METROLINX

Engineering Bulletin

March 8th, 2020

Facilities Engineering Assurance

FEA-008

Amendment Notice: Minor Mechanical Updates

This bulletin applies to and amends the following documents:

- GO Design Requirements Manual (DRM), GO-DRM-STD-2017 Revision 3, dated February 2020
- GO Technical Master Specification, 21 13 00 Fire Protection Sprinkler System Revision 0, dated August 2018
- GO Technical Master Specification, 23 21 18 Glycol Solution Snow Melting System Revision 1, dated September 2018
- GO Technical Master Specification, 23 74 17 Rooftop Air Conditioning Unit Revision 1, dated September 2018
- GO Technical Master Specification, 20 05 05 Mechanical Work General Instructions Revision 0, dated August 2018

This Bulletin updates existing DRM (Feb. 2020) requirements as follows:

- DRM Section 5.2.4.4 - Clarified Heating, Ventilation and Air Conditioning (HVAC) requirements
- DRM section 7.2.22.3 Emergency cooling- Specified mini hub room, hub room and elevator control room's emergency cooling requirement
- DRM Section 7.4.2 Heating, Ventilation, and Air Conditioning (HVAC) Systems - DRM requirement of 2 1/2% winter and summer design temperatures: Revised winter design condition to use 1% to align with the current industry standards which also provides safeguard for heating design as the 1% winter design condition is always lower than 2 1/2%
- DRM section 7.4.26.1.1 Stations: Clarified the 'radiant floor heating shall be installed in station building' requirement
- DRM section 7.4 .27.2.6 Hydrants and Hose Bibs: Added additional requirements for minimum quantities and length apart for Stations
- DRM Section 7.4.27.2.12: Clarified heat tracing requirements
- DRM table 57: Heating, Ventilation and Air Conditioning (HVAC): Specified mini hub room, hub room, elevator control room and sump pump room's design criteria requirements
- Standard Specification 21 13 00 Fire Protection Sprinkler System - All references to anti-freeze sprinkler piping were deleted because Metrolinx standard specification does not have specification for anti-freeze sprinkler systems and designers may have misinterpreted these systems as being acceptable
- Updated Standard Specification 23 21 18 Glycol Solution Snow Melting System for additional manifold chamber location requirements
- Standard Specification 23 74 17 Rooftop Air Conditioning Unit: Revised items 2.2.2, 2.2.3, 2.2.4, 2.3.3, 2.5.3, 2.5.5 & 2.7.6 (a)
- Standard Specification 20 05 05 Mechanical Work General Instructions- Include Environmental Regulators in section 1.16.1

This revision provides clarity on the mechanical design requirements to the designers and external consultants, Improves the technical requirements wording and covers the identified gaps in the standard documents.

Amendments to the DRM and specifications are provided in the following attachment:

- Attachment 1: Revisions to GO DRM Feb. 2020 – Minor Mechanical Updates
- Attachment 2: Revisions to Standard specification 21 13 00 Fire Protection Sprinkler System
- Attachment 3: Revisions to Standard specification 23 21 18 Glycol Solution Snow Melting System
- Attachment 4: Revisions to Standard Specification 23 74 17 Rooftop Air Conditioning Unit
- Attachment 5: Revisions to Standard Specification 20 05 05 Mechanical Work General Instructions

On MyLinx the Bulletin is available for staff download on the GO Manual page and the updated technical master specifications are available for staff download on GO Standard Drawings and Specifications page.

The Bulletin and updated Specifications are also available for external users to download via the Metrolinx public download site (http://www.gosite.ca/engineering_public/).

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- Elevator shaft, car enclosure and entrance doors shall be constructed with the maximum amount of glazing
- All serviceable equipment, not directly connected to elevator operation, to be serviceable from the exterior of the shaft.

