Materials Information System (WHMIS).
    1. Material Safety Data Sheets (MSDS).
4. LEED Canada for New Construction and Major Renovations 2009.

1.3. PRODUCT DATA

1. Submit product data in accordance with Section 01300 - Submittals.
2. Indicate the following:
    1. Pressure drop curve.
    2. Free area.

1.4. CERTIFICATION OF RATINGS

1. Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency.

PART 2– PRODUCTS

2.1. MULTI-LEAF DAMPERS

1. Use opposed for mixing duty, parallel for tight shut-off.
2. Extruded aluminum, interlocking blades, complete with butyl rubber, extruded vinyl seals or

neoprene on blade edges and frames top and bottom and side seals.

3. Thermally broken frames and blades, frames insulated with extruded polystyrene foam with 12 2.19 or better, blades constructed from aluminum extension with internal hollows insulated with polyurethane or polystyrene foam RSI 0.88.

4. Pressure fit self-lubricated bronze bearings.

5. Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

6. Operator: 24 V electric actuator with spring return for "fail safe" – supplied by control contractor.

7. Performance: leakage in closed position to be less than 2% of rated air flow at 1200 kPa differential across damper. Pressure drop at full open position to be less than 25 Pa differential across damper at maximum air flow.

8. Acceptable Products for insulated dampers to be Tamco 9000BF, Nailor 2020IBF, Alumavent 3960. Acceptable Products for non-insulated dampers to be Tamco 1000, Nailor 2020IB, Alumavent 3100.

2.2. BACK AND RELIEF DRAFT DAMPERS

1. Automatic gravity operated, multi-single leaf, aluminum construction with nylon bearings, centre pivotted, spring assisted.

PART 3– EXECUTION

3.1. INSTALLATION

1. Install where indicated. Provide insulated dampers on all ducts leading to outside.

2. Install in accordance with recommendations of SMACNA and manufacturer's instructions.

3. Seal multiple damper modules with silicon sealant.

4. Upon system start-up, ensure that dampers operate properly.

END OF SECTION 15913

PART 1 - GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. SUMMARY

1. Section Includes:
    1. Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents, intakes and gooseneck hoods.

1.3. REFERENCES

1. American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
    1. ANSI/NFPA 96-14, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
2. American Society for Testing and Materials International (ASTM)
    1. ASTM E 90-09, 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)

1.4. 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.

1.5. SUBMITTALS

1. Product Data:

1. Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01300 - Submittals. Include product characteristics, performance criteria, and limitations.

    1. Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01300 - Submittals.

2. Indicate following:

    1. Pressure drop.

    2. Face area.

    3. Free area.

    4. Water penetration characteristic.

2. Quality assurance submittals: submit following in accordance with Section 01300 - Submittals.

    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. Engineer will make available 1 copy of systems supplier's installation instructions.

3. Test Reports:

    1. Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90.

1.6. QUALITY ASSURANCE

1. Health and Safety Requirements: do construction occupational health and safety in accordance with Division 1.

1.7. DELIVERY, STORAGE, AND HANDLING

1. Packing, shipping, handling and unloading:

    1. Deliver, store and handle in accordance with Division 1.

    2. Deliver, store and handle materials in accordance with manufacturer's written instructions.

2. Waste Management and Disposal:

    1. Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 1.

PART 2- PRODUCTS

2.1. SUSTAINABLE REQUIREMENTS

1. Materials and products in accordance with Division 1.

2.2. FIXED LOUVRES - ALUMINUM

1. Construction: welded with exposed joints ground flush and smooth.

2. Material: extruded aluminum alloy 6063-T5.

3. Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.

4. Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.

5. Mullions: at 1500 mm maximum centres.

6. Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

7. Screen: 12 mm exhaust 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.

8. Finish: factory applied enamel. Colour: to Engineer’s approval.

9. Accepted Product: Construction Specialties 4110 or Ventex.

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. FIELD QUALITY CONTROL

1. Verification requirements in accordance with Division 1 Contractor's Verification, include:

    1. Materials and resources.

    2. Storage and collection of recyclables.

    3. Construction waste management.

    4. Resource reuse.

    5. Recycled content.

    6. Local/regional materials.

    7. Low-emitting materials.

3.4. CLEANING

1. Proceed in accordance with Division 1.

2. Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION 15941

PART 1 - TAB AGENCY

1. General:
    1. The basic testing and balancing shall be provided by Division 15 and in accordance with this Section.
    2. The independent TAB Agency employed and paid by Division 15 will be providing the final testing and balancing.
    3. Division 1, General Requirements is part of this Section and shall apply as if repeated here.
2. Quality assurance:
    1. TAB to be performed to standards of ASHRAE.
3. Co-ordination:
    1. Co-ordinate all work specified in this Section.
    2. Provide all facilities required by TAB Agency in order to carry out work of this Section.
4. Adequacy of work for TAB:
    1. TAB Agency to review contract documents before work is started and confirm in writing to Consultant adequacy of provisions for TAB and all other aspects of installation pertinent to TAB.
    2. Division 15 shall provide equipment commissioning and preliminary balancing and confirm the proper operation of all systems.
5. List of TAB Agencies:
    1. ABG Air Balance Group
    (416) 283-0637
    2. Aerodynamics Inspecting Consultants Ltd.
    (905) 625-4388
    3. Design Test Balance
    (905) 886-6513

PART 2- GENERAL

1. TAB: means to test, adjust and balance all systems to perform in accordance with Contract Documents.
2. Follow start-up procedures as recommended by manufacturer unless otherwise specified.

3. Special start-up procedures may be specified elsewhere.

4. Notify Consultant 7 days prior to start of TAB.

5. Operate all systems to permit TAB to be performed.

6. TAB to apply to systems, equipment and related controls specified in Division 15.

7. Reference organization standards:

    1. Do TAB over entire operating range in accordance with most stringent conditions of this specification and standard of following organization.

8. Alternate season testing to be provided by TAB Contractor where applicable.

9. TAB Contractor to inspect site during construction in order to assure that all balancing devices are installed properly and in pre-selected locations.

