

Part 1 General

1.1 SECTION INCLUDES

- .1 Pipe and equipment hangers and supports.
- .2 Equipment bases and supports.
- .3 Sleeves and seals.
- .4 Flashing and sealing equipment and pipe stacks.

1.2 RELATED SECTIONS

- .1 Section 23 07 19 - Piping Insulation.
- .2 Section 22 10 00 - Plumbing Piping.

1.3 REFERENCES

- .1 ASME B31.9 - Building Services Piping.
- .2 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- .3 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- .4 MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- .5 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- .6 UL 203 - Pipe Hanger Equipment for Fire protection Service.

1.4 SUBMITTALS

- .1 Division 01: Procedures for submittals.
- .2 Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- .3 Product Data: Provide manufacturers catalogue data including load capacity.
- .4 Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- .5 Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for support of plumbing, hydronic, steam and steam condensate piping.

Part 2 Products

2.1 PIPE HANGERS AND SUPPORTS

- .1 Manufacturers:
 - .1 Anvil.
 - .2 Grinnel.
 - .3 Substitutions: Refer to Division 01.
- .2 Plumbing Piping - DWV:
 - .1 Conform to ASME B31.9.
 - .2 Hangers for Pipe Sizes 13 to 38 mm (1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.
 - .3 Hangers for Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.
 - .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - .5 Wall Support for Pipe Sizes to 75 mm (3 inches): Cast iron hook.
 - .6 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.
 - .7 Vertical Support: Steel riser clamp.
 - .8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - .9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- .3 Plumbing Piping - Water:
 - .1 Conform to ASME B31.9.
 - .2 Perforated strap or wire hangers are not permitted.
 - .3 Hangers to be adjustable after pipe is in place.
 - .4 Clevis hangers shall be oversized to suit the outside diameter of insulation and jacket to maintain the integrity of insulation and vapour barrier.
 - .1 Protection Saddles
 - .1 On piping 2" and smaller, carry insulation over pipe hangers. On all domestic cold water piping over 1-1/4", use oversized clevis hangers and GSS insulation protection shield to maintain integrity of vapour barrier.
 - .2 On copper piping over 2", use at each hanger or support Grinnell Fig. 167 protection shield or equal. Shields shall have a minimum length of 12" (305mm) to spread weight. Rectangular solid wood blocks, cut to suit the insulation thickness, shall be installed at hanger locations. Wedges are not permitted.
 - .5 Hangers for Pipe Sizes 15 to 40 mm (1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.
 - .6 Hangers for Cold Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.
 - .7 Hangers for Hot Pipe Sizes 50 to 100 mm (2 to 4 inches): Carbon steel, adjustable, clevis.

- .8 Hangers for Hot Pipe Sizes 150 mm (6 inches) and over: Adjustable steel yoke, cast iron pipe roll, double hanger.
- .9 Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
- .10 Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm (6 inches) and over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.
- .11 Wall Support for Pipe Sizes to 80 mm (3 inches): Cast iron hook.
- .12 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.
- .13 Wall Support for Hot Pipe Sizes 150 mm (6 inches) and over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
- .14 Vertical Support: Steel riser clamp.
- .15 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- .16 Floor Support for Hot Pipe Sizes to 100 mm (4 inches): Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
- .17 Floor Support for Hot Pipe Sizes 150 mm (6 inches) and over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
- .18 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- .19 Isolation: Copper piping shall be isolated from steel supports by appropriate use of copper plated hangers, plastic coated hangers, tinning pipe at supports, or provision of suitable lead or copper isolators.

2.2 ACCESSORIES

- .1 Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.3 INSERTS

- .1 Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

- .1 Metal Flashing: 0.5 mm thick (26 gauge) galvanized steel.
- .2 Metal Counterflashing: 0.8 mm thick (22gauge) galvanized steel.
- .3 Lead Flashing:
 - .1 Waterproofing: 24.5 kg/sq m (5 lb/sq ft) sheet lead
 - .2 Soundproofing: 5 kg/sq m (1 lb/sq ft) sheet lead.
- .4 Flexible Flashing: 1.2mm (47 mil) thick sheet butyl; compatible with roofing.
- .5 Caps: Steel, 0.8 mm (22 gauge) minimum; 1.5 mm (16 gauge) at fire resistant elements.

