

PART 1 GENERAL

1.1 General

- .1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

1.2 Scope of Work

- .1 Work to include all labour, material and equipment required for installing, testing and placing in initial operation the following systems as detailed in specifications of each section and as shown on drawings.

- .1 Section 23 05 00 Common Work Results - Mechanical
- .2 Section 23 05 14 Acceptable Materials & Equipment
- .3 Section 23 07 12 Insulation
- .4 Section 22 10 01 Plumbing
- .5 Section 25 30 00 Controls
- .6 Section 23 05 93 Testing, Adjusting and Balancing
- .7 Section 23 54 11 HVAC System

1.3 Existing Conditions

- .1 Examine Site, existing adjacent buildings and local conditions affecting Work under this Contract. Examine Structural, Architectural, Mechanical and Electrical and all other Contract drawings to ensure Work can be performed without changes to the building as shown on plans. No allowance will be made later for necessary changes.

1.4 Regulations

- .1 Comply with, most stringent requirements of Manitoba Building Code, National Building Code and local regulations and by-laws, with specified standards and codes and this specification. Before any Work is proceeded with, approved layouts to be filed with and approved by proper authorities.
- .2 Provide necessary notices, obtain permits and pay all fees, in order that Work specified may be carried out. Charges and alterations required by authorized inspector of any authority having jurisdiction, to be carried out without charge or expense to the City of Winnipeg. Pay all charges for service connections to municipal mains.
- .3 Furnish certificates confirming Work installed conforms to requirements of authorities having jurisdiction.

1.5 Liability

- .1 Install Work in advance of concrete pouring or similar Work. Provide and set pipe sleeves as required.
- .2 Install concealed pipes and ducts neatly, close to building structure so furring is minimum size. Pipes, ducts and equipment installed improperly, to be removed and replaced without cost to the City of Winnipeg.
- .3 Protect and maintain Work until building has been completed and accepted. Protect Work against damage during installation. Cover with tarpaulins if necessary. Repair all damage to floor and wall surfaces resulting from carrying out of Work, without expense to the City of Winnipeg.

- .4 During welding or soldering ensure structure is protected against fire, shield with fire-rated sheets and galvanized iron sheets. Mount portable fire extinguishers in welding or soldering areas.
 - .5 Co-ordinate Work with other sections to avoid conflict and to ensure proper installation of all equipment. Review all Contract drawings.
 - .6 On completion of Work, remove tools, surplus and waste material and leave Work in clean, perfect condition.
- 1.6 Guarantee
- .1 Guarantee satisfactory operation of all Work and apparatus installed under this Contract. Replace, at no expense to the City of Winnipeg, all items which fail or prove defective within a period of one year after final acceptance of complete Contract by the City of Winnipeg, always provided such failure is not due to improper usage by the City of Winnipeg. Make good all damage to building incurred as a result of failure or repair of mechanical Work.
 - .2 No certification given, payment made, partial or entire use of equipment by the City of Winnipeg, shall be constructed as acceptance of defective Work or acceptance of improper materials. Make good at once, without cost to the City of Winnipeg all such defective Work or materials and consequence resulting therefrom, within one year of final acceptance date.
 - .3 This general guarantee shall not act as a waiver for any specified guarantee and/or warranty of greater length of time noted elsewhere in these documents.
 - .4 Domestic hot water tanks shall have manufacturer's warrantee for period of five (5) years.
 - .5 Plumbing brass shall have manufacturer's warrantee for period of five (5) years.
 - .6 Refrigeration compressor circuit connected to air-conditioning systems shall have manufacturer's warrantee period of four (4) years after initial one year guarantee.
- 1.7 Engineering Observations
- .1 Contractor's Work will be observed periodically by the City of Winnipeg, and/or Contract Administrator or their representatives, solely for purpose of determining general quality of Work, and not for any other purpose. Guidance will be offered to Contractor in interpretation of plans and specifications to assist him to carry out Work. Observations and directives given to Contractor does not relieve Contractor and his agents, servants and employees of their responsibility to erect and install Work in all its parts in a safe and workmanlike manner, and in accordance with plans and specifications, nor impose upon the City of Winnipeg and/or Contract Administrator or their representatives, any responsibility to supervise or oversee erection or installation of any Work.
- 1.8 Welding Regulations
- .1 Do not weld when temperature of base metal is lower than -17 degrees C except with consent of Contract Administrator. At temperature below 0 degrees C, surface of all areas within 75mm (3") of point where weld is to be started to be heated to temperature at least warm to hand before welding is commenced. At all temperatures below +4 degrees C, operator and Work to be protected against direct effect of wind and snow.
 - .2 Welding shall be performed by welder holding current welder's certificate from Provincial Department of Labour.
 - .3 Comply with CSA W117.2 "Safety in Welding, Cutting, and Allied Processes".
- 1.9 Mechanical Shop Drawings

- .1 Submit for review a minimum of six (6) sets of detailed shop drawings. Refer to 01 33 00 "Acceptable Materials and Equipment" for shop drawings requirements.
 - .2 Check shop drawings for conformity to plans and specifications before submission.
 - .3 Each drawing to bear a signed stamp including project name and Contractor's Firm name verifying drawings have been checked prior to submission to Contract Administrator. Signature of stamp shall signify the Contractor has checked and found all dimensions to be compatible with the Contract drawings and all capacities, quantities, sizes and other data contained in the Contract documents have been listed by the supplier on the drawings and have been checked by the undersigned and found correct.
 - .4 Clearly show division of responsibility. No item, equipment or description of Work shall be indicated to be supplied or Work to be done "By Other's or By Purchaser". Any item, equipment or description of Work shown on shop drawings shall form part of Contract, unless specifically noted to contrary.
 - .5 Take full responsibility for securing and verifying field dimensions. In case where fabrication must proceed prior to field dimensions being available, check all shop drawings and approve for dimensions only. In this case guarantee that dimensions will be worked to and ensure that other Subcontractors are aware of these dimensions and shall comply to them.
 - .6 Review by Contract Administrator shall be mutually understood to refer to general design only. If errors in detailed dimensions or interference with Work are noticed, attention of Contractor will be called to such errors of interferences, but Contract Administrator's review of drawings will not in any way relieve Contractor from responsibility for said errors or interferences, or from necessity of furnishing such Work, and materials as may be required for completion of Work as called for in Contract documents.
- 1.10 Mechanical Subcontractors
- .1 In accordance with D11, state names of all Subcontractors to be used in sublet Work. Also, state extent of any Work so sublet. Request and receive Contract Administrator's approval in writing, of all Subcontractors for such Work before placing Subcontractor's Contract.
 - .2 Contractor to have minimum five years experience in field of mechanical contracting and to have successfully performed Work of similar nature and approximate size to that indicated in specifications and on drawings. Subcontractor shall employ, on this project, foremen or supervisory personnel who have had similar experience to that required of Contractor.
- 1.11 Drawings
- .1 Drawings are diagrammatic only and do not show all details. Information involving accurate measurements of building to be taken from Architectural Drawings and/or at building. Make, without additional expense to the City of Winnipeg, all necessary changes or additions to runs to accommodate structural conditions. Locations of pipes, ducts and other equipment to be altered without charge to the City of Winnipeg, provided change is made before installation and does not necessitate additional materials and that all such changes are ratified by Contract Administrator, recorded on Record Set of Drawings.
 - .2 Drawings and specifications to be considered as an integral part of Contract Documents. Neither drawings nor specifications to be used alone. Misinterpretation of requirements of plans or specifications shall not relieve Contractor of responsibility of properly completing Work to approval of Contract Administrator.

- .3 As Work progresses and before installing piping, ductwork, fixtures and equipment interfering with interior treatment and use of building, consult Contract Administrator for comments. This applies to all levels and proper grading of piping. If Contractor fails to perform above checking and fails to inform Contract Administrator of such interference, Contractor to bear all subsequent expense to make good the installation.
 - .4 Drawings indicate general location and route to be followed by pipes and ducts. Where required pipes and/or ducts are not shown on plans or only shown diagrammatically, install in such a way as to conserve head room and interfere as little as possible with free use or space through which then pass.
 - .5 Refer to Architectural Drawings for roof construction details. These shall relate to roof supports, piping penetrating roofs, etc. as indicated on mechanical detail sheets.
- 1.12 Materials
- .1 Materials and equipment specified and acceptable manufacturers are named in this specification for the purpose of establishing the standard of materials and workmanship to which Contractor shall adhere. Bid Submission shall be based on the use of materials and equipment as specified.
 - .2 Materials of same general type to be of same manufacture (e.g. all air supply units shall be of same manufacturer). Contractor to ensure that all Subcontractors provide products of same manufacturer.
 - .1 Follow manufacturer's recommendations for safety, adequate access for inspection, maintenance and repairs of individual equipment installed.
 - .2 Permit equipment maintenance and disassembly with minimum disturbance to connecting piping and duct systems and without interference with building structure or other equipment.
 - .3 Provide accessible lubricating means for bearings, including permanent lubricated 'Lifetime' bearings.
 - .3 In accordance with B6, any substitutes or alternates the Contractor considers equal to that specified must not exceed available space limitations. All additional costs for mechanical, electrical, structural and/or architectural revisions required to incorporate materials substituted by Contractor shall be responsibility of Contractor.
 - .4 Equipment listed as 'equal' in specifications or submitted in accordance with B6 shall meet all space requirements, specified capacities and must have equipment characteristics of specified equipment as interpreted by Contract Administrator. Install equipment in strict accordance with manufacturer's published recommendations.
 - .5 Equipment and materials shown on drawings and not specified herein, or specified herein and not shown on drawings, shall be included in this Contract as though both shown and specified.
- 1.13 Removal and disconnection of the City of Winnipeg's Existing Equipment
- .1 N/A.
- 1.14 Electric Motors, Starters and Wiring
- .1 Provide electric motors for all equipment supplied in this Division. Motors to operate at 29 r/s (1800 rpm), unless noted otherwise. Motor design shall comply with Canadian Electrical Code requirements. All electric motors supplied shall be capable of being serviced locally.

- .2 Operating voltages: to CAN3-C235-83, motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Motors controlled by variable frequency drives (VFDs) shall comply with requirements of CSA Specification C22.2 No. 100-95, Clause 12.4 and shall be permanently marked with the following in addition to the normal marking requirements:
 - .1 Machine Application (Inverter Duty).
 - .2 Speed range over which the machine is designed to operate.
 - .3 Type of torque application for which the machine is designed (e.g. VT (variable torque), CT (constant torque), Chp (constant horsepower) or equivalent.
 - .4 Type(s) of inverter(s) with which the machine is intended to be used e.g.: VSI or VVI (6-step voltage source), CSI (6-step current source), VPWM (voltage-source pulse width modulated), LCI (load commutated), cyclonverter, or equivalent.
- .4 Motors 0.75 kW (1 hp) and larger shall be high efficiency motors as defined in CSA C390 or IEEE 112B Nominal Standards. Minimum efficiency (%) shall be per the following table.

Minimum efficiency (%)

kW	3600 RPM	1800 RPM	1200 RPM	900 RPM
.75	79.0	82.4	81.1	74.4
1.11	81.0	82.8	83.8	76.8
1.50	81.7	83.8	84.4	83.8
2.24	84.6	86.1	86.4	83.6
3.73	86.4	86.9	87.2	85.4
5.60	87.4	88.4	88.2	86.2
7.46	88.4	89.4	88.6	88.6
11.19	89.3	90.1	89.0	88.0
14.92	89.7	90.9	89.8	89.8
18.65	90.0	91.1	90.9	89.6
22.38	90.6	91.5	91.1	90.3
29.84	91.0	92.0	91.6	90.1

List information on shop drawing submittals

- .5 Determine from electrical drawings and specifications, voltage characteristics applying to each individual motor. Where motor voltages are mentioned in this specification, confirmation to be made by reference to electrical drawings and specifications ordering motors.
- .6 Division 26 – Electrical to provide starters for all motors, except as otherwise noted. Division 26 – Electrical shall wire from starters to motors.
- .7 Wiring required between starters and switching apparatus such as wiring from starters to float switches, pressure switches and all control wiring to be by Division 26 Electrical except as noted otherwise on drawings and in specification. Provide proper terminal connections and lead wires at motors and other apparatus ready for connection by Division 26 – Electrical. Provide Division 26 – Electrical with accurate locations of electrical connection points and all necessary schematic and other drawings to facilitate electric Work.
- .8 Wiring required under Section 25 30 00 – Instruments and Control Elements to be performed by Section 25 30 00 – Instruments and Control Elements except as noted

otherwise. Refer also to Section 25 30 00 – Instruments and Control Elements for further requirements.