10. Mechanical contractor to provide the TAB contractor with all related approved shop drawings and change notices.

11. Start TAB only when building is essentially completed, including:

    1. Installation of ceilings, doors, windows and other construction affecting TAB.

    2. Application of sealing, caulking and weatherstripping.

    3. All pressure, leakage and other tests specified elsewhere in Division 15 completed.

    4. All provisions for TAB are installed and operational.

12. Start-up, verification for proper, safe and normal operation of mechanical and associated electrical and control systems affecting TAB including, but not limited to, the following:

    1. Proper thermal overload protection in place for electrical equipment.

    2. Air Systems:

        1. Filters in place and in clean condition.

        2. Duct systems clean of debris.

        3. Air shafts, ceiling plenums are airtight to within specified tolerances.

        4. Correct fan rotation.

        5. Fire and volume dampers in place and open.

        6. Coil fins cleaned and combed.

        7. Access doors closed and duct end caps in place.

8. All outlets installed and connected.

13. Accuracy tolerances:

    1. Do TAB to following tolerances of design values:

        1. HVAC systems: Plus 5%; minus 5%.

        2. As original tolerances.

        3. Measurements to be accurate to within plus or minus 2% of actual values.

    2. Instrument calibration: to be in accordance with TAB referenced organization standard, but within 3 months of commencement of TAB.

14. Submittals prior to commencement of TAB:

    1. Proposed methodology and procedures for performing TAB.

    2. Proposed check lists and report forms.

    3. List of instrumentation, including details and certificates of calibration.

15. Report:

    1. Format to be in accordance with TAB referenced organization standard, but using SI units.

    2. Report to include as built full system schematics showing results of TAB.

    3. Submit, prior to formal submission of TAB reports, for checking and approval by Consultant, sample of rough TAB sheets. Include:

        1. Details of instruments used.

        2. Details of TAB procedures employed.

        3. Calculations procedures.

        4. Summaries.

    4. Submit 3 copies of TAB reports, each in "D" ring binders, complete with index tabs for verification and approval of Consultant.

16. Verification:

    1. Reported measurements shall be subject to verification by Consultant. Provide instrumentation and manpower to verify results of up to 30% of all reported measurements. Number and location of verified measurements to be at discretion of Consultant.

    2. Bear costs to repeat TAB, as required, to satisfaction of Consultant.

1. Settings: lock and permanently mark settings as required by reference standard.

2. Completion: TAB to be considered complete only when final reports are approved by Consultant.

PART 3- AIR MOVING SYSTEMS

1. General: measurements as required by referenced organization standards, including, but not limited to, following:

    1. Measurements:

        1. Air velocity.

        2. Static pressure.

        3. Velocity pressure.

        4. Temperature:

            1. Dry bulb.

        5. Cross sectional area.

        6. RPM.

        7. Electrical power:

            1. Voltage
            2. Current draw.

2. Location of equipment measurements:

    1. Inlet and outlet of each:

        1. Fan.

        2. Coil.

        3. Filter.

        4. Damper.

        5. Humidifiers.

        6. Terminal Units.

        7. Other auxiliary equipment.

3. Location of system measurements at:

1. Main ducts.
2. Main branch ducts.
3. Sub-branch ducts.
4. Each supply, exhaust and return air inlet and outlet.
5. Other auxiliary equipment.
6. All areas served by system.
7. Each thermostatically controlled zone.

END OF SECTION 15990

PART 1 - GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

2. This Section covers items common to Sections of Division 16. This Section supplements requirements of Division 1.

3. Coordinate all requirements with general contractor.

1.2. CODES AND STANDARDS

1. In this document, all references to Code numbers shall mean “Latest Edition”.

2. Do complete installation in accordance with Ontario Electrical Safety Code.

3. Do complete installation in accordance with CSA C22.1-12 except where specified otherwise.

4. Comply with all CSA and inspection Authority Bulletins in force at time of Tender.

5. Do overhead and underground systems in accordance with CSA C22.3 No.1-10 except where specified otherwise.

6. Abbreviations for electrical terms: to CSA Z85-1983.

7. Where requirements of this specification exceed those of above mentioned standards, this specification shall govern.

1.3. DEFINITIONS

1. “Provide” means supply and install.

2. “Approved” means approved in writing by Consultant.

3. “Inspection Authority” means Electrical Safety Authority.

4. “Consultant” means designated qualified professional engineer acting as representative of Owner for monitoring of work.

5. “Manual” means Operations and Maintenance manual.

6. “OESC” means latest edition of Ontario Electrical Safety Code

1.4. CARE, OPERATION, START-UP AND INSTRUCTION TO OWNERS

1. Provide certified personnel to instruct Owner of operation of electrical equipment. Provide

maintenance specialist personnel to instruct on maintenance and adjustment of electrical equipment and any changes or modification of equipment must be under terms of guarantee.

2. Provide instruction during regular work hours prior to acceptance and turn over to Owner's staff for regular operation.

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 all aspects of its care and operation.

4. Use operation and maintenance data manual for instruction purposes. On completion of instruction, turn three manuals over to the Owner.

5. Operation and maintenance manual to be approved by and final copies deposited with Consultant before final inspection.

1.5. AS-BUILT DRAWINGS

1. Site records:

    1. One set to be kept on site and all changes to be recorded on daily basis. At the completion of the project, all changes shall be transferred to clean set, signed and passed to the Consultant.

    2. Make these drawings available for reference purposes and to inspection at all times.

2. As-built drawings must be delivered before system acceptance.

1.6. VOLTAGE RATINGS

1. Operating voltages: to CAN3-C235-83 (R2006).

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.

1.7. PERMITS, FEES AND INSPECTION

1. Submit to Inspection Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

2. Consultant will provide drawings and specifications required by Inspection Authority at no cost.

3. Submit to the Building Department the necessary number of drawings and specifications for examination prior to commencement of work to obtain a building permit. The Contractor shall obtain and pay for the building permit. Include all costs in the tender price.

4. Submit Notice of Project to Ministry of Labour.

5. Pay associated fees and obtain all permits required for the performance of the work.

6. Notify Consultant of changes required by Inspection Authority or Building Department prior to making changes.

7. Furnish Certificates of Acceptance from Inspection Authority on completion of work to Consultant.

8. Where partial occupancy is required, additional Inspection Authority inspections and reports shall be provided at no additional cost to the contract.

1.8. MATERIALS AND EQUIPMENT

1. Provide materials and equipment in accordance with Division 1.

2. Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Inspection Authority.

3. Factory assemble control panels and component assemblies.

1.9. ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

1. Verify installation and co-ordination responsibilities related to motors, equipment and controls with other trades and as indicated.

2. Mechanical contractor shall supply and install all motors, controls and control wiring. Mechanical contractor shall supply all disconnect switches, starters, motor rated switches and relays, for all motor driven equipment under mechanical contract. All disconnect switches, starters, motor rated switches and relays shall be handed over to electrical contractor for installation and wiring. Both mechanical and electrical contractors to coordinate to ensure proper protection and equipment is provided and included in contract.

3. Control wiring and conduit to be installed in accordance with Section 16111 and 16122, except for connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

4. Electrical equipment not supplied by mechanical contractor is listed on the drawings or elsewhere in the specifications. Electrical contractor to coordinate with mechanical contractor to ensure proper protection and equipment is provided for all equipment and is included in Contract.