2.5 SLEEVES

- .1 Sleeves for Pipes Through Non-fire Rated Floors: 1.2 mm thick (18 gauge) galvanized steel.
- .2 Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 1.2mm thick (18 gauge) galvanized steel.
- .3 Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed refer to Division 07.
- .4 Where pipes pass through floors, walls or ceilings, in finished areas and where exposed to view, supply and install chrome-plated pressed steel floor plates.
- .5 Sleeves for Round Ductwork: Galvanized steel.
- .6 Sleeves for Rectangular Ductwork: Galvanized steel or wood.
- .7 Firestopping Insulation: Glass fibre type, non-combustible; refer to Division 07.
- .8 Sealant: Acrylic; refer to Division 07.

Part 3 Execution

3.1 INSTALLATION

- .1 Install to manufacturer's written instructions.

3.2 INSERTS

- .1 Provide inserts for placement in concrete formwork.
- .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 100 mm (4 inches).
- .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- .5 Install galvanized oversize pipe sleeves on all pipes passing through walls or partitions, for building into wall construction by other trades.
- .6 All sleeves are to be large enough to accommodate pipe insulation as specified.
- .7 The Mechanical Division shall include in tender price all cost of drilling for sleeves up to 175 mm (7") in precast sections relative to work under Mechanical Division. Prior to drilling all openings/locations must be checked by the Contract Administrator. Drilling shall be done using diamond core drilling machinery.
- .8 All sleeves in mechanical rooms, janitors closets and washrooms shall extend 100 mm (4") above the finished floor level to prevent water seeping down.

- .9 Caulk the space between pipes and floor sleeves or openings, to prevent water seeping down, with an approved caulking compound. The caulking compound and method of application shall be to the Contract Administrator's approval.
- .10 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

3.3 PIPE HANGERS AND SUPPORTS

- .1 Install to manufacturer's written instructions.
- .2 Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9.
- .3 Perforated strap or wire hangers will not be permitted.
- .4 Support horizontal piping as scheduled.
- .5 Hangers in new concrete structural floor systems shall be supported by inserts placed prior to pouring of concrete. Inserts shall be Grinnell cast iron or wrought steel adjustable type.
- .6 Where hangers must be installed in existing concrete slabs, approved expansion type inserts shall be used, or if heavy weights must be supported, a hole shall be drilled through the slab and a 50 mm x 50 mm (2" x 2") washer and nut installed above rough slab before the floor finish is poured.
- .7 Where the structural system is open web steel joists, piping shall be supported by means of angles spanning the bottom or top chords of adjacent joists. The number of joists to be spanned in this way shall be determined by the incident load of piping.
- .8 In no case shall the hanging of piping directly from roof decking be allowed, unless special permission is obtained from the Contract Administrator.
- .9 Copper hot water piping in long runs, where expansion may be significant and where hanger rods are less than 600 mm (2") in length may require roller hangers. Any such cases which cannot be avoided shall be referred to the Contract Administrator for a decision. If necessary, roller hangers shall be installed as directed with protection saddles as specified. Expansion and contractions of domestic H.W. piping should not be a problem, as wide fluctuations in temperature are not normal. Piping shall be hung from slabs, rather than from the bottom of beams, in order to keep hanger rods sufficiently long to take up any movement.
- .10 Install hangers to provide minimum 13 mm (1/2 inch) space between finished covering and adjacent work.
- .11 Place hangers within 300 mm (12 inches) of each horizontal elbow.
- .12 Use hangers with 38 mm (1-1/2 inch) minimum vertical adjustment.
- .13 Support horizontal cast iron pipe adjacent to each hub, with 1.5 m (5 feet) maximum spacing between hangers.

