



WEST TORONTO COMMUNITY HEALTH SERVICES (WTCHS)

**West Toronto Community Health Centre (WTCHC) – 209 Mavety St.
HDR Architecture Associates Inc. Project No.: 10355669
WSP Project No.: 221-11662-00**

ISSUED FOR MECHANICAL ADDENDUM, ADD-M02

October 17th, 2024

INCLUDE IN YOUR BID AMOUNT FOR THE FOLLOWING ITEMS OF ADDITION, DELETION OR CLARIFICATION. INDICATE IN THE SPACE PROVIDED ON THE BID FORM THAT YOU HAVE RECEIVED AND INCLUDED FOR THE REQUIREMENTS OF THIS ADDENDUM.

1. ISSUED SPECIFICATIONS

1.1 SECTION 20 05 10 BASIC MECHANICAL MATERIALS AND METHODS

1.1.1 Refer to attached Spec 20 05 10 for changes.

1.2 SECTION 20 05 25 MECHANICAL INSULATION

1.2.1 Refer to attached Spec 20 05 25 for changes.

1.3 SECTION 20 05 50 TESTING, ADJUSTING AND BALANCING

1.3.1 Refer to attached Spec 20 05 50 for changes.

1.4 SECTION 21 20 05 FIRE EXTINGUISHERS

1.4.1 Refer to attached Spec 21 20 05 for changes.

1.5 SECTION 22 30 00 PLUMBING EQUIPMENT

1.5.1 Refer to attached Spec 22 30 00 for changes.

1.6 SECTION 23 82 39 MOTORIZED HEATERS

1.6.1 Refer to attached Spec 23 82 39 for changes.

2. ISSUED DRAWINGS

Following drawings are issued with and form part of this addendum (include for additional work and/or revisions as shown/noted):

2.1 M-200 UNDERGROUND – PLUMBING

2.1.1 Updated the sanitary and storm piping.



2.2 M-201 LEVEL B01 – PLUMBING

2.2.1 Revised the sanitary and storm piping.

2.2.2 Added notes.

2.3 M-202 LEVEL 01 – PLUMBING

2.3.1 Added a note.

2.4 M-300 LEVEL B01 – FIRE PROTECTION

2.4.1 Updated FE labels.

2.4.2 Removed FE from HSK 005, and corridor.

2.4.3 Added notes.

2.5 M-301 LEVEL 01 – FIRE PROTECTION

2.5.1 Updated FE labels.

2.5.2 Added FE in Corridor 168, Public corridors 100, 110, and 169.

2.5.3 Added notes.

2.6 M-302 LEVEL 02 – FIRE PROTECTION

2.6.1 Removed FE from HSK 204.

2.6.2 Added two FE's in Staff/Client Corridor 225.

2.6.3 Added notes.

2.7 M-452 LEVEL 02 – HYDRONIC

2.7.1 Added a keynote.

2.8 M-702 MECHANICAL SCHEDULES

2.8.1 Added Vibration Isolation schedule.

END OF ADD-M02

SECTION 20 05 10
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 APPLICATION

- A. This Section specifies products, criteria and characteristics, and methods and execution that are common to one or more Sections of Mechanical Divisions. It is intended as a supplement to each Section and is to be read accordingly.
- B. Advise product vendors of requirements of this Section.

1.2 SUBMITTALS

- A. Submit shop drawings/product data sheets for:
 - 1. pressure gauges and thermometers;
 - 2. electric motors (submit with equipment they are associated with).
- B. Submit weight loads for selected equipment (upon request).
- C. Submit copy of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations.
- D. Submit sample of each proposed type of access door if supplied under work of this Division.
- E. Submit samples of materials and any other items as specified in Sections of Mechanical Divisions.
- F. Submit list of equipment identification nameplates indicating proposed wording and sizes.
- G. Submit list of pipe and duct identification colour coding and wording.
- H. Submit proposed valve tag chart and a list of proposed valve tag numbering and identification wording.
- I. Submit drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.
- J. As specified in Part 2 of this Section, submit spare belt set, tagged and identified, for each belt driven piece of equipment.
- K. Submit any other submittals specified in this Section or other Sections of Mechanical Divisions.

1.3 EQUIPMENT WITHSTAND RATINGS

- A. Coordinate with Electrical Divisions Contractor with regards to obtaining calculations of short circuit current ratings (SCCR) and available fault currents at each level of electrical distribution system that serves major mechanical equipment.
- B. Select mechanical equipment able to withstand and labeled with required appropriate SCCR sufficient for voltage employed and fault current at terminals of equipment.
- C. Where SCCR are not identified, assume for pricing minimum 35 kA for small equipment and 65 kA for larger HVAC units.
- D. Review with Consultant and Division 26 Electrical Contractor, prior to ordering equipment, and identify required SCCR on shop drawings.

1.4 PRE-TENDERED EQUIPMENT

- A. Refer to Appendix for complete information regarding scope of work for pre-tendered equipment. Equipment have been pre-tendered, ordered, and paid for by Owner. Associated work to be included as part of Work of Mechanical Division of this Project, that is to include for, but not be limited to, provision of following:

1. coordination with respective equipment manufacturers with regards to delivery, unloading and acceptance on site;
 2. inspection upon delivery and acceptance;
 3. unloading, transporting and moving/hoisting into installation position;
 4. installation, connection, testing, and certification.
- B. Take over order and coordinate with various manufacturers/suppliers of pre-ordered equipment and associated Work. During inspection of pre-ordered equipment and associated components at site, report deficiencies to respective supplier and to Owner and be responsible for resolving such deficiencies directly with respective supplier(s).
- C. Be available for and attend factory testing at supplier's offices of pre-ordered equipment and associated Work, as requested by Consultant.
- D. Coordinate final installation requirements with manufacturers/suppliers of pre-ordered equipment and associated Work.
- E. For reference purposes, copy of shop drawing may be obtained from Consultant after order has been made.
- F. Review installation schematics and diagrams, control system schematics, and wiring diagrams supplied by manufacturers/suppliers of pre-ordered equipment and associated Work. Coordinate interconnections with related various building systems.
- G. Refer to respective equipment Section - Part 3 for additional installation requirements.
- H. Refer also to Appendix for further details and requirements of pre-tendered equipment. Be responsible for review of issued documents and request further information from Consultant, if required. Include and incorporate required provisions and associated costs required for a complete installation.
- I. Install equipment in accordance with drawing notes, specifications, and manufacturer's instructions and to comply with Owner's on-site standards and regulations.
- J. Under Electrical Divisions scope of Work, electrical equipment was also pre-tendered. Mechanical Division Contractor to coordinate interconnections and integrations with Electrical Division Contractor.
- K. Obtain following from suppliers of per-tendered equipment and submit to Owner:
1. operating and maintenance materials, testing and commissioning reports, and inspection certificates/ULC approvals/local governing inspection authority approvals, warranties and other supplied documents; organize and combine documents into manuals as specified in Division 01;
 2. spare parts, maintenance tools and kits, and loose accessories.
- L. Review and coordinate with each respective vendor of pre-tendered equipment, exact pre-tendered equipment, and accessories that are being supplied and/or installed, and services being performed by pre-tendered equipment vendor. With each respective pre-tender equipment vendor, determine installation products and services which are not included as part of pre-tender packages but which need to be supplied by respective pre-tender equipment vendor in order to complete onsite installation of equipment. Obtain costs for supply of these items and include in Bid along with respective installation costs. Identify items as an itemized price included in Bid. Attach list of detailed items and itemized prices with Bid Form submission.

PART 2 - PRODUCTS

2.1 PIPE SLEEVES

- A. Galvanized Sheet Steel: Minimum #16 gauge galvanized steel with an integral flange at one end to secure sleeve to formwork construction.
- B. Polyethylene: Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.
- C. Waterproof Galvanized Steel Pipe: Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at sleeve midpoint.

D. Galvanized Steel or Cast Iron Pipe: Schedule 40 mild galvanized steel or Class 4000 cast iron.

2.2 FIRESTOPPING AND SMOKE SEAL MATERIALS

A. Firestopping and smoke seal system materials for mechanical penetrations through fire rated construction are specified in Division 07 and work will be included as part of work of Division 07.

2.3 WATERPROOFING SEAL MATERIALS

A. Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so when bolts are tightened the links expand to seal the opening watertight. Select seal assemblies to suit pipe size and sleeve size or wall opening size.

B. Acceptable products are:

1. Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S-316;
2. The Metraflex Co. "MetraSeal" type ES.

2.4 PIPE ESCUTCHEON PLATES

A. One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to building surface, each plate sized to completely cover pipe sleeve or building surface opening, and to fit tightly around pipe or pipe insulation.

2.5 PIPING HANGERS AND SUPPORTS

A. Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to following requirements:

1. unless otherwise specified, ferrous hanger and support products are to be electro-galvanized;
2. hangers and supports for insulated piping are to be sized to fit around insulation and insulation jacket.

B. Hangers and supports for horizontal suspended piping as follows:

1. adjustable steel clevis hanger – MSS Type 1;
2. adjustable swivel ring band hanger – MSS Type 10;
3. adjustable roller hanger – MSS Types 41, 43, and/or 45, with MSS Type 39 steel protection saddle.

C. Supports for horizontal pipe on vertical surfaces as follows:

1. steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;
2. heavy-duty steel pipe clip – MSS Type 26;
3. single steel pipe hook – Myatt Fig. 156;
4. epoxy coated steel pipe stays are not permitted.

D. Floor supports for vertical risers as follows:

1. copper tubing riser clamp – MSS Type 8;
2. heavy-duty steel riser clamp – MSS Type 8.

E. Supports for vertical piping on vertical surfaces as follows:

1. steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;
2. heavy-duty steel pipe bracket or soil pipe bracket – MSS Type 26;
3. extension split pipe clamp – MSS Type 12;
4. epoxy coated steel pipe stays are not permitted.

F. Base support for vertical risers in excess of 6 m (20') high extending out from base mounted equipment is to consist of a base elbow support with flange.

G. For horizontal pipe on racks, Unistrut or approved equal galvanized steel pipe racks with pipe securing hardware as follows:

1. standard galvanized steel U-bolts/clamps supplied by rack manufacturer;
2. adjustable roller chair – MSS Type 44 with MSS Type 39 steel protection saddle.

- H. Special hangers and supports for various applications as follows:
1. vibration isolated riser supports – black steel riser clamps as specified above, complete with neoprene–steel–neoprene sandwich type vibration isolation pads between clamp and floor;
 2. for groups of pipes having same slope – MSS Type 32 welded steel brackets, Anvil Fig. 46 universal trapeze assemblies, or Unistrut or approved equal support assemblies, all with U-bolts, clamps, etc., to secure pipes in place;
 3. for sections of piping connected to vibration isolated equipment – hangers and supports as specified above but complete with MSS Type 48 spring cushions;
 4. for piping on existing roof – Portable Pipe Hangers (Canada) Inc. "PP" Series prefabricated portable pipe support system components to suit pipe, complete with required accessories including bases, galvanized structural steel frames, and galvanized steel pipe hangers and supports conforming to MSS SP-58;
 5. for plastic piping – generally as specified above but in accordance with pipe manufacturer's recommendations;
 6. for fire protection piping – generally as above but ULC listed and/or FM approved, and in accordance with Chapter requirements of NFPA Standard applicable to piping system;
 7. for bare horizontal copper piping – generally as above but factory vinyl coated to prevent direct copper/steel contact;
 8. for bare copper vertical piping – corrosion resistant ferrous clamps with flexible rubber gasket type material (not tape) to isolate pipe from clamp;
 9. insulation protection shields to and including 40 mm (1-1/2") dia. – MSS Type 40 galvanized steel shields with ribs to keep shield centred on hanger.
- I. Hanger rods are to be electro-galvanized carbon steel (unless otherwise specified), round, threaded, to ASTM A36, complete with captive machine nuts with washers at hangers, sized to suit loading in accordance with Table 3 in MSS SP-58, but minimum 9.5 mm (3/8") diameter.
- J. Acceptable manufacturers are:
1. E. Myatt & Co. Inc.;
 2. Anvil International Inc.;
 3. Empire Industries Inc.;
 4. Hunt Manufacturing Ltd.;
 5. Unistrut Canada Ltd.;
 6. Nibco Inc. "Tolco";
 7. Taylor Pipe Supports.

2.6 DELETED

2.7 ACCESS DOORS

- A. Coordinate consistency of look and finish of access doors on project with each Division of Work. Coordinate exact requirements with General Trades Contractor.
- B. Access doors to be rust resistant steel door panels, with concealed hinges and positive locking and self-opening screwdriver operated lock. Wall type frame to be suitable for wall installation and have integral keys for plaster walls. Doors in tile wall to be stainless steel and in ceilings to be suitable for plaster covering with only frame joint showing. Other doors to be prime painted steel.
- C. Size access doors to suit the concealed work for which they are supplied, and wherever possible they are to be of standard size for all applications, but minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.

- D. Lay-in type tiles, properly marked, may serve as access panels. Coordinate marking of ceiling tiles with Consultant. Panels in glazed tile walls to be 12 gauge, 304 alloy stainless steel, No. 4 finish, with recessed frame secured with stainless steel counter-sunk flush head screws.
- E. Panels in plaster surfaces to have dish-shaped door and welded metal lath, ready to take plaster. Provide a plastic grommet for door key access.
- F. Other access doors to be welded 12 gauge steel, flush type with concealed hinges, lock and anchor straps, complete with factory prime coat. Submit to Consultant for review, details of non-standard door construction details.
- G. Access doors in fire rated ceilings, walls, partitions, structures, etc., to be ULC listed and labelled and of a rating to maintain fire separation integrity.
- H. Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting finish in which they are to be installed so as to maintain final building surface appearance throughout.
- I. Acceptable manufacturers include Le Hage, SMS, Pedlar and Acudor.

2.8 PRESSURE GAUGES AND THERMOMETERS

- A. Pressure gauges as follows:
 - 1. adjustable, glycerine filled, 100 mm or 115 mm (4" or 4-1/2") diameter and each accurate to within 1% of scale range;
 - 2. type 304 stainless steel case with relief valve and polished stainless steel bayonet;
 - 3. stainless steel rotary movement with stainless steel bushings and socket;
 - 4. clear acrylic window;
 - 5. dual scale white dial with a scale range such that working pressure of system is at approximate mid-point of scale;
 - 6. black pointer.
- B. Pressure gauge accessories and additional requirements as follows:
 - 1. bronze ball type shut-off valve is to be provided in piping to each pressure gauge;
 - 2. each pressure gauge for piping and equipment with normal everyday flow is to be equipped with a brass pressure snubber;
 - 3.
 - 4. pressure gauges in fire protection piping must be ULC listed and labelled;
- C. Thermometers as follows:
 - 1. round, 125 mm (5") diameter, adjustable (90°) angle bimetal dial type thermometers, each accurate to within 1% of full scale;
 - 2. hermetically sealed stainless steel case with stainless steel ring;
 - 3. dampened bimetal coil;
 - 4. calibration adjustment screw;
 - 5. white aluminum dual scale dial with black and blue markings and a range such that working temperature of system is approximate mid-point of the scale;
 - 6. black aluminum pointer;
 - 7. double strength glass window;
 - 8. 12 mm (1/2") NPT connection with 6.4 mm (1/4") diameter stainless steel stem;
 - 9. suitable thermowell.
- D. Acceptable manufacturers are:
 - 1. H.O. Trerice Co.;
 - 2. Weiss Instruments;
 - 3. Ashcroft.

2.9 EQUIPMENT BELT DRIVES

- A. ANSI/RMA Standard V-belt type rated at minimum 1.5 times motor nameplate rating, and in accordance with following requirements:

1. belts are to be reinforced cord and rubber, and multiple belts are to be matched sets;
 2. sheaves are to be cast iron or steel, secured to shafts with removable keys unless otherwise specified, standard adjustable pitch ($\pm 10\%$ range) for motors under 10 HP, fixed pitch type with split tapered bushing and keyway for motors 10 HP and larger, and, if required, replaced as part of mechanical work to suit system air/water quantity testing and balancing work;
 3. motor slide rail adjustment plates are to allow for centre line adjustment.
- B. Supply a spare belt set (tagged and identified) for each belt drive as reviewed with Consultant, and turn over to Owner upon Substantial Performance of the Work.

2.10 EQUIPMENT DRIVE GUARDS AND ACCESSORIES

- A. For V-Belt Drives: Removable, 4-sided, fully enclosed, galvanized sheet steel guards to OSHA standards, cleaned, factory primed and painted with yellow equipment enamel, complete with a 2-piece full length hinged front panel to permit belt maintenance or replacement without removing guard, and 40 mm (1-1/2") diameter tachometer openings at each shaft location.
- B. For Flexible Couplings: Removable "U" shaped galvanized steel guards to OSHA Standards with a 2.3 mm (3/32") thick frame and expanded mesh face.
- C. For Unprotected Fan Inlets and Outlets: Unless otherwise specified, removable 20 mm (3/4") galvanized steel wire mesh with galvanized steel frames, all to OSHA Standards.

2.11 ELECTRIC MOTORS

- A. Unless otherwise specified, motors are to conform to NEMA Standard MG1, applicable IEEE Standards, and applicable CSA C22.2 Standards, and are to meet NEMA standards for maximum sound level ratings under full load. Confirm motor voltages prior to ordering.
- B. Vertically mounted and submersible motors are to be purposely designed for mounting in this attitude.
- C. Efficiency of 1-phase motors to 1 HP is to be in accordance with CAN/CSA C747. Efficiency of 3-phase motors 1 HP and larger is to be in accordance with CAN/CSA C390 or IEEE 112B.
- D. Unless otherwise specified, 1-phase motors smaller than 1/2 HP are to be 115 volt, continuous duty capacitor start type with an NEMA 48 or 56 frame size, solid base, heavy-gauge steel shell with solid die-cast end shields, dynamically balanced die-cast rotor, integral automatic reset thermal overload protection, Class "B" insulation, and a 1.15 service factor at 40°C (105°F) ambient temperature.
- E. Explosion-proof 1-phase motors are to be totally enclosed, fan cooled, 115 volt continuous duty capacitor start type in accordance with CSA C22.2 No. 145, as specified for standard 1-phase motors but suitable for use in Class 1 Group D hazardous locations and complete with a rolled steel shell and a 1.0 service factor at 40°C (105°F) ambient temperature.
- F. Unless otherwise specified, motors 1/2 HP and larger are to be totally enclosed, fan cooled, 3-phase, T-frame, squirrel cage continuous duty induction motors suitable for voltages indicated on Drawings, NEMA Design "B" for normal starting torque or Design "C" for high starting torque as required by the application, each complete with Class "B" insulation, a 1.15 service factor at 40°C ambient temperature, grease lubricated open ball bearings with grease fittings to permit re-lubrication without dismantling motor, a cast iron frame with cast iron feet where required, cast iron end bracket and precision machined bearing fit, and balanced carbon steel shaft assembly with die-cast aluminum rotor windings.
- G. Explosion-proof 3-phase motors are to be totally enclosed fan cooled motors in accordance with CSA C22.2 No. 145, generally as specified above for standard 3-phase motors but suitable for use in Class 1 Group D hazardous locations and with a 1.0 service factor at 40°C (105°F) ambient temperature.
- H. Motor(s) for 2-speed fan(s) are to be as above but 2-speed double winding type.
- I. Unless otherwise indicated, motors 30 HP and larger are to be complete with a heat sensing PTC thermistor in the end turn of stator winding for each phase and connected in series inside motor with 2 marked leads brought out to motor conduit box.