1.10. FINISHES

1. Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals.

2. Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

3. Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

4. Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.11. EQUIPMENT IDENTIFICATION

1. Identify electrical equipment with nameplates and labels as follows:

2. Nameplates:

    1. Lamacoid 3 mm (1/8") thick plastic engraving sheet, white face, black core, mechanically attached with self tapping screws. For emergency power circuits, use a red face and black core.

NAMEPLATE SIZES

Size 1	10 x 50 mm (3/8 x 2")	1 line	3 mm (1/8") high letters
Size 2	12 x 70 mm (1/2 x 3")	1 line	5 mm (1/4") high letters
Size 3	12 x 70 mm (1/2 x 3")	2 lines	3 mm (1/8") high letters
Size 4	20 x 90 mm (3/4 x 4")	1 line	8 mm (3/8") high letters
Size 5	20 x 90 mm (3/4 x 4")	2 lines	5 mm (1/4") high letters
Size 6	25 x 100 mm (1" x 4")	1 line	12 mm (1/2") high letters
Size 7	25 x 100 mm (1" x 4")	2 lines	6 mm (1/4") high letters

3. Labels:

    1. Embossed plastic labels with 6 mm (1/4") high letters unless specified otherwise.

4. Wording on nameplates and labels to be approved by Consultant prior to manufacture.

5. Allow for average of twenty-five (25) letters per nameplate and label.

6. Identification to be English.

7. Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

8. Disconnects, starters and contactors: indicate equipment being controlled and voltage.

9. Terminal cabinets and pull boxes: indicate system and voltage.

10. Coordinate names of equipment and systems with Division 15 to ensure that identical names are used.

1.12. 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.

4. Use colour coded wires in communication cables, matched throughout system.

1.13. CONDUIT AND CABLE IDENTIFICATION

1. Colour code conduits, boxes and metallic sheathed cables.

2. Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

3. Colours: 25 mm (1") wide prime colour and 20 mm (3/4") wide auxiliary colour.

	PRIME	AUXILIARY
up to 250 V	yellow	
Telephone	green	
Other communication systems	green	blue
Emergency	red	blue
Voice		
Other security systems	red	yellow

1.14. WIRING TERMINATIONS

1. Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

1.15. MANUFACTURERS AND CSA LABELS

1. Ensure that manufacturer’s registration plates are properly affixed to all apparatus showing the size, name of equipment, serial number, and all information usually provided, including voltage, cycle, phase and the name and address of the manufacturer.

2. Do not paint over registration plates or approved labels. Leave openings through insulation for viewing the plates. Contractors or sub-contractors nameplate not acceptable.

1.16. WARNING SIGNS

1. As specified and to meet requirements of Inspection Authority and Consultant.

1.17. LOCATION OF OUTLETS

1. Locate outlets as shown on drawings.

2. Change location of outlets at no extra cost or credit, providing distance does not exceed 3 m (10 ft) and information is given before installation.

3. Locate light switches on latch side of doors. Locate disconnect devices in mechanical rooms

on latch side of door.

1.18. MOUNTING HEIGHTS

1. Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

2. If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3. Install electrical equipment at following heights unless indicated otherwise.

    1. Local switches: 1100 mm (43")

    2. Wall receptacles:

        1. General: 400 mm (16")

        2. In mechanical rooms and shop area: 1400 mm (55")

1.19. CONDUIT AND CABLE INSTALLATION

1. Protect alarm and emergency system wiring from fire for the required length of time.

1.20. FIELD QUALITY CONTROL

1. All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks – the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.

2. Conduct and pay for following tests:

    1. Circuits originating from branch distribution panels.

    2. Lighting and its control.

    3. Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

3. Furnish manufacturer’s certificate or letter confirming the entire installation as it pertains to each system has been installed to manufacturer’s instructions.

4. 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.

5. Carry out tests in presence of Consultant.

6. Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

7. Submit test results for Consultant's review.

1.21. COORDINATION WITH EXISTING UTILITIES

1. All existing utilities are to be maintained and protected for the length of construction.

2. Contractor to notify consultant if any conflicts arise and allow for minimum 48 hours for consultants review.

1.22. EXISTING SYSTEMS

1. Before submitting tender price verify on job site location of all accessible existing electrical systems affecting execution of this contract. Difficulties arising during construction will not be considered as grounds for additional payment.

2. Where work involves breaking into or connecting to existing systems, carry out work at times directed by governing authorities, with minimum of disturbance to pedestrian traffic.

3. Submit schedule to and obtain approval from Consultant for any shut down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.

4. Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.

1.23. OWNER OCCUPANCY SCHEDULE

1. The existing building will remain occupied during normal occupancy hours.

2. Provide temporary protection for all finishes, appliances or equipment in the existing building.

3. Protect and maintain existing boiler room and electrical room operations during the work.

END OF SECTION 16010

PART 1- GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. LOCATION OF CONDUIT

1. Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

1.3. REFERENCES

1. Canadian Standards Association (CSA)
    1. CSA C22.2 No. 18-98 (R2003), Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
    2. CSA C22.2 No. 45.2-08, Rigid Metal Conduit.
    3. CSA C22.2 No. 56-04 (R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
    4. CSA C22.2 No. 83-M1985(R2013), Electrical Metallic Tubing.

1.4. WASTE MANAGEMENT AND DISPOSAL

1. Separate and recycle waste materials in accordance with Division 1.
2. Place materials defined as hazardous or toxic waste in designated containers.
3. Ensure emptied containers are sealed and stored safely for disposal away from children.
4. Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Division 1.

PART 2- PRODUCTS

2.1. CONDUITS

1. Electrical metallic tubing (EMT): with steel couplings, sized as indicated.
2. Rigid metal conduit: galvanized steel threaded conduit, sized as indicated.
3. Epoxy coated conduit: with zinc coating and corrosion resistant epoxy finish inside and

outside.

4. Flexible metal conduit and liquid-tight flexible metal conduit, sized as indicated.

2.2. CONDUIT FASTENINGS

1. One hole steel straps to secure surface conduits 50 mm (2") and smaller. Two hole steel straps for conduits larger than 50 mm (2").

2. Beam clamps to secure conduits to exposed steel work.

3. Channel type supports for two or more conduits at 3 m (9') o/c.

4. 6 mm dia threaded rods to support suspended channels.