- .14 Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- .15 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .16 Support riser piping independently of connected horizontal piping.
- .17 Provide copper plated hangers and supports for copper piping.
- .18 Design hangers for pipe movement without disengagement of supported pipe.
- .19 All hanger rods shall have sufficient threaded length to allow for vertical adjustment of hangers after pipe is in place. Use 2 nuts on each rod, one above the clevis or angle iron and one below.
- .20 Where pipes or equipment are supported from floors or walls, structural steel supports shall be fabricated, using welded joints except where provision is made for adjustment. Where details of construction are not indicated, drawings shall be submitted to Contract Administrator for approval before fabrication.
- .21 Clamps should be located immediately below a coupling if possible. Risers up to 50 mm (2") size shall be braced at intervals not over 2100 mm (7').
- .22 Vertical piping other than risers through floors shall be provided with suitable supports, sway braces, etc.
- .23 Vertical piping shall be supported at the base in an approved manner.
- .24 On insulated piping supported by roller supports or trapeze supports (angle iron) provide at each hanger or support a protection saddle of 16 ga. galvanized sheet steel, rolled to match the outside diameter of the insulation. The saddle shall cover approximately the bottom one third of the circumference of the insulation. The length shall be at least as long as that recommended by the insulation manufacturer as published in their data.
- .25 On insulated pipe up to and including 50 mm (2") pipe, clevis hangers shall be sized to suit the O.D. of the pipe. On insulated pipe of 63 mm (2½") and above, the hangers shall be sized to suit the O.D. of the insulation and protection saddles, as described above shall be installed.
- .26 Prime coat exposed steel hangers and supports. [Refer to Division 09.] Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 EQUIPMENT BASES AND SUPPORTS

- .1 Provide housekeeping pads of concrete, minimum 100 mm (4 inches) thick and extending 150 mm (6 inches) beyond supported equipment.
- .2 Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- .3 Construct supports of steel members. Brace and fasten with flanges bolted to structure.

- .4 Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

- .1 Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- .2 Provide copper flashing for sleeves passing through exterior surfaces or waterproof assemblies.
- .3 Flash floor drains in floors with topping over finished areas with lead, 250 mm (10 inches) clear on sides with minimum 910 x 910 mm (36 x 36 inch) sheet size. Fasten flashing to drain clamp device.
- .4 Seal floor, shower, & mop sink drains watertight to adjacent materials.
- .5 Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed to manufacturer's written instructions for sound control.
- .6 Provide curbs for mechanical roof installations 350 mm (14 inches) minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- .7 Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

- .1 Set sleeves in position in formwork. Provide reinforcing around sleeves.
- .2 Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- .3 Extend sleeves through floors 25mm (1 inch) above finished floor level. Caulk sleeves.
- .4 All sleeves in mechanical rooms, janitors closets and washrooms shall extend 100 mm (4") above the finished floor level to prevent water seeping down.
- .5 Install galvanized oversize pipe sleeves on all pipes passing through walls or partitions, for building into wall construction by other trades.
- .6 All sleeves are to be large enough to accommodate pipe insulation as specified.
- .7 The Mechanical Division shall include in tender price all cost of drilling for sleeves up to 175 mm (7") in precast sections relative to work under Mechanical Division. Prior to drilling all openings/locations must be checked by the Contract Administrator. Drilling shall be done using diamond core drilling machinery.
- .8 Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with insulation and caulk, air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

- .9 Install stainless steel escutcheons at finished surfaces.

3.7 SCHEDULES

- .1 Maximum spacing between pipe supports:

.1 Hangers shall be installed not more than 12" (300mm) from each change in direction of pipes.

.2 Where there are concentrations of valves and fittings, closer spacing will be necessary.

.3 Steel Pipe:

.1	Up to 50mm (2")	2.4m (8 ft.)
.2	65mm (2½") to 150mm (6")	3.6m (12 ft.)
.3	200mm (8") to 300mm (12")	5.4m (18 ft.)
.4	350mm (14") to 450mm (18")	7.2m (24 ft.)
.5	500mm (20") to 600mm (24")	9.0m (30 ft.)