- .9 Division 26 – Electrical to perform all wiring and make final connections to all controls for roof-top HVAC units and all mechanical equipment where controls are supplied with equipment.
 - .10 Division 23 shall provide wiring diagrams indicating all power and control wiring requirements.
 - .11 Division 26 – Electrical to perform all wiring and make final connections to all controls for air cooled condensing units. Refer to Clause “Refrigeration Piping and Accessories”.
 - .12 Division 23 shall provide wiring diagrams indicating all power and control wiring requirements for equipment supplied by Division 23.
- 1.15 Identification of Valves
- .1 Provide engraved lamacoid colour coded tags secured to items with non-ferrous chains or “S” hooks. Use for valves and operating controllers of all systems. Consecutively number valves in each piping system i.e. domestic water, steam, etc.
 - .2 For each building, provide tag schedule, designating number, service, function, colour code, and location of each tagged item.
 - .3 Provide one plastic laminated copy and secure to mechanical room wall where instructed. Place one copy in each maintenance instruction manual.
 - .4 Identify controls and gauges by labels of 3mm (1/8”) plastic engraving stock with white lettering on black background. Size approximately 62mm x 25mm (2½” x 1”) high.
- 1.16 Hangers and Supports
- .1 General
 - .1 Piping, ductwork and equipment shall be securely supported from building structure. Perforated strap or wire hangers are not permitted.
 - .2 Support components shall conform to Manufacturers Standardization Society Specification.
 - .2 Installation – Horizontal
 - .1 Hangers shall adequately support piping system. Locate hangers near or at changes in piping direction and concentrated loads. Provide vertical adjustment to maintain pitch required for proper drainage. Allow for piping expansion and contraction. Piping weight and stresses shall be supported independently of any equipment.
 - .2 Maximum spacing between pipe supports:
 - .1 Steel Pipe: Up to 50mm (2”) diam. – 2.4m (8 ft.) 62mm (2½”) and larger – 3.6m (12 ft.).
 - .2 Copper Tubing (Hard): Up to 25mm (1”) diam. – 1.8 (6 ft.) 32mm and larger – 2.4m (8 ft.)
 - .3 Cast Iron Pipe: Maximum spacing – in accordance with Plumbing Code. Locate hangers adjacent to hubs or joints. Support M.J. pipe on both sides of joint. Provide with sway braces and anchor to Contract Administrator’s approval. At multiple fittings or short lengths provide

- sufficient hangers to support all joints to Contract Administrator's satisfaction.
- .4 Plastic Pipe as recommended by manufacturer.
- .3 Installation – Vertical Piping
- .1 Support vertical pipes at each floor by Anvil Fig. 261 riser clamps. Locate clamps immediately below coupling if possible. Support soil pipe at hub. Brace risers up to 50mm (2") size at intervals not over 2.13m (7"). Support base in approved manner.
- .4 Structural Attachments
- .1 To Concrete:
 - .1 Place inserts in structural floors for support of piping and equipment prior to pouring of concrete. Inserts in concrete slabs shall be Anvil Fig. 285 Light Weight Concrete Insert for loads up to 182 Kg (400#) or Anvil Fig. 281 Wedge type concrete insert for loads up to 544 Kg (1200#).
 - .2 Support hangers in corrugated steel deck by 50mm (2") piece of 3mm (1/8") thick steel plate placed across top of steel deck, secured to hanger rod by washer and nut; prior to pouring of concrete topping.
 - .3 Where inserts must be placed in existing concrete use Hilti H.D.I. steel anchors as recommended by manufacturer, or if heavy weights must be supported, drill hole through slab and provide 50mm x 50mm (2" x 2") washer and nut above rough slab before floor finish is poured.
 - .2 To Steel Beams:
 - .1 Where pipe size is 50mm (2") or less, use Anvil Fig. 87 Malleable Iron C-Clamp and Retaining Clip, or equal.
 - .2 Where pipe size is over 50mm (2"), use Anvil Fig. 229 Malleable Beam Clamp or Fig. 228 Forged Steel Beam Clamp, or equal.
 - .3 Miscellaneous:
 - .1 Provide suitable attachments equal in quality to above where required.
- .5 Hangers and Supports
- .1 Steel Pipe: Up to 50mm (2") – Anvil Fig. 65 light clevis – size to suit O.D. of pipe. 62mm (2 1/2") and larger – Fig. 260 clevis – size to suit O.D. of insulation.
 - .2 Copper Tubing (Hard):
 - .1 Up to 50mm (2") – Anvil CT65 copper plated clevis – size to suit O.D. of pipe. Fig. 65 may be used if isolation is provided – see below.
 - .2 62mm (2 1/2") and larger – Fig. 260 clevis – size to suit O.D. of insulation – on uninsulated pipe provide isolation as specified below.
 - .3 Cast Iron Pipe:
 - .1 All sizes – Fig. 260 clevis – size to suit O.D. of pipe.
 - .4 Plastic and Other Types of Piping: Support as recommended by manufacturer.
 - .5 Provide fabricated steel supports as detailed on drawings or as required to adequately support piping and equipment. Details to be approved by Contract

- Administrator. Supports shall be of welded construction except where adjustment is required.
- .6 Where thermal expansion in excess of 12mm (1/2") axially is anticipated, or where indicated, use Anvil Fig. 171 Adjustable Pipe Roll or Anvil Fig. 271 Pipe Roll Stand.
 - .7 For vertical piping support, use Anvil Fig. 261 clamp. For vertical copper piping, use Fig. CT-121-C.
 - .8 Above indicates general requirements. Provide hangers and supports of equal quality to suit job requirements where not covered by the above.
 - .9 Support groups of horizontal pipes by angle iron trapeze hangers.
 - .10 Rollers and chairs shall not be installed on trapeze hangers.
 - .11 Several individual hanger rods may be supported from a trapeze or individual inserts in concrete slab.
 - .12 Hangers to be adjustable after pipe is in place. Parts must be of adequate strength for weight to be supported with safety factor of 5 to 1.
 - .13 Hangar Rod:
 - .1 Support hangers with mild steel rod. Load on hanger not to exceed capacity indicated in following table:
 - .2 Rod Diam. Max. Safe Load
 - 9.5mm (3/8") 277 Kg (610 lbs.)
 - 13mm (1/2") 514 Kg (1130 lbs.)
 - 16mm (5/8") 822 Kg (1818 lbs.)
 - 19mm (3/4") 1232 Kg (2710 lbs.)
 - .3 Rods to have sufficient threaded length to allow for vertical adjustment after pipe is in place. Use two nuts in each rod, one above clevis or angle iron, and one below.
 - .6 Isolation
 - .1 Copper piping shall be isolated from steel supports by copper plated hangers, plastic coated hangers, tinning pipe at supports, or provision of suitable lead or copper isolators. Where no pipe movement or abrasion is expected, suitable plastic electricians tape may be wrapped around pipe at hangers.
 - .7 Protection Saddles
 - .1 On piping 50mm (2") and smaller, carry insulation over pipe hangers. Canvas jacket shall be neatly cut and formed to fit over hangers. On chilled and cold water piping, insert sections of insulation into space above pipe at each hanger. Seal saddle and pipe with insulation.
 - .2 On insulated steel pipe over 50mm (2") diameter, use at each hanger or support, Anvil Fig. 160, 161 or 162 to suit pipe size and insulation thickness. Pack space between saddle and pipe with insulation.
 - .3 On copper piping over 50mm (2") diameter, use at each hanger or support Anvil Fig. 167 protection shield or equal. Shields shall have minimum length of 300mm (12") to spread weight.

- 1.17 Supports, Bases, Pits
- .1 Supply and erect all special structural Work required for installation of tanks, pumps, fans, motors and other apparatus.
 - .2 Concrete pads, concrete for floating bases, curbs and pits to be supplied under Division 3. Supply all anchor bolts, fasteners and foundation drawings. Unless noted otherwise, all major pieces of equipment such as pumps, compressors, fans, etc. to be mounted on 150mm (6") concrete pad. Refer to standard details for method of forming pump bases, etc.
 - .3 Mount equipment suspended above floor level but not detailed on platform bracketed from wall. Where wall thickness is inadequate to permit such brackets, carry supports to either ceiling or floor, or both as required.
 - .4 Fire hose cabinets to be complete with suitable bases or mounting brackets. Where shown on or in walls, angle or channel iron supports to be installed to bear equipment.
- 1.18 Flashing
- .1 Where pipes or ducts go through a roof or wall, they should be boxed-in and flashed as per Division 3. Allow for expansion and contraction of pipe. Flashing shall be waterproof.
- 1.19 Access Doors
- .1 Division 23 – Mechanical Subcontractor to provide access doors where valves, dampers and/or any other mechanical equipment requiring access are built-in.
 - .2 In general terms, Mechanical Subcontractor responsible for supplying the valve, dampers, etc. shall provide the access door required to get to the valve, damper, etc.
 - .3 Access door to be 2.5mm (12 ga.) steel, 300mm x 450mm (12" x 18"), finished prime coat only, with concealed hinges, anchor straps, plaster lock and without screws, all equal to Milcor manufacture. Where it is necessary for persons to enter through door, doors to be at least 450mm x 600mm (18" x 24").
 - .4 In applied tile or exposed glaze or unglazed structural tile, access doors shall take the tile and be sized and located to suit tile patterns. In plaster ceilings, doors shall take the plaster. In masonry walls access doors to be sized and located to suit masonry unit sizes. In lay-in acoustic tile ceilings, no access doors are required, but install an approved coloured marking device in the ceiling tile below all points requiring access. Refer to Architectural Room Finish Schedule and details on architectural drawings.
 - .5 Supply access doors for concealed valves or groups of valves, dampers, fire dampers, flush valves, shock arrestors, trap seal primers, etc.
 - .6 Access doors located in fire rated ceilings and walls shall be an approved ULC stamped, fire rated door.
- 1.20 Identification of Equipment
- .1 Provide manufacturer's nameplate on each piece of equipment.
 - .2 In addition Mechanical Subcontractor shall provide equipment I.D. tag minimum size 87mm x 32mm x 2.3mm (3 ½" x 1 ½" x 3/32") nominal thickness laminated phenolic plastic with black face and white centre. Engraved 6mm (1/4") high lettering. For motors and controls and for larger equipment such as chillers, tanks, 25mm (1") high lettering; for hot equipment such as boilers and convertors, provide engraved brass or bronze plates with black paint filled identification.

- .3 Identify as follows: equipment type and number (e.g. pump no. 2), service or areas or zone building served (e.g. south zone chilled water primary).
 - .4 Provide manufacturer's registration plates (e.g. pressure vessel, Underwriters' Laboratories and CSA approval plates) as required by respective agency and as specified.
- 1.21 Floor Plates and Sleeves
- .1 Set sleeves in concrete forms for all pipes and ducts passing through concrete walls, beams and slabs.
 - .2 Pipe sleeves to extend above floor line as follows:
 - .1 Unfinished areas – 25mm (1")
 - .2 Finished areas (copper sleeves) – 6mm (1/4")
 - .3 Mechanical rooms, kitchens and washrooms – 100mm (4")
 - .4 Caulk sleeves to provide watertight installation
 - .3 Where pipes pass through floors and walls in finished areas and where exposed to view, provide Crane #10 B.C. chrome-plated pressed floor plates, or equal.
 - .4 Install galvanized oversize pipe sleeves on passing through walls or partitions, for building into wall construction, by other trades.
 - .5 Sleeves and holes for cold water, chilled water and ice water lines to be large enough to accommodate pipe insulation. Insulation on hot water lines may stop at walls or floors.
 - .6 Prior to installing sleeves in concrete beams, receive final jobsite approval by the Contract Administrator.
- 1.22 Mechanical Equipment Guards
- .1 Meet safety requirement of Provincial Department of Labour and local authorities having jurisdiction.
- 1.23 Screws, Bolts and Fasteners
- .1 Use standard commercial sizes and patterns with material and finish suitable for service.
 - .2 Use heavy hex heads, semi-finished unless otherwise specified. Use non-ferrous material throughout for plumbing services. Use type 304 stainless steel for exterior areas.
 - .3 Bolts used on fan equipment for access to motors, bearings, filters and the like shall be heavy-duty.
 - .4 Bolts shall not project more than one diameter beyond nuts.
 - .5 Washers
 - .1 Use plain-type washers on equipment, sheet metal and soft gaskets, lock-type washers where vibration occurs, and resilient washers with stainless steel.
- 1.24 Special Tools and Spare Parts
- .1 Furnish the City of Winnipeg with spare parts as follows:
 - .1 One set of pump seals, packing for each pump
 - .2 One casing joint gasket for each size pump
 - .3 One set of v-belts for each piece of machinery

- .4 One set of filters for each filter bank installed
 - .5 One spare cartridge for each thermostatic mixing valve
 - .2 Identify spare parts containers as to contents and replacement parts number.
 - .3 Provide one set of all specialized tools required to service equipment as recommended by manufacturers.
- 1.25 Pumps- General
- .1 Provide coupling guards on all pumps.
 - .2 Submit certified pump curves with shop drawings. Pumps shall be selected such that head at design conditions does not exceed 85% of maximum possible head at design flow rate.
 - .3 Manufacturer to include for checking and aligning pumps prior to start-up. Following completion of piping all base mounted pumps shall be aligned by a qualified millwright using a dial guage. Alignment using a straightedge is not acceptable as it does not provide sufficient accuracy. The millwright shall provide a report indicating the degree of misalignment prior to carrying out the Work and the final readings when the alignment Work has been completed. Final payment will not be made until a satisfactory report has been submitted.
 - .4 Piping adjacent to pump to be supported from structure so no weight is carried on pump casings. Use long sweep elbows at pump.
 - .5 All pumps to have motor size large enough to not overload at runout condition. If this requires larger motor than specified, pay for larger motor starter, wiring and the like.
 - .6 Provide mechanical seals on all pumps.
- 1.26 Openings in Fire Separations
- .1 Provide firestopping for all openings in fire separations for passage of pipes, ducts, etc. to maintain integrity of fire separations.
 - .2 Firestopping
 - .1 Firestopping to be Dow-Corning Fire Stop System, or approved equal.
 - .2 Material shall be Dow-Corning silicone elastomer Fire Stop penetration Seal and/or Dow-Corning liquid silicone elastomer Fire Stop Foam of density, width and depth to maintain assembly fire resistive rating, or approved equal.
 - .3 Components shall be ULC listed.
 - .3 Installation
 - .1 Prepare all surfaces so they are clean, dry and frost free, as per manufacturer's published recommendations.
 - .2 Use Sealant around single pipes and/or ducts.
 - .3 Use Foam for multiple pipe installation.
 - .4 Follow manufacturer's published installation instructions precisely including field quality control after installation.
 - .5 Submit to Contract Administrator, suitable document signed by manufacturer's local representative, stating:

- .1 Div. 23 Subcontractor received sufficient installation instruction from manufacturer's representative.
 - .6 Remove firestopping assembly for random inspection by Contract Administrator and replace at no extra cost to the City of Winnipeg.
- 1.27 Trial Usage
- .1 The City of Winnipeg reserves right to use any piece of mechanical equipment, device or material installed under this Contract, for such reasonable lengths of time and at such times as Contract Administrator may require, to make complete and thorough test of same, before final completion and acceptance of any part of Contract. It is agreed and understood, that no claim for damage will be made for any injury or breakage to any part or parts of the above due to aforementioned tests, whether caused by weakness or inaccuracy of parts, or by defective materials or workmanship of any kind whatsoever. Supply all labour and equipment for such tests.
- 1.28 Safety Device Testing
- .1 Make complete inspection of all safety devices to ensure:
 - .1 That safety devices are complete and in accordance with specifications and manufacturer's recommendations.
 - .2 That the safety devices are connected and operating according to all local regulations.
 - .2 Safety devices to be inspected shall include, but not be limited to:
 - .1 Pressure relief valves.
 - .2 Freeze protection devices.
 - .3 Fire dampers.
 - .4 Ceiling fire stops.
 - .3 On completion of inspections, supply to Contract Administrator letters and/or certificates for their record, confirming that inspections have been completed.
- 1.29 Temporary Use of Equipment
- .1 Permanent systems and/or equipment not to be used during construction period, without Contract Administrator's written permission.
 - .2 Heating systems may be used for temporary heating within limitations specified under Clause 'Temporary Heating'. Refer also to 'General Conditions'.
 - .3 Equipment used during construction period to be thoroughly cleaned and overhauled. Replace worn or damaged parts so equipment is in perfect condition, to entire satisfaction of Contract Administrator and the City of Winnipeg.
 - .4 Provide proper care, attention and maintenance for equipment while it is being used. If, in opinion of Contract Administrator, sufficient care and maintenance is not being given to equipment and systems, Contract Administrator reserves right to forbid further use of said equipment and systems.
 - .5 Temporary use of equipment shall in no way relieve Contractor of providing twelve month guarantee on all equipment so used. This guarantee period to commence as of date of final acceptance of building by the City of Winnipeg as interpreted by Contract Administrator.

- .6 All air filters shall have bi-monthly inspection. Filters shall be cleaned and/or replaced depending on filter type during period in which ventilation units are being used for temporary heat and/or commissioning of system. Contractor to be responsible for and pay all costs for air filter cleaning service. Filters to operate between pressure drops noted in filter manufacturer's catalogue.
- 1.30 Record Drawings
 - .1 Provide one set of Contract prints to form Record Drawings, marked clearly in red pencil with all changes and deviations from piping and ductwork, including all Contract Changes.
 - .2 Update Record drawings on a regular basis to ensure they are accurate.
 - .3 This information will be used by others to create Record Drawings on CAD.
- 1.31 Instructions to the City of Winnipeg's Personnel
 - .1 In addition to start-up supervision and instruction of the City of Winnipeg's personnel required of individual equipment manufacturers and systems as noted, Contractor's construction supervisor to instruct the City of Winnipeg's personnel in operation and maintenance of all equipment and systems to satisfaction of Contract Administrator.
 - .2 Provide the City of Winnipeg with four copies of manuals incorporating following:
 - .1 Service instructions – including lists of spare and replacement parts and names and addresses of suppliers.
 - .2 Maintenance and Operating instructions.
 - .3 Revised shop drawings.
 - .3 Forward manuals to Contract Administrator for review. Final payment will not be made until all required manuals have been received.
 - .4 Review instructions with the City of Winnipeg's representative to ensure the City of Winnipeg's representative has a thorough understanding of equipment and its operation.
 - .5 Contractor shall submit to Contract Administrator, suitable document signed by the City of Winnipeg's representative, stating:
 - .1 The City of Winnipeg has received satisfactory instruction in operation and maintenance of all equipment and systems.
 - .2 Operation and maintenance manuals have been reviewed with the City of Winnipeg.
 - .3 Specified spare parts, keys, removable handles and the like, have been turned over to the City of Winnipeg.
- 1.32 Temporary Heating
 - .1 Obtain written permission from Contract Administrator to use permanent heating system for temporary heat. Operate systems in strict accordance with equipment manufacturer and Contract Administrator's recommendations.
- 1.33 Painting
 - .1 Finish painting of mechanical equipment, piping and the like, to be performed by Section 09 91 10 – Painting.
 - .1 Co-operate with Section 09 91 10 – Painting in identifying equipment and piping where required for colour coding, pipe stencilling and the like.

<u>LEGEND</u>	<u>LEGEND</u>	<u>COLOUR</u>	<u>COLOUR</u>
Natural gas	N.G.	Yellow	Orange
Hot water heating supply (up to 121 C - 250 F)	H.W.H.S.	Yellow	Black
Hot water heating return (up to 121 C – 250 F)	H.W.H.R.	Yellow	Black
City water	CI.W.	Green	None
Cold water	C.W.	Green	None
Dom hot water supply	D.H.W.S.	Green	None
Dom hot water recirc	D.H.W.R.	Green	None
Make-up water	M.U.W.	Yellow	Black
Storm sewer	S.S.	Green	None
San sewer	SAN.S	Green	None
Comb san storm sewer	C.S.S.S.	Green	None
Refrigerant suction (include refrigerant no.)	REF.S. (N.O.)	Yellow	Black
Sprinkler water	S.W.	Red	White
Vent (plumbing)	V.P.	Green	None
Vent	V.	Yellow	Black

1.35 Identification of Ductwork

- .1 Use black 50mm (2”) high stencilled letters (e.g. “Cold”, “Hot”, “Return”, “Sanitary Exhaust”, “Kitchen Exhaust”) with arrow indicating air flow direction.
- .2 Distance between markings 15m (50’) maximum.
- .3 Identify ducts on each side of dividing walls or partitions and beside each access door.
- .4 Stencil only over final finish.
- .5 Prior to installation, review general application of identification with Contract Administrator.

1.36 Cutting and Patching

- .1 Refer to Section **01600**.
 - .1 Div. 15 shall mark all openings required for pipes, ducts, grilles and the like.
 - .2 Cutting to be ‘neat’ sizes. Patch all edges so grille frames hide cut edges.

1.37 Salvage

- .1 N/A

1.38 Cleaning and Flushing of Piping Systems

- .1 On completion, each piping system shall be flushed out before installation of equipment, fixtures, etc. in order to remove any foreign material in piping.
- .2 Flush with water, unless noted otherwise in individual mechanical sections of specifications.
- .3 All plumbing fixtures and all equipment shall be thoroughly cleaned and left in first class operating condition.

PART 1 GENERAL

1.1 General

- .1 Following Appendix of Manufacturers lists manufacturers of equipment and materials acceptable to Contract Administrator, subject to individual clauses under the various sub-sections of Mechanical Work Specifications. See item 'Materials' under this section of specification.
- .2 Product noted in individual specification clauses is an item that meets specification in all respects regarding performance, quality of material and workmanship, and is acceptable to Contract Administrator without qualification. Equipment proposed from other manufacturers listed as 'Approved Manufacturers' and alternates shall meet same standards.
- .3 Sound pressure levels of any proposed equal or alternate pieces of equipment shall not exceed sound pressure levels of the specified equipment where documents list such data.
- .4 Contractor to submit within forty-eight hours of notification form Contract Administrator, one (1) copy of fully and properly completed Appendix of Manufacturers listing thereon names of manufacturers of products which shall be used to execute Work of Contract. If list is not submitted within 48 hours, Contractor must use product named in each individual clause.
- .5 Submit shop drawings for all items marked with an asterisk (*).

1.2 EQUIPMENT OR MATERIAL AND APPROVED MANUFACTURERS

.1 Electric Motors

- .1 G.E.; Siemens; Tamper; Reliance; Leland; Lincoln; U.S Electric; Century; Baldor; WEG; Toshiba

.2 Insulation

- .1 Pipe Insulation Manville; Owens Corning: Knauf; Pabco; Fibreglas
- .2 External Duct Insulation Manville; Fibreglas; Knauf
- .3 Fire Retardant Canvas; Fattal; Radley
- .4 Lagging Adhesive/Coating; Bakor; Childers; Fosters
- .5 Refrigerant Piping; Armstrong; Rubatex
- .6 Aluminum Pipe Jacket; Childers; Permaclad; Pabco
- .7 PVC Pipe Jacket; Sure-Fit

.3 Plumbing

- .1 Grooved copper piping; Gruvlok; Victaulic system*
- .2 Drainage of Waste
 - .1 Cast iron soil pipe Bibby-Ste-Croix
- .3 Valves (gate & globe)* Crane; toyo; Kitz; Nibco
- .4 Valves (butterfly)* Keystone; Centre Line; Kurimoto; Victaulic; Gruvlok
- .5 Valves (ball)* Toyo; Kitz; Nibco; Anvil

- .6 Check valves to 2" diameter*
 - .1 Horizontal piping Crane; Toyo; Kitz; Nibco
 - .2 Vertical piping Val-Matic
- .7 Check valves 2 1/2" diameter & up*
 - .1 Horizontal piping Check-Rite; Moyes & Groves
 - .2 Vertical piping Val-Matic; Durabla; Keystone-Prince
- .8 Hangers and Supports Anvil; Crane; Myatt
- .9 Drainage specialties* Watts; Zurn; J.R. Smith; (floor drains, roof drains, Mifab cleanouts, chair carriers, etc).
- .10 Dielectric Watts
- .11 Shock absorbers* Zurn; Watts; J.R. Smith; Mifab
- .12 Strainers* Spirax-Sarco; Muessco; Toyo; Crane; Colton
- .13 Expansion joints* Fulton; Flexonics: Hyspan; Flextech
- .14 Pressure gauges* Ashcroft; Kunkle: Morrison; Winters; Marshalltown; Ametek; Terice; Weiss
- .15 Thermometers* Ashcroft; Terice; Taylor; Weiss; Marshalltown; Winters
- .16 Compression stops* Powers Crane; Brass Craft
- .17 Plumbing fixtures* Caroma; Crane; American-Standard; Kohler
- .18 Plumbing brass* American-Standard; Crane; Cambridge
- .19 Flush valves* Crane; Teck; Sloan; Zurn
- .20 Stainless steel sinks* American-Standard; K.I.L.; Bridges & Wessan; Kindred Industries; Architectural Metals Industries
- .21 Toilet seats* Olsonite; Moldex; Centoco; Bemis
- .22 Electric water heaters* State; John Wood; A.O. Smith
- .23 Hot water recirc. pumps* Armstrong; B & G; Grundfos
- .24 Shower controls* Symmons; Powers; Bradley
- .25 Shower heads* Symmons; Powers; Bradley
- .26 Backflow preventers* Watts; Conbraco; Ames
- .4 Fire Protection
 - .1 Automatic sprinkler; Reliable; Viking; Victaulic; equipment* Tyco Fire Products (Gem, Star, Central)
 - .2 Gate valves* Kennedy; McAvity; Mueller; Watts; Nibco
 - .3 Ball valves* Milwaukee; Global
 - .4 Check valves* Crane; Check-Rite; Val-Matic; Victaulic; Gruvlok
 - .5 Butterfly valves* Crane; Victaulic; Mueller; Watts; Gruvlok; Global; Nibco