2.3. CONDUIT FITTINGS

1. Fittings: manufactured for use with conduit specified. Coating: same as conduit.

2. Fittings to be suitable sized for conduit used.

3. Fittings used for EMT to be steel, not cast.

4. Factory "ells" where 90° bends are required for 25 mm (1") and larger conduits.

2.4. FISH CORD

1. Polypropylene.

PART 3- EXECUTION

3.1. INSTALLATION

1. Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

2. Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

3. Use rigid galvanized steel threaded conduit in areas subject to mechanical injury such as shops, loading docks etc.

4. Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

5. Use electrical metallic tubing (EMT) above 2.4 m not subject to mechanical injury.

6. Use flexible metal conduit for final connection to devices in ceiling space max. length 3 m.

7. Use liquid tight flexible metal conduit for final connection to a vibrating piece of equipment.

8. Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

9. Mechanically bend steel conduit over 21 mm diameter.

10. All unterminated conduit ends to be reamed and protected by insulating bushings.

11. Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.

12. Dry conduits out before installing wire.

3.2. SURFACE CONDUITS

1. Run parallel or perpendicular to building lines.

2. Locate conduits behind infrared or gas fired heaters with 1500 mm clearance.

3. Run conduits in flanged portion of structural steel.

4. Group conduits wherever possible on suspended channels.

5. Do not pass conduits through structural members except as indicated.

6. All exposed conduits in areas other than service spaces are to be painted to match existing finishes.

3.3. CONCEALED CONDUITS

1. Run parallel or perpendicular to building lines.

END OF SECTION 16111

PART 1- GENERAL

1.1. RELATED SECTIONS

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.
2. Section 16151 – Wire and Box Connections – 0 – 1000V.

1.2. REFERENCES

1. CSA C22.2 No. 0.3-09, Test Methods for Electrical Wires and Cables.
2. CAN/CSA-C22.2 No. 131-07 (R2012), Type TECK 90 cable.

1.3. PRODUCT DATA

1. Submit product data in accordance with Division 1.

1.4. WASTE MANAGEMENT AND DISPOSAL

1. Separate and recycle waste materials in accordance with Division 1.
2. Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Division 1.
3. Fold up metal banding, flatten and place in designated area for recycling.

PART 2- PRODUCTS

2.1. GENERAL

1. All conductors to be copper, unless otherwise noted.

2.2. BUILDING WIRES

1. All conductors to be copper, unless otherwise noted.
2. Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG for power and # 16 AWG for controls and fire alarm.
3. Copper conductors: size as indicated, with insulation of chemically cross-linked thermosetting polyethylene material type RW90, or with thermoplastic insulation and nylon jacket, type T-90 nylon.

4. 600V rating for nominal 208V system voltage; 1000V rating for nominal 600V system voltage.

5. All outdoor circuit conductors, including service entrance conductors to be type RWU90 or USEI-90, unless otherwise noted.

6. Wire and conduit sizes shown are based on RW75 XLPE and are minimum sizes. Contractor is responsible for wire and conduit sized for other approved wires.

7. Conductors shall be colour coded. Conductors size 10 AWG and smaller shall have colour impregnated into insulation at time of manufacture.

    1. Colour code wiring for 120 / 240 Volt equipment as follows

        1. Phase conductors: Red, Black

        2. Neutral conductors: White

        3. Bonding to ground: Green

PART 3- EXECUTION

3.1. INSTALLATION OF BUILDING WIRES

1. Install wiring in conduit in accordance with Section 16111, unless otherwise noted.

2. Use type RW90 where required by Ontario Electrical Safety Code, for all panelboard feeders and for all conductors sized 250 MCM and larger.

3. Use type RW90 or T-90 for branch circuit wiring unless otherwise indicated.

4. Minimum wire size shall be No. 12 AWG. For 15A, 120V branch circuit home runs which exceed 23 m length shall be minimum No. 10 AWG, and minimum No. 8 AWG for runs which exceed 36 m. For 20A, 120V branch circuit home runs which exceed 17 m in length shall be minimum No. 10 AWG, and minimum No. 8 AWG for runs which exceed 27 m. Where existing wiring is re-used, minimum wire sizes shall apply and wiring shall be replaced when it does not meet the minimum size.

5. Existing wiring may only be re-used if permitted by Engineer.

END OF SECTION 16122

PART 1- GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. REFERENCES

1. CSA C22.1-12 Canadian Electrical Code, Part 1.

1.3. WASTE MANAGEMENT AND DISPOSAL

1. Separate and recycle waste materials in accordance with Division 1, and with the Waste Reduction Workplan.

2. Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Division 1.

PART 2- PRODUCTS

2.1. OUTLET AND CONDUIT BOXES - GENERAL

1. Size boxes in accordance with CSA C22.1.

2. 102 mm (4") square or larger outlet boxes as required for special devices.

3. Gang boxes where wiring devices are grouped.

4. Blank cover plates for boxes without wiring devices.

5. Combination boxes with barriers where outlets for more than one system are grouped.

2.2. SHEET STEEL OUTLET BOXES

1. Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

2. Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm

3. 102 mm (4") square or octagonal outlet boxes for lighting fixture outlets.

4. 102 mm (4") square outlet boxes with extension and plaster rings for flush mounting devices in finished tile walls.

2.3. CONDUIT BOXES

1. Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2. Electro-galvanized utility tape for indoor surface wiring.

2.4. FITTINGS - GENERAL

1. Bushing and connectors with nylon insulated throats.

2. Knock-out fillers to prevent entry of debris.

3. Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.

4. Double locknuts and insulated bushings on sheet metal boxes.

PART 3- EXECUTION

3.1. INSTALLATION

1. Support boxes independently of connecting conduits.

2. Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

3. Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

4. Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area in which it is to be installed.

END OF SECTION 16132

PART 1 - GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. SHOP DRAWINGS AND PRODUCT DATA

1. Submit shop drawings and product data in accordance with Division 1.

PART 2- PRODUCTS

2.1. SWITCHES

1. 20A, 120V single pole, three-way, or four-way specification grade, as indicated.
2. Manually-operated general purpose ac switches with following features:
    1. Terminal holes approved for No. 10 AWG wire.
    2. Silver alloy contacts.
    3. Urea or melamine moulding for parts subject to carbon tracking.
    4. Suitable for back and side wiring.
    5. White toggle.
3. Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
4. Provide motor rated switches, where indicated. To be complete with pilot light.
5. Switches of one manufacturer throughout project.
6. Acceptable materials: Hubbell, Bryant, Leviton, Pass & Seymour.

2.2. WIRED DIMMERS

1. Wall box dimmer, Cat5 connected, white in colour to match switches and outlets.
2. Manually operated wallpod.
3. Solid-state, 0-10V control to match connected fixtures.