- J. Motors for equipment with variable frequency drives are to be generally as specified above but inverter duty type to NEMA Standard MG-1 Part 31, quantified by CSA for operation from a variable frequency drive of type specified, and complete with Class "H" insulation. Motors are to be equipped with AEGIS, or approved equal, shaft grounding ring system to protect bearings from damage by diverting harmful shaft voltages and bearing currents to ground.
- K. Motors for equipment which is scheduled or specified with a corrosion resistant coating or constructed from corrosion resistant materials are to be factory coated with a primer and epoxy paint finish.
- L. Acceptable manufacturers are:
 - 1. TECO-Westinghouse Motors (Canada) Inc.;
 - 2. Canadian General Electric;
 - 3. Baldor Electric Co.;
 - 4. U.S. Electrical Motors;
 - 5. WEG Electric Corp.;
 - 6. Marathon Electric;
 - 7. Toshiba Corp.;
 - 8. Leeson Canada.

2.12 MOTOR STARTERS AND ACCESSORIES

- A. Motor starters to be capable of starting associated motors under imposed loads. Confirm starter voltage matches motor prior to ordering.
- B. Unless otherwise specified, starters for 1-phase motors are to be 115 volt, thermal overload protected manual starting switches with neon pilot light, surface or recessed enclosure to suit application, and, where automatic operation is required, separate H-O-A switch in enclosure to match starter enclosure.
- C. Unless otherwise specified, starters for 3-phase motors less than 50 HP are to be combination "quick-make" and "quick-break" fused disconnects and full voltage non-reversing across-the-line starters, each complete with overload relay per phase, enclosure to suit application, and accessories in accordance with motor starter schedule.
- D. Unless otherwise specified, starters for 3-phase motors 50 HP to 150 HP are to be reduced voltage, non-reversing, auto-transformer type starters complete with one overload relay per phase, enclosure to suit application, and accessories in accordance with motor starter schedule.
- E. Unless otherwise specified, starters for 3-phase motors 150 HP and larger are to be reduced voltage, non-reversing, closed transition "wye-delta" starters complete with one overload relay per phase, enclosure to suit application, and accessories in accordance with motor starter schedule.
- F. Starters for 2-speed double winding motors are to be generally as specified above but suitable for motor and equipped with 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.
- G. Starters for 2-speed single winding motors are to be generally as specified above but suitable for motor and equipped with 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.
- H. Starters for reversible motors for cooling towers are to be generally as specified above but suitable for motor and equipped with 45 second time delay to allow fan(s) to coast down to stop before being operated in reverse rotation.
- I. Unless otherwise specified, motor starter enclosures are to be in accordance with following NEMA ratings:
 - 1. enclosures located in sprinklered areas – Type 2;
 - 2. enclosures exposed to the elements – Type 3R, constructed of stainless steel;
 - 3. enclosures inside the building in wet areas – Type 3R, constructed of stainless steel;
 - 4. enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application;
 - 5. enclosures except as noted above – Type 1;
 - 6. enclosures located in finished areas – as above but recess type with brushed stainless steel faceplate.

- J. Motor control centres are to be multi-unit, 2.28 m (9') high, NEMA Class 1, type "B", factory assembled, dead front, floor mounted, free-standing motor control centre with tin plated copper bus and NEMA Type 1 or Type 2 enclosure as for loose starters specified above. Each motor control centre is to be complete with starters as specified above, load and control wiring terminal boards, and required facilities for line and load side power wiring connections.
- K. Disconnect switches for motor control centres are to be heavy-duty, CSA certified, front operated switches as per motor starter schedule, each complete with a handle suitable for padlocking in "off" position and arranged so that door cannot be opened with handle in "on" position and an NEMA enclosure as specified for loose starters. Fusible units are to be complete with fuse clips to suit fuse types specified below.
- L. Fuses are to be, unless otherwise scheduled or specified, English Electric Ltd. HRC fuses, Form I Class "J" for constant running equipment and Form II Class "C" for equipment that cycles on and off.
- M. Acceptable manufacturers are:
 - 1. Rockwell Automation Inc. - Allen-Bradley;
 - 2. Eaton;
 - 3. Siemens Canada;
 - 4. Schneider Electric.

2.13 MECHANICAL WORK IDENTIFICATION MATERIALS

- A. Equipment nameplates are to be minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as damper motors and control valves, minimum 25 mm x 65 mm (1" x 2-½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:
 - 1. unless otherwise specified or required, each nameplate is to be white, complete with bevelled edges and black engraved wording to completely identify equipment and its use with no abbreviations;
 - 2. wording is generally to be as per drawings, i.e. Fan EF-1, and is to include equipment service and building area/zone served, but must be reviewed with Consultant prior to engraving;
 - 3. supply stainless steel screws for securing nameplates in place;
 - 4. nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level.
- B. Valve tags are to be coloured, 40 mm (1-½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match piping identification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:
 VALVE V12
 200 mm (8")
 CHILL. WATER
 NORMALLY OPEN
- C. Standard pipe identification to be Smillie McAdams Summerlin Ltd., Brady or Primark Manufacturing Inc. vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows, as follows:
 - 1. for pipe less than or equal to 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around pipe or pipe insulation;
 - 2. for pipe larger than 150 mm (6") diameter, saddle type strap-on markers with 2 opposite identification locations and complete with nylon cable ties.
- D. Identification wording and colours for pipe identification materials are to be as follows:

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
domestic cold water	green	DOM. COLD WATER

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
domestic hot water supply	green	DOM. HW SUPPLY
domestic hot water recirculation	green	DOM. HW RECIRC.
tempered domestic water	green	TEMP. DOM. WATER
chilled drinking water	green	CH. DRINK WTR.
storm drainage	green	STORM
sanitary drainage	green	SAN.
plumbing vent	green	SAN. VENT
fire protection standpipe	red	F.P. STANDPIPE
natural gas	to Code	to Code, c/w pressure
natural gas vent	to Code	to Code
heating water supply	yellow	HTG. WTR. SUPPLY
heating water return	yellow	HTG. WTR. RETURN
heating water drain	yellow	HTG. WTR. DRAIN
pumped condensate	yellow	PUMPED CONDENSATE
boiler feedwater	yellow	BLR. FEEDWATER
boiler blowdown	yellow	BLR. BLOW-OFF
refrigerant suction	yellow	REFRIG. SUCTION
refrigerant liquid	yellow	REFRIG. LIQUID
refrigerant hot gas	yellow	REFRIG. HOT GAS
control air	green	CONTROL AIR

E. Colours for pipe identification legends and directional arrows are to be as follows:

IDENTIFICATION COLOUR	LEGEND & ARROW COLOUR
yellow	black
green	white
red	white

F. Duct identification is to be custom made Mylar stencils with 50 mm (2") high lettering to accurately describe duct service, i.e. "AHU-1 SUPPLY", complete with a directional arrow, and coloured ink with ink pads and roller applicators. Ink colour is generally to be black but must contrast with lettering background.

2.14 FLEXIBLE CONNECTORS

A. Double wall stainless steel flexible connectors for piping connections to vibration isolated equipment, each selected by manufacturer to suit the application. Shop drawings or product data sheets must indicate construction and performance requirements that suit the application. Acceptable manufacturers are:

1. Hyspan Precision Products Inc.;
2. Senior Flexonics Ltd.;

3. The Metraflex Co.

PART 3 - EXECUTION

3.1 GENERAL PIPING AND DUCTWORK INSTALLATION REQUIREMENTS

- A. Unless otherwise specified, locate and arrange horizontal pipes and ducts above or at ceiling on floors, arranged so that under consideration of all other work in area, maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork, as reviewed with Consultant and with Owner approval.
- B. Unless otherwise specified, install work concealed in finished spaces, and concealed to degree possible in partially finished and unfinished spaces. Refer to and examine Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Walls which are painted are considered finished.
- C. Install pipes and ducts parallel to building lines and to each other.
- D. Neatly group and arrange exposed work.
- E. Locate work to permit easy access for service or maintenance as required and/or applicable. Locate valves, dampers and any other equipment which will or may need maintenance or repairs and which are to be installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate accessories at floor level.
- F. Make connections between pipes of different materials using adapters suitable for application. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.
- G. Comply with equipment and material manufacturer's installation instructions unless otherwise specified herein or on drawings, and unless such instructions contradict governing codes and regulations.
- H. Carefully clean ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.
- I. Install piping and ductwork which are to be insulated, to have sufficient clearance to permit insulation and finish to be applied continuously and unbroken around pipe or duct, except for ductwork at fire barriers, terminate insulation at each side of duct fire damper.
- J. Inspect surfaces and structure prepared by other trades before performing work. Verify surfaces or structure to receive work has no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing to Consultant. Installation of work will constitute acceptance of such surfaces as being satisfactory.
- K. Any ferrous piping that exhibits in excess of 5% surface rust, either inside or outside or both, is to be wire brush cleaned to bare metal and coated with suitable primer. Steel pipe, fittings and accessories are to be free of corrosion and dirt when work is complete or prior to being concealed from view. Where dirt is evident, clean piping prior to being concealed.
- L. Provide continuous galvanized sheet metal drip pan under drain, water and water solution piping extending through rooms with electrical equipment such as electrical, elevator equipment and transformer rooms, and other spaces provided primarily for the installation of electrical equipment. Provide drip pans with drain pipe connection and extend drain piping to closest drain.
- M. For factory applied finishes, repaint or refinish surfaces damaged during shipment and installation. Quality of repair work is to match original finish. This requirement also applies to galvanized finishes.
- N. Where mechanical work is located in high humidity areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on products to protect against corrosion or provide products which will not corrode in the environment, i.e. aluminium ductwork, copper or stainless steel pipe, etc.

- O. Provide screwed unions or flanges in piping connections to equipment and in regular intervals in long (in excess of 12 m [40']) piping runs to permit removal of sections of piping.
- P. Unless otherwise specified and except where space limitations do not permit, piping elbows are to be long radius. Eccentric reducers are to be installed with straight side at top of piping.

3.2 PIPE JOINT REQUIREMENTS

- A. Do not make pipe joints in walls or slabs.
- B. Ream piping ends prior to making joints.
- C. Properly cut threads in screwed steel piping and coat male threads only with Teflon tape or paste, or an equivalent thread lubricant. After pipe has been screwed into fitting, valve, union, or piping accessory, not more than 2 pipe threads are to remain exposed.
- D. Site bevel steel pipe to be welded or supply mill bevelled pipe. Remove scale and oxide from bevels and leave smooth and clean. Use factory made welding tees or welding outlet fittings for piping branches off mains. Do not use shop or site fabricated fittings unless written approval has been obtained.
- E. Welded joints are to be made by CWB certified licensed journeyman welders qualified in accordance with CSA B51, Boiler Pressure Vessel and Pressure Piping Code, and who are in possession of a proper certificate of qualification for each procedure to be performed. Each weld is to be identified with the welder's identification symbol, and welds are not to be concealed until welder making joints has inspected them for quality assurance. Electrodes are to be in accordance with CSA W48 Series, Electrodes, and requirements of CAN/CSA W117.2, Safety in Welding, Cutting and Allied Processes are to be followed.
- F. Unless otherwise specified, make flanged joints with Garlock 5500 or approved equal gasket materials to suit the application, and bolts and nuts. Bolts are not to be longer than length necessary to screw nut up flush to end of bolt. Bolts used for flanged connections in piping with a working pressure of 690 kPa (100 psi) and greater are to be ASTM A-193 Grade B-7, with heavy hexagon nuts to ASTM A-194 CL-2H. Provide suitable washers between each bolt head and flange and between each nut and flange.
- G. A random check by Consultant at Consultant's option, of bolted flanged connections may be made to verify flanged connections are properly mated with no shear force acting on bolts. When such random check is made, supply labour to disconnect and reconnect selected flanged joints. If improperly mated joints are found, remove and reinstall affected piping so flanges mate properly. If improperly mated joints are found, additional joints may be checked, and be responsible for repair of any other improper joints discovered.
- H. Unless otherwise specified make soldered joints in copper piping using flux suitable for and compatible with type of solder being used. Clean outside of pipe end and inside of fitting, valve, or similar accessory prior to soldering.
- I. Install mechanical joint fittings and couplings in accordance with manufacturer's instructions.
- J. Grooves are to be rolled. Make arrangements with coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required, and adhere to manufacturer's instructions with respect to pipe grooving, support, type of gasket required, anchoring and guiding grooved piping system.
- K. If pressure crimped couplings and fittings are used, ensure gaskets are fully compatible with piping fluid, and valves and piping accessories are suitable. Use only fitting manufacturer supplied crimping equipment. Comply with manufacturer's latest published specification, instructions, and recommendations with respect to pipe, coupling, and fitting preparation and installation, and support, anchoring and guiding of piping system.
- L. Solvent weld PVC piping in 2 parts, primer stage and cementing stage, in accordance with manufacturer's recommendations, ASTM D2855, and CSA requirements.
- M. Install PVC piping with gasketed joints in accordance with manufacturer's current published specifications, instructions and recommendations, and CSA requirements.

3.3 INSTALLATION OF PIPE SLEEVES

- A. Where pipes pass through concrete and/or masonry surfaces provide pipe sleeves as follows:

1. in poured concrete slabs – unless otherwise specified, minimum 16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves;
 2. in concrete or masonry walls – Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe.
- B. Sleeves in waterproofed slabs or walls are to be lengths of Schedule 40 mild galvanized steel pipe with waterstop plate in accordance with drawing detail. Provide waterproof sleeves in following locations:
1. in mechanical room floor slabs, except where on grade;
 2. in slabs over mechanical, fan, electrical and telephone equipment rooms or closets;
 3. in floors equipped with waterproof membranes;
 4. in roof slab;
 5. in waterproof walls.
- C. Size sleeves, unless otherwise specified, to leave 12 mm (½") clearance around pipes, or where pipe is insulated, 12 mm (½") clearance around pipe insulation.
- D. Pack and seal void between pipe sleeves and pipe or pipe insulation in non-fire rated construction for length of sleeves as follows:
1. pack sleeves in interior construction with mineral wool and seal both ends of sleeves with non-hardening silicone base caulking compound;
 2. pack sleeves in exterior walls above grade with mineral wool and seal both ends of sleeves watertight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified;
 3. seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified.
- E. Where sleeves are required in masonry work, accurately locate and mark sleeve location, and hand sleeves to mason for installation.
- F. Terminate piping for sleeves that will be exposed so sleeve is flush at both ends with building surface concerned so sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above finished floor.
- G. "Gang" type sleeving will not be permitted.
- H. Where sleeves are provided in non-fire rated construction for future piping, or where piping has been removed from existing sleeves, cap and seal both ends of sleeved opening.

3.4 INSTALLATION OF WATERPROOF MECHANICAL SEALS

- A. Provide watertight link type mechanical seals in exterior wall openings.
- B. Assemble and install each mechanical seal in accordance with manufacturer's instructions.
- C. After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until seal is completely watertight.

3.5 DUCT OPENINGS

- A. Duct openings, air inlet and outlet openings, fire damper and similar openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by trade responsible for particular construction in which opening is required.
- B. Size openings for fire dampers to 600 mm (24") high to suit damper arrangement with folding blade out of air stream.
- C. For duct openings except where fire dampers are required, pack and seal space between duct or duct insulation and duct opening as specified above for pipe openings in non-fire rated construction.

3.6 SLEEVE AND FORMED OPENING LOCATION DRAWINGS

- A. Prepare and submit for review, drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.

- B. Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.
- C. Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

3.7 INSTALLATION OF PIPE ESCUTCHEON PLATES

- A. Provide escutcheon plates suitably secured over exposed piping passing through finished building surfaces. Finished building surface is any surface with a factory finish or that receives a site applied finish.
- B. Install plates so they are tight against building surface concerned, completely covering pipe sleeves and/or openings, except where waterproof sleeves extend above floors, in which case fit plate tightly around sleeve.

3.8 INSTALLATION OF FASTENING AND SECURING HARDWARE

- A. Provide fastening and securing hardware required for mechanical work to maintain installations attached to structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding dead loads, live loads, superimposed dead loads, and any vibration of installed products.
- B. Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.
- C. Where floor, wall or ceiling construction is not suitable to support loads, provide additional framing or special fasteners to ensure proper securement to structure that is to support the products. Provide reinforcing or connecting supports where required to distribute loading to structural components.
- D. Obtain written consent from Owner and review with Consultant, before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CAN/CSA Z166.1 and CAN/CSA Z166.2.
- E. Do not attach fasteners to steel deck without written consent from Owner and review with Consultant.

3.9 INSTALLATION OF PIPE HANGERS AND SUPPORTS

- A. Provide required pipe hangers and supports.
- B. Provide any additional structural steel channels, angles, inserts, beam chaps and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from structure only.
- C. For insulated pipe, size hanger or support to suit diameter of insulated pipe and install hanger or support on outside of insulation and insulation finish.
- D. Support requirements for underground piping are as follows:
 - 1. support underground pipe, unless otherwise specified, on a well compacted bed of dry, natural, undisturbed earth free from rocks or protrusions of any kind, or on compacted material as specified;
 - 2. support underground service piping penetrating building exterior walls or foundations to prevent pipe damage if minor building settlement occurs, all as per drawing detail;
 - 3. ensure bedding and supports for underground pipes are flat and true and allowances are made for pipe hubs, couplings, or other protrusions so no voids are left between pipe and bedding.
- E. Unless otherwise shown or specified, hang and/or support horizontal pipe above ground by means of hangers and/or supports specified in Part 2 of this Section. Unless otherwise shown or specified, hangers for suspended pipe less than or equal to 25 mm (1") dia. are to be clevis type or adjustable ring type, and hangers for suspended pipe greater than or equal to 40 mm (1-½") dia. are to be adjustable clevis type.
- F. Space hangers and supports in accordance with following:
 - 1. cast iron pipe – hang or support at every joint with maximum 2.4 m (8') spacing;
 - 2. plastic pipe – conform to pipe manufacturer's recommended support spacing;
 - 3. copper and steel pipe – hang or support at spacing in accordance with following schedule:

PIPE DIA.	MAX. SPACING STEEL (meters)	MAX. SPACING COPPER (meters)
to 25 mm (1")	2.4 m (8')	1.8 m (6')
40 mm (1-½")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2-½")	3.6 m (12')	3.0 m (10')
75 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3-½")	3.6 m (12')	3.6 m (12')
100 mm (4")	4.2 m (14')	3.6 m (12')
250 mm (10")	6.0 m (20')	
300 mm (12")	6.7 m (22')	

4. flexible grooved pipe/coupling joint piping – as above but with not less than one hanger or support between joints.
- G. Where pipes change direction, either horizontally or vertically, provide a hanger or support on horizontal pipe not more than 300 mm (12") from elbow, and where pipes drop from tee branches, support tees in both directions not more than 50 mm (2") on each side of tee.
- H. When pipes with same slope are grouped and a common hanger or support is used, space hanger or support to suit spacing requirement of smallest pipe in group and secure pipes in place on common hanger or support.
- I. Provide roller hangers or supports for heat transfer piping greater than or equal to 150 mm (6") diameter and conveying a material 75°C (170°F) or greater to facilitate pipe movement due to expansion and contraction, and at each hanger or support tack weld a steel protection saddle to pipe to protect piping insulation.
- J. Unless otherwise shown or specified, support vertical piping by means of supports specified in Part 2 of this Section, spaced in accordance with following:
 1. support vertical pipes at maximum 3 m (10') intervals or at every floor, whichever is lesser;
 2. for sections of vertical piping with a length less than 3 m (10'), support pipe at least once;
 3. for vertical cast iron plain end pipe (mechanical joint type), secure riser or pipe clamp around pipe under a flange integral with pipe for vertical support purposes, or provide a length of hub and spigot pipe to facilitate proper support;
 4. for vertical steel pipe risers in excess of 3 m (10'), weld shear lugs to pipe to carry load;
 5. for vibration isolated piping risers, provide rubber-steel-rubber vibration isolation pads between riser clamps and floor.
- K. Support piping on the roof as follows:
 1. on existing roof – provide support members as specified in Part 2 of this Section spaced as per schedule above and of a type to suit the application, and, for each support, carefully scrape away roofing gravel, bed support in a heavy covering of roofing mastic, then scrape gravel back up around support and secure pipes to supports;
- L. Each hanger, support or securement for horizontal bare copper tubing is to be plastic coated to prevent direct contact between pipe and ferrous hanger. Each wall or floor clamp for vertical bare copper piping is to be isolated from pipe by means of strips of flexible rubber inserts. Use of painted ferrous hangers and supports, including those painted with copper coloured paint, is not acceptable. Site application of tape or other types of isolation is not acceptable.

