

1. General:

- .1 Comply with local Codes and Bylaws, Building Code Act (BCA) and Ontario Building Code (OBC) including:

BCA: 1.1-(3) Role of Buildings. *It is the role of a builder,*

- a) *To ensure that construction does not proceed unless any permit required under this act has been issued by the chief building official.*
- b) *To construct the building in accordance with the permit.*
- c) *To use appropriate building techniques to achieve compliance with this act and the Building Code.*
- d) *To notify the designer and an inspector or registered code agency as appropriate, when site conditions affect compliance with the Building Code.*

BCA 8 (13) Prohibition.

No person shall construct or demolish a building or cause a building to be constructed or demolished except in accordance with the plans, specifications, documents and any other information on the basis of which a permit was issued or any changes to them authorized by the chief building official.

- .2 Ontario Building Code (OBC) shall be considered a minimum standard for construction and where the Act or the OBC is exceeded by the requirements of this document (drawings and/or specifications), this document shall govern, unless revised in writing by the Engineer. Merely "Meeting the Code" and acceptance by the Building Official are not grounds for avoiding installation of the mechanical systems as documented and the Contractor shall bear any and all costs associated with making the required upgrades to the satisfaction of the Engineer.
- .3 Permits: Obtain all mechanical related permits, make arrangements for inspections, and effect repairs required by Inspectors at no cost to the Owner. Provide the Consultant a "Certificate of Approval" from the Inspecting Authorities at completion of the work.
- .4 Warrantee: Repair or replace, at no cost to the owner, any defect in workmanship or materials which appear within a period of one year from the date of substantial completion of the work. Pay for all damage resulting from the deficiency which occurs within the warrantee period. Contractor shall not be held liable for anything attributable to acts of the Owner or His Agents. Co-ordinate the work of this trade with the General Contractor for timely completion of each phase of construction.
- .5 Equipment Placement: Provide all hoisting, rigging and scaffolding associated with the installation of the equipment and material associated with this contract.

- .6 Roof Penetrations: Make arrangements with the Building Roofer to install all roof mounted equipment so the warrantee can be maintained.
- .7 Provide miscellaneous steel, cutting and patching or make arrangements with the General Contractor for such work as may be required to complete the contract. Include for marking of duct openings through block walls for the General Contractor to cut and reinforce based on details provided by the Structural Engineer. Cut and patch or core pipe sleeve openings as detailed on the drawings. Co-ordinate the work of this trade with the General Contractor for timely completion of each phase of construction.
- .8 Do not cut structural elements without written authorization from the Consultant and/or the Structural Engineer.
- .9 Drawings & CADD Files: Bekolay & Associates retain copyright to all drawings and specifications created for this project and said works (both hard copy and CADD files) are not to be copied or distributed without written consent. Costs for assimilation and/or distribution will be established upon written application to Bekolay & Associates for copies.

2. Equivalents and Alternates:

- .1 Manufacturer's names listed in these specifications set the standard for the material and energy efficiency requirements to comply with SB-10 but are not intended to exclude other manufactures from bidding with equivalent products.
- .2 Products not meeting all design requirements are considered "alternates" and they will be rejected until the specified item or equivalents meeting the energy efficiency requirements acceptable to the Engineer are provided. However, alternate products meeting the general intent accompanied by a savings allowance (including breakdown of material and labour) may be submitted for consideration provided they do not violate the SB-10 requirements. There is no obligation for acceptance.

3. Motor Efficiencies and Equipment Ratings for Mechanical Equipment:

- .1 All electrical motors supplied with mechanical equipment shall comply with OBC SB-10, sentence 10.4.1 and tables 10.4.1 (a) or 10.4.1 (b)
- .2 Energy Ratings: All furnished equipment to comply with energy efficiency regulations, current ASHRAE 90.1 Standard, and OBC SB-10: Section 6 Heating, Ventilating and Air Conditioning (Tables 6.8.1.A:G), and SB-10: Section 7 Service Water Heating (Table 7.8).

4. Seismic Restraints:

- .1 Include certified restraints for all mechanical equipment including piping, ductwork and equipment as required by OBC Part B, article 4.1.8.17 "Elements of Structures, Non-Structural Components and Equipment".
- .2 Provide suitable pre-engineered systems or;
- .3 Include the services of a Professional Structural Engineer (registered in Ontario) to design, sign and seal drawings for all seismic restraints (including permit approval from the Authority having jurisdiction).

5. Shop Drawings:

- .1 Provide "PDF" or 3 hard copies of shop drawings for review by the Engineer.
- .2 Submit product data for all specified equipment or trim including but not limited to:
 - (a) ULC listed Fire dampers complete with installation details and manufacturers installation drawings.
 - (b) Fire stop systems in use where plastic pipe penetrates fire rated assemblies.
 - (c) Grilles, diffusers, fans, AHU's, heat pumps, plumbing fixtures & trim, pumps, valves, hot water tanks, thermostats & controls.
- .3 Shop drawings and product data shall be accompanied by:
 - (a) Detailed drawings of bases, supports, and anchor bolts.
 - (b) Acoustical sound power data, where applicable.
 - (c) Points of operation on performance curves.
 - (d) Manufacturer to certify as to current model production.
 - (e) Certification of compliance to applicable codes.

6. Record Drawings:

- .1 Record all changes as work progresses and as changes occur on a set of clean prints. This shall include changes to existing mechanical systems, control systems and low voltage control wiring.
- .2 Use different colour waterproof ink for each service.
- .3 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "RECORD DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
- .4 Make available for reference purposes and inspection at all times.

7. Fire Stopping:

- .1 Retaining angles all around duct, on both sides of fire separation.
- .2 Fire stopping material and installation must not distort duct.
- .3 Provide details of ULC listed fire stopping system for use where plastic piping penetrates fire separations.
- .4 Fire Dampers: Comply with detail on the drawings or manufacturers ULC instructions.