4. Mechanical air-gap switch to disconnect load power.

5. Power failure memory.

6. RFI suppression.

7. Electrostatic discharge tested.

8. Dimmers controlling LED fixtures to be rated for such loads and shall meet all light fixture and lamp manufacturer's requirements.

9. Acceptable materials: nLight nPODMA series.

2.3. RECEPTACLES

1. Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features:

    1. White urea moulded housing.

    2. Suitable for No. 10 AWG for back and side wiring.

    3. Break-off links for use as split receptacles.

    4. Eight back wired entrances, four side wiring screws.

    5. Triple wipe contacts and riveted grounding contacts.

2. Housekeeping receptacles duplex CSA type 5-20R with following features:

    1. White urea moulded housing.

    2. External nickel-plated brass back wire clamps with #10 brass terminal screws.

    3. Ground terminal back wire clamp.

    4. 0.04" thick nickel-plated brass, triple-wiped power contacts.

    5. Nickel-plated one-piece mounting strap with integral ground and two screw anchor strap to back body.

3. Other receptacles with ampacity and voltage as indicated.

4. Receptacles of one manufacturer throughout project. Minimum of specification grade.

5. Acceptable materials: Hubbell, Bryant, Leviton, Pass & Seymour.

6. Sensorswitch or nLight shall be standard of acceptance. iLumin Plus sensors by Cooper shall also be accepted.

7. Confirm all light / switch voltages on site to ensure proper voltage rating is provided for all new devices.

8. Confirm number of circuits being controlled on site. Individual power pack to be provided for each circuit which is to be controlled by a low-voltage occupancy sensor.

9. Manufacturer or manufacturer recommended pre-terminated Cat5e cables required for all controls where applicable.

2.4. SPECIAL WIRING DEVICES

1. Pilot lights as indicated, with neon type 0.04W, 125V lamp and red plastic jewel flush type.

2. Feed through ground fault interrupters, Class A, trip level 4 to 6 milliamps. All receptacles within 1.5 meters of a sink, tub or shower to be GFI type.

2.5. COVER PLATES

1. Cover plates for wiring devices, complete with clear adhesive label with black lettering indicating source panel and circuit number.

2. Cover plates from one manufacturer throughout project.

3. Stainless steel, vertically brushed, 1 mm (1/16") thick cover plates for all wiring devices mounted in flush-mounted outlet box (including voice / data outlets).

4. Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes, or utility boxes.

PART 3- EXECUTION

3.1. INSTALLATION

1. Switches:

    1. Install single throw switches with handle in "UP" position when switch closed.

    2. Install switches in gang type outlet box when more than one switch is required in one location.

    3. Mount toggle switches at height specified in Section 16010 - Electrical General Requirements or as indicated.

    4. Where lighting controls are grouped, each control shall be labelled to indicate the area controlled.

2. Dimmers:

    1. Provide separate box for each dimmer, spaced to maintain full rating.

3. Receptacles:

1. Install receptacles in gang type outlet box when more than one receptacle is required in one location.

2. Mount receptacles at height specified in Section 16010 - Electrical General Requirements or as indicated.

4. Cover plates:

1. Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

2. Install suitable common cover plates where wiring devices are grouped.

3. Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

5. Occupancy Sensor Commissioning:

1. Manufacturer’s representative to provide on-site commissioning and set-up of system and provide letter confirming:

1. Installation is as per manufacturer’s recommendations.

2. Settings and time delay are as per specification.

3. Confirm devices are operating properly for installation, and provide minor field modifications as required.

4. Identify which devices were adjusted in the field.

6. Grounding:

1. Ground all wiring devices and respective outlet boxes in accordance with applicable sections of Ontario Electrical Safety Code.

END OF SECTION 16141

PART 1 - GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. REFERENCES

1. CSA C22.2 No. 65-13 Wire Connectors.
2. EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

PART 2 - PRODUCTS

2.1. MATERIALS

1. Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
2. Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
3. Bushing stud connectors: to EEMAC 1Y-2 to consist of:
    1. Connector body and stud clamp for stranded copper conductors.
    2. Clamp for stranded copper conductors
    3. Stud clamp bolts.
    4. Bolts for copper conductors
    5. Sized for conductors as indicated.
4. Clamps or connectors for armoured cable, flexible conduit, as required.

PART 3 - EXECUTION

3.1. INSTALLATION

1. Remove insulation carefully from ends of conductors and:
    1. Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

2. Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

3. Install fixture type connectors and tighten. Replace insulating cap.

4. Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION 16151

PART 1 - GENERAL

1.1. RELATED WORK

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

2. Fastenings and supports: Section 01600 Material and Equipment.

PART 2 - PRODUCTS

2.1. SUPPORT CHANNELS

1. U shape, size 41 x 41 x 2.5 mm thick, surface mounted or suspended.

2. Smaller sections subject to Consultant's approval.

PART 3 - EXECUTION

3.1. INSTALLATION

1. Secure equipment to poured concrete with expandable inserts.

2. Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

3. Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

4. Fasten exposed conduit or cables to building construction or support system using straps.

    1. One-hole steel straps to secure surface conduits and cables 50 mm and smaller.

    2. Two-hole steel straps for conduits and cables larger than 50 mm.

    3. Beam clamps to secure conduit to exposed steel work.

5. Suspended support systems.

    1. Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.

    2. Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

6. For surface mounting of two or more conduits use channels at 3 m oc spacing.

7. Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

8. Do not use wire lashing or perforated strap to support or secure raceways or cables.

9. Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.

10. Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

11. Provide minimum 2400 mm support channel on each suspended fixture in open areas, with rigid stem supports from structure to channel, and fixture secured to channel.

12. All fastenings and supports to be hot dipped galvanized. All cut ends exposing base material to be completely sealed with field applied coating to give equivalent protection prior to installation. Following complete installation, all damage to protective layer to be carefully and completely touched up with same field applied coating.

END OF SECTION 16191

PART 1- GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. SHOP DRAWINGS

1. Submit shop drawings in accordance with Division 1.

2. Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.3. 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

2.1. PANELBOARDS

1. Panelboards: product of one manufacturer.

2. Bus and breaker rated for the following symmetrical interrupting capacity, unless otherwise indicated. Series rated panel is acceptable.

    1. 120 / 240V Panelboards – 22 kA I.C.

        Refer to singleline diagram for other values.

3. Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

4. Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

5. Each panelboard to be equipped with integral lock and be complete with two keys. All panelboards to be keyed alike.

6. Aluminum bus with neutral of same ampere rating as mains.

7. Mains: suitable for bolt-on breakers.

8. Trim and door finish: baked grey enamel

9. NEMA 1 enclosure.

2.2. BREAKERS

1. Breakers: to Section 16477 - Moulded Case Circuit Breakers.

2. Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

3. Main breaker: separately mounted on top or bottom to suit cable entry. When mounted vertically, down position should open breaker.