- M. For insulated horizontal piping less than or equal to 40 mm (1-½") diameter, provide galvanized steel insulation protection shields between insulation and hanger or support. Install shields immediately after pipe is insulated.
- N. Do not support piping from steel deck without written consent from Owner and review with Consultant.

3.10 SUPPLY OF ACCESS DOORS

- A. Supply access doors to give access to mechanical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on drawings.
- B. Before commencing installation of mechanical work, coordinate with other trades and prepare on a set of reflected ceiling plans and wall elevations, complete layouts of access doors. Submit these layouts for Consultant's review and show exact sizes and locations of such access doors. Locate and arrange mechanical work to suit.
- C. Access doors will be installed by trade responsible for particular type of construction in which doors are required. Supply access doors to trade installing same at proper time.
- D. Wherever possible, access doors to be of a standard size for each application. Review exact dimensions and minimum size restrictions with Consultant prior to ordering.
- E. Group piping and ductwork to ensure minimum number of access doors is required.
- F. Submit a sample of each proposed access door for review with Consultant, prior to ordering.
- G. Coordinate with Electrical Contractor and General Trades Contractor to ensure access doors on project are provided by a single manufacturer, installed as part of work of General Trades Contractor and work involving both mechanical and electrical services should, where possible, be accessible from common access door. Coordinate work to ensure common location access doors are not supplied by both Mechanical Divisions and Electrical Divisions.

3.11 INSTALLATION OF VALVES

- A. Generally, valve locations are indicated or specified on drawings or specified in Sections of the Specification where valves are specified, however, regardless of locations shown or specified, following requirements apply:
 - 1. provide shut-off valves to isolate systems, at base of vertical risers, in branch take-offs at mains and risers on floors, to isolate equipment, to permit work phasing as required, and wherever else required for proper system operation and maintenance;
 - 2. install shut-off valves with handles upright or horizontal, not inverted, and located for easy access;
 - 3. unless otherwise specified, provide a check valve in discharge piping of each pump;
 - 4. valve sizes are to be same as connecting pipe size;
 - 5. valves are to be permanently identified with size, manufacturer's name, valve model or figure number and pressure rating, and wherever possible, valves are to be product of same manufacturer;
 - 6. for valves in insulated piping, design of valve stem, handle and operating mechanism is to be such that insulation does not have to be cut or altered in any manner to permit valve operation.

3.12 INSTALLATION OF PRESSURE GAUGES AND THERMOMETERS

- A. Provide pressure gauges in following locations:
 - 1. in valved tubing across suction, suction strainer (if applicable), and discharge piping of each circulating pump;
 - 2. in supply and return piping connections to main mechanical plant equipment such as boilers, chillers, heat exchangers, main coils, etc.;
 - 3. in expansion tank(s);
 - 4. in separate domestic hot water storage tank(s);
 - 5. at top most outlet in each standpipe fire protection system riser;
 - 6. in piping at each side of a pressure reducing valve;
 - 7. in potable water service piping downstream of meter;
 - 8. wherever else shown and/or specified.

- B. Provide thermometers in following locations:
 - 1. in supply and return piping connections to main mechanical plant equipment such as boilers, chillers, cooling towers, heat exchangers, main coils, etc., unless temperature indication is supplied with equipment;
 - 2. wherever else shown and/or specified.
- C. Conform to following installation requirements:
 - 1. for installation of thermometers in piping wells, provide a coat of metallic base heat transfer paste or grease in piping well;
 - 2. for pressure gauges in piping at equipment locations, install pressure gauge between equipment and first pipe fitting;
 - 3. locate, mount and adjust instruments so they are easily readable;
 - 4. where pressure gauges and/or thermometers are located at high level or in an area where they cannot be easily seen, provide remote reading instruments.

3.13 INSTALLATION OF EQUIPMENT DRIVE GUARDS AND ACCESSORIES

- A. Provide OSHA guards for exposed accessible rotating parts such as belt drives, couplings, fan wheels, and shaft ends on mechanical equipment.
- B. Install belt guards to allow movement of motors for adjusting belt tension.
- C. Provide a means to permit lubrication and use of test instruments with guards in place.
- D. Secure guards to equipment or equipment base but do not bridge sound or vibration isolation.
- E. Where equipment oil level gauges, oil reservoirs, grease cups, or grease gun fittings are integral with equipment but are not easily accessible for service, extend to an accessible location using aluminium or copper tubing.

3.14 MECHANICAL WORK IDENTIFICATION

- A. Identify new exposed piping and ductwork as per Part 2 of this Section in locations as follows:
 - 1. at every end of every piping or duct run;
 - 2. adjacent to each valve, strainer, damper and similar accessory;
 - 3. at each piece of connecting equipment;
 - 4. on both sides of every pipe and duct passing through a floor, wall or partition, unless otherwise specified;
 - 5. at 6 m (20') intervals on pipe and duct runs exceeding 6 m (20') in length;
 - 6. at least once in each room, and at least once on pipe and duct runs less than 6 m (20') in length.
- B. Unless otherwise specified identify new concealed piping and ductwork as per Part 2 of this Section in locations as follows:
 - 1. at points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas;
 - 2. at maximum 6 m (20') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room;
 - 3. at each access door location;
 - 4. at each piece of connected equipment, automatic valve, etc.
- C. Provide an identification nameplate for equipment provided as part of this project, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place, approximately at eye level if possible, with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate nameplates in the most conspicuous and readable location.
- D. Paint new natural and/or propane gas piping with primer and 2 coats of yellow paint in accordance with local governing code requirements and requirements of Division 09. Identify piping at intervals as specified above.
- E. Provide an identification nameplate for each motor starter or disconnect switch located in a motor control centre or on a motor starter panel, and on each individually mounted starter provided as part of mechanical

work, and on each disconnect switch provided as part of the electrical work for motorized equipment provided as part of mechanical work.

- F. Tag valves and prepare a valve tag chart in accordance with following requirements:
 - 1. attach a valve tag to each new valve, except for valves located immediately at equipment they control;
 - 2. prepare a computer printed valve tag chart to list tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed);
 - 3. frame and glaze one copy of chart and, unless otherwise directed, affix to a wall in each main Mechanical and/or Equipment Room;
 - 4. include a copy of valve tag chart in each copy of operating and maintenance instruction manuals;
 - 5. hand an identified CD of valve tag chart to Owner at same time O&M Manuals are submitted.
- G. Where shut-off valves, control dampers, sensors, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in ceiling panel material, or stickers equal to Brady "Quick Dot" on ceiling grid material to indicate locations of items. Unless otherwise specified, ceiling tack or sticker colours are to be as follows:
 - 1. HVAC piping valves and equipment: yellow
 - 2. fire protection valves and equipment: red
 - 3. plumbing valves and equipment: green
 - 4. HVAC ductwork dampers and equipment: blue
 - 5. control system hardware and equipment: orange

- H. For electrically traced mechanical work, identification wording is to include "ELECTRICALLY TRACED".

3.15 PIPE LEAKAGE TESTING

- A. Before piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test piping for leakage.
- B. Tests are to be witnessed by Consultant and/or Owner's representative, and, where required, representatives of governing authorities. Give ample notice (minimum 7 working days) of tests in writing and verify attendance. Have completed test report sheets dated and signed by those present to confirm proper test results.
- C. When circumstances prevent scheduled tests from taking place, give immediate and adequate notice of cancellation to all who were scheduled to attend.
- D. Gravity Drainage and Vent Piping
 - 1. Test piping in accordance with local governing building code.
 - 2. After fixtures and fittings are set and pipes are connected to building drain or drains, turn on water into pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Perform smoke test if required by local governing authorities.
- E. Pumped Drainage Piping
 - 1. Test piping with cold water at a pressure of 1-½ times normal working pressure and maintain pressure for minimum of 2 hours.
- F. Domestic Water Piping
 - 1. Test piping with cold water at a pressure of 1-½ times normal working pressure and maintain pressure for minimum of 2 hours.
- G. Standpipe System Piping
 - 1. Test system piping in accordance with requirements of NFPA No. 14, "Standpipe and Hose Systems", and in accordance with any additional requirements of governing authorities.
- H. Clean Agent Fire Extinguishing System Piping
 - 1. Test system piping in accordance with requirements of NFPA No. 2001, "Standard on Clean Agent Extinguishing Systems", and in accordance with any additional requirements of governing authorities.

- I. Heat Transfer (HVAC) System Piping
 - 1. Test piping with cold water at pressure of 1035 kPa (150 psi) for minimum of 2 hours.
 - a. 0 kPa to 105 kPa (0 psi to 15 psi) low pressure piping – 690 kPa (100 psi);
 - b. 110 kPa to 690 kPa (16 psi to 100 psi) medium pressure piping – 1035 kPa (150 psi);
 - c. greater than 690 kPa (100 psi) high pressure piping – 1380 kPa (200 psi).
- J. Natural Gas Piping
 - 1. Test piping in accordance with requirements of CAN/CSA B149.1 and any additional requirements of local governing authorities.
 - 2. After completion of the verification test, locate required tag stating results of verification test at point of entry of gas main into building, affixed to pipe in secure manner.
 - 3. Check piping joints and connections for leaks with water/soap solution while piping is under pressure.
- K. Refrigerant Piping
 - 1. Test refrigerant piping for leakage and dehydrate in accordance with requirements of Chapter 18 of ASHRAE Handbook - Fundamentals.
- L. Following requirements apply to all testing:
 - 1. ensure piping has been properly flushed, cleaned and is clear of foreign matter prior to pressure testing;
 - 2. temporarily remove or valve off piping system specialties or equipment which may be damaged by test pressures prior to pressure testing systems, and flush piping to remove foreign matter;
 - 3. when testing is carried out below highest level of particular system, increase test pressure by the hydrostatic head of 7 kPa (1 psi) for every 600 mm (24") below high point;
 - 4. include for temporary piping connections required to properly complete tests;
 - 5. piping under test pressure is to have zero pressure drop for length of test period;
 - 6. make tight leaks found during tests while piping is under pressure, and if this is impossible, remove and refit piping and reapply test until satisfactory results are obtained;
 - 7. where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions;
 - 8. perform tests in reasonably sized sections so as to minimize number of tests required;
 - 9. in addition to leakage tests specified above, demonstrate proper flow throughout systems including mains, connections and equipment, as well as proper venting and drainage, and include for any necessary system adjustments to achieve proper conditions.

3.16 SUPPLY OF MOTOR STARTERS AND ACCESSORIES

- A. DELETED.
- B. Unless otherwise shown or specified, supply starter for each item of motorized equipment.
- C. Where 3-phase starters are indicated and/or scheduled to be mounted on a motor starter panel, starters will be mounted and connected, complete with panels and splitter trough, as part of electrical work. Hand starters to electrical trade at site when they are required.
- D. Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with equipment is fed from motor starter panel, disconnect switch will be provided on motor starter panel as part of electrical work.
- E. Unless otherwise specified or shown on drawings, 1-phase motor starters will be mounted adjacent to equipment they serve and connected complete as part of electrical work. Hand starters to electrical trade at site at proper time.

3.17 ELECTRICAL WIRING WORK FOR MECHANICAL WORK

- A. Coordinate requirements and responsibilities for electrical wiring with Electrical Division 26 Contractor. Provide low voltage control wiring not provided under work of Division 26.
- B. Unless otherwise specified or indicated, following electrical wiring work for mechanical equipment will be done as part of electrical work:

1. "line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from starters or disconnects to equipment;
 2. "line" side power wiring to individual wall mounted starters, and "load" side wiring from starters to equipment;
 3. "line" side power wiring to pre-wired power and control panels and variable frequency drives (VFD), and "load" side power wiring from the panels and VFD's to equipment;
 4. provision of receptacles for plug-in equipment;
 5. provision of disconnect switches for motors in excess of 9 m (30') from starter location, or cannot be seen from starter location, and associated power wiring;
 6. motor starter interlocking in excess of 24 volts;
 7. wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts;
 8. 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers;
 9. 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units;
 10. 120 volt wiring connections to duplex receptacles integral with air handling unit control panels.
- C. Mechanical wiring work not listed above or specified herein or on drawings to be done as part of electrical work is to be installed in conduit and is to be done as part of mechanical work in accordance with wiring requirements specified for electrical work.

3.18 EQUIPMENT BASES AND SUPPORTS

- A. Unless otherwise specified or indicated on drawings, set floor mounted equipment on minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of equipment on each side and end, or a minimum of 200 mm (8") from centreline of equipment anchor bolts to edge of the base, whichever is larger. Conform to following requirements:
1. supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads;
 2. place anchor bolts during concrete pour and be responsible for required levelling, alignment, and grouting of equipment;
 3. as a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details.
- B. For equipment not designed for base mounting, where required, provide welded, cleaned and prime coat painted structural steel stands or supports conforming to following requirements:
1. provide stands and supports, except those for small equipment, designed by a structural engineer registered in jurisdiction of the work, and submit stamped and signed design drawings with calculations as shop drawings for review;
 2. flange bolt steel stands to concrete housekeeping pads;
 3. seismically restrained stands and supports in accordance with applicable requirements.

3.19 MECHANICAL SERVICE REQUIREMENTS FOR FLOATING FLOOR SLABS

- A. Where mechanical services are required to be installed in or through a vibration isolated floating slab, install such services so as not to transmit any vibration to base slab on which floating floor slab is placed.
- B. Wherever possible, arrange mechanical work to avoid penetrating a floating floor slab.

3.20 DELETED

3.21 CONCRETE WORK FOR MECHANICAL EQUIPMENT BASES/PADS

- A. Provide poured concrete work, including reinforcing and formwork, required for mechanical equipment bases/pads. Perform concrete work in accordance with requirements specified in Division 03. Coordinate work with Division 03.
- B. Concrete is to be minimum 20,700 kPa ready-mix concrete in accordance with CAN/CSA-A23.1 and the Building Code.

3.22 DELETED

3.23 EXCAVATION AND BACKFILL WORK

- A. Before commencement of excavation for work, determine in consultation with Consultant, Owner, Municipality and utilities, presence, if any, of existing underground services at site. Engage local utilities to locate and mark out such services. Ensure trades concerned are aware of their presence.
- B. Be responsible for any damage done to underground services caused by neglect to determine and mark out location of such services prior to excavation work commences.
- C. Where Work falls under jurisdiction of local governing utility, confirm requirements and comply with utility requirements.
- D. Provide excavation, backfill and related work required for mechanical work. Perform such work in accordance with requirements of Division 31, except as modified by this Article. Obtain a copy of soil test report if available from Consultant. Depth of excavations must accommodate local governing requirements and local standard practices to compensate for local frost levels of Place of the Work.
- E. Confirm inverts and locations are correct, prior to commencing excavation and contact Utilities to accurately locate their services. Where discrepancies are found, immediately inform Consultant, and await a direction. Grade bottom of trench excavations as required.
- F. In firm, undisturbed soil, lay pipes directly on soil, unless otherwise directed.
- G. Before backfilling, arrange for inspection of work by local governing authority and Consultant. Do not backfill work unless reviewed with Consultant. Failure to do so prior to backfilling will require re-excavating work and re-backfill at no additional cost to Owner.
- H. Unless otherwise specified, backfill trenches within building with clean sharp sand in individual layers of maximum 150 mm (6") thickness compacted to a density of 100% Standard Proctor. Hand compact first layers up to a compacted level of minimum 300 mm (12") above top of pipe. Hand or machine compact the balance up to grade.
- I. Unless otherwise specified, backfill trenches outside the building (not under roads, parking lots or traffic areas), up to a compacted level of 450 mm (18") thick above the pipe, hand compacted to a density of 95% Standard Proctor, using granular "A" gravel. Backfill the balance in 150 mm (6") layers with approved excavated material, compacted to 95% Standard Proctor density.
- J. Unless otherwise specified, backfill trenches outside building under roads, parking lots or traffic areas with crushed stone or granular "A" gravel in layers not exceeding 150 mm (6") thickness, compacted to 100% Standard Proctor density up to grade level.
- K. Provide minimum 1.37 m (4.5') of cover for underground piping subject to freezing and located outside building.
- L. Provide minimum 450 mm (18") of cover for underground piping subject to freezing and located inside building.
- M. After first lift of backfill has been compacted, mark entire path of pipe using continuous 75 mm (3") wide detectable identified marking tape equal to SMS Ltd. D-UGMT.
- N. Unless otherwise directed in Division 31, store and dispose of excavated materials as follows:
 - 1. during progress of contract, place material as directed in such a manner to minimize damage or disfigurement of ground and which in no way impedes progress of work;
 - 2. separately place surplus topsoil and subsoil as directed; leave site clean and unencumbered.
- O. Perform pumping as required to keep excavations free of water.