- .6 Pressure gauges* Dresser; Morrison; Marshalltown; H.O. Trerice; Ametek; Kunkle; Winters; Tyco
- .7 Fire extinguishers* Pyrene; Diamond; LynCar; Flag; Badger; Kidd; Ansul
- .8 Mechanical joints* Victaulic; Gruvlok
- .9 Pre-action control valves* Reliable; Griswold; Claval; Tyco Fire Products (Gem, Star, Central)
- .10 Backflow preventers* Watts; Conbraco; Ames
- .11 Valve monitor and flow switches* Potter; Tectra; Edson; Canwiss
- .12 Foam system* Ansul
- .5 Liquid Heat Transfer
 - .1 Welding fittings Anvil; Crane; Tube Turn
 - .2 Malleable iron fittings; Crane; Gourd: Anvil; flange, flange gaskets International Malleable
 - .1 Mechanical joints; Victaulic; Gruvlok
 - .3 Pipe hangers; Anvil; Crane; Myatt
 - .4 Floor plates; Crane
 - .5 Gate, globe valves* Crane; Toyo; Kitz; Nibco
 - .6 Radiator valves* Crane; Dahl; Toyo
 - .7 Check valves (up to 2" diam.)
 - .1 Horizontal piping* Crane; Toyo; Kitz; Nibco
 - .2 Vertical piping* Durablo; Nibco
 - .8 Check valves (2 1/2" diam. & up)
 - .1 Horizontal piping* Moyes & Groves; Chek-Rite; Keystone-Prince; Victaulic; Gruvlok
 - .2 Vertical piping* Val-Matic; Durabla; Victaulic; Gruvlok
 - .9 Ball valves* Toyo; Kitz; Nibco; Victaulic; Newman Hattersley; Jenkins; Anvil
 - .10 Circuit balancing valves* Armstrong; Tour & Andersson; Gruvlok
 - .11 Triple duty valves* Armstrong; B&G; Gruvlok; Victaulic
 - .12 Expansion joints* Fulton; Flexonics; Hyspan
 - .13 Alignment guides* Adesco; Flexon; Fulton; Flexonics; Hyspan
 - .14 Air vents* Dole; Hoffman; Maid-O-Mist
 - .15 Strainers* Spirax-Sarco; Mueller; Victaulic; Gruvlok; Colton
 - .16 Thermometers* Ashcroft; H.O. Trerice; Winters; Taylor; Weiss; Marshalltown
 - .17 Pressure gauges* Kunkle; Winters; Ametek; Ascroft; Trerice; Weiss; Marshalltown
 - .18 Water pressure reducing valve; Fisher 95-R; Braukmann chilled/hot water systems

- .19 Expansion tanks* Amtrol; Expanflex; Wessels; B & G; Taco; John Wood
- .20 Air supply units* McQuay; Carrier; York
- .21 Relief valves (water)* Conbraco; Spence; Farris
- .22 Wall fin, convectors* Rosemex; Engineered Air; Rittling
- .23 Forced flow, unit heaters* Rosemex; Engineered Air; McQuay
- .24 Radiant panels* Aritex; Frenger; TWA; Rosemex
- .25 Boilers*
 - .1 Condensing* Aerco; Viessmann
- .26 Boiler feed contraos* Honnewell; Johnson
- .27 Vertical in-line pumps* Armstrong; B & G
- .28 Flexible pipe connectors* Flexonics; Hydro-Flex; United Flexible
- .29 Chemical treatment* GE Betz
- .30 Welded pipe backing rings* Robvon; Anvil
- .31 Vibration control* Vibron; Vibro-Acoustic; Airmaster
- .6 Air Distribution
 - .1 Ducturns, damper hardware, fan connections* Duro-Dyne
 - .2 Duct sealer, Duro-Dyne; 3M; Flexa-Duct; United; Bakelite
 - .3 Fire damper* Controlled Air; Penn; Air Balance; C.A.A.; Hart & Cooley; Ruskin; Nailor; Cesco
 - .4 Fire/smoke dampers* Greenheck; Controlled Air; Prefco Lawson; Nailor; Taylor
 - .5 Pitot tube enclosures* Lawson Taylor
 - .6 Manometers* Dwyer
 - .7 Filters* A.A.F.; Camfill-Farr; Cambridge; Continental; Airguard
 - .8 Louvres* Airolite; Carnes; Penn; Air-)Vnet; Canadian Advanced Air; H & C; Westvent; Ventex
 - .9 Belt driven in-line fans* Greenheck; Loren Cook
 - .10 Air cooled condensing units* Carrier; McQuay; Keeprite; Engineered Air; York; Lennox
 - .11 Electric duct heaters* Wright; Temro Electric; Chromolus; White Star; Thermolec; Brasch
 - .12 Diffusers, registers; E.H. Price Hart & Cooley; & grilles* Titus; Carnes; Nailor
 - .13 Acoustic duct insulation* Manville; Fibreglas; Ultralite; Knauf
 - .14 Variable volume air valves* E.H. Price; Nailor; Titus; Hart & Cooley; Anemostat
 - .15 Duct silencers* Vibro-Acoustics; Commercial Acoustics; Vibron; Kinetics
 - .16 Vibration control* Airmaster; Vibro-Acoustics; Vibron; Kinetics

- .17 Positive pressure chimney* Metalbestos; Metal Fab; Van Packer; Security; Ampco; Cheminée Lining
- .18 Refrigerant piping and Henry; Mueller accessories
- .19 Spiral ductwork* AMS; Basar; United; Vent Air; Pellaers
- .7 Controls/ Instrumentation
 - .1 Temperature control system* Honeywell; Johnson; Siemens-Landis; Delta
 - .2 Flow switch*
 - .1 (Fluid) McDonnell & Miller
 - .2 (Air) Cleaveland Controls AFS-222
- .8 H.V.A.C. Balance and Testing
 - .1 H.V.A.C. Balance & Airdronics Inc.; DFC; AHS; Testing Agency Air Movement

PART 2 PRODUCTS

- 2.1 Not Used
 - .1 Not used.

PART 3 EXECUTION

- 3.1 Not Used
 - .1 Not used.

PART 1 GENERAL

1.1 General

- .1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.
- .2 Testing, Adjusting and Balancing (TAB) Agency shall be an experienced, independent Contractor specializing in the testing, adjusting and balancing of HVAC systems.
- .3 Include extended service for 90 days after completion of final balancing Work, during which time Contract Administrator at his discretion may request re-check or re-setting of any systems an/or equipment listed in test report.

1.2 Scope of Work

- .1 Provide complete testing, adjustment and final balancing of all building air systems.
- .2 Provide inspection, verification and testing of all fire dampers, fire/smoke dampers, smoke control dampers and ceiling fire stops after installation. Coordinate the Work with Sections 23 54 11 and 25 30 00.

1.3 References

- .1 AABC – National Standards for Total System Balance.
- .2 ADC – Test Code for Grilles, Registers, and Diffusers.
- .3 ASHRAE 111 – Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- .4 NEBB – Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.
- .5 SMACNA – HVAC Systems Testing, Adjusting and Balancing.

PART 2 PRODUCTS

2.1 Balancing Reports

- .1 Provide two copies of detailed draft balancing report to Contract Administrator for review after completion of all adjustments.
- .2 Final balancing report shall incorporate all changes resulting from Contract Administrator's comments and any adjustments undertaken since the draft report was issued.
- .3 Provide four copies of final balancing report.
- .4 Provide sufficient number of copies of final balancing report to Mechanical Subtrade for inclusion in Operating & Maintenance Manuals.

PART 3 EXECUTION

3.1 General

- .1 All instruments used shall be accurately calibrated and maintained in good working order. If requested, tests shall be conducted in the presence of Contract Administrator and/or his representative.
- .2 Schedule all Work to comply with completion date.
- .3 Work shall not begin until system has been completed and in full working order. Division 23 shall put all heating, ventilating, and air-conditioning systems and equipment into full

operation, as season would demand, and shall continue operation of same during each working day of testing, adjusting and balancing.

3.2 Air Balancing

- .1 Coordinate with Section 23 54 11 to ensure installation of all manual adjusting dampers and pitot tube enclosures are as indicated, as specified and as required to allow proper adjustment of air systems.
- .2 Testing Procedure
 - .1 Test, adjust and record all fan speeds, motor amperes.
 - .2 Make pitot tube traverse to main supply and obtain cfm at fan.
 - .3 Test and record static pressure for each system at fan suction and discharge.
 - .4 Adjust all supply and return air ducts to proper design cfm.
 - .5 Test and adjust each diffuser, grille, and register to within 5% of design requirements. Balance as per manufacturer's recommendations.
 - .6 All outlets shall be adjusted to provide proper throw and distribution, in accordance with architectural requirements.
 - .7 Fan operating conditions tested shall confirm air delivery within 5% of manufacturer's fan curves.
 - .8 System shall be balanced so that fans operate at lowest possible static pressure.
 - .9 Prepare single line diagrams of duct systems indicating terminal outlets identified by number. List on data sheets all such outlets denoted by the same numbers, including the outlet sizes, 'K' factor, location, cubic feet per minute and jet velocity. Provide this data for all supply, return and exhaust air systems.
- .3 As part of Work of this Contract, Section 23 54 11 shall make any changes in units set points, and any additional manual dampers for correct balance as recommended by Section 23 05 93, at no additional cost to the City. Section 23 05 93 shall provide final adjustment of equipment set points.

3.3 System Check

- .1 Provide spot checks of systems if called upon by Contract Administrator. If capacities, fan speeds, ratings, etc. do not agree with submitted balance report, rebalance system or systems in question, until satisfactory results are received.

3.4 Testing/Verification of Fire Protection Equipment

- .1 Section 23 05 93 shall test and verify operation all new and/or relocated fire dampers, combination fire/smoke dampers, ceiling fire stops and smoke control dampers on this Project. Coordinate Work with Sections 23 59 11 and 25 30 00.
- .2 Testing shall be performed after air balancing has been completed.
- .3 Test shall include following:
 - .1 Visual inspections of each device:
 - .1 Confirm appropriately rated device installed and CSA/ULC label affixed and visible through duct/ceiling access door.

- .2 Confirm appropriate duct and/or ceiling access door provided to permit servicing of device. Confirm duct access door open-able without interference from adjacent ceiling, pipes, ducts, etc.
- .3 Confirm device has been installed in accordance with requirements of the specifications, manufacturer's instructions and codes.
- .4 Confirm proper installation, clearances, use of proper angle framing, use of proper fasteners, use of fire rated material in wall opening, location of breakaway joints, etc.
- .5 Confirm that device has not been painted.
- .2 Operational inspection of each device to include:
 - .1 Manual release of fusible link allowing device to close. Confirm tight fit closure without binding.
 - .2 Confirm that appropriate fusible link is installed.
 - .3 Re-open device and reset fusible link connection.
- .3 Following requirements are in addition to the above noted testing requirements and shall apply to all motorized smoke and fire/smoke dampers, including all motorized dampers associated with smoke control systems.
 - .1 Associated fan system shall be operating as per normal conditions.
 - .2 Power to operator shall be applied/removed, as required to cause damper to open. Ensure full opening operation without binding or overdriving of operator.
 - .3 Power to operator shall be removed/restored, as opening operation without binding or overdriving of operator.
 - .4 Ensure damper closes/opens against associated fan operating static pressure.
 - .5 Ensure proper adjustment of all damper drive linkages for fully open and fully closed positions and operation through full range without binding.
 - .6 Ensure proper device configuration e.g. power-to-open or power-to-close as specified.
- .4 Coordinate Work with Sections 23 54 11 and 25 30 00. Instruct Sections 23 54 11 and 23 05 93 as appropriate to repair or replace, as required, all devices or components of devices identified as being faulty, and to correct any installation deficiencies noted.
- .5 After necessary repairs have been completed, Section 25 30 00 shall re-inspect/retest each device as indicated above.
- .6 Provide verification report on completion of Work. Report shall indicate general location (e.g. room number or description) and specific location (e.g. north wall above ceiling) of access door to device. Report shall include itemized verification of following, as appropriate, for each device.
 - .1 Device is fully accessible.
 - .2 Device has been properly installed.
 - .3 Device has been successfully tested.
 - .4 Device has been reset.

.5 Name of tester.

.6 Date device tested successfully.

3.5 Identification of Fire Dampers and Ceiling Fire Stops

- .1 At all fire dampers, fire/smoke dampers, smoke control dampers and ceiling fire stops, supply and install identification tags. Tags c/w envelopes shall be of type approved by Contract Administrator.
- .2 Envelopes shall be mechanically fastened to adjacent duct access door, or onto structure near dampers or ceiling fire stop where there is no connecting ductwork.
- .3 After each device has been verified as noted above, Section 23 05 93 shall label tag with permanent ink identifying device, location (room number), inspection date, inspector's signature and TAB Agency name.

PART 1 GENERAL

- 1.1 All drawings and all sections of the specification shall apply to and form an integral part of this section.
- 1.2 Work Included
 - .1 Labour, material, plant, tools, equipment and services necessary and reasonably incidental to completion of external insulation for mechanical equipment, piping, ductwork.
- 1.3 References
 - .1 NAIMA National Insulation Standards
 - .2 SMACNA – HVAC Duct Construction Standards – Metal and Flexible
- 1.4 Related Work
 - .1 Common Work Results - Mechanical Section 23 05 00
 - .2 Acceptable Materials and Equipment Section 23 05 14
 - .3 Plumbing Section 22 10 01
 - .4 HVAC System Section 23 54 11

PART 2 PRODUCTS

- 2.1 Materials
 - .1 All materials shall be equivalent in all respects to specified products and shall be used only in applications intended by the manufacturer. Materials not specifically intended for the purpose shall not be used. Approved materials shall not be diluted or blended with other materials unless specifically recommended by the manufacturer of the approved material.
 - .2 All final pipe and duct installations including insulation, covering and adhesive shall have a ULC Certified flame spread rating of not greater than 25, and a smoke developed classification of not more than 50.
 - .3 All canvas shall be treated to be fire retardant in accordance with ULC standards
 - .4 Wire to be 1.2mm (18 ga.) stainless steel, dead soft annealed, type 304.
- 2.2 Compatibility of Components
 - .1 All adhesives, sealers, vapour coating, mastics, laggings and bedding compounds, shall be compatible with materials to which they are applied. They shall not soften, corrode, or otherwise attack such material in either wet or dry state and shall only be those recommended by manufacturer of insulation as suitable for application proposed. They shall be applied at ambient conditions acceptable to the manufacturer.
- 2.3 Cold Insulation – Plumbing
 - .1 Material
 - .1 On pipes 50mm (2") diameter and under, use 12mm (1/2") Fiberglas 112 kg/m³ (7 lb./cu. ft.) density pipe insulation with ASJ jacket. 13mm (1/2") Armstrong Armaflex AP or Rubatex equal may be used for domestic cold water and cooling coil condensate drains piping only.