5.2.4.2 Communications

- All elevators shall have CCTV camera mounted inside elevator cab
- Camera mounted in vestibules and lobbies shall view inside and outside of each elevator at each level where possible
- All elevators shall have a two-way emergency call system

5.2.4.3 Heating

- Fan forced heater with built-in thermostat
- Heat Pump with hyper heating capability down to -25°C, ducted type and located outside the hoistway

5.2.4.4 ~~Ventilation or~~ Air Conditioning

- Air conditioning via Heat Pump type A/C unit with low ambient cooling
- All elevator shafts shall be provided ~~with two speed ventilation fans shall be supplied~~ with heating and air conditioning ~~HVAC~~ systems.

5.2.4.5 Floor Grille

- Constructed from stainless steel and shall be designed for cleanout by one person, unaided

5.2.4.6 Elevator Numbering Convention

- Elevators north of the tracks shall be assigned numbers first (if not applicable, east side of track shall be first)
- Elevators serving platforms shall be numbered in a sequence following platform numbers being served (i.e. platform one first, followed by subsequent platforms)
- Elevator groups serving a parking structure to be numbered in one sequence

5.2.5 Bridges and Overpasses

5.2.5.1 Open Overpasses

Open overpasses shall not have solid guards.

5.2.5.2 Enclosed Overpasses

- Enclosed overpasses and stairs shall have windows/skylights, including at the ends
- Overpasses connecting platforms shall have unobstructed interior barrier-free routes and turn-around spaces
- Corridors shall be free of overhead and protrusion hazards
- Stair center handrails shall terminate at landings to permit crossover

located in the Room. Temperature and humidity requirements are on a 24 hours, 7 days a week basis, regardless of the heat generated by normally operating electrical and communications equipment.

The required capacity shall be calculated based on the following:

- For sensible heat gain from electrical equipment use a minimum 5000 Watts per rack (in the Communications Room)
- Sensible heat gain from lighting
- Include the future growth of systems by 25%
- Determine heat gain/loss to the room from the outside (heat transfer through building structures, including solar load) g the following design criteria
- Outdoor temperatures

Use 1~~2½~~% winter & 2½% summer design temperatures per Ontario Building Code for the geographical location. Indoor temperatures:

- Winter design: 15°C
- Summer design**:** 22°C D B with a maximum of 50% relative humidity
- An infiltration rate from outside of 0.5 air changes per hour
- A recirculation rate of 100% for the air conditioning system
- A safety factor of 5%

The air conditioning system shall be selected to suit the specific capacity by taking into consideration the room's very high sensible load factor. Heat loss calculation shall not include credit for equipment and lighting heat gain.

7.2.22.3 Emergency Cooling

Provisions for emergency cooling in mini hub room, hub room, elevator control room, communication and electrical rooms:

- Provide a ~~6"~~150mm diameter vent opening provision, secured from inside, for portable A/C unit in both electrical and communication rooms, venting to the outside
- Provide dedicated 120V, 20A, 5-20R and 120V, 30A, 5-30R power receptacles (generator backed-up) from dedicated circuit breakers for portable A/C unit, in Electrical and Communication rooms.
- Receptacles to be mounted at 300mm height above finished floor
- Contractor to provide Labels above receptacles stating: the respective Amps, panel and circuit numbers and "DEDICATED FOR PORTABLE A/C UNIT"
- Provide an exhaust fan controlled by a reverse acting thermostat and an override switch
- High/low temperature alarm
- All alarm inputs to be placed in Chubb System and BAS

The sequence of operations shall be as follows:

- When A/C unit fails and temperature starts rising, the high temperature sensor sends an alarm to the current corporate supplier of security and monitoring services
- Station Operations will be notified to send a portable A/C unit and the HVAC service contractor is

7.4 Mechanical

7.4.1 Overview

This section applies to the mechanical engineering design related to:

- Heating, Ventilation and Air-Conditioning (HVAC) systems
- Building Automation System (BAS)
- Radiant Floor Heating and Snow Melting Systems
- Plumbing and Drainage systems
- Fire Protection systems
- Identification, Appearance and Noise Vibration
- Basic and user-friendly computerized and automated equipment controls and energy-management programs shall be utilized. Remote monitoring of equipment shall be provided if required by Metrolinx

Refer to GO Standard specifications and drawings for detailed requirements

7.4.2 Heating, Ventilation, and Air Conditioning (HVAC) Systems

7.4.2.1 Design Requirements

Heating, Ventilation and Air-Conditioning System shall be by means of the most cost-effective energy source available at the site. Daytime design temperatures (Daytime: with Nighttime setbacks) for rooms shall be as tabulated below.