.4 Copper Tubing (Hard):

.1	Up to 25mm (1")	1.8m (6 ft.)
.2	32mm (1½") to 50mm (2")	2.4m (8 ft.)
.3	63mm (2 ½") to 75mm (3")	3.0m (10 ft.)
.4	100mm (4") to 150mm (6")	3.6m (12 ft.)
.5	200mm (8") to 300mm (12")	4.8m (16 ft.)

.5 Cast Iron Pipe

.1 Maximum spacing – maximum 5 ft. (1.5m)

.2 Support M.J. pipe on both sides of joint. Provide with sway braces and anchors to Contract Administrator's approval. At multiple fittings, or short lengths, support every 300mm (12").

.6 Plastic

.1	All sizes	1.2m (4 ft.)
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END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Nameplates.
- .2 Tags.
- .3 Stencils.
- .4 Pipe Markers.

1.2 RELATED SECTIONS

- .1 Division 09 - Painting: Identification painting.

1.3 REFERENCES

- .1 ASME A13.1 - Scheme for the Identification of Piping Systems.
- .2 CAN/CGSB 24.3 – Identification of Piping Systems

1.4 SUBMITTALS

- .1 Division 01: Procedures for submittals.
- .2 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.
- .3 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- .4 Product Data: Provide manufacturers catalogue literature for each product required.
- .5 Manufacturer's Installation Instructions: Indicate special procedures, and installation.

1.5 PROJECT RECORD DOCUMENTS

- .1 Division 01: Submittals for project closeout.
- .2 Record actual locations of tagged valves.

Part 2 Products

2.1 NAMEPLATES

- .1 Description: Laminated three-layer plastic with engraved black letters on light contrasting background colour.

2.2 TAGS

- .1 Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Tag size minimum 40 mm (1-1/2 inch) diameter.
- .2 Chart: Typewritten letter size list in anodized aluminum frame.

2.3 STENCILS

- .1 Stencils: With clean cut symbols and letters of following size:
 - .1 20-30 mm (3/4 to 1-1/4 inch) Outside Diameter of Insulation or Pipe: 200 mm (8 inch) long colour field, 15 mm (1/2 inch) high letters.
 - .2 40-50 mm (1-1/2 to 2 inch) Outside Diameter of Insulation or Pipe: 200 mm (8 inch) long colour field, 20 mm (3/4 inch) high letters.
 - .3 65-150 mm (2-1/2 to 6 inch) Outside Diameter of Insulation or Pipe: 300 mm (12 inch) long colour field, 30 mm (1-1/4 inch) high letters.
 - .4 200-250 mm (8 to 10 inch) Outside Diameter of Insulation or Pipe: 600 mm (24 inch) long colour field, 65 mm (2-1/2 inch) high letters.
 - .5 Over 250 mm (10 inch) Outside Diameter of Insulation or Pipe: 800 mm (32 inch) long colour field, 90 mm (3-1/2 inch) high letters.
 - .6 Ductwork and Equipment: 65 mm (2-1/2 inch) high letters.
- .2 Stencil Paint: As specified in Division 09, semi - Painting.1.

2.4 PIPE MARKERS

- .1 Colour: Conform to ASME A13.1.
- .2 Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- .3 Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- .4 Underground Plastic Pipe Markers: Bright coloured continuously printed plastic ribbon tape, minimum 150 mm (6 inches) wide by 0.10 mm (4 mil) thick, manufactured for direct burial service.

2.5 CEILING TACKS

- .1 Description: Steel with 20 mm (3/4 inch) diameter colour coded head.
- .2 Colour code as follows:
 - .1 Yellow - HVAC equipment
 - .2 Red - Fire dampers/smoke dampers
 - .3 Green - Plumbing valves
 - .4 Blue - Heating/cooling valves

Part 3 Execution

3.1 PREPARATION

- .1 Degrease and clean surfaces to receive adhesive for identification materials.
- .2 Prepare surfaces to Division 09 for stencil painting.