Plumbing & Piping**8. Pipe Insulation:**

- .1 Piping:
- (a) Insulate all hydronic piping associated with pump loop P-3 and all hot and cold potable water piping as follows:
- i. Pre-formed fiberglass in 900mm sections with all service jackets sealed with aluminum tape.
 - ii. Closed cell elastomeric foam meeting the required 25/50 smoke and flame spread ratings (Armacell)
- (b) Thickness: (to ASHRAE 90.1 table 6.8.3A)
- | (a) Pipe Size | Heating & DHW | DCW |
|---------------------|---------------|------|
| (b) 12mm to 32mm | 25mm | 25mm |
| (c) 38mm and larger | 38mm | 25mm |
- (c) Jacket:
- i. Provide white, preformed PVC jacket for all exposed insulated pipe including mechanical rooms, closets, & exposed ceilings.
- (d) Hangers:
- i. Outside of jacket for all.

9. Identification:

- .1 50mm outside (or insulated) diameter: Provide all weather vinyl pipe markers and tags with arrows and tape bands to identify all piping (except sprinkler branch piping) including direction (and supply or return where applicable).
- .2 38mm & smaller: pre-formed, curled vinyl sleeves with coloured letters & background.
- .3 Comply with ANSI standards for colours and identification requirements. Meet WHMIS tag requirements where applicable.
- .4 Marker separation shall be such that any pipe can be readily identified and not exceed 25 feet between markings.
- .5 Std: Brady, Top Tape & Label Ltd

10. Hangers:

- .1 Uninsulated Copper Pipe (Any System):
- (a) Bare piping:
- i. Factory PVC coated or copper hangers. Duct tape or similar applications are not acceptable.
 - ii. Split Ring metal support ring with integral rod connection and EPDM corrugated pipe ring.
 - iii. Clevis hangers and tape are not acceptable.
 - iv. Std: Caddy Superfix Series 454
- (b) 32mm & smaller:
- i. Swivel loop hanger with electro-zinc plated band with hanger rod nut
 - ii. Std: Caddy Series 100

- (c) 38mm and larger:
 - i. epoxy coated or electro-zinc plated split black iron clevis
 - ii. Std: Caddy Series 401, 427 or 420
- .2 Insulated Piping (38mm & Larger)
 - (a) Oversize hangers to fit over the insulation and/or outside of the jacket
 - (b) Electro-zinc plated split clevis with spot welded shield
 - (c) Std: Caddy Series 403

11. Water Piping:

- .1 Potable Water Piping:
 - (a) type 'M' copper with 95-5 lead free solder joints and fittings
OR
 - (b) PEX:
 - i. Color coded cross-linked polyethylene (PEX) water piping with brass fittings and standard or SSC clamps installed by Plumber suitably trained in the manufacturer's installation methods and tools
 - ii. PEX Distribution System: ASTM F 877, SDR 9 tubing.
 - iii. Fittings: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
 - iv. Manifold: Multiple-outlet, plastic or corrosion resistant metal assembly complying with ASTM F 877
 - v. Std: Zurn PEX non-barrier tubing (Red & Blue)
 - (c) Isolation valves: ball valve type with adapters as required.
 - (d) Rigidly fasten water supplies to the internal wall structure and secure with wing back elbow or similar fastening. Limit exposed piping through wall and conceal with chrome escutcheon, terminate with chrome plated straight or angle ball valve. Extend to fixture with braided stainless steel supplies.
- .2 Water Hammer Arrestor: Provide manufactured stainless steel or copper construction, bellows or piston type to PDI-WH 201 shock absorber at end of water lines to wc's. (Air chambers not acceptable.)
- .3 TSP: Conceal trap seal primers in ceilings or walls c/w access doors as required. Provide TSP's on all floor drains outside suites.

12. Exterior Below Grade Walls and SOG Floor Pipe Penetration Seals:

- .1 EPDM mechanical rubber pipe seal to withstand up to 20 psig of head pressure in temperature ranges from -40 to 250°F including stainless steel backing plates and bolts.
- .2 Std: Proco Products Pen-seal model PS.

13. Plumbing Piping:

- .1 Plumbing & vent piping above grade:
 - (a) NPS 1-1/2" and smaller DWV copper with solder joints
 - (b) NPS 2" and larger shall be cast iron with MJ neoprene couplings
OR
 - (c) System XFR 15-50 PVC DWV solvent weld pipe and fittings with suitable fire stopping and MJ grey expansion couplings on risers. Note, regular PVC is not acceptable and shall not be installed.
 - (d) Extend vent piping from all plumbing fixtures to vent stacks through roof complete with weatherproof flashing to comply with OBC.
 - (e) Provide plumbing and vent connections to all fixtures with chrome plate traps with cleanouts. Brass or plastic not acceptable. Provide trap insulation for barrier free sinks.
 - (f) Floor drain trap seal primer: all brass with integral vacuum breaker, NPS 12mm continuous soft copper line drip line connection with tapping on drain body
- .2 Plumbing and vent piping below grade:
 - (a) PVC or ABS with solvent weld joints.
 - (b) SRD with ringtite joints.
 - (c) Provide 150mm of compacted sand bedding in the bottom of all trenches. After inspection by the Engineer cover and compact at least 150mm of sand over piping. Granular fill in contact with the piping is not acceptable.

14. Backflow Preventer:

- .1 Potable water & Sprinkler System Isolation: Provide one for each.
- .2 Double check assembly with an intermediate relief valve (piped to drain) for high hazard cross connections and continuous pressure applications c/w ball type test cocks, ball type isolation valves.
- .3 Std: Watts Regulator Series 909

15. Plumbing Fixtures:

- .1 Lavatories:
 - (a) Bowl Lav-1:
 - i. 518x441 semi-oval, counter mounted, vitreous china bowl, self-rimming, front overflow, gasket and swivel clamps, 100mm centers, and chrome trap meeting ADA requirements
 - ii. Std: American Standard "Aqualyn"
 - (b) Bowl Lav-2:
 - i. Vitreous china, universal design, wall-hung sink meeting the requirements for barrier free design c/w insulated trap or knee guard & concealed arm floor support.
 - ii. Size: 394x343x127
 - iii. Std: American Standard "Murro"