Table 57: Heating, Ventilation, and Air Conditioning (HVAC)

Room	C Winter Min.	C Summer Max	Energy Source
Passenger Waiting Room (including vending/ concessions)	18	25	HVAC
Station Attendant	22	22	HVAC
Staff Room	22	22	HVAC
Dispatcher Room	22	22	HVAC
Office Room	22	22	HVAC
Communication room	15	22	HVAC (Note 1)
Hub room	15	22	HVAC (Note 1)
Mini hub room	15	22	HVAC (Note 1)

Electronics Workshop	22	22	HVAC
Washroom	22	N/A	Ventilation & Heating
Janitor Room	18	N/A	Ventilation & Heating
Battery Room	18	N/A	Ventilation, Heating & Gas Monitoring
Electrical Room	15	25	HVAC (Note 1)
Elevator control room	15	25	HVAC (Note 1)
Mechanical Room	18	N/A	Ventilation & Heating
Sump pump room	18	N/A	Ventilation & Heating
Maintenance Room	18	25	HVAC
Boiler Room	18	N/A	Ventilation, Heating & Gas Monitoring
Elevator Hoistway	15	25	HVAC (Note 2)
Workshop	22	22	HVAC
Storage Room	20	22	HVAC
Station secondary entrance, tunnel, and pedestrian bridge	N/A	N/A	Ventilation
Hydro Vault	N/A	N/A	
Shelter	N/A	N/A	Note 3

Notes:

1. For HVAC system detail requirement refer to service rooms requirements in section F.
2. For HVAC system detail requirement refer to Elevators in section D.
3. For HVAC system detail requirement refer to GO-Shelter standard drawing and specification.

7.4.3 Stations

- Heating and Air Conditioning of the waiting area and the service area shall be achieved by energy efficient, premium quality air handling unit c/w outdoor condensing unit, or roof top unit depending on different projects, Equipment shall be accessible for operations and maintenance.
- The service area will have a VAV box controlled by a thermostat, while the main thermostat shall be located in the maintenance room and interlocked with the waiting area temperature sensor.

• Snow melting system • In Floor heating system • Natural gas system • All third party (retail, users) water and gas • Layover Systems including Sand, Fuel, Air and Track Load	(power consumption) • Monitoring of signalling system capability • Hydro • Generator, UPS and Emergency Power Systems (loss of power, monitoring of damper status, batteries status and alarms) • Layover Systems	

- Provide sub-metering for panels and sub-panels with remote communication capability from IT Central Gathering Centre. The system shall be able to store data for a minimum of three (3) years.
- The local BAS shall be able to communicate and send information to an IT Central Gathering Centre.
- The location of the BAS control panel and location of the outlets is to be included on the electrical drawings.
- BAS shall be part of the commissioning process. Two full years are necessary before final commissioning of the BAS system.

7.4.26 Radiant Floor Heating and Snow Melting Systems

7.4.26.1 Design Requirements

Radiant Floor Heating and Snow melting Systems shall refer Metrolinx Standard specifications and Standard drawings for detailed requirements, typical applications include:

7.4.26.1.1 Stations

- Full width hydronic snow melting system shall be installed on all rail platforms, and exterior ramps and stairs leading to platform area.
- Radiant floor heating shall be installed in Station building except areas identified as unconditioned in DS-04 GO Station Architectural Design Standard, mechanical room, communication room and electrical room.

7.4.26.1.2 Bus Operation Facilities

- Radiant Heating system shall be installed in all Bus Facilities.
- Partial snow melting system shall be provided at bus facility ramped entrances.