3.24 CUTTING, PATCHING AND CORE DRILLING

- A. Unless otherwise provided by General Trades, perform cutting, patching, and core drilling of existing building required for installation of Mechanical Divisions work. Perform cutting in a neat and true fashion, with proper tools and equipment to Consultant's approval. Patching is to exactly match existing finishes and be performed by tradesmen skilled in particular trade or application. Work is subject to review with Consultant and Owner approval.
- B. Criteria for cutting holes for additional services:
 - 1. cut holes through slabs only; no holes to be cut through beams;
 - 2. cut holes 150 mm (6") diameter or smaller only; obtain approval from Structural Consultant for larger holes;
 - 3. keep at least 100 mm (4") clear from beam faces;
 - 4. space at least 3 hole diameters on center;
 - 5. for holes that are required closer than 25% of slab span from supporting beam face, use cover meter above slab to clear slab top bars;
 - 6. for holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars;
 - 7. submit sleeving drawings indicating holes and their locations for Structural Consultant's review.
- C. Do not cut or drill any existing work without approval from Owner and review with Consultant. Be responsible for damage done to building and services caused by cutting or drilling.
- D. Where pipes pass through existing construction, core drill an opening. Size openings to leave 12 mm (½") clearance around pipes or pipe insulation.
- E. Prior to drilling or cutting an opening, determine, in consultation with Consultant and Owner, and by use of non-destructive radar scan (magnetic scan) of slab or wall, presence of any existing services and reinforcement bars concealed behind building surface to be cut and locate openings to suit. Coring is not permitted through concrete beams or girders.
- F. Where drilling is required in waterproof slabs, size opening to permit snug and tight installation of a pipe sleeve sized to leave 12 mm (½") clearance around pipe or pipe insulation. Provide a pipe sleeve, constructed of Schedule 40 galvanized steel pipe with a flange at one end and of a length to extend 100 mm (4") above slab, in opening. Secure flange to the underside of slab and caulk void between sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water-tight installation.
- G. Firestop and seal openings in fire rated construction in accordance with requirements of article entitled Firestopping and Smoke Seal Materials in this Section. Do not leave openings open overnight unless approved by Owner and reviewed with Consultant.

3.25 PACKING AND SEALING CORE DRILLED PIPE OPENINGS

- A. Pack and seal void between pipe opening and pipe or pipe insulation for length of opening as follows:
 - 1. non-fire rated interior construction – pack with mineral wool and seal both ends of opening with non-hardening silicone base caulking compound to produce a water-tight seal;
 - 2. exterior walls above grade – pack with mineral wool and seal both ends of sleeves water-tight with non-hardening silicone base caulking compound unless mechanical type seals have been specified;
 - 3. exterior walls below grade (and any other wall where water leakage may be a problem) – seal with link type mechanical seals as specified.

3.26 FLASHING FOR MECHANICAL WORK PENETRATING ROOF

- A. Perform required flashing work, including counter-flashing, for mechanical work penetrating and/or set in roof.
- B. Perform flashing work in accordance with requirements of drawing details, and requirements specified in Division 07.

3.27 CLEANING MECHANICAL WORK

- A. Refer to cleaning requirements specified in Division 01.

- B. Clean mechanical work prior to application for Substantial Performance of the Work.
- C. Include for vacuum cleaning interior of air handling units and ductwork systems.

3.28 CONNECTIONS TO OTHER EQUIPMENT

- A. Carefully examine Contract Documents during bidding period and include for mechanical work piping and/or ductwork connections to equipment requiring such connections.

3.29 INSTALLATION OF FLEXIBLE CONNECTORS

- A. Provide flexible connectors in piping connections to vibration isolated equipment.

3.30 FAN NOISE LEVELS

- A. Submit sound power levels with fan shop drawings/product data, with levels measured to AMCA 300 and calculated to AMCA 301.

3.31 EQUIPMENT AND SYSTEM MANUFACTURER'S CERTIFICATION

- A. When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for equipment/system manufacturer's authorized representative to visit site to examine installation, and after any required corrective measures have been made, to certify in writing to Owner and Consultant that equipment/system installation is complete and in accordance with equipment/system manufacturer's instructions.

3.32 EQUIPMENT AND SYSTEM START-UP

- A. When installation of equipment/systems is complete but prior to commissioning, perform start-up for equipment/systems as specified in mechanical work Sections and in accordance with following requirements:
 - 1. submit a copy of each equipment/system manufacturer's start-up report sheet to Consultant for review, and incorporate any comments made by Consultant, Owner or Commissioning Agent, as applicable;
 - 2. under direct on-site supervision and involvement of equipment/system manufacturer's representative, start-up equipment/systems, make any required adjustments, document procedures, leave equipment/systems in proper operating condition, and submit to Consultant complete set of start-up documentation sheets signed by manufacturer/supplier and Contractor;
 - 3. submit documents signed by equipment/system manufacturer testing technician, in both hard copy and pdf electronic copy formats.

3.33 INTEGRATED SYSTEMS TESTING

- A. Perform testing of integrated systems and equipment in accordance with CAN/ULC-S1001.
- B. Engage respective systems or equipment vendors or trades to be onsite during inspection and testing work to perform adjustments or remedial work to correct issues identified by inspection and testing work.

END OF SECTION

SECTION 20 05 25 MECHANICAL INSULATION

PART 1 - GENERAL

1.1 APPLICATION

- A. This Section specifies insulation requirements common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly.

1.2 DEFINITIONS

- A. "concealed" – means mechanical services and equipment above suspended ceilings, in non-accessible chases, in accessible pipe spaces, and furred-in spaces.
- B. "exposed" – means exposed to normal view during normal conditions and operations.
- C. "mineral fibre" – includes glass fibre.
- D. "mineral wool" – includes rock wool and slag wool.
- E. "domestic water" or "potable water" – means piping extended from building Municipal supply main.

1.3 SUBMITTALS

- A. Submit a product data sheet for each insulation system product. Include identification that product has also been tested to CAN/ULC S102.

1.4 QUALITY ASSURANCE

- A. Mechanical insulation is to be applied by a licensed journeyman insulation mechanic, or by an apprentice under direct, daily, on-site supervision of a journeyman mechanic.
- B. Do not apply insulation unless leakage tests have been satisfactorily completed.
- C. Ensure surfaces to be insulated are clean and dry.
- D. Ensure ambient temperature is minimum 13°C (55°F) for at least 1 day prior to application of insulation, and for duration of insulation work, and relative humidity is and will be at a level such that mildew will not form on insulation materials.
- E. Company with sub-contract for mechanical insulation work is to be a member in good standing of Thermal Insulation Association of Canada (TIAC).
- F. Insulation materials must be stored on site in a proper, dry storage area. Any wet insulation material is to be removed from site.

PART 2 - PRODUCTS

2.1 FIRE HAZARD RATINGS

- A. Unless otherwise specified, insulation system materials inside building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.

2.2 THERMAL PERFORMANCE

- A. Unless otherwise specified, thermal performance of insulation is to meet or exceed values given in Tables entitled Minimum Piping Insulation Thickness Heating and Hot Water Systems and Minimum Piping Insulation Thickness Cooling Systems, as stated in ANSI/ASHRAE/IES Standard 90.1 version referenced in Ontario Building Code.

2.3 PIPE INSULATION MATERIALS

- A. Horizontal Pipe Insulation at Hangers and Supports
 - 1. Equal to Belform Insulation Ltd. "Koolphen K-Block" insulated pipe support inserts consisting of minimum 150 mm (6") long, pre-moulded, rigid, sectional phenolic foam insulation (of same thickness as adjoining insulation) with a reinforced foil and kraft paper vapour barrier jacket and a captive galvanized steel saddle.
- B. Flexible Foam Elastomeric
 - 1. Closed cell, sleeve type, longitudinally split self-seal, foamed plastic pipe insulation with a water vapour transmission rating of 0.10 in accordance with ASTM E96, Procedure B, and required installation accessories.
 - 2. Acceptable products are:
 - a. Armacell AP/Armaflex;
 - b. IK Insulation Group K-Flex "LS" Self-Seal Pipe Insulation.
- C. Closed Cell Foamed Glass
 - 1. Pittsburgh Corning "FOAMGLAS", expanded, sectional, rigid sleeve type insulation with a liquid or vapour permeability rating (in accordance with ASTM C240) of 0.00, and a factory applied "PITWRAP SSII" self-sealing jacket.
- D. Pre-Moulded Mineral Wool
 - 1. Rigid, sectional, sleeve type, fire-rated, non-combustible, longitudinally split mineral wool or basalt pipe insulation with a reinforced vapour barrier jacket, and compatible with ULC S115 and ULC S101 firestopping.
 - 2. Acceptable products are:
 - a. Roxul "Techton 1200";
 - b. IIG (Johns Manville Inc.) MinWool-1200.
- E. Pre-Moulded Calcium Silicate
 - 1. Non-combustible, high-temperature insulation to ASTM C553 with maximum flame spread/smoke developed rating of 25/50 in accordance with ULC S102.
 - 2. Acceptable products are:
 - a. Johns Manville Inc. "Thermo-12 Gold";
 - b. Industrial Insulation Group "Thermo-12 Gold".
- F. Pre-Moulded Mineral Fibre
 - 1. Rigid, sectional, sleeve type insulation to ASTM C547, with a factory applied vapour barrier jacket.
 - 2. Acceptable products are:
 - a. Johns Manville Inc. "Micro-Lok AP-T Plus";
 - b. Knauf Fiber Glass "Pipe Insulation" with "ASJ-SSL" jacket;
 - c. Manson Insulation Inc. "ALLEY K APT";
 - d. Owens Corning "Fiberglas" Pipe Insulation.
- G. Blanket Mineral Fibre
 - 1. Blanket type roll insulation to ASTM C553, 24 kg/m³ (1-½ lb/ft³) density, with a factory applied vapour barrier facing.
 - 2. Acceptable products are:
 - a. Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - b. Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - c. Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - d. Certainteed Corporation Softtouch FSK Duct Wrap Type 150.
- H. Pre-Moulded Weatherproof Jacketed Mineral Fibre
 - 1. Knauf Insulation "Redi-Klad 1000" sectional, sleeve type pipe insulation with a self-sealing weatherproof jacket and a 100 mm (4") butt joint sealing strip with each section.

2.4 BARRIER-FREE LAVATORY PIPING INSULATION KITS

- A. Removable, flexible, reusable, white moulded plastic insulation kits for barrier-free lavatory drain piping and potable water supplies exposed under lavatory.
- B. Acceptable products are:
 - 1. Truebo "Lav-Guard 2" E-Z Series;
 - 2. Zeston "SNAP-TRAP";
 - 3. McGuire Manufacturing Co. Inc. "ProWrap".

2.5 EQUIPMENT INSULATION MATERIALS

- A. Blanket Mineral Fibre
 - 1. Blanket type roll form insulation to ASTM C553, 24 kg/m³ (1-½ lb/ft³) density, with a factory applied vapour barrier facing.
 - 2. Acceptable products are:
 - a. Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - b. Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - c. Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - d. Certainteed Corporation Softtouch FSK Duct Wrap Type 150.
- B. Semi-Rigid Mineral Fibre Board
 - 1. Roll form, moulded insulation to ASTM C1393, with a factory applied vapour barrier facing consisting of laminated aluminium foil and kraft paper.
 - 2. Acceptable products are:
 - a. Knauf Fiber Glass Pipe and Tank Insulation;
 - b. Manson Insulation Inc. "AK FLEX";
 - c. Johns Manville Inc. Pipe and Tank Insulation "Micro-Flex";
 - d. Multi-Glass Insulation Ltd. "MULTI-FLEX MF";
 - e. Owens Corning Pipe and Tank Insulation.
- C. Semi-Rigid Mineral Wool Blanket
 - 1. Equal to Roxul "Enerwrap MA 960" flexible, black fibrous scrim faced mineral wool blanket insulation to ASTM C553.
- D. Closed Cell Foamed Glass
 - 1. Pittsburgh Corning "FOAMGLAS" expanded, rigid board and block type insulation with a liquid or vapour permeability rating (in accordance with ASTM C240) of 0.00.

2.6 REMOVABLE/REUSABLE INSULATION COVERS

- A. Covers for equipment 12 mm (½") to less than 150 mm (6"):
 - 1. Valve, etc. covers are to be NO SWEAT reusable insulation wraps with vapour barrier jacket and self-sealing ends and longitudinal seam, with a length to suit application and an insulation thickness equal to adjoining insulation.
- B. Covers for equipment greater than or equal to 150 mm (6"):
 - 1. Custom manufactured equipment covers conforming to shape of item to be insulated, designed to be easily removable and replaceable to suit use and maintenance procedures of particular item, and to provide adequate personnel protection. Covers are to be complete with minimum 95 kg/m³ (6 lb/ft³) density ceramic fibre insulation sewn between minimum 542.5 g/m² (1.8 oz/ft²) weight silicone impregnated fibreglass fabric in a quilted pattern using double stitches made with Kelvar or Teflon coated fibreglass thread. Overlap flaps are to be secured using laces, snaps, or Velcro double stitched in place.
 - 2. Acceptable manufacturers are:
 - a. Crossby Dewar Inc.;
 - b. Insufab Systems Inc.;
 - c. ADL Insulflex Inc.;
 - d. Firwin Corp.;
 - e. GlassCell Isofab Inc.

2.7 DUCTWORK SYSTEM INSULATION MATERIALS

- A. Rigid Mineral Fibre Board
 - 1. Pre-formed board type insulation to ASTM C612, 48 kg/m³ (3 lb/ft³) density, with a factory applied reinforced aluminum foil and kraft paper facing.
 - 2. Acceptable products are:
 - a. Knauf Fiber Glass Insulation Board with FSK facing;
 - b. Manson Insulation Inc. "AK BOARD FSK";
 - c. Johns Manville Inc. Type 814 "Spin-Glas";
 - d. Owens Corning 703.
- B. Blanket Mineral Fibre
 - 1. Blanket type roll form insulation to ASTM C553, 24 kg/m³ (1-½ lb/ft³) density, 40 mm (1-½") thick, with a factory applied vapour barrier facing.
 - 2. Acceptable products are:
 - a. Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - b. Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - c. Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - d. Certainteed Corporation Softtouch FSK Duct Wrap Type 150.
- C. Flexible Foam Elastomeric
 - 1. Sheet form, CFC free, closed cell, self-adhering elastomeric nitrile rubber insulation with a water vapour permeability rating of 0.08 in accordance with ASTM E96 Procedure A.
 - 2. Acceptable products are:
 - a. Armacell "AP Armaflex";
 - b. IK Insulation Group "K-Flex Duct Wrap", S2S.

2.8 FIRE RATED DUCT WRAP

- A. Flexible, non-combustible, blanket type mineral fibre duct wrap completely encapsulated in reinforced foil, and suitable for installation with zero clearance to combustibles (for grease ducts), and ULC tested and listed (to category HNKNC) to facilitate a 2 hour fire resistance rating (76 mm [3"] thick) or a 1 hour fire resistance rating (38 mm [1-½"] thick) in accordance with local governing authority.
- B. Submit FRD design number documentation with shop drawing.
- C. Acceptable manufacturers are:
 - 1. 3M Fire Barrier Duct Wrap 615;
 - 2. CL4 Inc. "CL4Fire";
 - 3. Unifrax Corp. "FyreWrap Elite 1.5";
 - 4. Morgan Thermal Ceramics "FireMaster FastWrap XL".

2.9 INSULATING COATINGS

- A. Equal to Robson Thermal Manufacturing Ltd. insulating coatings as follows:
 - 1. anti-condensation coating, "No Sweat-FX";
 - 2. thermal insulating coating, "ThermaLite".

2.10 INSULATION FASTENINGS

- A. Wire
 - 1. Minimum #15 gauge galvanized annealed wire.
- B. Stainless Steel Banding
 - 1. Equal to ITW Insulation Systems Canada "FABSTAPS" 0.6 mm (1/16") thick, minimum 12 mm (½") wide type 304 stainless steel strapping.
- C. Duct Insulation Fasteners
 - 1. Weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm (1-½") square plastic or zinc plated steel self-locking washers.
- D. Tape Sealant

1. Equal to 3M 1520-CW self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match surface being sealed.
- E. Mineral Fibre Insulation Adhesive
 1. Clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with type of material to be secured, and WHMIS classified as non-hazardous.
- F. Flexible Elastomeric Insulation Adhesive
 1. Armacell "Armaflex" #520 air-drying contact adhesive.
- G. Screws
 1. No. 10 stainless steel sheet metal screws.

2.11 INSULATION JACKETS AND FINISHES

- A. Canvas Jacket Material
 1. ULC listed and labelled, 25/50 fire/smoke rated, roll form, minimum 170 g (6 oz.).
- B. Flexible Insulation Jacketing
 1. Equal to 3M VentureClad 1577CW Series, flexible, laminated, self-adhering, protective jacketing, vapour barrier with 0.00 permeability rating and weatherproofing membrane, having a high performance acrylic adhesive capable of installation with no additional mechanical attachment and with a maximum flame spread/smoke developed rating of 25/50 when tested in accordance with ULC S102. Review finish colour requirements with Consultant before ordering.
- C. Roll Form Sheet and Fitting Covers
 1. Minimum 15 mm (½") thick white PVC, maximum 25/50 fire/smoke rated tested in accordance with ULC S102, complete with installation and sealing accessories. Acceptable products are:
 - a. Johns Manville Inc. "Zeston" 300;
 - b. Proto Corp. "LoSMOKE".
- D. Rigid Aluminium Jacket
 1. Equal to ITW Insulation Systems Canada "Lock-on" 0.406 mm (0.016") thick embossed aluminium jacket material to ASTM B209, factory cut to size and complete with polysurlyn moisture barrier and continuous modified Pittsburgh Z-Lock, butt straps with "Fabstraps" to weatherproof the end to end joints, and 2-piece epoxy coated pressed aluminium fittings with weather locking edges.
- E. Stainless Steel Jacket
 1. Equal to ITW Insulation Systems Canada "Lock-on" 0.254 mm (0.010") thick type 304 embossed stainless steel jacket material to ASTM A240, factory cut to size and complete with moisture barrier and continuous modified Pittsburgh Z-Lock, butt straps with "Fabstraps" to cover end to end joints, and 2-piece pressed stainless steel fittings with weather locking edges.
- F. Adhesive-Backed Flexible Aluminium
 1. MFM Building Products Corp. "Flex-Clad 400" roll form sheet material with an aggressive rubberized asphalt adhesive backing, high density polyethylene reinforcement, and an embossed aluminium facing.
- G. Thermal Insulating and Finishing Cement
 1. Heat resistant, trowel consistency thermal insulating and finishing cement to CAN/CGSB 51.12, and suitable for the application.
- H. Coating for Foamed Glass Insulation
 1. Foamed glass insulation protective coating is to be Pittsburgh Corning "PITTCOTE 404" flexible acrylic latex weather barrier coating, white unless otherwise specified.
- I. Coating for Flexible Foam Elastomeric Insulation
 1. Flexible foam elastomeric insulation protective coating equal to Armacell "WB Armaflex" weatherproof, water-based latex enamel finish.