4. Lock-on devices for unit equipment and exit sign circuits.

2.3. EQUIPMENT IDENTIFICATION

1. Provide equipment identification in accordance with Section 16010 - Electrical General Requirements.

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.

2.4. ACCEPTABLE MATERIALS

1. Eaton / Cutler-Hammer

2. Schneider

3. Alternate materials as approved by addendum in accordance with general instructions.

PART 3- EXECUTION

3.1. INSTALLATION

1. Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

2. Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.

3. Plywood backboard to be painted with fire-retardant paint.

4. In non-combustible construction, provide one layer of 16 mm (5/8”) gypsum wall board behind each panel, full size of panel.

5. Mount panelboards to height specified in Section 16010 - Electrical General Requirements or as indicated.

6. Connect loads to circuits.

7. Connect neutral conductors to common neutral bus with respective neutral identified.

3.2. PANELBOARD LAYOUTS

1. Follow panelboard details attached or on drawings, for layout of circuit and breaker sizes wherever possible.

2. Record all changes to panelboard details, and submit as part of As-Built drawing set for review at completion of the project. Insert copies in each maintenance manual.

END OF SECTION 16471

PANELBOARD SCHEDULE -- Pony

WIRE & COND	SERVICE	BRKR	Load kW	CCT. No.		CCT. No.	Load kW	BRKR	SERVICE	WIRE & COND
	Space			1		2		15A	Unit Heater #1	
	Space			3		4		15A	Unit Heater #2	
	Space			5		6		15A	Unit Heater #3	
	Space			7		8		50A	Unlabelled	---
	Space			9		10				
	Space			11		12				
	Space			13		14				
	Space			15		16				
	Space			17		18				

100A/2P Main Breaker

CONNECTED LOAD: 0.0 kW

MAX. CURRENT: 0.0 Amps

PANEL DESCRIPTION: Existing Panel Pony

PANEL RATING: 125A, 120/240 V, 1P 3W - 18 CCT

PANELBOARD SCHEDULE -- Generator

WIRE & COND	SERVICE	BRKR	Load kW	CCT. No.		CCT. No.	Load kW	BRKR	SERVICE	WIRE & COND
	Main Breaker	30A	---	1		2	---	15A	Fuel Pumps	---
				3		4				
				5		6	---	15A	Furnace	2#12-16mmC
	Generator Breaker	30A	---	7		8	---	(2x)15A	Alarm / Lights	---
				9		10	---	15A	Water Pump	---
				11		12				

CONNECTED LOAD: 0.0 kW

MAX. CURRENT: 0.0 Amps

PANEL DESCRIPTION: Existing Panel Generator

PANEL RATING: 100A, 120/240 V, 1P 3W

PANELBOARD SCHEDULE -- Main

WIRE & COND	SERVICE	BRKR	Load kW	CCT. No.		CCT. No.	Load kW	BRKR	SERVICE	WIRE & COND
Extend Existing	Existing	15A		1		2		15A	Existing	Extend Existing
				3		4		30A	Existing	Extend Existing
Extend Existing	Existing	40A		5		6		20A	Existing	Extend Existing
				7		8				
Extend Existing	Existing	15A		9		10		15A	Existing	Extend Existing
Extend Existing	Existing	15A		11		12		60A	Existing	Extend Existing
Extend Existing	Existing	15A		13		14				
Extend Existing	Existing	30A		15		16		15A	Existing	Extend Existing
Extend Existing	Existing	15A		17		18		15A	Existing	Extend Existing
Extend Existing	Existing	15A		19		20		15A	Existing	Extend Existing
Extend Existing	Existing	15A		21		22		15A	Existing	Extend Existing
Extend Existing	Existing	20A		23		24		60A	Existing	Extend Existing
				25		26				
Extend Existing	Existing	15A		27		28		15A	Existing	Extend Existing
Extend Existing	Existing	30A		29		30				
				31		32		15A	Existing	Extend Existing
Extend Existing	Existing	15A		33		34		15A	Existing	Extend Existing
Extend Existing	Existing	15A		35		36		40A	Existing	Extend Existing
Extend Existing	Existing	20A		37		38		15A	Existing	Extend Existing
				39		40				
2#12-16mmC	Shop Receptacles - West/North Wall	20A		41		42	---	20A	SPARE	---
2#12-16mmC	Shop Receptacles - North Wall	20A		43		44	---	20A	SPARE	---
2#12-16mmC	Shop Receptacles - Column In Addition	20A		45		46	---	20A	SPARE	---
---	SPARE	15A	---	47		48	---	20A	SPARE	---
---	SPARE	15A	---	49		50	---	20A	SPARE	---
---	SPARE	15A	---	51		52	---	20A	SPARE	---
---	SPARE	15A	---	53		54		15A	Existing (Pony)	Extend Existing
---	SPARE	15A	---	55		56		15A	Existing (Pony)	Extend Existing
---	SPARE	15A	---	57		58		50A	Existing (Pony)	Extend Existing
---	SPARE	15A	---	59		60				

NOTE: 120V Wire & Conduit sizes noted in this panel schedule are for branch circuit reference information only. Group wiring and derate wiring depending on wire length as per specification sections 16111 and 16122.

CONNECTED LOAD: 0.0 kW

MAX. CURRENT: 0.0 Amps

PANEL DESCRIPTION: Panel Main

PANEL RATING: 225 A, 120/240 V, 1P 3W - 60 CCT

PART 1- GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. PRODUCT DATA

1. Submit product data in accordance with Division 1.

PART 2- PRODUCTS

2.1. BREAKERS - GENERAL

1. Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

2. Common-trip breakers: with single handle for multi-pole applications.

2.2. THERMAL MAGNETIC BREAKERS

1. Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3. OPTIONAL FEATURES

1. Include:

    1. on-off locking device.

PART 3- EXECUTION

3.1. INSTALLATION

1. Install circuit breakers as indicated.

END OF SECTION 16477

PART 1 - GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. REFERENCES

1. Illuminating Engineering Society (IES)
    1. IES LM-79, Electrical and Photometric Measurements of Solid State Lighting Products.
    2. IES LM-80, Measuring Lumen Maintenance of LED Light Sources.
2. American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
    1. ANSI/IEEE C62.41-2002, Surge Voltages in Low-Voltage AC Power Circuits.
3. American Society for Testing and Materials (ASTM)
    1. ASTM F 1137-11e1, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
4. United States of America, Federal Communications Commission (FCC)
    1. FCC (CFR47) EM and RF Interference Suppression.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1. Submit shop drawings in accordance with Division 1.
2. Submit complete data prepared by independent testing laboratory for all luminaires, for review by Consultant.
3. Photometric data to include: total input watts, candle power summary, Polar Plot candela distribution zonal lumen summary, luminaire efficiency, CIE type, coefficient of utilization, lamp type and lumen rating in accordance with IESNA testing procedures, lens and louver type and finish.
4. Indicate fixture manufacturer and model number.
5. Submit shop drawings for all luminaire types.