7.4.26.1.3 Rail Operation Facilities

- Radiant Heating system and snow melting system shall be installed as directed by Metrolinx.

7.4.27.2.2 Hot Water System

- Where gas is available, gas type DHW tank shall be provided.
- Service hot water shall be provided tempered 40°C at station and bus terminal washbasins and in washrooms. Shops, maintenance and garage facilities may have higher temperatures if required.
- A re-circulation system normally is not required in a typical Metrolinx/GO Station building.
- Hot water heaters in stations/bus terminals shall be located in maintenance rooms, ceiling-hung to suit space requirements. Relief valves shall be piped to floor drains with air break.
- A gas fired tankless type hot water system may be used where approved by Metrolinx/GO, to minimize piping.

7.4.27.2.3 Landscape Water System

- Buried water supply piping systems shall be provided for the manual watering of landscaping only if specifically requested by Metrolinx/GO. If requested, they shall consist of PVC piping and quick coupling hose attachments spaced so that every point in the landscaped area can be reached by a 30 m hose extended from the hose attachment.
- The system shall be capable of being completely drained or air-blown dry in the autumn

7.4.27.2.4 Storm Drainage System

- Drainage shall be designed to meet the requirements of local authorities, and the relevant stormwater management study.
- Drainage: oil and grit interceptors and inlet control devices may be required.
- The location of scupper drains and splash pads shall be coordinated with the prime consultant.
- Rail platform shelter roof drains where required, may be directed to Railway R.O.W. ditches, where approved by the Railway, or to a sump pit in the tunnel and then pumped to the storm system.

7.4.27.2.5 Sanitary Drainage System

- Drainage shall be designed to meet the requirements of local authorities.
- All washrooms, maintenance/janitor rooms, mechanical rooms, vending and concession areas and certain maintenance areas as directed by Metrolinx, shall be provided with floor drains and strainers.
- Strainer and sediment buckets shall be provided for heavy-duty floor drains, trench drains, and tunnel floors. Tunnels shall have open shallow trench drains at the wall perimeters.
- Food preparation areas require grease interceptors. This applies particularly to tenant premises.
- Service stations, repair shops, and garages require oil interceptors. Parking lots and elevator pits do not require oil interceptors as per O.B.C.

7.4.27.2.6 Hydrants and Hose Bibs

- Wall hydrants and hose bibs shall be minimum 20 mm anti-siphon, non-freeze type in flush mounted box with locking cover and located at buildings, tunnels and on platforms to suit maintenance requirements as directed by Metrolinx.
- Non-freeze wall mounted hose bibbs shall be provided at station buildings spaced no further than 30m apart along the perimeter of the station building. The location of the hose bibbs shall be

placed such that the surrounding landscape around the station building (i.e. planters, pedestrian walkways etc.) can be serviced by a 18.3m hose. Where there are obstructions preventing a single hose bibb from meeting this criteria, additional hose bibbs shall be provided as required.

- ~~Two non-freeze hose-bibs shall be provided for S~~station buildings shall not be provided with less than two non-freeze hose-bibs. For station buildings where two hose bibbs are sufficient to meet the above criteria, they shall be located ~~at~~on different exterior facing walls.
- Non-freeze wall mounted hose bibbs shall be provided at platforms and in pedestrian tunnels spaced no further than 30m apart along the length of the platform and pedestrian tunnel. The location of the hose bibbs shall be placed such that the entire platform and tunnel can be serviced by a 18.3m hose. Where there are obstructions preventing a single hose bibb from meeting this criteria, additional hose bibbs shall be provided as required.
- Interior wall mounted hose bibbs shall be provided in any room which contains a sump pit.
- Tunnel/platform hose-bib pipe systems shall have gravity drain capability for water shut-off.
- Hose-bibs shall also be located in shops, maintenance facilities, loading docks, bus platforms, etc. as directed by Metrolinx, sized to suit.
- Refer to Metrolinx Standard Domestic Water Piping and Specialties Specification 22 11 00 for detailed requirements