PART 3 - EXECUTION

3.1 GENERAL INSULATION APPLICATION REQUIREMENTS

- A. Unless otherwise specified, do not insulate following:
 - 1. factory insulated equipment and piping;
 - 2. heating piping within radiation unit enclosures, including blank filler sections of enclosures;
 - 3. heating piping in soffits and/or overhang spaces and connected to bare element radiation in spaces;
 - 4. branch potable water piping located under counters to serve counter mounted plumbing fixtures and fittings, except barrier-free lavatories;
 - 5. exposed chrome plated potable water angle supplies from concealed piping to plumbing fixtures and fittings, except barrier-free lavatories;
 - 6. heated liquid system pump casings, valves, strainers and similar accessories;
 - 7. heating system expansion tanks;
 - 8. fire protection pump casings;
 - 9. manufactured expansion joints and flexible connections;
 - 10. acoustically lined ductwork and/or equipment;
 - 11. factory insulated flexible branch ductwork;
 - 12. fire protection system water storage tanks;
 - 13. piping unions, except for unions in "cold" category piping.
- B. Install work generally in accordance with TIAC National Insulation Standards Manual except conform to manufacturer's instructions and recommendations, and requirements specified in this Section.
- C. Install insulation directly over pipes and ducts, not over hangers and supports.
- D. Install piping insulation and jacket continuous through pipe openings and sleeves.
- E. Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.
- F. For insulation thicknesses greater than or equal to 75 mm (3"), provide double layer of insulation to achieve required insulation thickness and stagger joint locations.
- G. When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect insulation jacketing from condensation at its junction with metal.
- H. When insulating vertical piping risers 75 mm (3") diameter and larger, use insulation support rings welded directly above lowest pipe fitting, and thereafter at 4.5 m (14.7') centres and at each valve and flange. Insulate in accordance with Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.
- I. Where mineral fibre rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover exposed end of insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping.
- J. Carefully and neatly gouge out insulation for proper fit where there is interference between weld bead, mechanical joints, etc., and insulation. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.
- K. Where thermometers, gauges, and similar instruments occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required, create a neat, properly sized hole in insulation and provide a suitable grommet in the opening.

3.2 INSULATION FOR HORIZONTAL PIPE AT HANGERS AND SUPPORTS

- A. At each hanger and support location for piping 50 mm (2") diameter and larger to be insulated, except where roller hangers and/or supports are required, and unless otherwise specified, supply a factory fabricated section of phenolic foam pipe insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply insulation sections to piping installers for installation as pipe is erected.

3.3 PIPE INSULATION REQUIREMENTS – MINERAL FIBRE

- A. Insulate following pipe inside building and above ground with mineral fibre insulation of thickness indicated:
1. domestic cold water piping, less than 100 mm (4") dia. – 25 mm (1") thick;
 2. domestic cold water piping, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;
 3. domestic hot water piping, less than 40 mm (1-½") dia. – 25 mm (1") thick;
 4. domestic hot water piping, greater than or equal to 40 mm (1-½") dia. – 40 mm (1-½") thick;
 5. tempered domestic water piping, supply and return, less than 40 mm (1-½") dia. – 25 mm (1") thick;
 6. tempered domestic water piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
 7. storm drainage piping from roof drains to the point where main vertical risers extend straight down, without offsets, and connect to horizontal underground mains – 25 mm (1") thick;
 8. condensate drainage piping from fan coil unit or any other air conditioning system/unit drain pans to main vertical drain risers or to indirect drainage point – 25 mm (1") thick;
 9. drainage piping from refrigerated drinking fountains to nearest 75 mm (3") dia. or larger drain pipe – 25 mm (1") thick;
 10. chilled water piping, supply and return, less than 100 mm (4") dia. – 25 mm (1") thick;
 11. chilled water piping, supply and return, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;
 12. chilled glycol solution piping, supply and return, less than 100 mm (4") dia. – 25 mm (1") thick;
 13. chilled glycol solution piping, supply and return, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;
 14. hot water heating piping, supply and return, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;
 15. hot water heating piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
 16. glycol solution heating or heat reclaim piping, supply and return, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;
 17. glycol solution heating or heat reclaim piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
 18. drum drip(s) in dry zone standpipe and/or sprinkler system piping – 50 mm (2") thick;
 19. refrigerant suction piping (between compressor and evaporator coil) inside building – 25 mm (1") thick;
 20. refrigerant hot gas piping (between compressor and condenser) inside building – 25 mm (1") thick;
 21. refrigerant hot gas by-pass piping (between compressor discharge and evaporator coil) inside building – 25 mm (1") thick;
 22. piping indicated to be traced with electric heating cable – minimum 50 mm (2") thick;
 23. low pressure (to 140 kPa [20 psi]) steam piping, less than 100 mm (4") dia. – 65 mm (2-½") thick;
- B. Secure overlap flap of sectional insulation jacket tightly in place. Cover section to section butt joints with tape sealant.
- C. Insulate fittings with sectional pipe insulation mitred to fit tightly, and cover butt joints with tape sealant, or, alternatively, wrap fittings with blanket mineral fibre insulation to a thickness and insulating value equal to sectional insulation, secure in place with adhesive and/or wire, and cover with PVC fitting covers.
- D. Unless otherwise specified, insulate unions, valves, strainers, and similar piping system accessories in "cold" piping with cut and tightly fitted segments of sectional pipe insulation with joints covered with tape sealant, or, alternatively, wrap piping union, valve, strainer, etc., with blanket mineral fibre and cover with PVC covers as for paragraph above.
- E. Terminate sectional insulation approximately 50 mm (2") from flange or coupling on each side of flange or coupling. Cover flange or coupling with a minimum 50 mm (2") thickness of blanket mineral fibre insulation wide enough to butt tightly to ends of adjacent sectional insulation. Secure blanket insulation in place and cover with a purpose made PVC coupling cover.
- F. Drum drips in dry zone sprinkler and/or standpipe system piping will be traced with electric heating cable as part of electrical work, and are generally not shown on drawing(s). Confirm number and size of drum drips

required with trade providing piping and include for insulation to suit. Wherever possible locate drum drips in heated areas.

- G. Take special care at concealed water rough-in piping at plumbing fixtures to ensure piping is properly insulated. If necessary due to space limitations, use 12 mm (½") thick sectional pipe insulation in lieu of 25 mm (1") thick insulation.

3.4 PIPE INSULATION REQUIREMENTS – FLEXIBLE FOAM ELASTOMERIC

- A. Install flexible elastomeric pipe insulation in strict accordance with manufacturer's instructions to suit application, and using adhesive, joint sealants and finish to produce a water-tight installation. Insulate following pipe with flexible elastomeric pipe insulation of thickness indicated:
1. refrigerant suction and hot gas piping outside building – 25 mm (1") thick.

3.5 PIPE INSULATION REQUIREMENTS – FIRE-RATED INSULATION

- A. Where pipe (inside building and above ground) which is to be insulated penetrates fire rated construction, provide fire-rated, non-combustible sectional insulation on portion of pipe in fire barrier and for a distance of 50 mm (2") on either side of fire barrier. Insulation thickness is to be as specified, but in any case minimum 25 mm (1").

3.6 EQUIPMENT INSULATION REQUIREMENTS – BLANKET TYPE MINERAL FIBRE

- A. Insulate following equipment with mineral fibre blanket type insulation of thickness indicated:
1. chilled water and/or domestic cold-water pump casings – 40 mm (1-½") thick;
 2. roof drain sumps where inside the building – 25 mm (1") thick;
 3. water meter(s) – 40 mm (1-½") thick;
 4. top of radiant ceiling panels – 50 mm (2") thick.
- B. Unless otherwise noted, wrap equipment to a thickness and insulating value equal to an equivalent thickness of rigid sectional pipe insulation. Laminate insulation in place with a full coverage of adhesive and secure with wire. Apply a jacket of insulation vapour barrier material secured in place with adhesive or sealant tape.
- C. Cover roof drain sumps with purpose made PVC fitting covers.
- D. Lay fibreglass blanket on radiant ceiling panels after testing is complete.

3.7 EQUIPMENT INSULATION REQUIREMENTS – SEMI-RIGID MINERAL FIBRE

- A. Insulate following equipment with semi-rigid mineral fibre board insulation of thickness indicated:
1. uninsulated refrigeration machine and suction elbow(s) – 50 mm (2") thick;
 2. uninsulated domestic hot water storage tank(s) – 40 mm (1-½") thick;
 3. shell and tube type heat exchangers – 40 mm (1-½") thick;
 4. condensate receiver(s) – 40 mm (1-½") thick;
 5. flash tanks – 40 mm (1-½") thick;
 6. hot well tank – 40 mm (1-½") thick;
 7. deaerating feedwater heater – 40 mm (1-½") thick;
 8. blow-down tank – 40 mm (1-½") thick;
 9. chilled water or chilled glycol solution storage tank – 50 mm (2") thick;
 10. heating main air separator – 40 mm (1-½") thick;
 11. chilled water expansion tank – 40 mm (1-½") thick.
- B. Install insulation as required to fit shape and contour of equipment. Secure insulation in place with adhesive, and with aluminium straps on 450 mm (18") centres. Apply a 6 mm (¼") thick skim coat of insulating cement, then, when insulating cement has dried, apply a 6 mm (¼") thick coat of cement trowelled smooth.
- C. Provide removable and replaceable insulated metal covers for equipment with removable heads to permit heads to be removed and replaced without damaging adjacent insulation work.

3.8 DUCTWORK INSULATION REQUIREMENTS – MINERAL FIBRE

- A. Insulate following ductwork systems inside building and above ground with mineral fibre insulation of thickness indicated:
1. outside air intake ductwork, casings and plenums from fresh air intakes to and including mixing plenums or sections, or, if mixing plenums or sections are not provided, to first heating coil, or if both mixing plenums or sections and heating coil sections are not provided, and fresh air is not tempered, then the fresh air ductwork system complete – minimum 40 mm (1-½") thick as required;
 2. mixed supply air or preheated supply air casings, plenums and sections to and including the fan section where not factory insulated – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;
 3. supply air ductwork outward from fans, except for supply ductwork exposed in area it serves – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;
 4. exhaust discharge ductwork for a distance of 3 m (10') downstream (back) from exhaust openings to atmosphere, including any exhaust plenums within the 3 m (10') distance – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;
 5. any other ductwork, casings, plenums or sections specified or detailed on drawings to be insulated – thickness as specified.
- B. Provide rigid board type insulation for casings, plenums, and exposed rectangular ductwork. Provide blanket type insulation for concealed round, oval or rectangular ductwork. Provide semi-rigid mineral fibre board type insulation for exposed round or oval ducts.
- C. Liberally apply adhesive to surfaces of exposed rectangular ducts and/or casings. Accurately and neatly press insulation into adhesive with tightly fitted butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom and side surfaces. Secure and seal joints with 75 mm (3") wide tape sealant. Additional installation requirements as follows:
1. at trapeze hanger locations, install insulation between duct and hanger;
 2. provide drywall type metal corner beads on edges of ductwork, casings and plenums in equipment rooms, service corridors, and any other area where insulation is subject to accidental damage, and secure in place with tape sealant.
- D. Liberally apply adhesive to surfaces of concealed rectangular or oval ductwork, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom surfaces. Secure and seal joints with 75 mm (3") tape sealant. At each trapeze type duct hanger, provide a 100 mm (4") wide full length piece of rigid mineral fibre board insulation between duct and hanger.
- E. Accurately cut sections of insulation to fit tightly and completely around exposed and concealed round or oval ductwork. Liberally apply adhesive to surfaces of duct, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Seal joints with tape sealant. At duct hanger locations install insulation between duct and hanger. At each hanger location for concealed ductwork where flexible blanket type insulation is used, provide a 100 mm (4") wide full circumference strip of semi-rigid board type duct insulation between duct and hanger.
- F. Insulation application requirements common to all types of rigid ductwork are as follows:
1. at duct connection flanges, insulate flanges with neatly cut strips of rigid insulation material secured with adhesive to side surfaces of flange with a top strip to cover exposed edges of the side strips, then butt the flat surface duct insulation up tight to flange insulation, or, alternatively, increase insulation thickness to depth of flange and cover top of flanges with tape sealant;
 2. installation of fastener pins and washers is to be concurrent with duct insulation application;
 3. cut insulation fastener pins almost flush to washer and cover with neatly cut pieces of tape sealant;
 4. accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers;
 5. prior to concealment of insulation by either construction finishes or canvas jacket material, patch vapour barrier damage by means of tape sealant.

3.9 DUCTWORK INSULATION REQUIREMENTS – FLEXIBLE ELASTOMERIC

- A. Insulate exposed exterior ductwork (except fresh air intake ductwork) and associated plenums and/or casings outside building with minimum 50 mm (2") thick flexible elastomeric sheet insulation as required, applied in two minimum 25 mm (1") thick layers with staggered tightly butted joints.
- B. Install with adhesive in strict accordance with manufacturer's instructions to produce a weather-proof installation. Ensure sheet metal work joints are sealed watertight prior to applying insulation.

3.10 INSTALLATION OF FIRE RATED DUCT WRAP

Provide blanket type fire rated duct wrap system material for following ductwork to produce fire rating indicated:

- 1. kitchen exhaust ductwork from exhaust hood to roof penetration – 2 hour rating in accordance with NFPA 96;

3.11 INSULATION FINISH REQUIREMENTS

- A. Flexible Insulation Jacketing
 - 1. Flexible insulation jacketing is to be considered equivalent to canvas and lagging, PVC, and rigid metal jacketing, and may be provided in lieu of aforementioned materials/products. Submit list with shop drawing submittal indicating which services are to be provided with flexible insulation jacketing. For services inside building, ensure product utilized has been tested to CAN/ULC S102 and meets local governing flame spread/smoke developed requirements.
 - 2. Confirm finish/colour with Consultant before ordering.
 - 3. Install in accordance with manufacturer's instructions and recommendations.
- B. Rigid Aluminium Jacket
 - 1. Install rigid aluminium jacket material tightly in place with overlapped circumferential joints positioned to shed water and covered with butt straps supplied with jacket.
 - a. All exterior piping and ductwork shall be covered with rigid aluminium jacket.

END OF SECTION

PART 1 - GENERAL

1.1 APPLICATION

- A. This Section specifies mechanical system testing, adjusting, and balancing requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.2 DEFINITIONS

- A. “Agency” – means agency to perform testing, adjusting and balancing work.
- B. “TAB” – means testing, adjusting and balancing to determine and confirm quantitative performance of equipment and systems and to regulate specified fluid flow rate and air patterns at terminal equipment, e.g., reduce fan speed, throttling, etc.
- C. “hydronic systems” – includes heating water, chilled water, glycol-water solution, condenser water, and any similar system.
- D. “air systems” – includes outside air, supply air, return air, exhaust air, and relief air systems.
- E. “flow rate tolerance” – means allowable percentage variation, minus to plus, of actual flow rate values in Contract Documents.
- F. “report forms” – means test data sheets arranged for collecting test data in logical order for submission and review, and these forms, when reviewed and accepted, should also form permanent record to be used as basis for required future testing, adjusting and balancing.
- G. “terminal” – means point where controlled fluid enters or leaves the distribution system, and these are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- H. “main” – means duct or pipe containing system’s major or entire fluid flow.
- I. “submain” – means duct or pipe containing part of the systems’ capacity and serving 2 or more branch mains.
- J. “branch main” – means duct or pipe servicing 2 or more terminals.
- K. “branch” – means duct or pipe serving a single terminal.

1.3 SUBMITTALS

- A. Within 30 days of work commencing at site, submit name and qualifications of proposed testing and balancing agency in accordance with requirements of article entitled Quality Assurance below.
- B. Submit sample test forms, if other than those standard forms prepared by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB), are proposed for use.
- C. Submit a report by Agency to indicate Agency’s evaluation of mechanical drawings with respect to service routing and location or lack of balancing devices. Include set of drawings used and marked-up by Agency to prepare report.
- D. Submit a report by Agency after each site visit made by Agency during construction phase of this Project.
- E. Submit a draft report, as specified in Part 3 of this Section.
- F. Submit a final report, as specified in Part 3 of this Section.
- G. Submit a testing and balancing warranty as specified in Part 3 of this Section.
- H. Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

1.4 QUALITY ASSURANCE

- A. Employ services of an independent testing, adjusting, and balancing agency meeting qualifications specified below, to be single source of responsibility to test, adjust, and balance building mechanical systems to produce design objectives. Agency is to have successfully completed testing, adjusting and balancing of mechanical systems for a minimum of 5 projects similar to this Project within past 3 years, and is to be certified as an independent agency in required categories by one of following:
 - 1. AABC - Associated Air Balance Council;
 - 2. NEBB - National Environmental Balancing Bureau.
- B. Testing, adjusting and balancing of complete mechanical systems is to be performed over entire operating range of each system in accordance with 1 of following publications:
 - 1. National Standards for a Total System Balance published by Associated Air Balance Council;
 - 2. Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by National Environmental Balancing Bureau;
 - 3. Chapter 37, Testing, Adjusting, and Balancing of ASHRAE Handbook HVAC Applications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCOPE OF WORK

- A. Perform total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of fluid quantities of mechanical systems as required to meet design specifications and comfort conditions, and recording and reporting results.
- B. Mechanical systems to be tested, adjusted and balanced include:
 - 1. TAB of domestic water systems (all piping extended from Municipal main) is to include:
 - a. domestic hot water recirculation piping;
 - b. tempered water piping flows.
 - 2. TAB of swimming pool systems is to include all pool piping water flows.
 - 3. TAB of laboratory systems is to include flows through piping, fittings including bench work fittings, and associated equipment including special ventilation systems.
 - 4. TAB of medical gas systems is not part of TAB work and is specified in Section entitled Medical Gas Piping Systems.
 - 5. TAB of fuel oil system is to include supply and return oil flows as applicable, and is to be in accordance with requirements of CAN/CSA B139.
 - 6. TAB of heating systems is to include piping and equipment fluid temperatures, flows and control, and if TAB is not done during heating season, a follow-up site visit during heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
 - 7. TAB of cooling systems is also to include piping and equipment fluid temperatures, flows and control, and if TAB is not done during cooling season, a follow-up site visit during cooling season will be required to confirm proper flows and temperatures, and any required system "fine".
 - 8. TAB of air handling systems is to include equipment and ductwork air temperatures, capacities and flows.