1.4. WASTE MANAGEMENT AND DISPOSAL

1. Separate and recycle waste materials in accordance with Division 1, and with the Waste Reduction Work Plan.

2. Place materials defined as hazardous or toxic waste in designated containers.

3. Ensure emptied containers are sealed and stored safely for disposal away from children.

4. Be responsible for the storage of all obsolete fluorescent lamps and ballasts in approved containers.

5. Include for the co-ordination and disposal with the lamp and ballast disposal company for removal of spent lamps and ballasts.

PART 2- PRODUCTS

2.1. LED Lights

1. All LED lighting fixtures to be energy star or DLC rated.

2.2. CONTROLS

1. Ensure all lighting controls are fully compatible with the specific light fixtures and drivers being controlled.

2. Dimmers controlling LED fixtures to be rated for such loads and shall meet all light fixture manufacturer's requirements.

2.3. FINISHES

1. Baked enamel finish:

    1. Conditioning of metal before painting:

        1. For corrosion resistance conversion coating to ASTM F 1137.

        2. For paint base, conversion coating to ASTM F 1137.

    2. Metal surfaces of luminaire housing and reflectors finished with high gloss baked enamel to give smooth, uniform appearance, free from pinholes or defects.

    3. Reflector and other inside surfaces finished as follows:

        1. White, minimum reflection factor 85%.

        2. Colour fastness: yellowness factor not above 0.02 and after 250h exposure in Atlas fade-ometer not to exceed 0.05.

        3. Film thickness, not less than 0.03 mm average and in no areas less than

0.025 mm.

4. Gloss not less than 80units as measured with Gardner 60° gloss meter.

5. Flexibility: withstand bending over [12] mm mandrel without showing signs of cracking or flaking under 10 times magnification.

6. Adhesion: 24mm square lattice made of 3mm squares cut through film to metal with sharp razor blade. Adhesive cellulose tape applied over lattice and pulled. Adhesion satisfactory if no coating removed.

2. Alzak finish:

1. Aluminium sheet fabricated from special aluminum alloys and chemically brightened, subsequently anodically treated to specifications established by Alcoa, to produce:

1. Finish for mild commercial service, minimum density of coating 7.8 g/m ², minimum reflectivity 83% for specular, 80.5% for semi-specular and 75% for diffuse.

2. Finish for regular industrial service, minimum density of coating 14.8 g/m ², minimum reflectivity 82% for specular and 73% for diffuse.

3. Finish for heavy duty service, minimum density of coating 21.8 g/m ², minimum reflectivity 85% for specular, 65% for diffuse.

2.4. LUMINAIRE SCHEDULE

'P' Building mounted LED wall fixture, complete with dark bronze die-cast aluminium housing, 4000°K, 70 CRI, 20C LED, 350mA, 2990 lumens output, T2S distribution, 2.5 kV surge protection device, 120-277V, CSA Certified.

Acceptable product:

Lithonia	DSXW2 LED Series
Eaton Galleon	GWC Series

'P1' Building mounted LED wall fixture, complete with dark bronze die-cast aluminium housing, 4000°K, 70 CRI, 20C LED, 350mA, 2950 lumens output, T3S distribution, 2.5 kV surge protection device, 120-277V, CSA Certified.

Acceptable product:

Lithonia	DSXW2 LED Series
Eaton Galleon	GWC Series

'P2' Building mounted LED wall fixture, complete with dark bronze die-cast aluminium housing, 4000°K, 70 CRI, 20C LED, 530mA, 4280 lumens output, TFTM distribution, 2.5 kV surge protection device, 120-277V, CSA Certified.

Acceptable product:

Lithonia	DSXW2 LED Series
Eaton Galleon	GWC Series

'Q' LED high bay fixture, high gloss white baked enamel finish, frosted polycarbonate lens, general distribution, 8,000 lumens, standard efficiency package, c/w 0-10V dimming option, 4,000°K, 80 CRI, 120-277V, complete with integral PIR motion sensor and suspension aircraft cables. CSA Certified.#

Acceptable products:

Lithonia	IBG Series with nLight control system
Cooper	OHB Series with iLumin Plus control system

'Q1' LED high bay fixture, high gloss white baked enamel finish, frosted polycarbonate lens, general distribution, 12,000 lumens, standard efficiency package, c/w 0-10V dimming option, 4,000°K, 80 CRI, 120-277V, complete with integral PIR motion sensor and suspension aircraft cables. CSA Certified.#

Acceptable products:

Lithonia	IBG Series with nLight control system
Cooper	OHB Series with iLumin Plus control system

'T' 8 feet LED strip-light, nominally 2440 mm (96”) long with steel housing, high-gloss, baked enamel finish, flat diffused lens, complete with suspension aircraft cables, white, 4000K Colour Temp., 10,000 lumens output, 80CRI, 120V. CSA Certified and DLC Rated.

Acceptable products:

Lithonia	TZL1N Series
Eaton	SNLED Series

'T1S' LED strip-light, nominally 2440 mm (96”) long with steel housing, high-gloss, baked enamel finish, flat diffused lens, complete with low mounted 360° PIR occupancy sensor, suspension aircraft cables, white, 4000K Colour Temp., 14,000 lumens output, 80CRI, 120V. CSA Certified and DLC Rated.

Acceptable products:

Lithonia	TZL1N Series
Eaton	SNLED Series

PART 3- EXECUTION

3.1. INSTALLATION

1. Locate and install luminaires as indicated.

2. For all luminaires with reflective surfaces, contractor is to use clean gloves during installation and clean off all fingerprints, dirt and dust at completion of project.

3. Where new luminaires are specified, the Contractor shall include for all required assembly and mounting. Provide all wiring, connections, inter-fixture wiring harnesses, fittings, hangers, safety chains, aligners, box covers and accessories which may be required to ensure a complete, safe and fully operational system.

4. Thoroughly review all ceiling types, construction details and mounting arrangements prior to

placing orders for new luminaires.

5. Standard octagonal boxes may be supplied where conduits feeding luminaires in finished areas are exposed on ceiling if hanger canopies entirely cover outlet boxes and are neatly notched for conduit. Otherwise, provide cast conduit outlet boxes with a diameter larger than canopies.