7.4.27.2.7 Pipe Sleeves

- Galvanized steel pipe sleeves shall be provided in concrete structures to accommodate future piping installations, if required.
- Hangers and fasteners shall also be protected from the detergents and moisture or be fabricated of materials that are not subject to corrosion.
- Refer to Metrolinx Standard Basic Mechanical Materials and Methods Specification 20 05 10 for detailed requirements

7.4.27.2.8 Water Meters

- Water supply lines shall be sized for the specific requirements of the facility.
- The incoming service shall be metered inside with an exterior readout acceptable to the local utility.
- Major tenants shall have check-meters.
- Valves: Each fixture shall have a key operated service valve or shut-off valve. All valves shall be labelled with a metal tag.
- Back flow preventers shall be provided.
- Additional shut-off valves shall be provided for each group of fixtures, e.g., a washroom. At least one shut-off valve shall be provided for each room with one or more fixtures.
- Refer to Metrolinx Standard Domestic Water Piping and Specialties Specification 22 11 00 for detailed requirements

7.4.27.2.9 Sump Pumps

- Where storm or sanitary drains cannot be discharged to the sewer by gravity flow, flow shall be discharged into a tightly covered and vented sump pit, from which the liquid is lifted and discharged to the sewer by an automatic duplex pump system with automatic changeover and guide bars. Each pump shall be sized for 100% flow. Pumps shall be epoxy coated with two

- System shall be complete with lifting equipment including lifting davit, chain hoist, lifting device, and chain hook.
- Sump pits are used for shelter, roof, and tunnel drainage, and in elevator or escalator pits.
- Special sump pumps may be required for maintenance facilities or rural stations (TBD).
- Refer to Metrolinx Standard Plumbing Equipment Specification 22 30 00 for detailed requirements.

7.4.27.2.10 Plumbing Fixtures

- All fixtures except janitor sink shall be vandal resistant vitreous china Certified to CAN/ CSA-B45.0, “General Requirements for Plumbing Fixtures”
- All trims to be touchless, electronic, hard-wired barrier free where applicable.
- Refer to Metrolinx Standard Plumbing Fixtures and Trim Specification 22 42 00 for detailed requirements.

7.4.27.2.11 Compressed air system

- Refer to Metrolinx Standard General Service Compressed Air System Specification 22 15 00 for detailed requirements.

7.4.27.2.12 Special Requirements

- Septic systems and/or holding tanks for rural facilities
- Filling stations for locomotive and coach washroom water supply.
- Coach washroom sewage removal facilities at PMBs in train maintenance facilities
- Train and bus wash facilities including recycling of wash water
- Wells or water reservoirs at rural facilities to approval of authorities having jurisdiction, including filtration and purification systems
- A minimum Metrolinx requirement is ultraviolet purification for coliforms and E.coli bacteria with pre-filters
- Thermostat controlled electric pipe heating cables shall be used on all ~~water~~ pipes above frost line in unheated areas, where the water temperature may fall below freezing
- Minimum burial depth of piping shall be 1650 mm or to municipal requirement

7.4.28 Fire Protection Systems

7.4.28.1 Design Requirements

Fire Protection System shall be provided as per Ontario Building Code, NFPA, Ontario Fire Code and Regulators, and refer Metrolinx Standard specifications for detailed requirements.

Table 59: Fire Protection System

Item	Features
Sprinkler System	• Sprinkler heads in public areas shall be concealed flush type. • Drum drips shall be insulated and electrically heat traced, with

3.17. INSTALLATION OF ZONE CONTROL RISER MODULE CABINETS

3.17.1. Provide flush wall mounting cabinets for zone control and inspector's test connection assemblies where required in finished areas. Confirm exact locations prior to roughing-in.