3.2 INSTALLATION

- .1 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- .2 Install tags with corrosion resistant chain.
- .3 Apply stencil painting to Division 09.
- .4 Install plastic pipe markers to manufacturer's written instructions.
- .5 Install plastic tape pipe markers complete around pipe to manufacturer's written instructions.
- .6 Install underground plastic pipe markers 150 to 200 mm (6 to 8 inches) below finished grade, directly above buried pipe.
- .7 Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- .8 Identify control panels and major control components outside panels with plastic nameplates.
- .9 Identify thermostats relating to terminal boxes or valves with nameplates.
- .10 Identify valves in main and branch piping with tags.
- .11 Identify air terminal units and radiator valves with numbered tags.
- .12 Tag automatic controls, instruments, and relays. Key to control schematic.
- .13 Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 20 mm (3/4 inch) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 6 m (20 feet) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- .14 Identify ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- .15 Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 SCHEDULES

- .1 As per ASME A13.1

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Testing, adjustment, and balancing of air systems.
- .2 Fire and smoke damper testing & verification.
- .3 Measurement of final operating condition of HVAC systems.

1.2 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.

1.3 SUBMITTALS

- .1 Division 01: Procedures for submittals.
- .2 Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- .3 Submit draft copies of report for review prior to final acceptance of Project. Draft copies shall be submitted in electronic format (Adobe Acrobat PDF file). Provide final copies for Contract Administrator and for inclusion in operating and maintenance manuals.
- .4 Provide final reports in letter size, soft cover or 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Also submit an electronic copy (PDF file) of the same. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- .5 Test Reports: Indicate data on AABC National Standards for Total System Balance forms. Submit data in either S.I. Metric or IP units to match the primary units used on the drawings and schedules.

1.4 PROJECT RECORD DOCUMENTS

- .1 Division 01: Submittals for project closeout.
- .2 Record actual locations of flow measuring stations, balancing valves, balancing dampers, and fire dampers.

1.5 QUALITY ASSURANCE

- .1 Perform total system balance to AABC National Standards for Field Measurement and Instrumentation, Total System Balance.

1.6 QUALIFICATIONS

- .1 Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years documented experience, and certified by AABC.
- .2 Perform Work under supervision of AABC Certified Test and Balance Supervisor.

1.7 PRE-BALANCING CONFERENCE

- .1 Convene one week prior to commencing work of this section, to Division 01.

1.8 SEQUENCING

- .1 Sequence work to Division 01.
- .2 Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.9 SCHEDULING

- .1 Schedule work to Division 01.
- .2 Schedule and provide assistance in final adjustment and test of life safety, smoke evacuation, and/or smoke control system with Fire Authority.

1.10 PROJECT CLOSE-OUT

- .1 The Testing, Adjusting and Balancing agency as part of its contract shall act as authorized inspection agency, responsible to list all items that are installed incorrectly, require correction or have not been installed in accordance with contract drawings and/or specifications, pertaining to the air distribution, cooling and heating systems. The Mechanical Contractor shall make good these items.
- .2 Final payment on the building will not be issued until the final air balance report has been submitted to the Contract Administrator and has been approved by the Contract Administrator.

Part 2 Products

- .1 Not used

Part 3 Execution

3.1 AGENCIES

- .1 Air Movement Services Ltd.

- .2 Airdronics Inc.
- .3 D.F.C. Mechanical Testing & Balancing Ltd.

3.2 EXAMINATION

- .1 Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - .1 Systems are started and operating in a safe and normal condition.
 - .2 Temperature control systems are installed complete and operable.
 - .3 Proper thermal overload protection is in place for electrical equipment.
 - .4 Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - .5 Duct systems are clean of debris.
 - .6 Fans are rotating correctly.
 - .7 Fire and volume dampers are in place and open.
 - .8 Air coil fins are cleaned and combed.
 - .9 Access doors are closed and duct end caps are in place.
 - .10 Air outlets are installed and connected.
 - .11 Duct system leakage is minimized.
 - .12 Service and balance valves are open.
- .2 Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- .3 Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- .1 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Contract Administrator to facilitate spot checks during testing.
- .2 Provide additional balancing devices as required.