- (c) Trim Lav-1 & Lav-2:
 - i. Chrome plated brass with dual lever, washerless, pressure balanced supplies, pop-up waste and aerator.
 - ii. Provide chrome plated trap with cleanout and ADA trap insulation
 - iii. Set temp limit to 43°C
 - iv. Std: Moen, Delta or Waltec
- .2 SS Sinks:
 - (a) KS-1:
 - i. Single bowl (hospitality sink) 330x280x150mm stainless steel, ledge back, kitchen sinks complete with strainer & trap.
 - ii. Std: Kindred QSL1515/6
 - (b) Trim:
 - i. Commercial grade two blade handle (barrier free compliant) gooseneck faucet (108mm swing), stainless steel and brass construction chrome finish, pressure balanced replaceable cartridge,
 - ii. Std: Delta 2171-WBHDF
- .3 Water Closets:
 - (a) WC-1:
 - i. Floor mounted, close coupled, barrier free compliant, tank type, vitreous china, universal height, elongated bowl, low consumption toilet.
 - ii. 4.8LPF flush tank and fittings. 12mm Chrome plated angle ball valve with chrome nipple & wall escutcheon, braided stainless steel flexible supply.
 - iii. Std: Toto "Eco Drake, ADA" with "SoftClose" seat and cover. American Std. or Crane equivalents.
- .4 Showers SH-1:
 - (a) Shower Enclosure:
 - i. Tiled by GC
 - (b) Trim:
 - i. Pressure balanced, single lever, concealed type with, temperature limits and integral water stops, chrome-plated lever handle, access escutcheon and 9.5 L/m shower head. Provide wing back elbow, & securely fastened structure to support shower head nipple.
 - ii. All suites to include handshower on slide bar with 5 foot spiral hose. (Moen model 3868)
 - iii. Std: Moen Commercial Single Handle Posi-temp
- .5 Garbage Room Service Faucet:
 - (a) Built-in elevated vacuum breaker, cast brass spout, 400mm long rubber hose, indexed cross handles, escutcheons, union inlets, heavy cast brass spout with pail hook, braced to the wall, integral stop valves
 - (b) Std: Cambridge Brass 53t4333, Crane CH-8560, Emco 390 XXBE, Fiat 830 AA, Chicago Faucet

- .6 Mop Sink:
 - (a) Molded stone, 550x450x300mm deep complete with cast brass outlet strainer, stainless steel rim guard, continuous on three sides, bolted to the rim.
 - (b) Std: American Std. AB-7692-0230, Crane 7-525, Fiat TSB-100
 - (c) Trim:
 - i. Built-in elevated vacuum breaker, cast brass spout, 400mm long rubber hose, indexed cross handles, escutcheons, union inlets, heavy cast brass spout with pail hook, braced to the wall, integral stop valves
 - ii. Std: Cambridge Brass 53t4333, Crane CH-8560, Emco 390 XXBE, Fiat 830 AA, Chicago Faucet
- .7 Laundry Tub:
 - (a) Molded stone, 116x610x352mm, wall mounted, twin compartment
 - (b) Std: Fiat "LTD Laundry Tub"
 - (c) Trim:
 - i. Deck mounted rough chrome brass construction, 86mm fixed centers, hot and cold water laundry sink faucet with mounting clamps.
 - ii. 150mm S type swing spout & metal lever handles
 - iii. Std: Chicago Faucets "686-RCF"

16. Grease Interceptor:

- .1 Fabricated steel grease interceptor, epoxy coated inside and outside.
- .2 To include; one piece removable baffle assembly, code approved deep seal trap, and secured non-slip cover with gasket.
- .3 Capacity:
 - (a) 20 GPM
 - (b) 40 Lbs
- .4 Std: Watts WD-120

17. Hair Interceptor:

- .1 Cast iron sediment interceptor, epoxy coated with removable stainless steel sediment bucket and secured, flush mounted, gasket sealed cover.
- .2 Std: Watts SI-740

18. Floor Drains:

- .1 General:
 - (a) General duty, round cast iron body, adjustable head and nickel bronze strainer.
- .2 FD-1: Watts FD-200
- .3 FD-2: Watts FD-460-AF (300x300mm)
- .4 FD-3: Watts FD-100-C-L (152x152mm)
- .5 FFD-1: Watts FD-200-EG
- .6 SC-1: Watts FD-200-AS
- .7 SC-2: Watts FD-100-C-AS

19. Trench Drain:

- .1 Pre-sloped trench drain system with polypropylene frame, & channel, integral 4" bottom outlet, & polypropylene grate.
- .2 To include frame connectors & grate anchors.
- .3 Watts Dead Level P

20. Roof Drains:

- .1 Controlled flow aluminum or cast iron body, under deck clamp and sump receiver to suit roof construction, flashing clamp ring with integral gravel stop, bearing pan, flow control two weir assembly, aluminum, self-locking cast iron or polyethylene dome.
- .2 A single slot weir in each roof drain
- .3 Std: Equal to Watts RD 100 ABED, Enpoco E2600 BDX Zurn ZCF 121 RC, Uflow "Classic-P", Jay R.Smith 1011

21. Thermal Expansion Tank (EXP-1):

- .1 Diaphragm type, vertical expansion tank for use in potable closed loop water systems
- .2 Capacity: 8 Gal, 125 PSI working pressure
- .3 Std: Amtrol Therm-x-trol ST-20VC

22. Domestic Hot Water Tanks:

- .1 General:
 - (a) High efficiency, gas fired, direct vent, condensing water heater with, spiral wound flue tube, and modulating gas, down fired, power burner.
- .2 Capacities (DHWT-1 & 2):
 - (a) 379 L (100 usgal) glass lined tank.
 - (b) 44 kW (150 mbh) input & 674 LPH (175 usgal) recovery thro' 56°C temp rise.
- .3 Std: AO Smith Cyclone Mxi BTH-150.

23. Instantaneous Hot Water Heater:

- .1 General:
 - (a) Tankless, gas fired condensing water heater with stainless steel heat exchangers & direct vent.
 - (b) For outdoor installation.
- .2 Capacity:
 - (a) 58kW (199MBH) gas input.
 - (b) 120V/1% \pm C/60hz electrical
 - (c) 18.5LPM (4.9USGPM) flow through 43°C (77°F) temp rise.
- .3 Std: Rheem RTGHN-95XLN Outdoor, HTP RTC-199, Navian NPE Series

24. DHW Re-Circulation Pumps (P-3,4,5):

- .1 Stainless steel body, cartridge type pump with, built in check, 24 hour timer/aquastat combination, and plug in cord.
- .2 Capacity: 6GPM @ 20ft
- .3 Electrical: 120/1/60
- .4 Std: Taco 009-IFC w/ Timer Aquastat.