3.2 TESTING, ADJUSTING AND BALANCING

- A. Conform to following requirements:
 - 1. as soon as possible after award of Contract, Agency is to carefully examine a white print set of mechanical drawings with respect to routing of services and location of balancing devices, and is to issue a report listing results of the evaluation;
 - 2. set of drawings examined by Agency is to be returned with evaluation report, with red line mark-ups to indicate locations for duct system test plugs, and required revision work such as relocation of balancing devices and locations for additional devices;

3. after review of mechanical work drawings and specification, Agency is to visit site at frequent, regular intervals during construction of mechanical systems, to observe routing of services, locations of testing and balancing devices, workmanship, and anything else that will affect testing, adjusting and balancing;
 4. after each site visit, Agency is to report results of site visit indicating date and time of visit, and detailed recommendations for any corrective work required to ensure proper adjusting and balancing;
 5. testing, adjusting and balancing is not to begin until:
 - a. building construction work is substantially complete and doors have been installed;
 - b. mechanical systems are complete in all respects, and have been checked, started, adjusted, and then successfully performance tested.
 6. mechanical systems to be tested, adjusted and balanced are to be maintained in full, normal operation during each day of testing, adjusting and balancing;
 7. obtain copies of reviewed shop drawings of applicable mechanical plant equipment and terminals, and temperature control diagrams and sequences;
 8. Agency is to walk each system from system "head end" equipment to terminal units to determine variations of installation from design, and system installation trades will accompany Agency;
 9. Agency is to check valves and dampers for correct and locked position, and temperature control systems for completeness of installation before starting equipment;
 10. wherever possible, Agency is to lock balancing devices in place at proper setting, and permanently mark settings on devices;
 11. for belt-driven equipment, Agency is to report to Commissioning Agent who in turn is to inform Contractor and Consultant of any situation where sheaves have to be replaced to suit testing and balancing, and replacements are to be done by Contractor at no cost;
 12. Agency is to leak test ductwork as specified in Section entitled HVAC Air Distribution in accordance with requirements of SMACNA "HVAC Air Duct Leak Test Manual", coordinate work with work of aforementioned Sections, provide detailed sketch(es) to Sheet Metal Contractor and Consultant identifying ductwork not in accordance with acceptable leakage values specified in aforementioned Sections, and retest corrected ductwork;
 13. Agency is to balance systems with due regard to objectionable noise which is to be a factor when adjusting fan speeds and performing terminal work such as adjusting air quantities, and should objectionable noise occur at design conditions, Agency is to immediately report problem and submit data, including sound readings, to permit an accurate assessment of noise problem to be made;
 14. Agency is to check supply air handling system mixing plenums for stratification, and where variation of mixed air temperature across coils is found to be in excess of $\pm 5\%$ of design requirements, Agency is to report problem and issue a detail sketch of plenum baffle(s) required to eliminate stratification;
 15. Agency is to perform testing, adjusting and balancing to within $\pm 5\%$ of design values, and make and record measurements which are within $\pm 2\%$ of actual values;
 16. for air handling systems equipped with air filters, test and balance systems with simulated 50% loaded (dirty) filters by providing a false pressure drop;
 17. test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 2.8°C (5°F) wet bulb temperature of maximum summer design condition, and within 5.5°C (10°C) dry bulb temperature of minimum winter design condition, and take final temperature readings during seasonal operation.
- B. Prepare reports as indicated below.
1. Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on AABC or NEBB forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in same manner specified for final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
 2. Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports. Use units of measurement (SI or Imperial) as used on Project Documents.
 3. Report forms are to be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, 3-ring binders. Provide binding edge labels

with project identification and a title descriptive of contents. Divide contents of binder into divisions listed below, separated by divider tabs:

- a. General Information and Summary;
- b. Air Systems;
- c. Hydronic Systems;
- d. Temperature Control Systems;
- e. Special Systems;
- f. Domestic Hot Water Systems.

4. Agency is to provide following minimum information, forms and data in report:

- a. inside cover sheet to identify Agency, Contractor, and Project, including addresses, and contact names and telephone numbers and a listing of instrumentation used for procedures along with proof of calibration;
 - b. remainder of report is to contain appropriate forms containing as a minimum, information indicated on standard AABC or NEBB report forms prepared for each respective item and system;
 - c. Agency is to include for each system to be tested, adjusted and balanced, a neatly drawn, identified (system designation, plant equipment location, and area served) schematic "as-built" diagram indicating and identifying equipment, terminals, and accessories;
 - d. Agency is to include report sheets indicating building comfort test readings for all rooms.
- C. After final testing and balancing report has been submitted, Agency is to visit site with Contractor and Consultant to spot check results indicated on balancing report. Agency is to supply labour, ladders, and instruments to complete spot checks. If results of spot checks do not, on a consistent basis, agree with final report, spot check procedures will stop and Agency is to then rebalance systems involved, resubmit final report, and again perform spot checks with Contractor and Consultant.
- D. When final report has been accepted, Contractor is to submit to Owner, in name of Owner, a certificate equal to AABC National Guaranty Certification or a NEBB Quality Assurance Program Bond, and in addition, Contractor is to submit a written extended warranty from Agency covering one full heating season and one full cooling season, during which time any balancing problems which occur, with exception of minor revision work done during scheduled site visits, will, at no cost, be investigated by Agency and reported on to Owner, and if it is determined that problems are a result of improper testing, adjusting and balancing, they are to be immediately corrected without additional cost to Owner.
- E. After acceptance of final report, Agency is to perform post testing and balancing site visits in accordance with following requirements:
1. post testing and balancing site visits are to be made:
 - a. once during first month of building operation;
 - b. once during third month of building operation;
 - c. once between fourth and tenth months in a season opposite to first and third month visit.
 2. during each return visit and accompanied by Owner's representative, Agency is to spot rebalance terminal units as required to suit building occupants and eliminate complaints;
 3. Agency is to schedule each visit with Contractor and Owner, and inform Consultant;
 4. after each follow-up site visit, Agency is to issue to Contractor and Consultant a report indicating any corrective work performed during visit, abnormal conditions and complaints encountered, and recommended corrective action.

END OF SECTION

SECTION 21 20 05 FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Submit product data sheets for all products specified in this Section.

1.2 QUALITY ASSURANCE

- A. Fire extinguishers are to be in accordance with following Codes and Standards:
 - 1. National Fire Code of Canada;
 - 2. NFPA 10, Standard for Portable Fire Extinguishers;
 - 3. CAN/ULC S508, Standard for the Rating and Testing of Fire Extinguishers.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Fire extinguishers are to be pressurized (stored pressure) rechargeable type, in accordance with NFPA 10, and UL and/or ULC listed and labelled for the class of fires and hazard locations for which they are specified.
- B. Each extinguisher is to be complete with:
 - 1. manufacturer's identification label indicating extinguisher model number, rating, and operating instructions;
 - 2. anodized aluminum or chrome plated forged brass valve with positive squeeze grip on-off operation and a pull-pin safety lock;
 - 3. discharge hose with nozzle or horn and hose securing clip;
 - 4. for wall mounting extinguishers, a wall mounting bracket.
- C. Fire extinguishers in fire hose cabinets will be supplied with the cabinet and are specified in Section entitled Fire Protection Standpipe System.

2.2 4A80B:C RATED DRY CHEMICAL EXTINGUISHERS.

- A. Multi-purpose 4A80B:C dry chemical extinguishers are to be as above but 175 mm (7") dia., 9 kg (20 lb.).

2.3 3A10B:C RATED DRY CHEMICAL EXTINGUISHERS

- A. Multi-purpose 3A10B:C dry chemical extinguishers are to be 100 mm (4") dia., 2.27 kg (5 lb.), each complete with a steel cylinder with a safety red baked enamel finish and a waterproof stainless steel pressure gauge.

2.4 CLEAN AGENT FIRE EXTINGUISHERS

- A. Ansul Inc. model CleanGuard FE13 clean agent extinguisher, 6 kg (13.25 lb.), ULC listed and labelled to 2-A:10-B:C, suitable for fires involving live electrical equipment and will not damage the equipment, each complete with required wall mounting brackets and securing hardware.
- B. Acceptable manufacturers are:
 - 1. Ansul Inc.;
 - 2. Pyro Chem.

2.5 KITCHEN FIRE EXTINGUISHERS

- A. To CAN/ULC-S554, wet chemical type, stored pressure rechargeable type, stainless steel valve, ULC listed.
- B. ULC Classification: Class K fires.

- C. Capacity: 6.0 L
- D. Cylinder Finish: Stainless steel, polished.

2.6 FIRE EXTINGUISHER CABINETS

- A. Recessed: Rectangular cabinets sized to suit the extinguishers to be housed, with a #18 gauge corrosion resistant white enamelled steel tub, #14 gauge cleaned and prime coat painted steel door and adjustable trim assembly with rounded corners, semi-concealed piano hinge, safety glass panel, and flush stainless steel door latch.

PART 3 - EXECUTION

3.1 INSTALLATION OF FIRE EXTINGUISHERS

- A. Provide fire extinguishers of type(s) in accordance with requirements of NFPA 10.
- B. Unless otherwise shown or specified, wall mount extinguishers using wall brackets supplied with extinguishers.
- C. Do not install extinguishers until after wall finishing work is complete.
- D. Be responsible for maintaining fire extinguishers until Substantial Completion of the Work.
- E. If extinguishers are indicated adjacent to a door, locate extinguishers at the strike side of the door.

3.2 INSTALLATION OF FIRE EXTINGUISHER CABINETS

- A. Provide wall cabinets for fire extinguishers where required.
- B. Unless otherwise shown or specified, locate cabinets so centerline is approximately 1.2 m (4') above finished floor.
- C. Confirm exact locations prior to installation.

END OF SECTION

SECTION 22 30 00 PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Submit shop drawings/product data sheets for all equipment and associated hardware specified in this Section.
- B. Include pump motor product data sheets and pump performance curves with shop drawing/product data sheet submission.
- C. Submit, prior to Substantial Performance of the Work, start-up or test data specified in Part 3 of this Section.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE PUMP SET

- A. Hydromatic Pumps submersible duplex sump pump set in accordance with drawing schedule, each pump complete with:
 - 1. cast iron pump casing and motor cover;
 - 2. oil-filled, overload protected, submersible, ball bearing type, 3-phase motor with a minimum of 3 m (20') of PVC jacketed power cord pre-wired to motor;
 - 3. open, 2-vane type, non-clog impeller secured to a stainless steel pump and motor shaft;
 - 4. grinder type, replaceable, minimum 57 Rockwell hardness cutting disc;
 - 5. MTM guide rail package complete with cast iron discharge elbow, discharge flanges for connection to pumps, steel spacer, stainless steel upper guide rail bracket, and lift chain.
- B. Pump set control components, supplied by pump manufacturer, to consist of:
 - 1. 4 switches, each sealed in a polyurethane float and complete with a minimum of 3 m (20') of control cord; 3 for pump set control and 1 for sump high water level alarm;
 - 2. bracket to support float switch cables in the sump pit;
 - 3. duplex factory pre-wired and tested power and control panel complete with a NEMA 3R enclosure with hinged and gasketed padlockable door, galvanized steel back panel with power and control wiring terminal blocks, bundled and identified wiring, and following:
 - a. circuit breaker, a H-O-A switch, an overload protected magnetic motor starter with test and reset pushbuttons, an identified "RUN" pilot light for each pump, and a relay alternating circuit to automatically alternate lead pump after each successive pumping cycle;
 - b. fused control transformer;
 - c. solid state pump controller with LED indicator lights;
 - d. high level alarm horn with push to silence switch and automatic reset flashing red light;
 - e. dry contacts for high water level alarm condition connection to a building automation system.
- C. Pump power cords and float switch cords to be of sufficient length to extend unbroken through sump pit conduit to wall on which starter and control panel is to be located.
- D. Acceptable manufacturers are:
 - 1. Hydromatic Pumps;
 - 2. Liberty Pumps;
 - 3. F.E. Myers (Canada) Ltd.;
 - 4. ITT Flygt Canada;
 - 5. Barnes Pumps (GSW Pump Company).

2.2 SUMP FRAMES AND COVERPLATES

- A. Welded sump curb frame and coverplate assembly constructed of hot dip galvanized mild steel, suitable in all respects for the application and location, complete with angle frame designed for flush with floor

coverplate mounting with trim bar and countersunk screws, centre brace, and two-piece minimum 8 mm (5/16") thick cover with lifting rings, gaskets, and, in one cover, a vent pipe opening and discharge pipe opening(s) with sealing flange(s), sealed opening(s) for pump power cord(s), and mounting plate with sealed opening(s) for control cables.

- B. Heavy-gauge hot-dipped galvanized steel sump curb frame with concrete anchors and 2-leaf minimum 8 mm (5/16") thick continuously hinged blank coverplate, complete with recessed lifting ring, gaskets, reinforced as required to suit the application and loading, and secured to frame by means of countersunk non-corrosive screws.
 - 1. steel angle frame with strap anchors welded around perimeter or extruded aluminium angle frame with strap anchors bolted around perimeter;
 - 2. concealed cast steel, cam-action hinges;
 - 3. zinc plated/chromate sealed [for both] hardware or Type 316 stainless steel [for both] hardware;
 - 4. submersible pump guide rails;
 - 5. vent pipe opening and discharge pipe opening(s) with sealing flange(s), sealed opening(s) for pump power cord(s), and mounting plate with sealed opening(s) for control cables.
- C. Acceptable manufacturers are:
 - 1. Bilco Corp.;
 - 2. Acudor Products Ltd.;
 - 3. Nystrom.

2.3 DOMESTIC HOT WATER STORAGE TANK

- A. Vertical steel domestic hot water storage tank, 1103 kPa (150 psi) rated, sized in accordance with drawing schedule, constructed in accordance with ASME Boiler Pressure Vessel Code, Section IV, Part HLW, and complete with:
 - 1. double interior coating of high temperature porcelain enamel, 2 magnesium anodes rigidly secured in place, 50 mm (2") thick polyurethane foam insulation, and an enamelled steel jacket;
 - 2. tank openings for circulating lines, hot water outlet relief valve, temperature control drain valve and a thermometer;
 - 3. ASME rated relief valve;
 - 4. drain valve;
 - 5. factory fabricated type "L" hard copper manifold kit.
- B. Acceptable manufacturers are:
 - 1. A.O. Smith Water Products Co.;
 - 2. John Wood (GWS Water Heating Co.);
 - 3. Rheem Canada Ltd.;
 - 4. Bradford White Canada Inc.

2.4 DOMESTIC COLD WATER PRESSURE BOOSTER PUMP SET

- A. Packaged type, multi-pump pressure booster set in accordance with drawing schedule, completely factory assembled and pre-piped on a primed and painted steel baseplate with primed and painted structural steel framework, with rubber mounts to isolate pipework from baseplate assembly, and a pre-wired power and control panel, all factory tested, and calibrated, and ready for suction and discharge piping connections and electrical power connections.
- B. Each pump is to be a bronze fitted, centrifugal, single suction in-line pump complete with following:
 - 1. cast iron volute and motor/pump bracket;
 - 2. dynamically balanced closed type cast bronze impeller secured to a stainless steel shaft;
 - 3. motor in accordance with Section entitled Basic Mechanical Materials and Methods;
 - 4. water-tight mechanical seal serviceable without breaking pipe connections;
 - 5. common suction and discharge headers with isolating valves and non-slam check valves for each pump, all minimum 1725 kPa (250 psi) rated;
 - 6. pressure reducing valve for each pump, with by-pass on discharge;
 - 7. thermal bleed circuit with aquastat and solenoid valve.

- C. Control panel to consist of a NEMA 2 primed and painted steel enclosure complete with following:
 - 1. hinged (full length piano hinge) door with catch and padlocking facilities;
 - 2. wiring diagram on back side of door;
 - 3. main door, interlock disconnect switch with a fused circuit for each motor;
 - 4. fully protected, full voltage, non-reversing across-the-line magnetic starter for each motor;
 - 5. current sensing device;
 - 6. H-O-A selector switch for each pump to permit manual or automatic pump operation;
 - 7. control section with 115 volt fused secondary control circuit transformer, adjustable pressure switches, and minimum run time delay;
 - 8. identified suction and discharge pressure gauges conforming to requirements specified in Section entitled Basic Mechanical Materials and Methods;
 - 9. low limit pressure switch with low suction pressure alarm LED, arranged to shut-off pump(s) should pressure in the water service main fall to a dangerously low level, with auxiliary contact to connect to a central control and monitoring system;
 - 10. high pressure cut-out switch with alarm LED and auxiliary contact;
 - 11. power "ON" indicating light;
 - 12. manual alternation of lead pump;
- D. Pump controls to be factory pre-set to suit job conditions, sequence pumps to deliver constant pressure domestic cold water, and operate as follows:
 - 1. lead pump is to operate continuously;
 - 2. when demand exceeds capacity of lead pump, second pump is to automatically start in parallel, and run for a minimum period of time to prevent pump from cycling on and off.
 - 3. should lead pump fail for any reason, second pump is to start automatically and run continuously.
- E. Acceptable manufacturers are:
 - 1. S.A. Armstrong Ltd.;
 - 2. ITT Fluid Products Bell & Gossett;
 - 3. Pentair Pump Group "Aurora".

2.5 HORIZONTAL IN-LINE CIRCULATING PUMPS

- A. Bronze construction centrifugal pumps in accordance with drawing schedule and complete with:
 - 1. lead free cast bronze casing with flanged pipe connections;
 - 2. alloy steel shaft with integral thrust collar, copper shaft sleeve, and oil lubricated bronze sleeve bearings;
 - 3. balanced lead free cast bronze impeller;
 - 4. motor conforming to requirements of Section entitled Basic Mechanical Materials and Methods, connected to motor by means of a 4-spring coupling with guard;
 - 5. mechanical seal.
- B. Acceptable manufacturers are:
 - 1. S.A. Armstrong Ltd.;
 - 2. ITT Bell & Gossett;
 - 3. Grundfos Canada Inc.;
 - 4. Patterson Pump Company.

PART 3 - EXECUTION

3.1 DRAINAGE COORDINATION

- A. Coordinate drain requirements of plumbing equipment provided by Mechanical Division and/or Owner with location of drains specified in Section 22 13 00.
- B. Refer to Section entitled Basic Mechanical Materials and Methods for equipment/system start-up requirements.

- C. Refer to Section entitled Basic Mechanical Materials and Methods for equipment/system manufacturer certification requirements. Submit a copy of the letter prior to Substantial Performance of the Work.
- D. Include for 4 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.2 INSTALLATION OF CIRCULATING PUMPS

- A. Provide horizontal in-line domestic hot water circulating pumps.
- B. Install pumps in place in vertical piping approximately 1.2 m (4') above floor in accordance with pump manufacturer's instructions.
- C. Refer to Section entitled Basic Mechanical Materials and Methods for equipment/system start-up requirements.
- D. Include for 2 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.3 INSTALLATION OF DOMESTIC COLD WATER PRESSURE BOOSTER PUMP SET

- A. Provide a package type domestic cold water pressure booster pump set.
- B. Mount assembly on vibration isolation on a concrete housekeeping pad, shim the unit level such that suction and discharge headers are vertical, and secure in place.
- C. Ensure housekeeping pad is keyed to the structure, and pump, motor base and framework are secured to structure by slack cable restraints. Refer to Section entitled Seismic Control and Restraint.
- D. Provide flexible connections to suction and discharge headers, and support suction and discharge piping independent of pump set assembly. Pipe thermal bleed to drain.
- E. Refer to Section entitled Basic Mechanical Materials and Methods for equipment/system start-up requirements.
- F. Refer to Section entitled Basic Mechanical Materials and Methods for equipment/system manufacturer certification requirements. Submit a copy of the letter prior to Substantial Performance of the Work.
- G. Include for 4 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.4 INSTALLATION OF SUBMERSIBLE DRAINAGE PUMP(S)

- A. Provide submersible drainage pump(s) in sump. Refer to drawing detail.
- B. Provide required sump piping, including a shut-off valve and a check valve for each pump. Ensure valves are readily accessible from floor level and piping is easily removable for removal of pump(s) from sump.
- C. Install pump removal guide rail system with accessories in accordance with manufacturer's instructions.
- D. Install float switch(es) at proper height in sump and secure cable to a sump wall mounted bracket such that cables cannot twist around each other.
- E. Leave pump power and control cables outside sump, neatly coiled, taped and identified for extension and connection to starting and control equipment.
- F. Hand pump starter and control panel(s) and high water level alarm panel(s) to electrical trade at site for installation.
- G. Provide sump and pump accessories.
- H. Clean sump(s) prior to Substantial Performance of the Work.