3.4 INSTALLATION TOLERANCES

- .1 Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- .2 Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- .3 Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.5 ADJUSTING

- .1 Ensure recorded data represents actual measured or observed conditions.

- .2 Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- .3 Make any changes in pulleys and belts, and add any manual dampers as required for correct balance, at no additional cost to the City of Winnipeg.
- .4 After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- .5 Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.6 AIR SYSTEM PROCEDURE

- .1 Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- .2 Test and record motor full load amperes.
- .3 Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- .4 Measure air quantities at air inlets and outlets.
- .5 Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- .6 Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- .7 All outlets shall be adjusted to provide proper throw and directional distribution in accordance with the requirements on the drawings and/or schedules.
- .8 Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- .9 Provide system schematic with required and actual air quantities recorded at each outlet or inlet. Each grille, diffuser and register shall be identified as to location and area.
- .10 Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- .11 Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Any re-adjustments of controls as deemed necessary, shall be made in co-operation with the Control Subcontractor.
- .12 Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
 - .1 Test and record entering air temperatures (D.B. heating and cooling).
 - .2 Test and record entering air temperatures (W.B. cooling).

- .3 Test and record leaving air temperatures (D.B. heating and cooling).
- .4 Test and record leaving air temperatures (W.B. cooling).
- .13 Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating. Refer to the maximum and minimum rates on the drawings and schedules.
- .14 All pitot-tube openings shall have plastic plugs of proper size in uninsulated or internally insulated ductwork. Insulated ductwork shall be provided with rubber plugs that extend to the face of the insulation. Cover the plugs on insulated ductwork with strip of grey tape.
- .15 After completion of final balance, the Balance Contractor shall permanently fix the damper operator with a strip of contact tape and spray the quadrant with bright paint to permanently mark its balanced position.

3.7 FIRE & SMOKE DAMPER TESTING & VERIFICATION

- .1 Testing of Fire Dampers, Ceiling Fire Stops and/or Fire/Smoke Dampers
 - .1 General
 - .1 The Testing, Adjusting and Balancing agency shall test this equipment after installation.
 - .2 Test and verify operation of all fire dampers and ceiling fire stops in this project.
 - .3 Test shall include manually releasing fusible link; allowing damper to close to ensure that it has tight-fit closing operation without binding; opening fire damper and/or closing ceiling fire stop and resetting fusible link connection.
 - .4 Instruct Sections 23 31 00 and 23 33 00 to repair all fire dampers and/or ceiling fire stops that have been identified as being faulty.
 - .2 Identification of Fire Dampers and Ceiling Fire Stops
 - .1 At all fire dampers and ceiling fire stops, supply and install tags as approved by the Contract Administrator.
 - .2 Tags shall be mechanically fastened to duct fire damper access door, or onto or on structure near fire dampers or ceiling fire stops which have no connecting ductwork.
 - .3 After each fire damper has been tested and has been proven to operate satisfactorily as noted in previous clause, a representative of the Testing, Adjusting and Balancing agency shall label unit number and mark date and signature on tag. Tags shall have space for minimum size further dates and signatures for future checking of damper operation by City of Winnipeg's staff.
 - .3 Test Report for Fire Dampers and Ceiling Fire Stops
 - .1 The Testing, Adjusting and Balancing agency shall provide a Test Report.
 - .2 The report shall include following for each fire damper:
 - .1 Verification that the unit is fully accessible.
 - .2 Verification that the unit has been successfully tested.
 - .3 Verification that the unit has been reset.