3.17.2. Identify each cabinet with a nameplate in accordance with requirements of Section 20 05 10.

3.18. INSTALLATION OF SPRINKLER HEADS

3.18.1. Provide required sprinkler heads in accordance with following schedule:

Table 3-1: Sprinkler Heads Schedule (Standard of Quality Assurance Manufacturers)

APPLICATION	SPRINKLER HEAD TYPE
Rooms/areas with a suspended ceiling	Victaulic V38/V39 or Tyco Series RFII "Royal Flush II" concealed pendent Victaulic V27 or Tyco Series TY-FRB recessed pendent Victaulic V27 or Tyco Series TY-FRB pendent with escutcheon plates
Rooms/areas without a suspended ceiling	Victaulic V27 or Tyco Series TY-FRB pendent
Elevator shafts	Victaulic V27 or Tyco Series TY-FRB horizontal sidewall
Unheated exterior stairwells	Victaulic V36 or Tyco Series DS-1 dry pipe horizontal sidewall Victaulic V36 or Tyco Series DS-3 wet pipe horizontal sidewall
Air handling system outdoor air and relief air plenums (unheated)	Tyco Series DS-3 ECOH dry horizontal sidewalls in wet piping Victaulic V27 or Tyco Series TY-FRB upright or horizontal sidewall in dry pipe ~~or anti-freeze piping~~
Unheated and unfinished areas	Victaulic V36 or Tyco Series DS-3 ECOH dry horizontal sidewall in wet piping Victaulic V27 or Tyco Series TY-FRB upright or horizontal sidewall in dry pipe ~~or anti-freeze piping~~
Heated areas with overhead doors	Victaulic V27 or Tyco Series TY-FRB horizontal sidewall

c) All hot fluid piping inside the manifold chamber shall be copper, adequately insulated and identified. Each manifold chamber shall have general shut-off valves, capable of isolating the contained manifolds.

d) Piping drainage ports, equipped with isolation valves shall be provided at the low points. Adequate means of drainage shall be provided, to ensure that any leak in the manifold chambers will be disposed of by gravity.

e) Each manifold chamber shall be equipped with a metallic lockable access hatch, equipped with recessed handles.

~~e)~~f) Manifold chamber shall be minimum 2.44 m clearance from edge of platform (track side).

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1.2.5. Hot Fluid Underground Distribution

a) All underground hot fluid distribution between the boiler plant and the manifold chambers, or between various chambers shall be through pre-insulated flexible piping installed in scheduled 40 PVC sleeves; bell and spigot of sleeves to be oriented in the direction of flow through the pre-insulated pipes. Due to its all-plastic construction, the pre-insulated pipe compensates for thermal movement and there is no requirement for expansion joints. The sleeves shall be 2 diameter sizes larger than the combined diameter of the flexible piping, insulation and protection jacket, and buried at a depth suitable for the surface above (pedestrian traffic, vehicular traffic, track right of way, etc).

b) Due to diameter limitations of the pre-insulated piping, multiple circuits may be required between the boiler plant and the manifold chambers, to limit the hot fluid velocity at 1 to 1.5 m/s (3 to 5 ft/s).

c) When leaving the boiler plant and entering the manifold chambers, the pre-insulated piping and associated sleeves will respect the minimum bending radiuses recommended by the manufacturer. Manufacturer-supplied connectors and unions shall be provided where the pre-insulated plastic piping connects to the copper piping in the boiler room and manifold chambers.

1.2.6. Digital Controls

a) The intent is to supply, install, test and commission a complete microprocessor- based programmable control system including all components as described herein and as necessary to make the snow-melting system operate in accordance with the sequences described in these specifications.

2. PRODUCTS

2.1. UNIT GENERAL CONSTRUCTION

2.1.1. Factory assembled rooftop packaged air conditioning units. Units shall include down flow economizer c/w barometric relied damper, solid state enthalpy, and differential enthalpy control. All specified components installed at the factory. Field fabrication of units and their components will not be accepted. Field assembly of modules is acceptable only when performed and certified by the manufacturer's representatives.