6. Do not mount luminaires above pipes, ducts or equipment. In event of unavoidably tight locations, provide hangers to clear obstruction. Luminaires in any room shall hang at one height. Obtain approval before any changes are made to layouts shown.

3.2. WIRING

1. Connect all luminaires to lighting circuits as indicated via centralized junction boxes.

3.3. LUMINAIRE SUPPORTS

1. Chains shall be No. 4 Tensile, bright zinc coated, with a strength of 400 lbs. where luminaires are indicated to be chain hung. Attachments shall be made using a No. 105 "S" hook. Caddy fasteners to be used where applicable.

2. Support luminaires mounted in continuous rows at each end of each fixture.

3.4. LUMINAIRE ALIGNMENT

1. Align luminaires mounted in continuous rows to form straight uninterrupted line.

2. Align luminaires mounted individually parallel or perpendicular to building grid lines.

3. Install luminaires accurately, in line and level, complete with mounting appurtenances and hardwares, free from undue interferences.

3.5. TESTS

1. Perform tests in accordance with Section 16010.

2. Clean and check luminaries and replace defective luminaires or drivers just prior to turnover to owner.

END OF SECTION 16505

PART 1- GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. REFERENCES

1. Atomic Energy Control Board Regulations.
2. Canadian Code for Preferred Packaging.
3. Canadian Standards Association (CSA)
    1. CSA C22.2 No. 141-10, Unit Equipment for Emergency Lighting.
    2. CSA C860-11, Performance of Internally-Lighted Exit Signs.
4. Natural Resources Canada (NRCan)
    1. NRCan C860 Registered.
5. National Fire Protection Association (NFPA) requirements.

1.3. PRODUCT DATA

1. Submit product data in accordance with Division 1. Include product characteristics, performance criteria, physical size, limitations and finish.

1.4. WASTE MANAGEMENT AND DISPOSAL

1. Separate and recycle waste materials in accordance with Division 1, and with Waste Reduction Workplan.
2. Place materials defined as hazardous or toxic waste in designated containers.
3. Ensure emptied containers are sealed and stored safely for disposal away from children.
4. Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
5. Fold up metal banding, flatten and place in designated area for recycling.

PART 2- PRODUCTS

2.1. PICTOGRAM EXIT LIGHTS - GENERAL

1. Pictogram Exit lights: to CSA C22.2 No. 141 and CSA C860.
2. Housing: one piece extruded aluminum, baked white enamel finish.
3. Face and back plates: extruded aluminum, baked white enamel finish.
4. Lamps: LED, non-protruding type, maximum 2 watts per face, to operate from 120V or 347 V emergency lighting circuit.
5. Designed for 25 year life of continuous operation without relamping.
6. Interchangeable Pictogram Face Plate.
7. Face plate to remain captive for relamping.
8. CSA C860-11 listed and certified model with five year warranty.
9. NRCan Registered.

2.2. DESIGN

1. Universal type for wall, end to wall, or ceiling mounted as required.
2. Number of faces as per drawings.
3. Three faceplates to be provided with each Pictogram Exit, with final faceplate selection based on drawings and site conditions.

PART 3- EXECUTION

3.1. INSTALLATION

1. Install pictogram exit lights as indicated, in accordance with OBC 2012.
2. Connect fixtures to exit light circuits as indicated.
3. Ensure that exit light circuit breaker is locked in on position.

END OF SECTION 16519

PART 1- GENERAL

1.1. GENERAL

1. Division 1, General Requirements is part of this Section and shall apply as if repeated here.

1.2. PRODUCT DATA

1. Submit product data in accordance with Division 1, including:
    1. Electrical data of components, including input and output voltages, operating time, phase, AC and DC ampere ratings.
    2. Mounting methods, dimensional outline and accessories.
    3. Lamp heads type, watt/ampere, lumen output, horizontal and vertical adjustments.
    4. Data for battery, charger and auxiliary instruments and devices.

1.3. DELIVERY

1. Deliver batteries in dry state, unless hermetically sealed.
2. Provide electrolyte in hazard-proof container.

1.4. WARRANTY

1. For batteries, the 12 months warranty period prescribed in subsection GC 32.1 of General Conditions “C” is extended to 120 months, with a no-charge replacement during the first 5 years and a pro-rate charge on the second 5 years.
2. Provide written copy of terms of battery guarantee in maintenance manual, and note date of acceptance for start of guarantee period.

PART 2- PRODUCTS

2.1. EQUIPMENT

1. Unit equipment for emergency lighting: to CSA C22.2 No. 141.
2. Supply voltage: Universal Voltage 120 V or 347 V AC.
3. Output voltage: 12 V DC.
4. Battery: sealed, maintenance free, sized to 30 min. operation plus 20% spare capacity.

Battery capacity to be 360 W, unless otherwise noted.

5. Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variation.

6. Solid state transfer circuit.

7. Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

8. Signal lights: solid state, life expectancy 100,000 h minimum, for 'AC Power ON' and 'High Charge'.

9. Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.

10. Finish: white baked enamel.

11. Auxiliary equipment:

    1. Time delay relay.

    2. Shelf.

    3. Self-diagnostics (auto-test).

2.2. WIRING OF REMOTE HEADS

1. Conduit: type EMT, to Section 16111.

2. Conductors: RW90 type to Section 16122, sized to limit voltage drop to 5%.

PART 3- EXECUTION

3.1. INSTALLATION

1. Install unit equipment for emergency lighting in accordance with CSA C22.1-12.

2. Install unit equipment and remote mounted fixtures as indicated.

3. Unit equipment shall be mounted with the bottom of the enclosure not less than 2 meters above the floor.

4. Receptacles to which unit equipment is to be connected shall be not less than 2.5 meters above the floor.

5. Connect exit lights to unit equipment as indicated.

6. Clean all heads and direct as indicated by Consultant at type of acceptance.

7. Test each unit and verify operation of all remote heads.

8. Unit equipment shall be installed in such a manner that it will be automatically actuated upon failure of the power supply to the normal lighting in the area covered by that unit equipment.

9. For all battery units that are equipped with self-diagnostics (auto-test), ensure that the system is connected as per manufacturer's instructions. Note that some battery packs with self-diagnostics have two circuits and the circuits should be balanced as close as possible for the system to work properly. Also, the DC side of the system must be connected first before the AC is initiated to prevent damage to the circuit board electronics.

10. Provide complete instruction for the operation and maintenance of the unit equipment for emergency lighting as per the OBC and the manufacturer's recommendations. Instructions to include testing unit equipment at least once a month to ensure proper operation. Installation instructions to be posted on the premises in a frame under glass.

END OF SECTION 16536