- .4 Name of tester.
- .5 Date that the unit tested successfully.
- .6 Location schedule of all dampers i.e. each damper must be labelled.
- .3 Provide one copy of completed report to Contract Administrator. After the Contract Administrator has reviewed report, provide to the Mechanical Subtrade sufficient copies of report to insert one in each Maintenance/Operating Manual.
- .4 Testing of Fire/Smoke Dampers
 - .1 Provide all testing, tagging, and Test Report for all Fire/Smoke Dampers.
 - .2 Follow instruction noted in previous clause as noted for Fire Dampers and Ceiling fire stops.

3.8 SCHEDULES

- .1 Equipment requiring testing, adjusting and balancing:
 - .1 Air Handling Units
 - .2 Air Filters
 - .3 Air Inlets and Outlets
- .2 Report Forms
 - .1 Title Page:
 - .1 Name of Testing, Adjusting, and Balancing Agency
 - .2 Address of Testing, Adjusting, and Balancing Agency
 - .3 Telephone number of Testing, Adjusting, and Balancing Agency
 - .4 Project name
 - .5 Project location
 - .6 Project Contract Administrator
 - .7 Project City of Winnipeg
 - .8 Project Contractor
 - .9 Project altitude
 - .10 Report date
 - .2 Summary Comments:
 - .1 Design versus final performance
 - .2 Notable characteristics of system
 - .3 Description of systems operation sequence
 - .4 Summary of outdoor and exhaust flows to indicate amount of building pressurization
 - .5 Nomenclature used throughout report
 - .6 Test conditions
 - .3 Instrument List:
 - .1 Instrument
 - .2 Manufacturer
 - .3 Model number
 - .4 Serial number

- .5 Range
- .6 Calibration date
- .4 Electric Motors:
 - .1 Manufacturer
 - .2 Model/Frame
 - .3 HP/BHP
 - .4 Phase, voltage, amperage; nameplate, actual, no load
 - .5 RPM
 - .6 Service factor
 - .7 Starter size, rating, heater elements
 - .8 Sheave Make/Size/Bore
- .5 V-Belt Drive:
 - .1 Identification/location
 - .2 Required driven RPM
 - .3 Driven sheave, diameter and RPM
 - .4 Belt, size and quantity
 - .5 Motor sheave diameter and RPM
 - .6 Centre to centre distance, maximum, minimum, and actual
- .6 Electric Duct Heater:
 - .1 Manufacturer
 - .2 Identification/number
 - .3 Location
 - .4 Model number
 - .5 Design kW
 - .6 Number of stages
 - .7 Phase, voltage, amperage
 - .8 Test voltage (each phase)
 - .9 Test amperage (each phase)
 - .10 Air flow, specified and actual
 - .11 Temperature rise, specified and actual
- .7 Air Moving Equipment
 - .1 Location
 - .2 Manufacturer
 - .3 Model number
 - .4 Serial number
 - .5 Arrangement/Class/Discharge
 - .6 Air flow, specified and actual
 - .7 Return air flow, specified and actual
 - .8 Outside air flow, specified and actual
 - .9 Total static pressure (total external), specified and actual
 - .10 Inlet pressure

- .11 Discharge pressure
- .12 Sheave Make/Size/Bore
- .13 Number of Belts/Make/Size
- .14 Fan RPM
- .8 Return Air/Outside Air Data:
 - .1 Identification/location
 - .2 Design air flow
 - .3 Actual air flow
 - .4 Design return air flow
 - .5 Actual return air flow
 - .6 Design outside air flow
 - .7 Actual outside air flow
 - .8 Return air temperature
 - .9 Outside air temperature
 - .10 Required mixed air temperature
 - .11 Actual mixed air temperature
 - .12 Design outside/return air ratio
 - .13 Actual outside/return air ratio
- .9 Duct Traverse:
 - .1 System zone/branch
 - .2 Duct size
 - .3 Area
 - .4 Design velocity
 - .5 Design air flow
 - .6 Test velocity
 - .7 Test air flow
 - .8 Duct static pressure
 - .9 Air temperature
 - .10 Air correction factor
- .10 Air Distribution Test Sheet:
 - .1 Air terminal number
 - .2 Room number/location
 - .3 Terminal type
 - .4 Terminal size
 - .5 Area factor
 - .6 Design velocity
 - .7 Design air flow
 - .8 Test (final) velocity
 - .9 Test (final) air flow
 - .10 Percent of design air flow

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Duct work insulation.
- .2 Duct Liner.
- .3 Insulation jackets.