- I. Refer to Section entitled Basic Mechanical Materials and Methods for equipment/system start-up requirements.
- J. Refer to Section entitled Basic Mechanical Materials and Methods for equipment/system manufacturer certification requirements. Submit a copy of the letter prior to Substantial Performance of the Work.
- K. Include for 4 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.5 INSTALLATION OF SUMP FRAMES AND COVERPLATES

- A. Supply a frame and cover for each drainage sump. Covers and frames are to be delivered to site pre-assembled and installed as such. Carefully coordinate supply of frames and covers with concrete trade forming and pouring sumps. Hand frames to concrete trade for incorporation into formwork.
- B. Follow manufacturer's installation instructions.

3.6 INSTALLATION OF DOMESTIC HOT WATER STORAGE TANK

- A. Provide domestic hot water storage tanks.
- B. Install in accordance with manufacturer's instructions. Secure each tank in place, level and plumb on a reinforced concrete housekeeping pad by means of machine bolts.
- C. Install piping manifolds factory supplied with tanks.
- D. Unless otherwise specified or instructed, set tank control to maintain 48.8°C (120°F) hot water. Check control and safeties, and adjust as required.

END OF SECTION

SECTION 23 82 39 MOTORIZED HEATERS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Submit shop drawings/product data sheets for motorized heaters, including accessories.
- B. Submit a site start-up report from manufacturer's representative as specified in Part 3 of this Section.

PART 2 - PRODUCTS

2.1 UNIT HEATERS

- A. CSA certified hot water unit heaters in accordance with drawing schedule, each complete with:
 - 1. for vertical unit casing, top and bottom heavy-gauge circular steel plates, top plate equipped with a depression for motor and an opening for motor cooling air as well as threaded hanger rod connections, bottom plate equipped with a die-formed fan venturi and a bolt-on adjustable air deflector, both plates bolted together with a circular heating coil in between;
 - 2. for horizontal unit casing, minimum #20 gauge die-formed steel front and back casing halves with formed ribs and rounded corners, both halves secured together top and bottom with screws and equipped with threaded hanger rod connections in the top, a formed fan venturi with bolt-on wire grid guard in the back, and a rectangular formed discharge opening with adjustable horizontal and vertical air deflectors in the front;
 - 3. factory applied casing finish, consisting of electrostatically applied baked powder epoxy on cleaned and primed casing surfaces;
 - 4. factory leak tested heating coil, consisting of minimum 16 mm (5/8") OD seamless copper tubing mechanically expanded into and permanently bonded to continuous plate type aluminum fins, and equipped with screwed steel supply and return piping connections and silver braced tube joints;
 - 5. continuous duty TEFC motor conforming to requirements specified in Section entitled Basic Mechanical Materials and Methods, direct connected to a balanced propeller type fan wheel with aluminum blades secured to a steel hub;
- B. Acceptable manufacturers are:
 - 1. Modine Manufacturing Co.;
 - 2. Rosemex Inc.;
 - 3. Armstrong-Hunt Inc.;
 - 4. Daikin;
 - 5. Engineered Air;
 - 6. Ouellet.

2.2 CABINET UNIT HEATERS

- A. CSA certified hot water cabinet unit heaters in accordance with drawing schedule, each complete with:
 - 1. cabinet, of welded fabrication, constructed from one-piece top and sides, and one-piece partition panels and backsheet, both die-formed from single sheets of minimum #18 gauge insulated furniture grade steel and complete with minimum 825 mm (32-1/2") space at each end for piping and wiring, stamped grilles where required, and, for surface floor and wall mounted cabinets, key lock access doors for access to valves and speed controls;
 - 2. #16 gauge removable front panel with tamperproof fasteners, stamped grille where required, and insulation applied to the inside face;
 - 3. for all exposed cabinet surfaces, a baked enamel prime coat finish applied to cleaned metal surfaces;
 - 4. factory leak tested heating coil, consisting of seamless copper tubing mechanically expanded into and permanently bonded to continuous plate type aluminum fins, and equipped with screwed steel supply and return piping connections and silver brazed tube joints;

5. removable galvanized steel fan board with centrifugal forward curved, formed aluminum fan wheel(s) with galvanized steel housings, direct connected to a continuous duty, three-speed, permanent split capacitor motor conforming to requirements specified in Section entitled Basic Mechanical Materials and Methods;
- B. Acceptable manufacturers are:
 1. Modine Manufacturing Co.;
 2. Rosemex Inc.;
 3. Armstrong-Hunt Inc.;
 4. Daikin;
 5. Engineered Air;
 6. Ouellet.

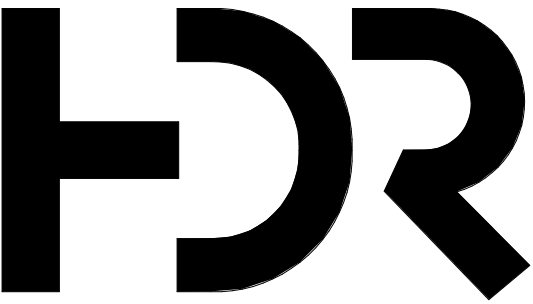
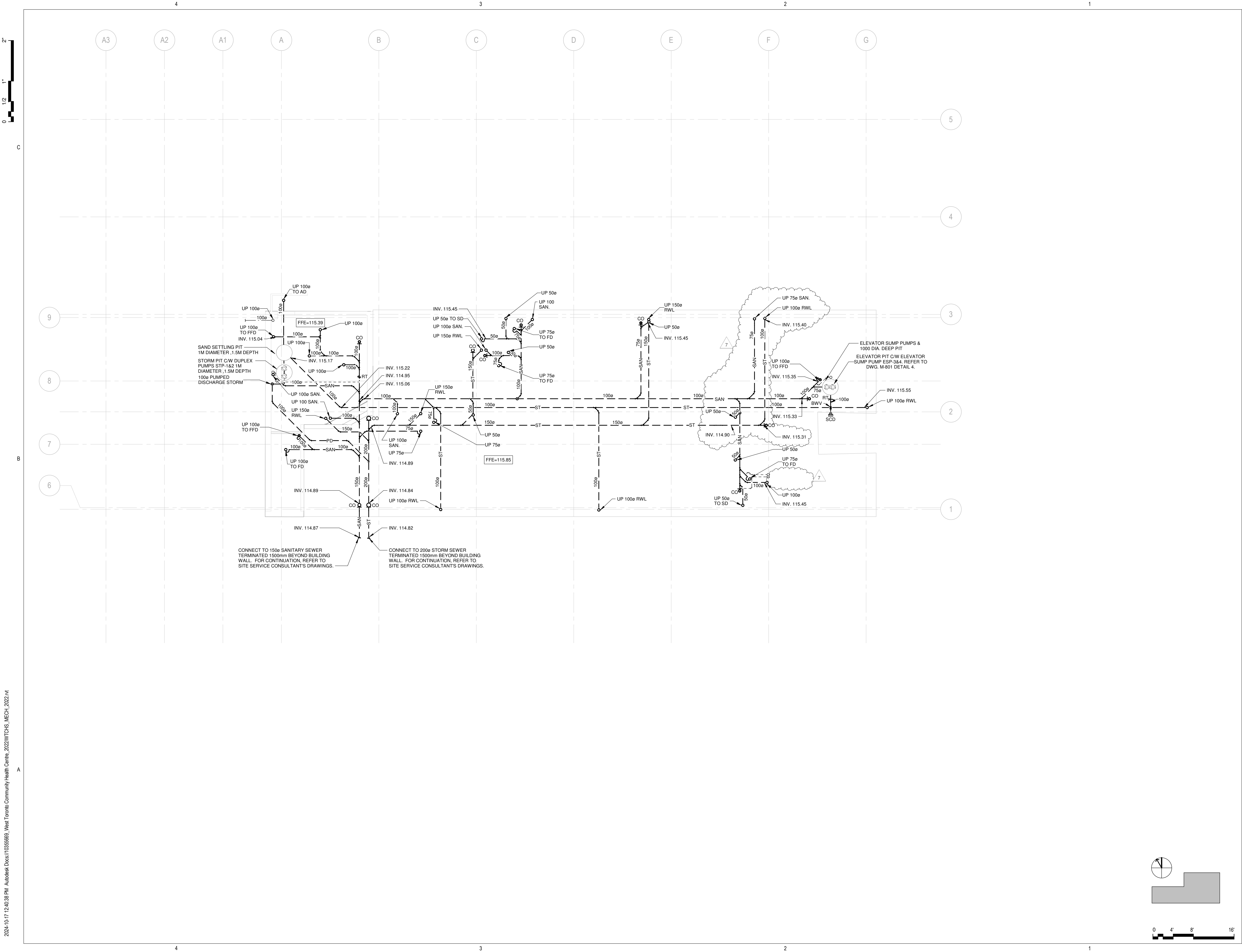
PART 3 - EXECUTION

3.1 INSTALLATION OF MOTORIZED HEATERS

- A. Provide motorized heaters.
- B. Secure unit heaters in place at proper height by means of hanger rods attached to structure. Ensure heaters are level and plumb. Confirm exact locations prior to roughing-in.
- C. Carefully coordinate installation of cabinet heaters with trades constructing building surfaces in or on which heaters are located. Confirm exact locations prior to roughing-in.
- D. Connect with piping in accordance with drawing detail.
- E. Refer to Section entitled Basic Mechanical Materials and Methods for equipment/system start-up requirements.
- F. Include for a 4 hour on-site heater operation demonstration and training session. Training is to be a full review of all components including but not limited to construction details, operation, and maintenance.

END OF SECTION

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Interior Designer	Interior Designer
Equipment Planner	Equipment Planner
Wayfinding	

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MARK	DATE	DESCRIPTION
1	2023-05-05	ISSUED FOR STAGE 3.2 COSTING
2	2023-07-05	ISSUED FOR MOH STAGE 3.2
3	2023-11-24	ISSUED FOR STAGE 3.3 COSTING
4	2024-02-12	ISSUED FOR MOH STAGE 3.3
5	2024-03-22	ISSUED FOR BUILDING PERMIT
6	2024-09-18	ISSUED FOR TENDER
7	2024-10-17	ISSUED FOR ADDENDUM M02

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UNDERGROUND - PLUMBING

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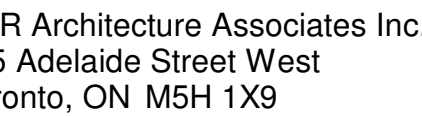
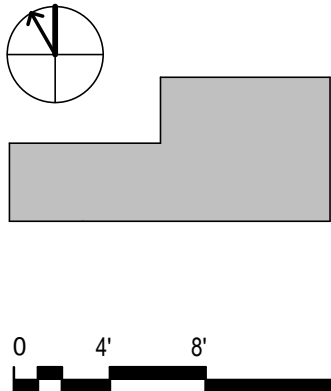
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Wayfinding	

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5	2024-03-22	ISSUED FOR BUILDING PERMIT
6	2024-06-07	ISSUED FOR BUILDING PERMIT R1
7	2024-09-18	ISSUED FOR TENDER
8	2024-10-07	ISSUED FOR ADDENDUM M01
9	2024-10-17	ISSUED FOR ADDENDUM M02

Project Number	221-11662-00
Original Issue	02/23/21

Sheet Name

LEVEL B01 - PLUMBING

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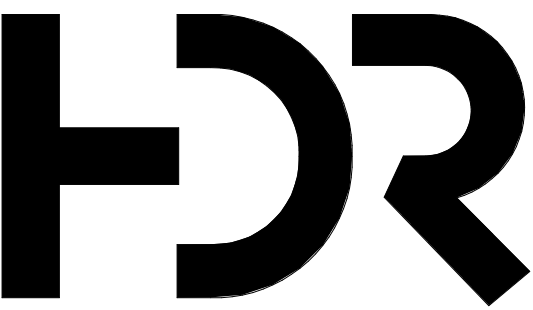
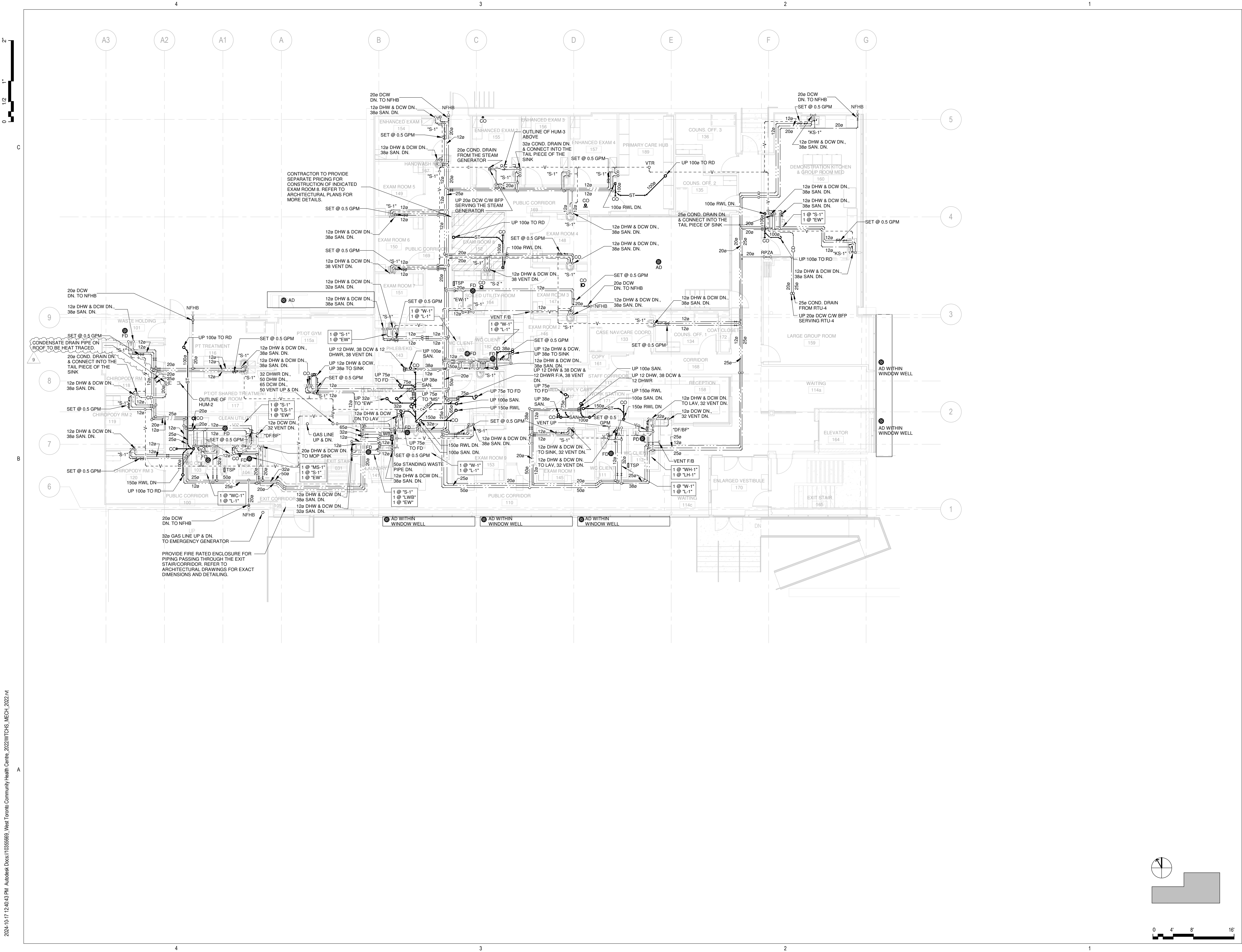
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Equipment Planner	Equipment Planner
Wayfinding	

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8	2024-10-07	ISSUED FOR ADDENDUM M01
9	2024-10-17	ISSUED FOR ADDENDUM M02

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Sheet Name
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M-202

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Equipment Planner	Equipment Planner
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1	2023-07-05	ISSUED FOR MOH STAGE 3.2
2	2023-11-24	ISSUED FOR STAGE 3.3 COSTING
3	2023-12-15	ISSUED FOR CLASS A COST ESTIMATE
4	2024-02-12	ISSUED FOR MOH STAGE 3.3
5	2024-03-22	ISSUED FOR BUILDING PERMIT
6	2024-08-29	RE-ISSUED FOR PERMIT
7	2024-09-18	ISSUED FOR TENDER
8	2024-10-17	ISSUED FOR ADDENDUM M02

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Project Number	221-11662-00
Original Issue	02/23/21

Sheet Name

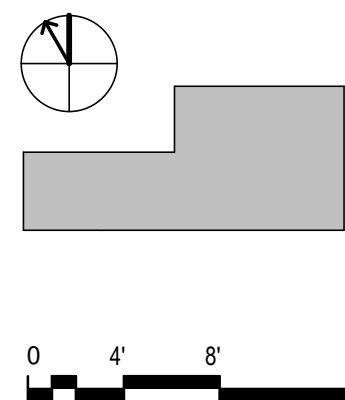
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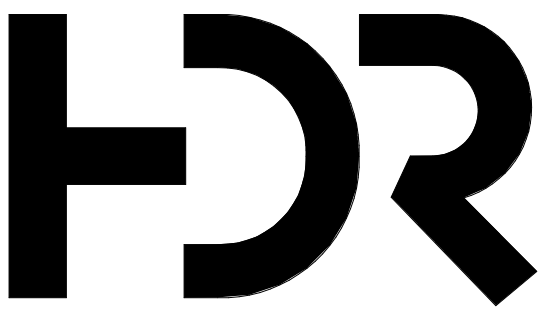
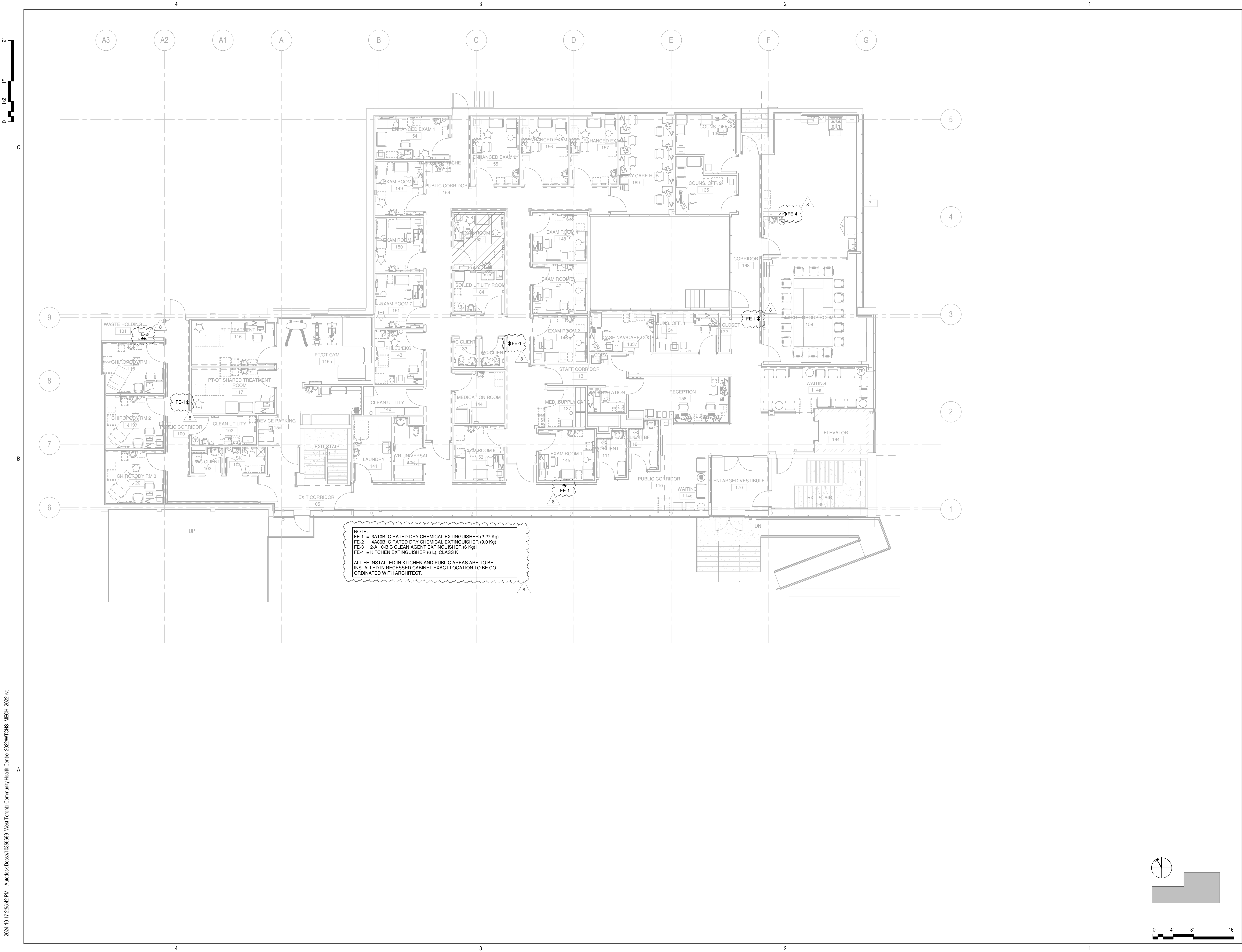
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Equipment Planner	Equipment Planner
Wayfinding	