25. Sump Pumps (SP-1, 2, & 5):

- .1 SP-1 & SP-5:
 - (a) Packaged, basin type sump system.
 - (b) 1/4 hp submersible sump pump with vertical mechanical float switch and oil-filled motor with cast iron housing.
 - (c) Heavy duty, 5 Gallon polypropylene tank
 - (d) Capacities:
 - i. 120/1/60, 0.25 HP
 - ii. 20 usgpm @ 10 ft
 - (e) Std: Hydromatic 118-5
- .2 SP-2:
 - (a) Submersible drainage effluent sump pump with vertical mechanical float switch and oil filled motor with cast iron housing, auto reset, and thermal overload protection.
 - (b) Capacities:
 - i. 120/1/60, 3/10 HP
 - ii. 20 usgpm @ 10 ft
 - (c) Std: Hydromatic V-A1

26. Sewage Pumps (SP-3 & 4):

- .1 Packaged, Basin type duplex sewage pump system capable of 2" solids handling.
- .2 2x 4/10 hp submersible sewage pumps with vertical mechanical float switch, duplex controller, high level alarm, oil filled motors, and cast iron housings.
- .3 Heavy duty 110 Gallon polypropylene basin.
- .4 Capacities: (per pump)
 - (a) 120/1/60, 4/10 HP
 - (b) 100 gpm @ 10 ft
- .5 Std: Liberty pumps 1100 series with LE40 pumps.

27. Natural Gas Piping:

- .1 Provide natural gas piping from Enbridge meter to building gas fired equipment.
- .2 Piping shall be schedule 40 black iron complete with lubricated isolating valves and:
 - (a) Malleable iron fittings for exposed installation.
 - (b) Welded fittings for ceiling or concealed installation.
- .3 Conform to Ontario gas Utilization Code including installation and testing.
- .4 Painting: Clean and epoxy prime paint bare piping followed by two coats of enamel.

HVAC**28. Duct Work:**

- .1 Ductwork shall comply with ASHRAE (medium pressure standards), SMACNA and ICGIH details and recommended practices.
- .2 All Supply, Return and Exhaust ductwork: Provide radiused elbows and take-offs ($r/D=1$ min) unless turning vanes are provided.
- .3 At supply and return connections to roof top units, provide full radius fittings from vertical to horizontal runs, preferably with size transition just below the curb.
- .4 Bull head fittings, short and zero inside radius elbows (except where turning vanes are used) are entirely unacceptable and must be replaced at the Contractor's expense.
- .5 Do not re-organize ductwork layouts (indicated on the drawings) without written approval from the Engineer.
- .6 Tape and seal all supply air ductwork.
- .7 Install the ductwork free of pulsation and chatter and make any repairs required when system is commissioned.

29. Kitchen Exhaust Ductwork:

- .1 All welded 16 Gauge ductwork from hood to exhaust fan including required access doors for inspection and cleaning in accordance with NFPA 96.

30. Fire Dampers:

- .1 Do work in accordance with CAN4-S112-M82 (R1987), Fire Test of Fire Damper Assemblies, except where specified otherwise.
- .2 Fire dampers: listed and bear label of ULC meet requirements of provincial fire authority.
- .3 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .4 Top hinged: multi-blade hinged or interlocking type; sized to maintain full duct cross section.
- .5 Fusible link actuated, weighted to close and lock in closed position when released or having negator spring closing operator for multi-leaf type in horizontal position with vertical air flow.
- .6 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .7 Provide access doors into ductwork to permit re-setting of fire dampers Contractor shall demonstrate that the fire damper can be reset through the access door provided by an average sized serviceman.
- .8 Install in accordance with NFPA 90A-1985 and in accordance with conditions of ULC listing.
- .9 Maintain integrity of fire separation.
- .10 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdictions.
- .11 Install access door adjacent to each damper.

31. Fire stopping:

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

32. Duct Insulation:

- .1 Acoustic Insulation:
 - (a) Maintain the inside duct dimensions on the drawings by increasing the duct sizes to accommodate the insulation where required.
 - (b) Natural cotton fiber or rigid board glass fiber duct liner acoustic/thermal (R-2) duct liner with air side factory coated with black fire resistant and abrasion resistant liner over 100% of the exposed surface.
 - (c) Microbial resistant (complying with ASTM G21 and G22) and moisture resistant (ASTM C1104) with a flame spread and smoke development rating not exceeding 25/50 respectively without emitting toxic fumes (complying with UL 181 and NFPA90A)
 - (d) Thickness:
 - i. 25mm (1") thick insulation on interior of supply and return ducts within 3m (10 ft) of fans as indicated.
 - (e) Std: Titus Enviroloc, Fiberglass Canada "Line Acoustic-R" or Ottawa Fibre Industries Series 48
 - (f) Adhesive & Sealer:
 - i. To requirements of ANSI/NFPA 90A with same flame spread and smoke ratings as insulation.
 - (g) Fasteners:
 - i. Weld or adhesive plated pins 2.0mm diameter, length to suit insulation with metal retaining clips, 32mm square.
 - (h) Joint Tape:
 - i. Poly-vinyl treated open weave fiberglass membrane 50mm wide.
- .2 Thermal Insulation:
 - (a) Insulate rectangular ductwork with rigid insulation, pinned and fastened complete with foil jacket.
 - (b) Insulate round ductwork with flexible insulation complete with foil jacket (except for flexible ductwork which shall be supplied with factory installed insulation).
 - (c) Thickness:
 - i. Inside space: 25mm w/ installed R=0.74
 - ii. Truss space: 75 mm w/ installed R=1.46
 - iii. Std: Owens Corning Duct Wrap Type 75
 - (d) Insulate exhaust ductwork with 25mm insulation, at last 1500mm from the outlet.

- .3 Kitchen Exhaust Ductwork Insulation:
 - (a) Provide ULC listed "3M Firemaster Duct Wrap" zero clearance insulation consisting of 1-1/2" flexible fireproof blanket fully encapsulated in a foil scrim from hood collars to exhaust fan inlet in lieu of required clearances from ceiling to duct.
 - (b) The wrap material shall be applied onto the installed ductwork strictly in accordance with the manufacturer's instructions and ULC listing design number FRO-4, guide number 40U21 "fire resistant ducts" and tested to ISO Standard 6944 and ULC Guide Number 440E9 per 0mm clearance to combustibles.
 - (c) All hangers, support rods, concrete anchors, and fire stopping in accordance with the ULC listing and the Manufacturer's Instructions

33. Turning Vanes:

- .1 Factory or shop fabricated single and double thickness to recommendations of SMACNA, as indicated and in all elbows supply and return where the inside radius of the elbow is less than ½ the duct width.