2.1.2. The units will be completely factory pre-wired and tested, requiring a single point power supply at the voltage available at the location where the installation will take place.

2.1.3. The units shall also be equipped with a transformer to provide a separate 115V/1 phase service to ancillary factory pre-wired components such as marine lights, receptacles, controls, etc. The transformer shall be wired to a different circuit from that serving the air handler, so that shutting down the power to the unit will not affect the power supply to the 115V/1phase circuit. Preeminent labelling in this respect will be provided inside and outside the unit.

2.1.4. The units shall be designed to be supported by perimeter roof curb.

2.2. CASING

2.2.1. The unit shall be constructed out of 50 mm (2") thick wall and roof panels.

2.2.2. ~~The panel outer layer shall be made out of painted 16 gauge solid satin coat steel sheet in accordance with ASTM-653.~~Cabinet shall be constructed of heavy gauge, minimum 18 gauge galvanized steel panels. Galvanized coating shall conform to ASTM 653.

2.2.3. ~~Acoustic/ thermal insulation 50 mm (2") thick and 4.5 lb/cu.ft. density fibreglass to be installed between the outer and inner layers.~~ Insulation shall be 50 mm (2") thick neoprene faced, minimum 32 kg/m³ (2 lb/ft³) density insulation meeting 25/50 flame spread/smoke developed ratings when tested to CAN/ULC S102.All insulation and accessories including adhesives and facing shall have a composite fire and smoke hazard rating tested by ASTM E84, NFPA 225, and UL 723 not exceeding; Flame Spread 25, Smoke Developed 50.

2.2.4. All outdoor units shall be finished with Amershield, High Solids two component Aliphatic polyurethane coatings weather resistant topcoat for extra heavy service. The exterior finish for outdoor units shall withstand the Salt Spray Test of ~~3,000 hrs~~ minimum 672 hours and per ASTM B117.

2.3. ACCESS DOORS

2.3.1. Units shall be provided with access doors on one side of the unit.

2.3.2. Doors must be the same thickness as the unit casing to maximize thermal and acoustical resistance.

2.3.3. Standard stainless steel hinged access panels, air and water sealed and equipped with ¼ turn latching handles. ~~Hinges shall be continuous piano type stainless steel complete with 2 "Ventlok" type high pressure latches operable from either side of the door shall be provided. The door opening shall be fully gasketed with continuous ½" closed cell hollow round black gasket and a metal encapsulated reinforcing backing that mechanically fastens to the door frame.~~

2.4. FILTERS

2.4.1. Filter sections shall be provided with adequately sized access doors to allow easy removal of filters.

2.4.2. 50 mm (2") Pleated Panel Disposable Filters: Non-woven cotton fabric media with a metal support grid and heavy duty beverage board enclosing frame. The filter media shall have minimum average efficiency of 65% and MERV 11 as per ASHRAE Standard 62.1 and tested to ASHRAE Standard 52.2.

2.5. INDIRECT GAS FIRED HEATING SECTION

2.5.1. Heating units shall have an indirect natural gas heating section that is C-ETL, approved for both sea level and high altitude areas. The entire assembly shall be approved and labelled by a nationally recognized certification agency.

2.5.2. Efficiency: no less than 82% across the full firing spectrum.

2.5.3. ~~Heat exchanger shall be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane metal tubulators, and shall be of a floating stress relieved design.~~Heat exchanger shall consist of stainless steel tubes and burner.

2.5.4. The burner assembly shall be a blow through positive pressure type with an intermittent pilot ignition system to provide a high seasonal efficiency. Flame surveillance shall be with a solid state programmed flame relay complete with flame rod.

2.5.5. ~~Unit discharge air control shall include 15:1 turndown (HT burner) turndown for all input ranges from 29.3 kW to 410 kW (100MBH to 1400MBH).~~Unit discharge air control shall include 4:1 turndown (HT burner) turndown for all input ranges from 29.3 kW to 410 kW (100MBH to 1400MBH).