- .2 On pipes 62mm (2 ½") diameter and larger, use 25mm (1") Fibreglas 88 kg/m³ (5 ½" lb./cu. ft.) density pipe insulation with ASJ jacket, complete with vapor barrier.
- .3 Vent piping in cold attics shall be less vapor barrier jacket and wired on.
- .2 Location
 - .1 All domestic cold water piping.
 - .2 All cooling coil condensate drains.
 - .3 Roof hoppers, vertical and horizontal storm drains except in crawlspaces.
 - .4 Vent piping for a developed length of 3m (10' – 0') from roof terminals.
 - .5 Vent piping located in cold attics and in other cold locations.
 - .6 Sump pump discharge lines that pass through ceiling spaces.
 - .7 Water meters.
 - .8 Run outs from mixing valves to shower heads.
- 2.4 Hot Insulation – Plumbing
 - .1 Material
 - .1 Fibreglas insulation with all service jacket (ASJ) and self seal lagging adhesive.
 - .2 On pipes 50mm (2") diameter and under, use 25mm (1") Fibreglass 112 kg/m³ (7 lb./cu. ft.) density insulation.
 - .3 On pipes 62mm (2 ½") diameter and larger, use 38mm (1 ½") Fibreglas 88 kg/m³ (5 ½ lb./cu. ft.) density insulation.
 - .2 Location
 - .1 All domestic hot water, and tempered water supply and hot water recirculation piping.
- 2.5 Hot Insulation – Heating
 - .1 Materials
 - .1 On piping 50mm (2") diameter and under, use 25 (1") Fibreglas 88 kg/m³ (5 ½ lb./cu. ft.) density pipe insulation with ASJ all service jacket and self seal lagging adhesive.
 - .2 On piping 62mm (2 ½") diameter and larger, use 37mm (1 ½") Fibreglas 88 kg/m³.
 - .2 Location
 - .1 All new hot water heating supply and return piping, including accessory apparatus such as air eliminators and the like.
- 2.6 White PVC Insulation Cover
 - .1 Cover insulation and insulated fittings with white PVC fitting covers.
 - .2 The fitting cover system shall consist of one-piece pre-molded high impact PVC fitting covers with fiber glass inserts and accessories, including elbows, tee-valves, end caps, mechanical line couplings, specialty fittings, jacketing, tacks, and PVC tape.

- .3 Cover shall have a flame spread rating of not more than 25 and a smoke developed classification of not more than 50.
 - .4 Cover shall be resistant to and not promote growth of fungi or bacteria.
 - .5 Cover shall be UV resistant for use indoors or outdoors. Paint outdoor fittings for further UV and colorfast protection.
 - .6 Locations
 - .1 All exposed piping and storage rooms.
 - 2.7 Vapour Barrier Flexible Duct Insulation
 - .1 Following duct externally insulated with Fibreglas RFFRK reinforced foil-faced vapour seal duct insulation PF335, 340 g. (3/4 lb./cu. ft.) density.
 - .1 25mm (1") Thickness
 - .1 All round supply air ductwork, and all rectangular supply air ductwork, less than 1200mm (48") wide on discharge of fan systems with cooling coils.
 - .2 All ductwork on supply and discharge to HRV1 and HRV2.
 - .3 All ductwork for fresh air supply to HRV's and AHU's.
 - .2 50mm (2") Thickness
 - .1 All outside air ductwork.
 - 2.8 Refrigerant Pipe Insulation
 - .1 Insulate all refrigerant piping lines with 12mm (1/2") Armstrong Armaflex AP sealed with Armstrong 520 adhesive. Refinish exposed and exterior insulation with Armstrong WB Armaflex finish.
 - .2 Cover outdoor insulation with aluminum jacket CSA HA Series-M1980.
 - .1 Crimped or embossed alloy jacketing 0.4mm thick with longitudinal slip joints and 50mm end laps with factory attached protective liner on interior surface. Aluminum alloy butt straps with mechanical fastener.
 - .2 Jackets on fittings, 0.4mm thick, die shaped components of alloy with factory attached protective liner on interior surface.
- PART 3 EXECUTION**
- 3.1 Workmanship
 - .1 Work shall be performed by licensed journeymen.
 - .2 Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations.
 - .3 Do not apply coverings until hydrostatic tests have been completed, surfaces are free of grease, scale, moisture, and heat tracing where required has been installed. Insulation shall be clean and dry when installed and during application of any finish.
 - .4 Apply insulation and coverings to equipment and piping which will operate with hot or warm liquid vapour, while surface is hot. Provide any required temporary heat to accomplish this.

- .5 Cold surfaces to be dry and ferrous surfaces to be coated with rust penetrating protective paint before applying insulation and vapour barriers.
 - .6 Vapour barriers and insulation to be complete over full length of pipe or surface, without penetration for hangers, duct or seams, and without interruption at sleeves, pipe and fittings.
 - .7 Install insulation with smooth and even surfaces, with round shapes laid to true circular and concentric shape, shaped to blend with fitting insulation and adjacent covering; with full length section and tight to insulated object.
 - .8 Pack solid around all pipes where they pass through sleeves in walls, floor slabs, etc. for full thickness of floor with fibreglass or rockwool. Refer to firestopping clause where piping passes through fire separations. On all services, carry full insulation thickness through walls, floor, etc. protect insulation of exposed pipes passing through floors with 1.2mm (18 ga.) galv. Iron 150mm (6") from finished floor.
 - .9 On piping, gouge out insulation for proper fit where there is interference between weld bead and insulation. Bevel insulation away from studs and nuts to permit their removal without damage to insulation. Closely and neatly trim around extending parts of pipe saddles, supports, hangers and clamp guides. Seal with insulating cement.
 - .10 Use pipe covering protection saddles with roll type hangers unless otherwise indicated.
 - .11 Butt joints
 - .1 Place joints on top of duct wherever practical. Butt joints on side of duct for flexible duct insulation.
 - .2 Adhere and seal laps of vapour barrier cover or vapour barrier strip of 100mm (4") minimum width furnished with insulation, using vapour seal adhesives.
 - .12 Sagging of duct insulation will not be acceptable.
 - .13 Stagger both longitudinal and horizontal joints, on duct insulation of multi-layered construction.
 - .14 Duct insulation with vapour barrier shall be continuous, except at fire dampers.
 - .15 Ducts acoustically lined need no external insulation, except at fire dampers.
 - .16 Existing duct and pipe covering damaged or cut back during installation Work to be made good with same insulation as specified for new Work.
 - .17 Protect insulation against elements during all stages of application.
 - .18 Do not cover manufacturer's nameplates. Cut insulation on 45 deg. Angle to nameplate edge and seal.
 - .19 Covering to be uniform in diameter, smooth to finish. Place longitudinal seams so as to be invisible.
- 3.2 Cold Insulation- Plumbing
- .1 Fibreglass
 - .1 Insulate flanges, fittings and valve bodies, etc.
 - .2 Fasten longitudinal laps with staples and seal with Swifts Adhesive #3218.
 - .3 Butt joints wrapped with a 100mm (4") strip of ASJ. Stagger joints on multiple layers.

- .4 Refinish exposed piping with canvas and coat with Bakor 120-18 white fire retardant lagging adhesive.
 - .5 All firings shall be insulated by wrapping with 25mm (1") thick layers of 340g. (3/4 lb.) density flexible fibreglass attached with jute twine. Surface shall be wrapped with Friction Tape and sealed with an asphaltic sealing compound. Over this to be applied a smooth coating of insulating cement. Recover fittings with ASJ vapour seal jacket and brush coat with fire retardant white lagging adhesive.
- .2 Armaflex
- .1 Insulate fitting, valve bodies, etc.
 - .2 All fittings shall be insulated with mitre-cut pieces of Armaflex AP pipe insulation the same size as on adjacent piping.
 - .3 Seal joints and seams with Armstrong 520 adhesive, and refinish exposed fitting with Armstrong Armaflex finish.
 - .4 Refinish all exposed piping with two coats of Armstrong Armaflex finish, colour selected by Contract Administrator.
 - .5 Where Armaflex insulation comes in close contact with adjacent equipment or piping having surface temperatures above 100 deg. C, Section 23 07 12 shall provide additional protection to ensure against deterioration of insulation by heat.
- 3.3 Hot Insulation – Plumbing
- .1 Application as per Clause "Cold Insulation – Plumbing".
- 3.4 Hot Insulation – Heating
- .1 Application as per Clause "Cold Insulation – Plumbing".
- 3.5 Insulation Cladding
- .1 For aluminum jacketing installation, install in strict accordance with manufacturer's published recommendations.
- 3.6 White PVC Insulation Cover
- .1 Preparation
 - .1 Proto Fitting Covers shall be applied on clean, dry surfaces.
 - .2 Application
 - .1 General
 - .1 The matching fibreglass insert shall either be wrapped completely around the fitting or snugly positioned inside the Proto Fitting cover for proper fit. The insert shall cover the full inner surface area of the Proto Fitting Cover. The Proto Fitting Cover shall then be applied over the fitting and insert. And the throat secured by either tack fastening, taping, sealing with a solvent type PVC adhesive, or bonding.
 - .2 Cold Pipe
 - .1 Fitting systems below ambient temperature must have a continuous vapour retarder, either with Proto PVC Tape, Proto Butt Strips, Proto PVC Adhesive, or a vapour retarder mastic as specified by the Contract Administrator. When using Proto PVC Tape, a 51mm (2") minimum downward overlap is recommended for optimum performance. Care

should be taken not to stretch the last 51mm (2") of Proto PVC Tape, to avoid stretching or creeping.

.3 Hot Pipe

- .1 Insulate as per General Instructions given above. Due to PVC softening point at approximately 150 deg. F (70.6 deg.C.), care should be taken to ensure sufficient insulation thicknesses are applied. For hot piping which requires Knauf Pipe Insulation over 51mm (1- 1 1/2") wall thickness, an extra fibreglass insert shall be applied for each additional inch of pipe insulation wall thickness. Knauf recommends the surface temperature of the pipe insulation and PVC to be no higher than 125 deg. F (52 deg. C). to complete application of Proto PVC Fittings on hot piping, the throat seam shall be riveted or tacked.

.4 Outdoor Pipe

- .1 Insulate as per above instructions. When installing Proto PVC fittings outdoors, add one layer aluminum foil over the first fibreglass insert applied, making sure the aluminum foil is extended over the adjacent pipe insulation. A second fibreglass insert shall then be applied over the aluminum foil, and the Proto PVC fitting applied.
- .2 Minimum Proto PVC jacketing thickness for outdoor application should be .5mm (.020"). the PVC jacketing shall be overlapped a minimum of 51 mm (2") on the down side so as to shed water, longitudinal joints shall be completely weather sealed with solvent type PVC sealer. Circumferential joints shall be wrapped with a minimum 51mm (2") wide butt strips and completely sealed using a solvent type PVC sealer. On hot piping, insulation shall be of sufficient thickness to keep the surface temperature below 52 deg. C. (125 deg. F). additionally, a slip type expansion joint of 101mm (4") minimum width shall be applied at least every 6.1 lineal meters (20 lineal feet)

3.7 Vapour Barrier Flexible Duct Insulation

.1 Rectangular Ductwork

- .1 On ducts 600mm (24") wide and wider apply fasteners to bottom surface of duct by impaling on welded pins on 300mm (12") centres. Spot adhesive on 300mm (12") centres on all sides of duct. Apply insulation with edges tightly butted together and secured with 100% coverage of 3-M No.17 or approved alternate. Staple joints and seal with 100mm (4") strips of vapour barrier foil of same quality as duct insulation membrane sealed with BF85-15.
- .2 On ducts 575mm (23") wide or less insulation applied as above but welded pins may be omitted.

.2 Round Ducts

- .1 adhere to duct surface applied in strips 150mm (6") wide, 300mm (12") o.c. Butt all edges of insulation, staple and seal all joints with tape adhered over the joint. Seal all breaks with vapour barrier type.