34. Flexible Connections:

- .1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.
- .2 Material: Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at minus 40°C to 90°C, density of 1.3 kg/m².
- .3 Length of connection: 100mm with min 75 mm installed clearance between frames.

35. Flexible Ducts:

- .1 Factory fabricated spiral wound flexible aluminum.
- .2 Minimum working pressure 2.5 kPa.
- .3 Maximum length in a branch run to a diffuser not to exceed 2 meters.
- .4 Provide nylon tie wrap around flex at connection to branch duct and sectional elbow at ceiling diffusers.

36. Constant Volume Air Valves (CVAV):

- .1 Pressure independent control valve with factory calibrated integral plunger assembly accurate to within 5% of flow.
- .2 14 Ga spun aluminum construction with stainless steel shaft and bearings.
- .3 Operational pressure: 0.6 - 3.0"wc
- .4 Sizes according to CVAV Schedule.
- .5 Std: EH Price VVA

37. Provide New Diffusers As Follows:

- .1 Type "A"
 - (a) Supply:
 - i. Aluminum, double deflection wall grilles with 20mm vertical blades parallel to the short dimension, opposed blade damper, 25mm border with separate mounting frame and baked enamel finish
 - ii. Std: EH Price 620
 - (b) Return:
 - i. Aluminum, fixed deflection wall grilles with 20mm spacing parallel to the long dimension, opposed blade damper, 25mm border with separate mounting frame and baked enamel finish
 - ii. Std: EH Price 630
- .2 Type "B"
 - (a) Surface mounted, steel, round cone ceiling diffuser with OBD, & 2 position adjustment.
 - (b) Std: EH Price RCDE
- .3 Type "WMG"
 - (a) Field fabricated wire mesh grill.

38. Transfer Fan:

- .1 TF-1:
 - (a) Direct drive, backward inclined, plug type fan.
 - (b) Capacity: 90 L/s @ 75 Pa c/w high limit, line voltage t'stat.
 - (c) Electrical: 120/1/60
 - (d) Std: Reversomatic RI-250

39. Exhaust Fans:

- .1 EXH-1:
 - (a) Direct drive, forward inclined, inline duct blower with vibration isolation.
 - (b) Provide timeclock for off hour operation.
 - (c) Capacity: 165 L/s @ 32 pa
 - (d) Electrical: 120/1/60, 1/20 HP
 - (e) Std: Greenheck SQ 85
- .2 EXH-2:
 - (a) Direct drive, forward inclined, inline duct blower with vibration isolation & high limit line voltage t'stat
 - (b) Capacity: 142 L/s @ 32 pa
 - (c) Electrical: 120/1/60, 1/30 HP
 - (d) Std: Greenheck SQ 75

40. Kitchen Exhaust Fan (EXH-3):

- .1 Continuously welded 16 gauge painted steel utility blower to be belt drive centrifugal with backward inclined wheel. Vibration isolated and UL rated for grease laden air and compliant with NFPA 96.
- .2 Motor to be VFD ready, fresh air cooled and accessible for maintenance.
- .3 Provide separate VFD Control:
 - (a) Rated for 600V, 3 phase, 1.5 kW
 - (b) 0-10V analog inputs
 - (c) 24V control voltage
 - (d) To control fan speed from conveniently located manually controlled 0-10V speed selector.
 - (e) Interlock with fire suppression system for full speed when alarm is triggered.
- .4 Capacities:
 - (a) 1700 L/s @ 187 Pa (3600 CFM @ 0.75" WG)
 - (b) 208V/3/60 1.5 HP VFD capable motor
- .5 Std: Delhi BI-RM-16 & Honeywell SmartVFD

41. Packaged Heat Recovery Make-up Air unit (MUA-1):

- .1 Packaged gas fired rooftop unit with modulating gas, (25:1) water cooled DX cooling, heat recovery pipe, insulated roof curb, & vibration isolation.
- .2 Programmable Controller with adjustable discharge air temperature set point, heating/cooling/auto and fan switch, trouble and filter status indicators, mounted in ground floor admin office.
- .3 Statically and dynamically balanced belt driven fan with slide rails and isolators.
- .4 Casing: 18 Gauge galvanized sheet metal with baked enamel finish and neoprene coated 2" insulation with perforated metal liner for fan, coil and heating section. Include access doors with cam lock fasteners for service to all components.
- .5 Filter Section: As above less insulation complete with rack of 2" pleated, 30% ASHRAE efficiency replaceable filters and intake hood.
- .6 Direct expansion cooling system complete with hermetic compressors, refrigerant piping and accessories, coils, water source heat exchanger, condensate drain and controls.
- .7 Standard efficiency, indirect gas fired heating section with stainless steel heat exchanger and 25:1 turndown. To include supply air temperature controls with freezestat & smoke detector.
- .8 Hermetically sealed refrigerant heat pipe system to transfer heat from the exhaust to the supply air system including defrost, tilt, & controller.
- .9 Capacities:
 - (a) Heat Pipe:
 - i. Cooling - 32/22°C to 27/21°C
 - ii. Heating - -27°C to -6/-9°C

- (b) MUA-1:
 - i. Supply - 3300 L/s @ 310 Pa
 - ii. Exhaust - 3300 L/s @ 250 Pa
 - iii. DX Cooling - 36kW total
 - iv. Gas Heating - 132kW(450 MBH) EAT: -6°C LAT: 20°C
- (c) Electrical: 600V/3/60
- .10 Std: Engineered Air model UPEW Series & TRU series HRP