Sheet Reviewer	Checker
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8	2024-10-17	ISSUED FOR ADDENDUM M02

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LEVEL 01 - FIRE PROTECTION

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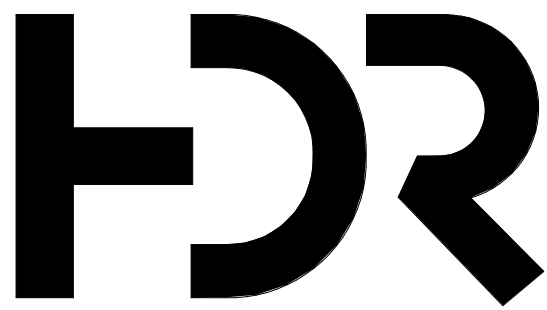
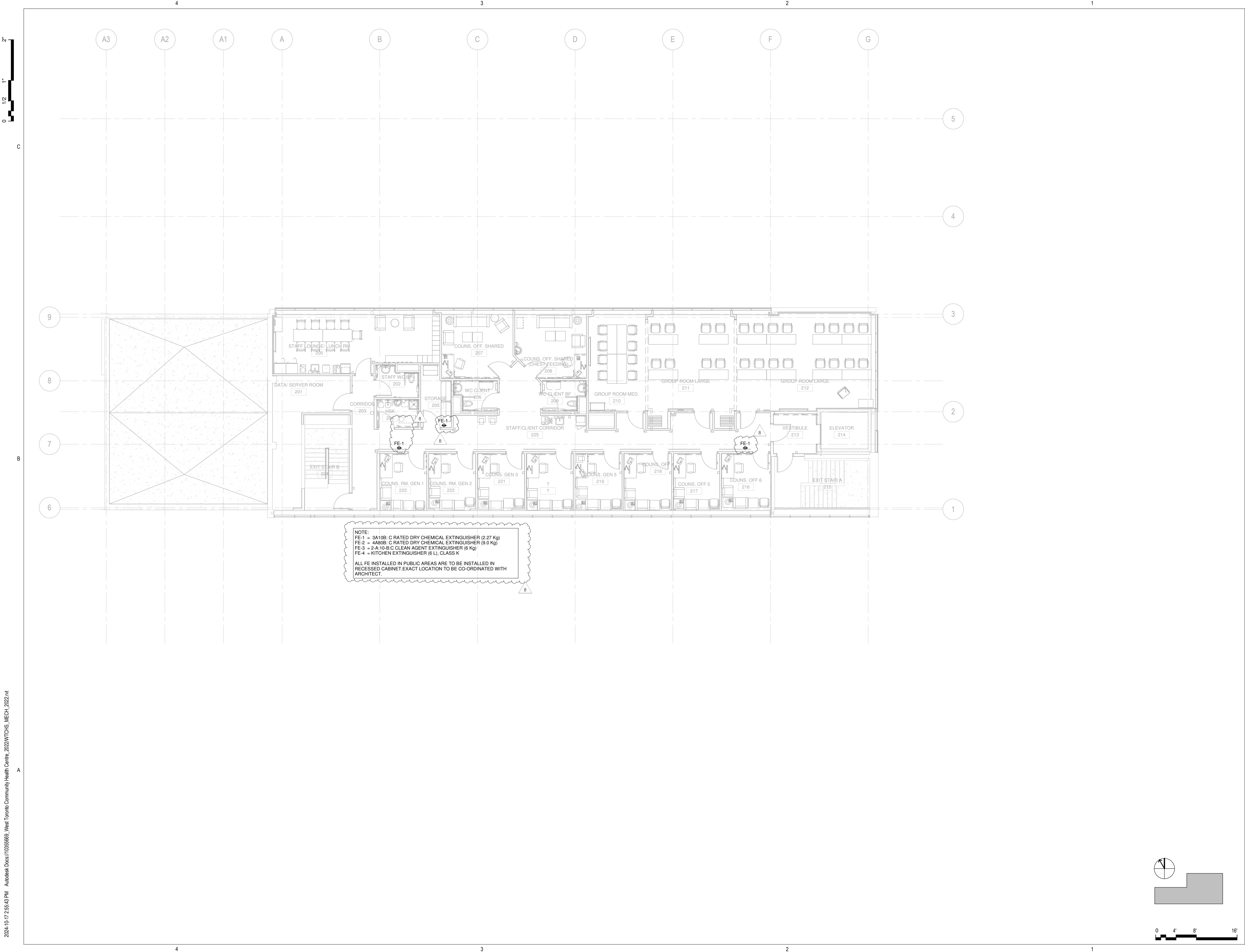
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Electrical Engineer	WSP
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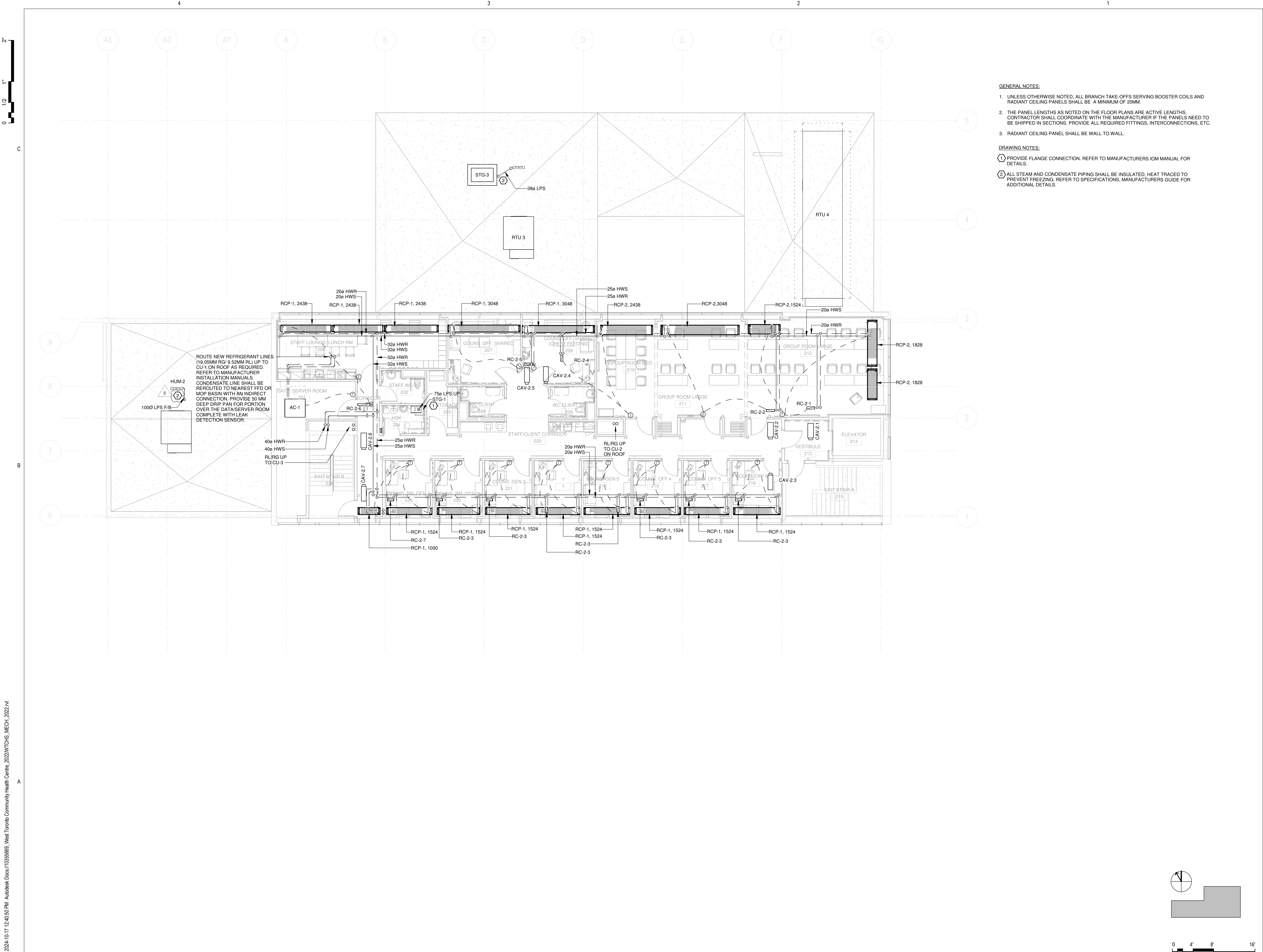
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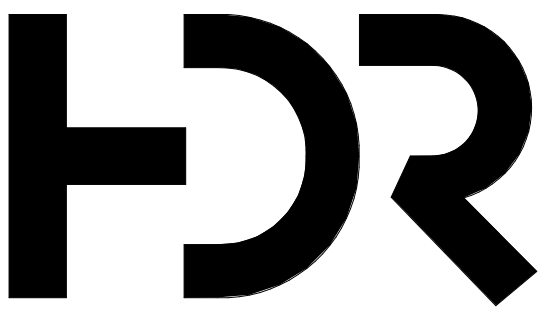


GENERAL NOTES:

- UNLESS OTHERWISE NOTED, ALL BRANCH TAKE-OFFS SERVING BOOSTER COILS AND RADIANT CEILING PANELS SHALL BE A MINIMUM OF 20MM.
- THE PANEL LENGTHS AS NOTED ON THE FLOOR PLANS ARE ACTIVE LENGTHS. CONTRACTOR SHALL COORDINATE WITH THE MANUFACTURER IF THE PANELS NEED TO BE SHIPPED IN SECTIONS. PROVIDE ALL REQUIRED FITTINGS, INTERCONNECTIONS, ETC.
- RADIANT CEILING PANEL SHALL BE WALL TO WALL.

DRAWING NOTES:

- PROVIDE FLANGE CONNECTION. REFER TO MANUFACTURERS IOM MANUAL FOR DETAILS.
- ALL STEAM AND CONDENSATE PIPING SHALL BE INSULATED. HEAT TRACED TO PREVENT FREEZING. REFER TO SPECIFICATIONS, MANUFACTURERS GUIDE FOR ADDITIONAL DETAILS.



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Wayfinding	

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7	2024-10-07	ISSUED FOR ADDENDUM M01
8	2024-10-17	ISSUED FOR ADDENDUM M02

Project Number	221-11662-00
Original Issue	02/23/21

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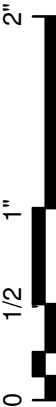
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C

B

A



SCHEDULE OF H.V.A.C. PUMPS

TAG	SYSTEM	LOCATION	MANUFACTURER	MODEL	QTY	MEDIUM	FLOW RATE (L/s)	HEAD (kPa)	MOTOR				VFD	EMERGENCY POWER	REMARKS
									RPM	BHP	HP	V/PHZ			
HWP-1.2	HEATING WATER PUMPS	BASEMENT MECHANICAL ROOM	BELL & GOSSETT	E-90 1AAB	2	WATER	2.6	257	3600	1.69	3.0	575/3/60	YES	NO	DUTY/DUTY
NOTES: 1. ALL PUMPS WITH VFD CONTROLLERS SHALL BE SUPPLIED WITH INVERTER DUTY MOTORS SUITABLE FOR USE WITH VFD OPERATION. ALLOW LOOSE VFD INSTALLATION IN MECHANICAL ROOM WALL.															

SCHEDULE OF PLUMBING PUMPS

TAG	SYSTEM	LOCATION	MANUFACTURER	MODEL	FLOW RATE (L/s)	HEAD (kPa)	MOTOR			EMERGENCY POWER	REMARKS
							RPM	HP	V/PHZ		
STP-1&2	DUPLEX STORM PUMPS	BASEMENT MECHANICAL ROOM	SCARBORO PUMP	-	3	105	3450	1(each)	208/3/60	YES	
DCWP-1&2	DUPLEX DOMESTIC COLD WATER BOOSTER PUMPS	BASEMENT MECHANICAL ROOM	S.A. ARMSTRONG	-	6 (each)	310	3600	5 (each)	575/3/60	NO	DUTY / STANDBY.
DHWR-1	DOMESTIC HOT WATER RECIR. PUMP	BASEMENT MECHANICAL ROOM	S.A. ARMSTRONG	-	1.0	138	3000	0.33	120/1/60	NO	
ESP-3&4	DUPLEX ELEVATOR SUMP PUMPS	EL MACHINE ROOM	SCARBORO PUMP	-	3 (each)	60	3450	1 (each)	208/3/60	YES	DUTY / STANDBY.
NOTES: PROVIDE DCWP-1&2 SCOPE AS A SEPARATE PRICE											

SCHEDULE OF MOTORIZED HEATERS

TAG	LOCATION	MANUFACTURER	MODEL NO.	CAPACITY (KW)	MEDIUM	POWER SUPPLY (V/PH/Hz)	MOTOR		REMARKS
							HP	RPM	
UH-1	MECHANICAL ROOM 117	OUELLET	OASU07538AM	7.5	ELECTRIC	208/1/60	0.033	1550	SUSPENDED/CEILING MOUNTED UNIT.
CFH-1	ENLARGED VESTIBULE 170, EXIT STAIR 165	OUELLET	ODSR05008	5	ELECTRIC	208/1/60	0.020	1550	RECESSED CEILING MOUNTED UNIT.
CUH-2	EXIT STAIR 022 - BASEMENT	OUELLET	OAC08008-T	8	ELECTRIC	208/1/60	-	-	EXPOSED WALL MOUNTED UNIT.
CUH-3	EXIT STAIR 031 - BASEMENT	OUELLET	OAC08008-T	8	ELECTRIC	208/1/60	-	-	EXPOSED WALL MOUNTED UNIT.

NOTES:
1. AIR FLOW SPECIFIED IS AT LOW SPEED UNLESS NOTED OTHERWISE.

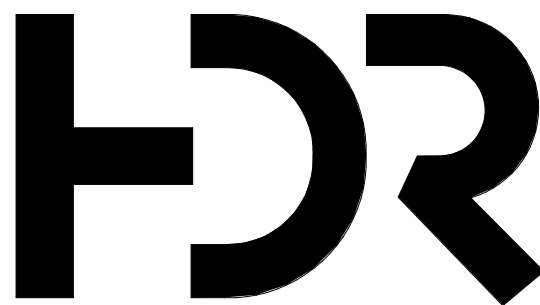
SCHEDULE OF EXPANSION TANK (S.A. ARMSTRONG)

TAG	SYSTEM	MODEL NO.	TYPE	DIAMETER (mm) x HEIGHT (mm)	TANK CAPACITY (L)	ACCEPTANCE VOLUME (L)	REMARKS
ET-1	DOMESTIC COLD WATER SYSTEM	ST-100CL	BLADDER	406 x 991	100	-	
ET-2	DOMESTIC HOT WATER SYSTEM	ST-100CL	BLADDER	406 x 991	100	-	
ET-3	HEATING WATER SYSTEM	AX-100V	BLADDER	508x1245	227.1	87.8	

SCHEDULE OF VIBRATION ISOLATION

SYSTEM	TYPE OF BASE	TYPE OF ISOLATION	STATIC DEFLECTION (mm)	MODEL NO.
AIR HANDLING UNITS	-	ROOF	6	REFER TO NOTE 1. REFER MANUFACTURER RECOMMENDED ISOLATION SYSTEM.
EXHAUST FANS	-	ROOF	25	SHR
BOILERS	-	FLOOR	-	REFER MANUFACTURER RECOMMENDED ISOLATION SYSTEM.
PUMPS LESS THAN 5 HP	-	FLOOR	-	INSTALL WITH MANUFACTURER RECOMMENDED ISOLATION SYSTEM.
PUMPS MORE THAN 5 HP	-	FLOOR	6	PADS / SPRING-RUBBER. REFER TO NOTE 2.
PIPING	-	SUSPENDED	25	SHR SPRING HANGER ISLATOR WITH NEOPRENE ELEMENT.

NOTES:
1. INTERNALLY ISOLATE ALL FANS WITH 50mm DEFLECTION SPRING MOUNTS.
2. PUMPS TO INCLUDE VIBRATION ISOLATION (RUBBER OR NEOPRENE PAD MOUNT) AND FLEXIBLE JOINTS FOR PIPING TO/FROM PUMP. PROVIDE 6MM STATIC DEFLECTION NEOPRENE OR RUBBER PAD UNDER THE STAND (IF SUPPORT FROM FLOOR) OR SPRING RUBBER/ ISOLATOR WITH 12MM STATIC DEFLECTION.



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Structural Engineer	WSP
Mechanical Engineer	WSP
Electrical Engineer	WSP
Plumbing Engineer	WSP
Interior Designer	Interior Designer
Equipment Planner	Equipment Planner
Wayfinding	

Sheet Reviewer	Checker
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MARK	DATE	DESCRIPTION
1	2023-05-05	ISSUED FOR STAGE 3.2 COSTING
2	2023-07-05	ISSUED FOR MOH STAGE 3.2
3	2023-11-24	ISSUED FOR STAGE 3.3 COSTING
4	2024-02-12	ISSUED FOR MOH STAGE 3.3
5	2024-03-22	ISSUED FOR BUILDING PERMIT
6	2024-09-18	ISSUED FOR TENDER
7	2024-10-07	ISSUED FOR ADDENDUM M01
8	2024-10-17	ISSUED FOR ADDENDUM M02

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Sheet Name

MECHANICAL
SCHEDULES 2

Scale

N.T.S.

Sheet Number

M-702

Project Status

ISSUED FOR TENDER