.3 Exposed Ducts

- .1 Recover ducts exposed to view with 170 g. (6 oz.) canvas secured with Bakor 120-18 white fire retardant lagging adhesive. Finish with brush coat of same adhesive.
- .4 Outdoor Ducts
 - .1 On roof and other ductwork located outside of building, provide 26 ga. G.I. sheet metal cover to protect insulation. Seal all joints and make weather-tight.
 - .2 On square or rectangular ductwork provide slight peak along top centre line so moisture will run off.
- 3.8 Vapour Barrier Rigid Duct Insulation
 - .1 Outdoor Ducts
 - .1 On roof and other ductwork located outside of building, provide 26 ga. G.I. sheet metal cover to protect insulation. Seal all joints and make weather-tight.
 - .2 Provide slight peak along top centre line so moisture will run off.
- 3.9 Refrigerant Pipe Insulation
 - .1 Insulate fittings, valve bodies, etc.
 - .2 All fittings shall be insulated with mitre-cut pieces of Armaflex AP pipe insulation the same size as on adjacent piping.
 - .3 Seal joints and seams with adhesive, and refinish exposed fittings with specified finish. Refinish all exposed piping with two additional coats.
 - .4 Where insulation comes in close contact with adjacent equipment or piping having surface temperatures above 100 deg. C, provide additional protection to ensure against deterioration of insulation by heat.
 - .5 Allow adhesive joints of Pipe Insulation to dry 24 hours to 36 hours before applying finish. Apply finish directly to clean, dry insulation in two coats. Wipe surface with cloth dampened with non-oily solvent such as alcohol or toluol to clean surface and remove powdered lubricant. Allow first coat to dry minimum of two hours before applying second coat. Before applying finish, read precautionary information on can label
 - .6 Finish insulation located outdoor with Armstrong WB black Armaflex finish. Do not apply over joints freshly cemented with 520 adhesive. Allow adhesive joints of Armaflex pipe insulation to dry 24 to 36 hours before applying finish. Apply finish directly to clean, dry Armaflex insulation in two coats, wipe surface with cloth dampened with non-oily solvent such as alcohol or tuloul to clean surface and remove powdered lubricant. Allow first coat to dry minimum of two hours before applying second coat. Before applying Armaflex WB finish, read precautionary information on can label.
 - .7 For aluminum jacketing insulation install in strict accordance with manufacturer's published recommendations. Make weather-tight application.

PART 1 GENERAL

1.1 Scope

- .1 The Contractor shall provide all labour, materials, and equipment necessary, to put in working operation a complete system to remove both diesel and automotive exhaust gases, and particulate of operating vehicles within the confines of specified fire station(s). All necessary controls, motors, fittings, louvers, ductwork, blower(s), labour and all other equipment and materials specified shall be part of the Contractors work.
- .2 All items of equipment and materials described in these specifications are to be furnished installed and placed into proper operating condition in accordance with good practice and manufacturer's written or published instructions.
- .3 All workmanship and materials shall be in accordance with applicable codes and regulations, i.e. SMACNA, BOCA, NEC, ASTM, UBC, UMC, NFPA, AMCA and IMC. Such codes and regulations are to be considered part of these specifications.
- .4 The Contractor shall warranty all materials, equipment and workmanship for a period of two (2) years from the date of final acceptance of the completed job, against original defects of material and workmanship, excessive wear and deterioration. Repairs shall be made at the Contractors expense.
- .5 Contractor shall install a complete automatic disconnect Diesel Exhaust Removal System, that addresses the problem of diesel fumes in the fire department station house that will not interfere with normal day-to-day operations. The system shall be a Sliding Balancer Track type system that has the following performance criteria:
 - .1 The exhaust removal system must provide 100% complete evacuation of all diesel fumes at the source from start up to exit of the apparatus from the fire station. The diesel exhaust removal system shall be capable of reaching to the undercarriage of the vehicle tailpipe located anywhere from 10 to 75 feet away from the exiting door threshold. The system must be able to accommodate drive through bays to meet all the needs of the fire department.
 - .2 The system must not affect personnel boarding the apparatus. Hose loops shall not hang any lower then seven feet from the bay floor. The hose assembly shall not touch or drag on the bay floor.
 - .3 The exhaust system shall not block doorways, exits, and aisles in the apparatus bay, which could endanger the welfare of fire personnel visitors.
 - .4 To protect the apparatus electrical system from any possible damage, the system bid shall not incorporate any type of electromagnetic device that requires the apparatus to be utilized as an electrical ground for the systems operation.
 - .5 Due to the harmful effects of diesel exhaust, the system must be designed and capable of capturing 100% of the exhaust gas and particulate even in the event of a complete power failure. The system shall not detach itself from the apparatus for any reason during a power failure other then normal exiting of the apparatus bay. No exception to this requirement will be allowed.

1.2 Standard Products

- .1 Equipment and materials provided for the system installation(s) shall be a standard product of manufacturer's currently engaged in the manufacturing of automatic vehicle exhaust removal systems. Where the requirement calls for a packaged exhaust system to be provided, all items shall be the product of the manufacturer.

- 1.3 Quality Assurance
- .1 All workmanship, manufacturing procedures, airflow design, and materials shall be performance guaranteed. If any findings or test studies reveal improper materials, defective components or inadequate performance as outlined in the performance/technical specifications, the Contractor shall remove and replace the materials in question.
- 1.4 Equipment Warranty
- .1 The Contractor shall guarantee all materials, equipment and workmanship for a period of two (2) years from the date of the final acceptance of the completed job against original defects of material and workmanship, or excessive wear or deterioration. Defects shall be made good at the Contractor's expense with not cost or obligation to the City.
- 1.5 Product Delivery, Storage and Handling
- .1 The Contractor shall be solely responsible for the delivery, storage, and handling of all products. Any equipment placed in storage shall be protected from weather, humidity, temperature variations, dirt, dust, or other contaminants.
- 1.6 Contractor Qualifications
- .1 Bids will only be accepted from companies that have an established reputation in the field of manufacturing and installing Diesel Exhaust Removal Systems. The Contractor must be established in the business of Diesel Exhaust Removal Systems for a minimum of no less than eight (8) years. Contractor shall show proof that their system has been field tested and proven by supplying a list of not less than 15 fire department references. Include a phone number and contact name.

PART 2 PRODUCTS

- 2.1 System Manufacturer:
- .1 All equipment specified herein shall be a standard product of the manufacturer, or an approved equal. An approved equal shall be determined by the Contract Administrator. The Contractor shall provide all labour and materials required to install and operate the Diesel Exhaust Removal System which shall be included in the following performance and technical specifications. Any adjustments involving equipment locations within the building shall be determined in the field and approved by the City.
- 2.2 Air Moving Devices
- .1 Centrifugal Fans:
- .1 The fan shall be a direct drive centrifugal type, high pressure, single width, single inlet as required or indicated. Impeller wheels shall be of a radial design for high static pressure performance. Impeller wheels shall be spark resistance and made of Almag material to prevent static electricity build up. The impeller shall be dynamically and static balanced, and of the non-overloading type to provide maximum efficiency while achieving quiet, vibration-free operation.
- .2 The fan housing shall be manufactured from a non-ferrous material- Almag (or) approved equivalent. The fan motor and assembly shall be mounted on a stainless steel frame for durability in any type of weather conditions. The base shall have four (4) pre-punched openings at bottom of fan base for field attachment to either an exterior wall or roof structure.

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- .2 Fan Motor and Bearing:
 - .1 All 1 to 10 horsepower motors shall be totally enclosed fan cooled (TEFC). The bearings shall be self-aligned; ball bearing type permanently sealed and lubricated. Fan shafts shall be steel and rotate in a non-sparking TEFLON seal to prevent hot gases coming in contact with the motor bearings. The exhaust discharge outlet shall be in compliance with ACGIH recommendations and EPA requirements (min. of 40" above roofline). Air intakes, windows, cascade systems, prevailing currents, communication equipment and building aesthetics shall be considered in the final location of the fan. Silencers shall be provided when fan sound decibels exceed 64Dba.
 - .3 Performance:
 - .1 The Fan Capacity shall be sized as such as to deliver the required CFM at each hose drop the vehicle engine exhaust (based on an airtight connection at tailpipe), lengths of ductwork, elbows, branches, shut down, Y's , etc. which accumulate the static pressure at the field inlet. The manufacturer's provided fan(s) shall be performance guaranteed.
 - .4 Location:
 - .1 The fan shall be located on the outside of the fire station as far away from any living quarters as possible so that firefighters would not be disturbed by the system activation. No blower fans shall be mounted in side the fire station. No exception.
- 2.3 Electric Controllers
- .1 Controller Type:
 - .1 The controller shall be manufactured and delivered as an Operating System with one series controller manufactured by the Contractor or an equal to the specifications to follow.
 - .2 Electrical Controllers:
 - .1 The electrical controller offered shall be approved by Underwriters Laboratories (UL) as a complete electrical system for enclosed industrial control panels. No exceptions.
 - .1 Electrical controllers shall be UL listed/approved and manufactured in accordance with Underwriters Laboratories standard UL-508 enclosed industrial control panels. The electrical trolley shall include a limited energy control circuit. Enclosures shall be NEMA 12 rated and UL listed as Type 12. The electrical enclosure shall be provided and mounted in an electrical enclosure to restrict access to internal components of controller by only authorized entry.
 - .3 Electrical Contactors:
 - .1 Contactors shall be Allen Bradley Industrial Electrical Contactors, provided with the appropriate adjustable overload relays to meet the proper full load amperage of motor that is outlined in these specifications. The Contactor shall conform to the following standards: BS-5424, VDE0660, and be approved by UL Certification as an approved component.

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- .4 Control Transformer:
- .1 Shall be UL listed industrial control circuit transformer with primary and secondary fuse blocks. Transformer shall be provided with multi-tap primary 208V through 480V, AC, and 24V through 120V secondary.
- .5 Electrical Timer:
- .1 Shall be solid state five (5) minute adjustable timer. The operating logic shall complete this cycle. Input voltage shall be applied to the timer at all times. Upon closure of a normally open isolated start switch, the load energizes and remains energized as long as the switch is closed. When the start switch opens, the timing cycle shall start. At the end of the preset time delay, the load de-energizes and the timer is ready for a new timing cycle. Timer shall be a UL recognized component under file number E65038.
- .6 Engine Start Switch:
- .1 Shall be of an engine pressure sensing type, capable of recognizing the output pressure of any type of motor vehicle exhaust. The electrical contact shall be dry type or not to exceed 24V.
- .7 Electrical Wiring:
- .1 Shall be run in wire channel to allow for easier identification of wiring circuit and appearance. All wiring circuitry shall meet UL listed for proper bending radiuses and terminations.
- .8 Electrical Terminal Block:
- .1 Shall be 600V, UL rated and recognized. It shall provide individual connection points for remote controls, power and motor connections.
- .9 Electrical Wiring Schematic:
- .1 Shall be provided with each electrical control box supplied. Wiring schematic shall show internal circuitry as well as all primary and secondary connections to the controller. This schematic shall be provided as a "D" size print drawing.
- .10 Electrical Interface:
- .1 To protect the apparatus and communications, designs that incorporate the use of a controller that utilizes or produces an electrical frequency transmission or any possibility of electrical back-feed which may interfere with a central services communication or onboard vehicle computer logic or navigational equipment will not be accepted.
- .11 Controller Performance:
- .1 It shall be designed to sense the output pressure, which is normally generated by any internal combustion engine designed to propel a motor vehicle. The operating logic shall be designed to complete this cycle. At any point in time when a collection device is connected to a motor vehicle's exhaust tailpipe, at which time the operator manually or automatically starts the vehicle, this controller shall automatically sense the engine's output pressure and in turn energize the electrical contactors which will provide proper full load amperage to the exhaust removal system fan motor. The controller through the use of an adjustable timer shall keep the contactors energized for up to five minutes in accordance with the station response requirement. If the responding vehicle does not disconnect from the exhaust ventilation system in less than the designated

setting, a temperature override switch shall be incorporated to override the timer delay relay to ensure continuous operation. This automated function will work for as long as the exhaust gas temperature is in excess of setting on heat sensor located in the ductwork. This cycle shall not allow the electrical contactor, which energizes the exhaust fan, to short cycle or stop the fan while the system is connected to an operating vehicle.

2.4 Ductwork System

.1 Ductwork Type and Materials:

.1 Shall be UMC class C or SMACNA class 11 product conveying. It must meet or exceed criteria for construction and performance as outlined in Round Industrial Duct Construction Standards, SMACNA. Materials of construction unless otherwise specified for all ductwork and fittings shall be a minimum G-90 galvanized sheet metal in accordance with ASTM-A525 and A527. Only when specified, type 304 stainless steel in accordance with ASTM A240 shall be provided.

.2 Ductwork Sizing and Gauges:

.1 All ductwork subject to positive or negative pressure shall be of round spiral pipe construction, with the range of available sizes not to exceed 10 inches in diameter. Duct gauge shall depend on diameter and a minimum operating pressure of 8 inches water gauge. Acceptable gauge and reinforcement requirements shall be in accordance to the following. Inner duct diameter 4" – 7" diameter shall be 26 gauge standard spiral pipe and 9" – 10" diameter shall be 24-gauge standard spiral pipe.

.3 Ductwork Fittings:

.1 All exhaust fittings shall be round and have a wall thickness 2 gauges (one even gauge number) heavier than the lightest allowable gauge of the downstream section of duct to which they are connected. Air duct branch entrances shall be factory fabricated fittings or factory fabricated duct/tap assemblies. Fittings shall be constructed so that air stream converge at angles no greater than 45 degree. All seams shall be continuous stitch welded and if necessary internally sealed to insure airtightness. Turning elbows shall be stitch-welded and used for all diameters and pressures. They shall be fabricated of 24 gauge galvanized steel and constructed as two piece with continuous welded seam construction fittings. Tapered body fittings shall be used manifold. No exceptions.