42. Kitchen Make-up Air Unit (MUA-2):

- .1 Direct fired outdoor air unit of weatherproof heavy gauge galvanized steel. Packaged VFD. Belt driven centrifugal forward inclined fan wheel. Modulating gas with 25:1 turndown. Unpowered weatherproof convenience outlet. Vibration isolation.
- .2 Programmable controller with adjustable discharge air temperature set point, trouble & filter status indicators.
- .3 To be interlocked with kitchen exhaust fan speed selection and fire suppression system per NFPA 96.
- .4 Capacities:
 - (a) Gas Heating - 112kW(382 MBH) EAT: -27°C LAT: 20°C
 - (b) DX Cooling - 17kW (59 MBH) EAT(DB/WB): 31.7°C/22.2°C
LAT(BD/WB): 24.5°C/20.0°C
 - (c) 1700 L/s @ 125Pa (3600 CFM @ 0.5" WG)
 - (d) 600V/3/60, 2 HP motor
- .5 Std: Engineered Air HE40/MV

43. Ceiling Mounted Ductless Split (A/C-1)

- .1 See notes on details 2/M-6 and M-8
- .2 Std: Enviromaster International - Evaporator: CHP12 -
Condenser SCC12

- 44. Include the services of an air balancing company to verify and adjust the air quantities for the equipment shown.

Heat Pump Hydronic System

45. Hydronic Piping:

- .1 Steel pipe to ASTM A53, Grade B. Insulate according to specification 8, Pipe Insulation.
 - (a) 100mm (NPS 4) or smaller:
 - i. Schedule 40

46. Pipe Joints:

- .1 50mm (NPS 2") & under:
 - (a) Screwed fittings with Teflon tape.
 - (b) Roll grooved: rigid coupling to CSA B242.
 - (c) Flanges: plain or raised face, slip-on weld neck.
 - (d) Unions: malleable iron, to ASTM A47M and ANSI/ASME B16.3
- .2 65mm (NPS 2½") and over:
 - (a) Butt weld fittings to ANSI/ASME B16.9. and flanges to CSA W47.1 and CSA W47.1S1.
 - (b) Pipe flanges and flanged fittings:
 - i. Steel: to ANSI/ASME B16.5.
 - ii. Cast Iron: to ANSI/ASME B16.1, Class 125 WOG
 - iii. Fittings for roll grooved piping: malleable iron to ASTM A47M

47. Hangers:

- .1 All piping shall be substantially supported with oversize hanger to include for insulation, elongated clevis type hangers.
- .2 Provide shop fabricated galvanized shields for all insulated piping. Hanger spacing shall not exceed 6 feet.
- .3 Std: Myatt Fig. 122 or Grinnell Fig. 165.

48. Ball Valves:

- .1 50mm (NPS 2") and under for equipment isolation or drains.
- .2 Body and cap: cast high tensile bronze to ASTM B62.
- .3 Pressure rating: Class 125 WOG.
- .4 Connections: Screwed ends to ANSI B1.20.1 and with hex. Shoulders
- .5 Stem: tamper proof ball drive.
- .6 Stem packing nut: external to body.
- .7 Operator: removable lever handle.
- .8 Ball and seat: replaceable stainless steel solid ball and teflon seats.
- .9 Stem seal: TFE with external packing nut.
- .10 Std: Watts Regulator, Crane, Belimo

49. Check Valves:

- .1 50mm (NPS 2") and under, swing type, bronze disc, Class 125:
 - (a) Standard specification: MSS SP-80.
 - (b) Body: Y-pattern with integral seat at 45°, screw-in cap with hex head.
 - (c) Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
 - (d) Std: Crane
- .2 65mm (NPS 2-1/2") and over: Silent, Flanged ends.
 - (a) Body: malleable or ductile iron with integral seat.
 - (b) Pressure rating: Class 125, WP = 860 kPa.
 - (c) Connections: grooved ends.
 - (d) Disc: bronze or stainless steel renewable rotating disc.
 - (e) Seat: renewable, EPDM.
 - (f) Std: Crane

50. Butterfly Valves:

- .1 65mm (NPS 2-1/2") and over: Resilient seated lug type body rated to 1724 kPa and 120°C
- .2 Body: lug type, ductile iron
- .3 Stem: 316 SS
- .4 Disc: nickel plated bronze
- .5 Seat: EPT
- .6 Operator: 10 Position Lever up to NPS 4 and gear drive operator for NPS 6" incl. chain operators on valves more than 2m above the floor.
- .7 Std: Demco, Dezurik

51. Thermometers:

- .1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB 14.4.
- .2 Brass or stainless steel thermometer wells
- .3 Std: Ashcroft, Winters, Trerice

52. Pressure Gauges:

- .1 100mm dial type: to ANSI/ASME B40.1, Grade 2A, phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified complete with bronze stop cock.
- .2 Std: Ashcroft, Winters, Trerice

53. Differential Pressure Gauges:

- .1 112 mm, dial type: to ANSI/ASME B40.1 with calibrated spring
- .2 Working Pressure: 1200 kPa
- .3 Range: 1.5 x Pump Head
- .4 Std: Orange Research Series 1201

54. Diaphragm Type Expansion Tank (EXP-2):

- .1 Diaphragm type, vertical hydronic expansion tank for use in non-potable closed loop water systems.
- .2 Capacity: 11 Gal, 125 PSI working pressure
- .3 Std: Amtrol Extrol AX-20V

55. Air Separator - 100mm Inline:

- .1 Working pressure: 860 kPa.
- .2 Size: as indicated.
- .3 Std: Taco Series; Sarco

56. Pot Feeder:

- .1 Provide pot feeder piped across circulating pumps complete with isolating valves and drain piped to waste.
- .2 Welded steel, pressure rating: 175 Psi Temperature rating: 200°F

57. Micron Filter:

- .1 Provide micron filters in a bypass loop around pump p-3 as indicated on the drawings.
- .2 Inline medium flow filters with cast iron head and base, 316 stainless steel shell.
- .3 Working pressure: 860 kPa
- .4 Capacity: 0.9 l/s
- .5 Bleached cotton filter tubes with two complete sets of spares.
- .6 Std: Specialty Chemicals Series E5700

58. Cleaning Solutions:

- .1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.
- .2 Sodium carbonate: 0.40 kg per 100 L water in system.
- .3 Low-foaming detergent: 0.01 kg per 100 L water in system.