2.6. DX COOLING COILS

2.6.1. Coils shall be ARI certified and Underwriter's Laboratories listed. All coils shall be circuited in a counter flow manner with uniform circuits. Coils shall be designed and tested in accordance with ASHRAE 15. Coils shall be fully enclosed within casing and mounted on angle frames manufactured to allow coils to be individually removed.

2.7. CONDENSING SECTION

2.7.1. Refrigeration Compressors

a) Compressors shall be fully hermetic scroll type, set on resilient neoprene mounts. Compressors are complete with crankcase heaters, internal line break motor protection and an internal pressure relief. Compressors are high efficiency and matched with liberally sized condenser coils so that the EER ratings meet or exceed ASHRAE 90.1 recommendations. Refrigerant: choice of R-410A or R- 134A.

2.7.2. Each compressor piping circuit shall have a liquid line filter dryer and a moisture indicating sight glass.

2.7.3. Compressors shall incorporate an internal or external pressure-limiting device to protect against high pressure. Compressors shall be provided with means of over-load protection. Scroll compressors shall be equipped with a device to limit noise due to scroll reversal.

2.7.4. Heat Rejection Fans and Motors

a) Heat Rejection fans shall be direct driven propeller type arranged for vertical draw through air flow.

2.7.5. Heat Rejection Coils

a) Heat Rejection coils shall be copper tube type, mechanically expanded into aluminium fins. Fins density shall not exceed 14 units per inch.

2.7.6. Refrigerant Accessories

a) ~~Thermal expansion valves shall be equipped with a remote sensing bulb, external equalizer line and fully adjustable superheat setting (default value: 66 °C to 93 °C [150 °F to 200 °F]).~~Thermal expansion valve shall be equipped with adjustable superheat and external equalizer as standard feature setting (default value: 66 °C to 93 °C [150 °F to 200 °F]).

b) Hot gas by-pass shall be provided on the lead compressor to maintain adequate suction pressure at low loads. The hot gas by-pass shall be introduced into the evaporator distributor and not directly into the suction line.

c) Five-minute anti-short cycling timer shall be provided on the lead compressor, together with inter-stage time delay relays on subsequent stages.

2.8. FACTORY MOUNTED CONTROLS

2.8.1. Unit control panel shall be compatible with and integrated to BAS.

1.14.15. Electrical items associated with mechanical equipment are to be certified and bear stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.

1.15. EXAMINATION OF DOCUMENTS AND SITE

1.15.1. Carefully examine Documents and visit site to determine and review existing site conditions that will or may affect work, and include for such conditions.

1.15.2. Report to Consultant any existing site condition that will or may affect performance of work as per Documents. Failure to do so will not be grounds for additional costs.

1.15.3. Upon finding discrepancies in, or omissions from Documents, or having doubt as to their meaning or intent, immediately notify Consultant, in writing.

1.16. PERMITS, CERTIFICATES, APPROVALS AND FEES

1.16.1. Contact and confirm with local authorities having jurisdiction including utility providers and environmental regulators, requirements for approvals from such authorities. Obtain and pay for permits, certificates, and approvals required to complete Work.

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1.16.2. Be responsible for ensuring that authorities having jurisdiction which require on-site inspection of work, have ample notification to perform inspection, with sufficient lead time to correct deficiencies in a manner that will not impede schedule of completion of Work. If any defect, deficiency or non-compliant is found in work by inspection, be responsible for costs of such inspection, including any related expenses, making good and return to site, until work is passed by governing authorities.

1.16.3. Obtain and submit to Consultant, approval/inspection certificates issued by governing authorities to confirm that Work as installed is in accordance with rules and regulations of local governing authorities and are acceptable.

1.16.4. Include in each copy of operating and maintenance instruction manuals, copies of approvals and inspection certificates issued by regulatory authorities.

1.17. REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS

1.17.1. Professional engineers retained to perform consulting services with regard to Project work, i.e. seismic engineer, fire protection engineer or structural engineer, are to be members in good standing with local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of governing authorities in Place of the Work.