.4 Ductwork Design Velocities:

.1 Shall be a minimum of 4000 – 4500 feet/minute transport velocity in metal ductwork which is the standard for design. Capture velocity shall be 5500 – 6000 FPM to extract 100% of the exhaust gases.

.5 External Ductwork:

.1 Shall be sized for the exact inlet and outlet of the exhaust fan blower. If the fire station is exposed to unusual inclement weather, unusual levels of acid rain or is within 3 miles of salt water, stainless steel shall be considered for all exterior ductwork components. An exhaust rain cap shall be supplied and manufactured in accordance with EPA standard for free draft rain cap requirements. Included as an integral part of this rain cap shall be a back draft damper to provide protection from rain and other inclement weather or air.

.6 Exhaust Penetrations:

- .1 To protect the City's best interest ductwork shall only penetrate exterior walls rather than a roof penetration. In all cases when making a wall penetration through masonry or concrete walls it shall be done by the use of a professional core-drilling machine. The core drilling shall be properly sized to reduce the diameter of the opening to the smallest possible size. Only after all possible avenues for wall penetration are exhausted, shall the roof penetration be accepted. The original roofing Contractor shall perform the Work if possible to insure any warranties on the existing roof are not voided. If the original roofing Contractor cannot be notified a licensed roofing Contractor shall be used.

2.5 Vehicle Exhaust Removal System Requirements

.1 Scope of System Operations:

- .1 The vehicle exhaust removal system shall capture 100% of the exhaust emissions directly at the tailpipe of the vehicle and exhaust those emissions to a specified area safely outside the building. The operating controller shall be designed to complete this cycle. A pneumatically operated collection nozzle shall be connected to the motor vehicle's exhaust tailpipe, when the vehicle is started by the driver, the exhaust fan will automatically energize and vent the toxic gases directly to the outside of the building. This automatic feature shall be achieved by means of a pressure sensor located inside the exhaust ducting; this pressure sensor shall sense the engines output pressure upon the first stroke of the engine piston and energize the fan starter. The automatic controller shall use an adjustable timer to keep the contactors energized for a designated period of time. Should the operating vehicle not exit the station within the designated preset time period, a temperature override switch shall be incorporated to override the timer relay. This override shall be achieved by means of an adjustable temperature sensor located inside the exhaust ductwork. The adjustable temperature (heat) sensor shall have a range of 90 – 130 degrees. If the vehicle is still running inside the station longer then anticipated, the heat sensor will override the timer relay. The pneumatic connection device shall stay connected to the vehicle tailpipe as it travels to the exit door in a pre-engineered sliding track system. The sliding track shall be securely attached to the building structure and supports a flexible hose assembly that moves with vehicle inside the station. As the vehicle nears the exit door, the pneumatic nozzle connection located at the tailpipe shall release its air pressure automatically therefore releasing the nozzle from the tailpipe. This shall be accomplished by means of an uncoupling valve strategically located on the sliding track. After the system releases the vehicle tailpipe at the door, it shall retract passively and smoothly into a convenient storage position. When the vehicle returns to the station, a system operator manually pulls the flexible hose assembly to the entrance door. The system operator holds the pneumatic connection device approximately 18" from the floor and at the door threshold. The system operator, without bending over, attaches the pneumatic connection device just inside the door threshold as the vehicle enters the station, at which time the exhaust fan motor energizes. The vehicle driver momentarily stops the vehicle when the tailpipe is just at the door threshold (a backup man will notify the driver when it is time to stop the vehicle). The system operator, standing straight up with the pneumatic slide valve in his left hand, shall slide the connection device up against a flanged adapter attached to the vehicle tailpipe; the operator will then inflate the pneumatic nozzle around tailpipe. The cycle is completed as the exhaust fan starts and vents the toxic

gases with the pneumatic connection nozzle firmly attached to the vehicle exhaust pipe. The vehicle then proceeds to its designated resting position.

.2 Sliding Track:

- .1 The sliding track shall be a one-piece continuous extruded aluminum track in a minimum length of 20 feet. The construction profile shall be of a Boxloc type profile, which shall adhere to the following dimensions. Track height 3 1/8", width 1 1/2", thickness 1/8". The track material shall be aircraft aluminum alloy type AA-06063. The aluminum track shall be an extruded design that shall incorporate three separate and functioning channels. The three channels shall be for the following, mounting channel, trolley channel and the boxloc channel. Each of these sections performs a specific function to make the system work effectively. The mounting compartment shall be designed to accept the slider bars (which shall be provided with factory supplied vertical legs and riser clamp duct connection) and allow positioning along the full length of the slotted track mounting channel. The mounting channel shall also accommodate the compressed airlines for the purposes of safe storage and appearance. The trolley channel shall allow the trolley/balancer/hose assembly to glide to the door threshold in a safe and effective manner. The boxloc channel shall allow the whole track to remain rigid as it hangs from factory supplied leg supports and also shall provide an area to attach bolts for splicing additional tracker together for systems over 20 feet long. The overall extruded track lengths shall be 20 foot standard and weight no more than 35 lbs. The track system shall be equipped with end stops that limit travel of flex hose as the vehicle exits the building. The end stop shall be fabricated of zinc plated steel in a U shape form, with a rubber end stop on the impact end. It shall be attached by using a 1/4" molded locked bolt. The end stop shall be secured to the track with no less than (2) 1/4" bolts and locking nuts located on the underside of the track. For security, a 1/4" bolt shall be drilled through the ends of each track system to insure that the trolley/balancer assembly(s) roll no further then the end of the track system.

.3 Support Legs:

- .1 Support legs shall be manufactured and provided by the supplier of the primary exhaust removal system. (Equipment Manufacturer). This is to ensure that the unit is installed as a complete system including the mounting hardware. Supports shall be zinc-plated telescoping adjustable type and shall be capable of adjusting travel lengths from 6 inches to 13 feet. A minimum of one support with appropriate bracing shall be provided for every 10 linear feet of track profile. The support legs shall consist of a square outer profile with dimensions no less than 1 3/4" OD. With 3/8" fastening hardware provided. Inner leg shall be a C profile type with continuous slot along its traveling length. Welded securely to the bottom of C profile shall be a mounting foot complete with a slider bar and 3/8" hardware necessary for mounting the horizontal track to the mounting channel system. The support leg shall be equipped with round tubular zinc-plated steel with pressed ends. The angle shall be completely adjustable to the leg support and mounted perpendicular and parallel to direction of the track. The typical support angle shall be 45 degrees from the centre line of the factory provided support leg. The standard leg shall be capable of meeting a Seismic 4 requirement.

.4 Double track joiner plate:

- .1 Should the exhaust removal system require a double track type system due to the length of the apparatus bays, the tracks shall be attached in the following manner. The joiner plate shall be constructed from a minimum of 1/4" thick zinc-

plated material and be designed to connect two parallel tracks to make a double track system to accommodate an apparatus bay over 40 feet in length. The joiner plate shall be 10" x 8" flat zinc-plated steel and designed to attach the two tracks to a single factory supplied support leg. The steel plate shall have (6) 3/8" holes drilled 6 7/8" apart to accommodate the slider bar provided with factory support legs. The joiner plates shall have two slider bars attached to the plate and shall be located on the outside edges of plate, these slider bars shall fit into the boxloc track mounting channel for a simple and secure attachment of the plate to boxloc track. The center portion of the joiner plate shall provide attachment for the factory supplied support leg.

.5 Track Splicing Assembly:

- .1 The track splicing assembly shall be fabricated for the sole function of connecting two extruded aluminum boxloc sliding tracks end-to-end. Track splice shall be manufactured of galvanized steel in two parts and utilized as a clamping device. This clamp shall accurately secure both tracks together in a fashion, which shall eliminate any possibility of obstructing the trolley assembly as it passes through this connection point of track system. Connecting length of splice shall be a minimum of 15 3/4" long and fabricated of 14 gauge material. Four 1/4" bolts with lock nuts shall pass directly through internal partition of boxloc track. The splicing sleeve shall fit externally around the outside dimension of extruded aluminum track profile.

.6 Riser Clamp Assembly:

- .1 The riser clamp shall be fabricated as a one piece welded assembly and manufactured to create the transfer of the hard spiral pipe joined at the top and flexible duct connection at the bottom. The riser clamp shall be pre-drilled to mount an air regulator assembly for the pneumatic nozzle and to accept airlines that pass through airtight seals mounted to riser pipe. A slider bar and associated hardware shall be provided with riser clamp assembly. Sizes of the riser clamp will range from 3" – 6" diameter to match the output velocity of the vehicles that will park in that station.

.7 Accutrack Trolley / Balancer Assembly

- .1 The trolley assembly shall be manufactured as a two piece galvanized steel assembly including bumper stops at each end. Fixed to the side of the trolley are solid steel pins, which shall be for load carrying bearings that are sealed and permanently lubricated. The load carrying bearings shall travel internally in track trolley channel. Two additional permanently lubricated trolley wheels shall be provided on bottom side of the track to reduce wobble of trolley as it conveys the hose assembly to the door threshold. A release plate shall be attached to the chassis of the trolley to smoothly energize the uncoupling release valve when the trolley balancer assembly approaches the door threshold. The system balancer assembly shall be a self-adjusting weight spring tension balancer with a lifting capacity of no less than 31 lb. The balancer shall have a minimum diameter stainless steel cable of .080 and a safety link connection. The system supplier shall manufacture the balancer and trolley for the sole purpose of conveying the flexible hose to the door threshold for automatic release of the system. Only a stainless steel balancer cable will be accepted. No exceptions.

.8 Regulator Assembly:

- .1 The regulator assembly shall be constructed of cast aluminum and refinished with black epoxy coating for durability. The regulator shall safely operate with an

input pressure of 0-200 psi; the output pressure shall be preset at 15 psi. The regulator shall be attached to each Riser Clamp Assembly/Hose Drop or to the boxloc track to allow for independent adjustment of each pneumatic nozzle. The regulator shall also be provided with needle type adjustment gauge that is clearly marked with the proper operating range of system, and which can be visibly read from standing on the bay floor.

.9 Uncoupling Valve Assembly:

- .1 Shall be provided to activate the release of the pneumatic nozzle connection located on vehicle's exhaust pipe. The valve shall be single direction action and affixed to a mounting bracket, which can be easily positioned and adjusted along the full length of the extruded aluminum track profile. The mounting bracket shall be formed from a minimum of 16 gauge galvanized steel and designed to fit snugly over the top of the boxloc track system. A 1/2" opening shall be centered to the top side of bracket to accommodate a 1" x 1/2" bolt with a 1/2" plated 1 1/2" long bar providing the secure attachment of Uncoupling Valve when system is put into service. The release valve shall be set for the maximum exiting speed of the vehicle.

.10 Upper Flexible Hose:

- .1 Hose shall be flexible exhaust hose manufactured for the sole purpose of venting high temperature exhaust gasses, which are produced by internal combustion engines. The flexible hose shall be designed strictly for the harsh environment of rapid response and auto-release of a vehicle exhaust tailpipe. Hose shall range from 3" – 5" diameter with varying lengths depending on the system length required ranging from 20 – 43 feet without joining or splicing connections. Hose material shall be high temperature synthetic rubber impregnated into a high temperature laminated fabric with a minimum overlapping thickness of 2 7/16". This construction of hose must be capable of operating at continuous temperatures of 400 degrees F and intermittent temperatures of 500 degrees F such as are experienced when pump checks are performed inside the station. Independent testing by a recognized UL laboratory must accompany this bid as proof of performance claim. Wire helix shall be bound and protected in laminations of hose winding. This shall be accomplished in a fashion, which eliminates any possibility of personnel coming in contact with an exposed hot metal Helix. The hose shall further protect the internal wire helix from heat build-up and in turn add increased visibility to personnel. Wear strip shall be 9/16" wide and be provided as a safety yellow colour. The bend radius of the high temperature hose shall be no lesser than 1.5 times the diameter of hose to insure that hot gases be restricted as they pass through the system.

.11 Lower Hose Assembly:

- .1 Shall be a rigid 3" – 5" diameter by 2 foot long section of yellow and black hose identical in appearance to the upper hose assembly. Lower hose shall support the pneumatic connection nozzle and chrome reducing elbow in a rigid fashion as to allow for the operator to place hose collection nozzle onto the tailpipe without bending over. Lower hose is the only section of hose which shall disconnect from the upper hose assembly and act as a safety disconnect in the unlikely event the nozzle gets entangled.

.12 Safety Disconnect Coupling:

- .1 A rubber coupling shall be incorporated in the design of the system enabling the lower two foot hose assembly to separate from the upper hose assembly thus

reducing the possible chance of damage to the system, in the unlikely event the exhaust connection nozzle assembly may become entangled. This device shall consist of two spun aluminum collars connected by a reusable rubber band. The release tension of this device shall separate the two at no greater than 88 Lb. This is considered a safety requirement and any system bid must incorporate a safety disconnect. No exceptions.