59. Chemical Treatment:

- .1 Retain water treatment specialist to inject sufficient chemicals into the new heating piping systems to restore the system chemical balance to normal operating standards.
- .2 In addition, provide chemicals through pot feeders to the new heating piping network for normal operation as recommended by the chemical treatment specialist to the manufacturer's specifications.
- .3 Std: Dearborn or Bird Archer

60. Hydronic Heating System Control Panel:

- .1 Indoor/Outdoor reset control panel with night setback timer for the building heating system. Connect all sensors, provide control circuit for on/off control of zone pumps to start and stop on signal from outdoor air cut-off temperature.
- .2 Equivalent to Tekmar boiler control panel 265

61. Boilers (B-1 & B-2):

- .1 Sealed combustion gas fired condensing boiler with packaged primary circulation pump, modulating gas valve capable of 5:1 turndown, welded stainless steel tube heat exchanger, & certified zero clearance to combustibles.
- .2 Provide condensate neutralization tank
- .3 To conform with ASHRAE 90.1 efficiency requirements
- .4 95% Annual fuel utilization efficiency
- .5 Controls:
 - (a) Integrated electronic PID temperature & ignition control for boiler operation & firing rate via touchscreen display
 - (b) Integrated system pump & domestic water pump control with delay features and variable speed boiler pump control.
 - (c) Able to Cascade and lead-lag with other controllers
 - (d) Built in outdoor reset with customizable curves, flue gas high temp shutdown, timeclock with battery backup, system diagnostic, & fault alarm.
 - (e) 24 VAC and 4-20mA 10VDC BAS input
 - (f) BACnet capable
- .6 Capacity:
 - (a) 285 MBH input, 270 MBH Output
 - (b) Pump: 18 GPM @ 20 FT (30°F ΔT)
 - (c) 160 PSI working pressure, 75 PSI relief
 - (d) 100mm intake & exhaust to a maximum equivalent length of 100 ft
 - (e) 120/1/60, 15A MOP
- .7 Std: Laars NeoTherm 285 w/ pump, NTI-Trinity-Tft-300, Weil-McLain-Ultra, Lochinvar-KB286

62. Secondary Circulation Pumps (P-1 & 2):

- .1 Volute: dual mounted pumps on a single casting, cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.
- .2 Impellers: brass or bronze.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical for service to 135°C.
- .5 Coupling: flexible self-aligning.
- .6 Motors: squirrel cage induction type incorporating an integrated variable frequency drive resilient mounted, drip proof, sleeve bearing,
- .7 Control:
 - (a) Built in integrated variable speed sensor-less motor control with VCC-PWM and line voltage filters and motor protection including phase to phase fault, phase to ground, loss of supply phase, over/under voltage, motor over temp, inverter overload and over-current
 - (b) Power factor correction
 - (c) Sensorless control software imbedded in the VFD to provide automatic speed control with field adjustable max/min head set

- points.
- (d) Manual bypass or closed loop PID control
- (e) Alarm and reset
- .8 Capacities:
 - (a) 125 GPM (each) @ 120 FT
 - (b) Design pressure: 200 PSI
 - (c) Electrical: 600/3/60, 7.5 HP
- .9 Std:
 - (a) Armstrong 4302 Series

63. MUA Glycol Circulation Pump (P-6):

- .1 Cast iron radially split casing with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.
- .2 Impeller: brass or bronze.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical for service to 135°C.
- .5 Coupling: flexible self-aligning.
- .6 Motors: squirrel cage induction type incorporating an integrated variable frequency drive resilient mounted, drip proof, sleeve bearing.
- .7 Control:
 - (a) Built in integrated variable speed sensorless motor control with VCC-PWM and line voltage filters and motor protection including phase to phase fault, phase to ground, loss of supply phase, over/under voltage, motor over temp, inverter overload and over-current
 - (b) Power factor correction
 - (c) Sensorless control software imbedded in the VFD to provide automatic speed control with field adjustable max/min head set points.
 - (d) Manual bypass or closed loop PID control
 - (e) Alarm and reset
- .8 Capacities:
 - (a) 33 GPM @ 60 FT (10% added for 30% Glycol)
 - (b) Design pressure: 200 PSI
 - (c) Electrical: 600/3/60, 1.5 HP
- .9 Std: Armstrong 4300 Series

64. Dry Fluid Cooler FC-1:

- .1 Heavy gauge galvanized steel. Sectionalized cabinet with individual fan chambers. Side access panels for coil inspection and cleaning.
- .2 30" dia fans with spun venturi to provide maximum fan efficiency.
- .3 Fans with aluminum blades, steel hubs, statically and dynamically balanced
- .4 Coils: Heavy wall copper tubes mechanically expanded in self-spaced aluminum corrugated plate fins for permanent bond and maximum heat transfer
- .5 Fan guard: Welded wire construction. Baked on powder epoxy coating

- for corrosion protection and motor mounts
- .6 Control Panel:
 - (a) Staged aqua-stat control of fan pairs.
 - (b) Weather resistant electrical box with hinged access panel
 - (c) 24 V control voltage
- .7 Capacity:
 - (a) 650 MBH Sensible cooling @ 125 GPM
 - (b) EWT= 105°F, LWT= 95°F
 - (c) EAT= 90°F, LAT=100°F
 - (d) Head= 35 kPa
- .8 Electrical: 600/3/60
- .9 Std: Kool Air FEV

65. HP Water to Potable Water Heat Exchanger (HTX-1):

- .1 Deleted

66. Water to Glycol Heat Exchanger (HTX-2):

- .1 Plate & frame heat exchanger of stainless steel alloy construction.
- .2 Capacities: (125 MBH)
 - (a) Water Side (H2O): 25 GPM @ 5.6°C ΔT (95°F to 105°F)
 - (b) Glycol Side (30%PG): 33 GPM @ 5.6°C ΔT (110°F to 100°F)
- .3 Std: Armstrong PFX, Alfa-Laval