.13 Collection Nozzle Assembly:

- .1 The nozzle shall provide a substantially air tight seal around exhaust tail pipe when connected thus allowing for 100% source capture. The seal shall not allow for escape of life threatening exhaust gases, which may be present during the following conditions. If vehicle's engine is accelerated above normal idle resulting in an exhaust velocity greater than 5000 feet per minute or in the event that the output velocity of CFM of the exhaust exceeds the manufacturers normal capture velocity or CFM of exhaust system. The nozzle shall automatically adjust its internal orifice to accept any tail pipe ranging from one inch through six inch diameter. The Contractor of the nozzle shall offer, if required, both maximum diameter nozzles ranging from 4.75" to 8.25" diameter. The nozzle pressure shall not exceed 15 psi when connected to the vehicle's tailpipe. Nozzle construction shall be high temperature synthetic rubber, vulcanized to a high temperature synthetic fabric. A NOMEX inner liner shall be provided for the primary temperature source at the tailpipe and also act as a friction barrier. The chrome-reducing elbow that connects to the connection nozzle shall be fabricated using continuous welded construction. This important feature eliminates the escape of any potentially lethal exhaust gases and must provide for a smooth air flow transition from connection nozzle into the high temperature flexible hose. The angle of transition shall be no less than or greater than 67 degrees from the centre line of reducer. The chrome-reducer shall incorporate a primary expanded metal debris screen, which is permanently affixed by welded seams to the inside opening of exhaust fitting. Since this item is a point of safety for both personnel and the system itself, no exception will be tolerated for this point.

.14 Manual Fill Valve:

- .1 A manual connection fill valve shall be located one foot above safety release coupling approximately 4 feet from floor and shall be of a sliding/push button type for manual or automatic release. This valve shall incorporate in its design a handle, which the operator may easily operate in a standing position. The attachment of collection nozzle shall not position in the operator's breathing zone closer than 44" from the exhaust tailpipe. The automatic release of the connection valve shall be no greater than 3 psi shift pressure to activate the automatic nozzle deflation. The primary air supply shall be accomplished by means of compression type fitting. The regulated air supply line to collection nozzle shall be designed to safely release from the upper hose at pressure no greater than 80 lbs. Since this is a safety item, no exceptions will be tolerated.

.15 Compressed Air Features:

- .1 Airlines shall be 1/4" (6mm) OD tubing capable of exposure of high temperature air stream inside the ventilation hose and duct. The airlines shall be fed through the exterior of the hose and ductwork by the use of substantially airtight chrome fittings. Unless a fire station air compressor is to be utilized the Contractor shall provide a quiet operating compressor to be located accessible to the vehicle bays. It shall also be located so that preventative maintenance can be performed quickly and effectively. The operation of compressor running inside the station

shall not generate sound decibels in excess of 25 Dba. The compressor shall be equipped with a filter/dryer to insure the conveyance of clean dry air to the pneumatic controls incorporated in the auto-release ventilation system.

.16 Hose Saddle:

- .1 A hose suspension saddle shall be fabricated of a rubber molded cushion specifically manufactured for the sole purpose of suspending high temperature exhaust ventilation hose in a rapid response and auto-release application. The design of the saddle shall smoothly transition the direction of the hose during its travel along the track. Securing clamps shall be provided including a link fastener, for the purpose of mounting it to the balancer safety link.

.17 Special Features:

- .1 The system must be designed to expand for future apparatus to a tandem vehicle arrangement (one vehicle behind the other) by adding to the proposed system. Systems that require replacement of the existing system or major components to meet a tandem vehicle arrangement shall not be accepted. A special emergency disconnect feature shall be provided to enable the vehicle to back off the system through a rear exit door. Unique occasions may require the emergency vehicle to depart from the back door in a drive through station. Also a malfunction of the front over-head door may force the vehicle to exit from the station outside the confines of normal operation. Overall system design and performance shall be for both back in and drive through configurations when applicable, this assures door to door coverage and collection of dangerous exhaust gases from the point of connection at the doorway.

.18 Vehicle Tailpipe Modification:

- .1 The Contractor shall supply a drawing for the precise modification procedure for the vehicles to attach to the exhaust removal system. The modification shall vent the exhaust gases at a 90 degree angle on the passenger side of the vehicle. Tailpipe modifications requiring a 45 degree angle of exhaust shall not be acceptable, so to prevent exhaust blow back into the station after the auto-release system disengages from the tailpipe. A flange shall be provided and installed by the Contractor as a precisely located stopping point for the collection nozzle. The manufacturers supplied adapter shall securely attach to the vehicle tailpipe. The flange shall be fabricated form 14 gauge aluminized steel. Two sections (or) half shall be provided for simple attachment to vehicle's tailpipe. The sections shall be bolted together with four (4) $\frac{3}{4}$ " x $\frac{1}{2}$ " long bolts and nuts.

PART 3 EXECUTION

3.1 Training

- .1 The Contractor or authorized approved personnel shall provide training to the City personnel in the daily use and maintenance of the vehicle exhaust removal system that has been installed and specified herein. The City shall be notified at least 7 days prior to the date scheduled for the training course. Training shall be for all personnel involved with the operation of the exhaust removal system to include all shifts required to man the particular facility. The training session shall be performed in person by a recognized representative of the manufacturer of the exhaust removal system, in addition a training video shall be provided to the City.

PART 1 GENERAL

1.1 General

- .1 All drawings and all specifications shall apply to and form an integral part of this section.
- .2 All applicable codes are to be adhered to and are considered to be minimum standard requirements. It is noted in some cases the code requirements are exceeded where indicated on the drawings.

1.2 Work Included

- .1 Work to include Labour, materials, plant, tools, equipment and services necessary and reasonably incidental for complete installation, testing and placing in initial operation of the HVAC system described and shown on drawings and specifications.

1.3 Related Sections

- .1 Common Work Results – Mechanical Section 23 05 00
- .2 Insulation Section 23 07 12
- .3 Controls Section 25 30 00
- .4 Testing, Adjusting and Balancing Section 23 05 93
- .5 Common Work Results – Mechanical Section 26 05 00

1.4 References

- .1 ANSI/NFPA (Latest Edition)- Installation of Air Conditioning and Ventilating Systems
- .2 ANSI/NFPA (Latest Edition)- Installation of Warm Air Heating and Air Conditioning Systems
- .3 NFPA 54 (AGA Z223.1) – National Gas Code
- .4 Ashrae 90A – Energy Conservation in New Building Design
- .5 Ashrae 62 (latest edition) – Ventilation for Acceptable Indoor Air Quality
- .6 SMACNA 006- 2006- HVAC Duct Construction Standards Metal and Flexible

1.5 Submittals for Review

- .1 A minimum of five (5) copies of manufacturers shop drawings for all the new equipment shall be submitted for approval prior to placing order.

PART 2 PRODUCTS

2.1 Materials

- .1 Refer to equipment schedules on drawings for specific product information including but not limited to air handling units, heat recovery ventilators, exhaust fans, grilles, dampers, etc.
- .2 Equipment and materials are to be new and CSA approved.
- .3 Ductwork, fittings, hangers to Ashrae and SMACNA standards (latest editions)

PART 3 EXECUTION

3.1 Installation

- .1 Equipment shall be installed in strict accordance with manufacturers recommendations and standards.
- .2 The latest edition of all codes and standards shall apply. Obtain all permits, approvals and the like required to complete the Work ready for operation.
- .3 Finish all materials, labour, tools and equipment necessary to complete the Work as shown on Drawings and herein specified.
- .4 All workmanship and fabrication shall meet with the standards set for this trade. All work shall be done by competent and experienced workmen.
- .5 Products used by Contractor other than those specified on plan or in specifications, including alternate and/or approved equal items that may incur additional cost to this project for dimension difference, modification to structure, power, control requirements or other reasons, the Contractor will bear all additional costs to make all systems functional.
- .6 Support all equipment and ductwork securely to the building structure.
- .7 All equipment shall be supported with galvanized hanger rod, canstrut or painted angle iron members, clamps and saddles. Wire hangers or perforated straps will not be accepted.
- .8 Duct installations shall conform to SMACNA 006-2006 HVAC Duct Construction Standard – Metal and Flexible.
- .9 Construct ducts in accordance with the dimensions shown on the plans, where possible. Where necessitated by building construction, alter these dimensions maintaining the same equivalent duct size. Size ducts from ASHRAE Table of Equivalent Rectangular and Round Ducts or approved acceptable engineering methods. Any changes shall be approved by the Contract Administrator and noted on the as- built drawings.
- .10 All duct and plenum dimensions as indicated on the drawings refer to clear inside duct dimensions.
- .11 Provide U.L. listed fire damper or fire stop flap for wall, floor, attic and ceiling as indicated on plans. These are life safety items and shall be carefully done. If they are not indicated, the Contractor to provide fire damper at fire separation as requested by the Authority having jurisdiction without additional cost to the City. Installation shall conform to manufacturer's instructions with retaining angles and breakaway joints, Contractor shall provide airtight duct access at convenient location, to access fusible links to facilitate testing and maintenance, at all fire damper locations.
- .12 Brace all ducts properly, so as not to interfere with the free flow of air, make air tight and free from buckling and sagging. All flat surfaces to be cross broken.
- .13 All bends, tees and elbows shall be made with a centre line radius of not less than 1-1 ½ times the width of the duct in the plane of rotation of the radius and where this is not possible, such turns will be fitted with double turning vanes (at 64mm on centre) of the proper sizes, airfoil type turning vanes, Hart & Cooley ducturns.
- .14 Low Pressure Rectangular Ductwork Schedule

<u>Max Side</u>	<u>Bracing</u>
.1 Up to 600mm (24")	None
.1 Gauge: .60mm (24 USSG)	

- | | | |
|----|---------------------------------|---|
| .2 | 635mm to 750mm
(25" to 30") | 25mm (1") x 25mm (1") x 3.2mm (1/8") angle,
1.2m (4'0") from joint. |
| .1 | Gauge: .60mm (24 USSG) | |
| .3 | 785mm to 1000mm
(31" to 40") | 25mm (1") x 25mm (1") x 3.2mm (1/8") angle,
1.2m (4'0") from joint. |
| .1 | Gauge: .80mm (22 USSG) | |
| .4 | 1040mm to 1.5m
(41" to 60") | 37.5mm (1-1 1/2") x 37.5mm (1- 1 1/2") x 3.2mm
(1/8") angle, 1.2m (4'0") from joint. |
| .1 | Gauge: .80mm (22 USSG) | |
- .15 Round Ductwork Schedule
- | | <u>Duct Diameter</u> | <u>Gauge</u> |
|----|--------------------------------|-----------------|
| .1 | Up to 508mm (20") | 0.5mm (26 ASSG) |
| .2 | 533mm to 1.02m
(21" to 40") | 0.6mm (24 ASSG) |
- .16 Provide "Shaftloc" damper locking quadrant with damper position indicator (close-open) for all manual balancing dampers.
- .17 All laps shall be in the direction of air flow. Rivets and bolts shall be used throughout. All edges and slips to be hammered down to leave a smooth interior duct.
- .18 Connect ductwork to furnace with 75mm Duro-Dyne flexible connection, secure in place with rigid strapping and make airtight.
- .19 Seal all transverse joints and connections air tight with gaskets, sealant or combination thereof. Longitudinal seams unsealed. Use an approved duct dealer on all joints and seams. No duct tape allowed.
- .20 All horizontal ductwork shall be supported by non-perforated, galvanized steel hanger strap or rod. Hanger strap to be next sheet metal thickness heavier than duct at a maximum of 2400mm on centre. Maximum size duct supported by strap hanger, 500mm. Hanger rod size 6mm c/w 40 x 40 steel support angle. Wire hangers or perforated straps will not be accepted. Hangers and supports shall not damage or pierce insulation.
- .21 Contractor to provide additional bracing and/ or support for any ductwork or equipment, on request by the Contract Administrator, if not adequately braces, at no additional cost to the City.
- .22 Duct hangers, supports, bolts, rods and sleeves, etc. shall be of galvanized (non-rust) or stainless steel type.
- .23 No cutting of beams, columns or slabs will be allowed without the approval of the Contract Administrator for the installation of ductwork, etc. Protect all Work from damage, any Work defaced must be repaired by the Contractor.
- .24 Seal all duct openings made in the building structure properly to provide a weather tight, water proof seal.
- .25 At completion of project, clean interior of all ductwork.
- .26 Air balancing of the air conditioning/heating system done by Section 25 05 93. Section 23 54 11 shall provide initial set up/adjustment of all HVAC equipment. Section 23 54 11 shall coordinate with the Air Balance Agency to assure the installation of all manual adjusting dampers are as required to allow proper adjustment of the air system.

- .27 Section 23 59 11 shall make any adjustments to equipment controls/settings and any additional manual dampers for correct balance as recommended by the Air Balance Agency, at to additional cost to the City.
- .28 The plans are considered as diagrammatic only and the Contract Administrator reserves the right to change the location of equipment or piping within 300mm of where shown provided such change is made before installation.
- .29 System schematics shown on plans are of minimum requirements. Equipment installation including all controls, fittings, and accessories shall be in strict accordance with manufacturer's instructions, and Contractor shall include and bear all cost for such installations.
- .30 At the completion of the job, provide one set of as-built drawings showing wiring diagram, system equipments, operation descriptions and maintenance procedures, etc. in transparent plastic laminate sheet. Identify all dampers clearly and accurately on the as-built drawings. Attach these drawings onto a convenient wall location for instructing service personnel and the City.