67. Water Source Heat Pumps:

- .1 General:
 - (a) See schedule on drawing for sizes and capacity.
 - (b) Packaged water source heat pumps (console & vertical) c/w:
 - i. Heat/Cool/Off controls.
 - ii. High/Low fan controls.
 - iii. Single stage integral t'stat for consoles and remote thermostat for vertical units with adjustable setting and automatic change-over.
 - iv. Safety controls incl high pressure, low water
 - v. Disposable 1/2" filters.
 - vi. High efficiency hermetically sealed refrigeration system including expansion valve, reversing valve & thermal overload protection.
 - vii. Vibration isolation and acoustically lined cabinets.
 - viii. DWDI forward curved fan providing quiet and efficient operation.
 - ix. Single point electrical power connection.
 - x. Drain Pan and condensate line piped to drain.
 - xi. Normally closed water regulating valve assembly (for use with variable speed pumping control), self-regulating water balancing valve c/w test ports, isolation valves, drain valve and stainless steel braided connection hoses.
 - (c) Operating Conditions: 25°F to 120°F EWT and 40°F to 95°F EAT
- .2 Std: Trane console model Axiom GEC and vertical model GEV

68. Flushing & Cleaning of Heating Piping:

- .1 Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Cleaning to be carried out on area of work (ie. boiler room). Flushing to be carried out on entire system. Entire building system to be filled, air bled and chemicals set to new boiler manufacturers specifications. (Aluminum heat exchanger)
- .3 Retain qualified water treatment specialist to perform system cleaning.
- .4 Conditions at time of cleaning of systems:
 - (a) Systems to be free from construction debris, dirt and other foreign material.
 - (b) Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.
 - (c) Strainers to be cleaned prior to initial fill.
 - (d) Install temporary filters on pumps not equipped with permanent filters.
 - (e) Install pressure gauges on strainers to detect plugging.
- .5 Report on Completion of Cleaning: When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .6 Hydronic Systems:
 - (a) Fill system with water, ensure air is vented from system.
 - (b) Add chemicals under direct supervision of chemical treatment supplier.
 - (c) Closed loop systems: circulate system cleaner at 60°C for at least 36 h. Drain as quickly as possible. Refill with water plus inhibitors. Test concentrations and adjust to recommended levels.
 - (d) Flush velocity in system mains and branches to be adequate so as to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
 - (e) Add chemical solution to system.
 - (f) Establish circulation, raise temperature slowly to maximum design or 82°C minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38°C. Drain as quickly as possible. Refill with clean water. Circulate for 6h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water. Coordinate with chemical treatment specialist

69. Filling of Heating System:

- .1 After cleaning is completed fill the heating system with clean water and chemical treatment specified by the chemical treatment specialist
- .2 Establish circulation and check system static pressure.
- .3 Ensure all air is removed.
- .4 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
- .5 Clean out strainers repeatedly until system is clean.
- .6 Repeat with water at design temperature.
- .7 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and all other noises.
- .8 Bring system up to design temperature and pressure slowly.
- .9 Perform Testing, Adjusting and Balancing (TAB).
- .10 Adjust pipe supports, hangers, springs as necessary.
- .11 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .12 Re-tighten all bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
- .13 Check operation of drain valves.
- .14 Adjust valve stem packings as system settles down.
- .15 Fully open all balancing valves (except those that are factory-set).
- .16 Check operation of over-temperature protection devices on circulating pumps.
- .17 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

Fire Protection**70. Fire Extinguishers:**

- .1 Recessed, prime coated steel cabinet with 25mm return, glass window in the latched door.
- .2 Extinguisher 3A-10BC
- .3 Std: National Fire Equipment Ltd. Multi-purpose Model WBDL-ABC-5

71. Fire Protection:

- .1 Sprinklers:
 - (a) Provide sprinkler system complying with NFPA 13R (for residential buildings up to four stories.)
 - (b) Provide hydraulic calculations for sprinkler system certified by a professional engineer, registered in Ontario. Based on recent flow test of closest hydrant which, showed static pressure of 81 PSI and 900 GPM at 32 PSI
 - (c) Include seismic restraints required to meet OBC requirements, pre-engineered or certified by a Structural Engineer with Ontario License.
 - (d) Sprinkler piping shall be schedule 40 black with malleable iron screwed fittings.
 - (e) Fittings and joints to ANSI/NFPA 13 & 14. To be Ferrous screwed, welded, flanged or roll grooved.
- .2 Valves:
 - (a) ULC listed for fire protection service.
 - (b) Up to NPS 2: bronze, screwed ends, OS&Y gate.
 - (c) NPS 2½ and over: cast iron, flanged or roll grooved ends, indicating butterfly valve.
 - (d) Swing check valves.
 - (e) Ball drip
- .3 Backflow Preventer:
 - (a) Double Check (See Plumbing "Backflow Preventer")
- .4 Pipe Hangers:
 - (a) ULC listed for fire protection services.
- .5 Pressure Gauges:
 - (a) ULC listed, 3" face, bronze bourbon tube movement having maximum limit of not less than twice normal working pressure at point where installed.
- .6 Signs:
 - (a) Bilingual Signs for control drain and test valves: to ANSI/NFPA 13.
- .7 Test Stations:
 - (a) Provide test station for each zone piped to nearest drain or building exterior.
 - (b) Provide site glass at test stations.
 - (c) Demonstrate satisfactory operation of each zone through test station operation.

- .8 Spare Parts Cabinet:
 - (a) For storage of maintenance materials, spare sprinkler heads and special tools.
 - (b) Construct to sprinkler head manufacturers standard.
- .9 Heads:
 - (a) Quick response per NFPA 13
 - (b) Finished Drywall:
 - i. Fully concealed with factory painted covers (color by architect from standard finishes)
 - (c) Tiled Ceilings:
 - i. Semi-recessed chrome.
 - (d) Attic or Mech/Elec Room:
 - i. Upright or pendant brass with intermediate temperature rating.

72. Supervisory Switches:

- .1 To ANSI/NFPA 13 and ULC listed for fire service.
- .2 Valves:
 - (a) Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.
- .3 Flow Switch:
 - (a) Normally open and normally closed contacts and supervisory capability.
- .4 Pressure Alarm Switch:
 - (a) Normally open and normally closed contacts and supervisory capability.

73. Fire Department Connections:

- .1 To ANSI/NFPA 13 and ULC listed, Siamese, type, location as indicated. Thread specifications to be compatible with local fire department.
- .2 Polished bronze exposed with identifying sign cast on plate. Threaded metal caps and chains.

74. Alarm Valves:

- .1 Alarm Check Valve to ANSI/NFPA 13 and ULC listed for fire service.

75. Installation:

- .1 Install, inspect and test to acceptance in accordance with
 - i. ANSI/NFPA 13.
- .2 Testing to be witnessed by authority having jurisdiction.