1.2 RELATED SECTIONS

- .1 Section - Roofing: Finishing outdoor insulation jacket.
- .2 Painting: Painting insulation jackets.
- .3 Section 23 05 53 - Mechanical Identification.
- .4 Section - Roofing: Installation and finishing of outdoor insulation jacket under roofing.

1.3 REFERENCES

- .1 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .2 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .3 ASTM C553 - Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .4 ASTM C612 - Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
- .5 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- .6 ASTM C1071 - Fibrous Glass Duct Lining Insulation(Thermal Sound Absorbing Material).
- .7 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .8 ASTM E96 - Water Vapour Transmission of Materials.
- .9 ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
- .10 ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .11 NAIMA National Insulation Standards.

- .12 NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- .13 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .14 UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS FOR REVIEW

- .1 Division 01: Procedures for submittals.
- .2 Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .2 Applicator Qualifications: Company specializing in performing the work of this section minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- .1 Materials: Flame spread/smoke developed rating of 25/50 to NFPA 255 / UL 723.

1.7 DELIVERY, STORAGE, AND PROTECTION

- .1 Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- .2 Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

Part 2 Products

2.1 VAPOUR BARRIER EXTERNAL DUCT WRAP, GLASS FIBRE, FLEXIBLE

- .1 Manufacturers:
 - .1 Johns Manville Microlite XG
 - .2 Owens Corning SoftR Duct Wrap.
 - .3 Other acceptable manufacturers offering equivalent products.
 - .1 Knauf.
- .2 Insulation: ASTM C553; flexible, noncombustible blanket.
 - .1 'ksi' ('K') value: ASTM C518, 0.045 at 24 degrees C (0.31 at 75 degrees F).
 - .2 Maximum service temperature: 121 degrees C (250 degrees F).

- .3 Maximum moisture absorption: 0.20 percent by volume.
- .4 Density 72 kg/cu. meter (4.5 lb/cu. Foot).
- .3 Vapour Barrier Jacket:
 - .1 Kraft paper with glass fibre yarn and bonded to aluminized film (FRK).
 - .2 Moisture vapour transmission: ASTM E96; 0.02 perm.
 - .3 Secure with pressure sensitive tape.
- .4 Vapour Barrier Tape:
 - .1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- .5 Outdoor Vapour Barrier Mastic:
 - .1 Vinyl emulsion type acrylic or mastic, compatible with insulation, black colour.
- .6 Tie Wire: Annealed steel, 1.5 mm (16 gauge).

2.2 VAPOUR BARRIER EXTERNAL GLASS FIBRE RIGID INSULATION BOARD

- .1 Manufacturers:
 - .1 Johns Manville 800 Series
 - .2 Owens Corning Series 700
 - .3 Other acceptable manufacturers offering equivalent products.
 - .1 Knauf.
- .2 Insulation: ASTM C612; rigid, noncombustible blanket.
 - .1 'ksi'('K') value : ASTM C518, 0.045 at 24 degrees C (0.31 at 75 degrees F).
 - .2 Maximum service temperature: 121 degrees C (250 degrees F).
 - .3 Maximum moisture absorption: 0.20 percent by volume.
 - .4 Density: 72 kg/cu m (4.5 lb/cu ft).
- .3 Vapour Barrier Jacket:
 - .1 Kraft paper with glass fibre yarn and bonded to aluminized film.
 - .2 Moisture vapour transmission: ASTM E96; 0.04 perm.
 - .3 Secure with pressure sensitive tape.
- .4 Vapour Barrier Tape:
 - .1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- .5 Indoor Vapour Barrier Finish:
 - .1 Cloth: Untreated; 305 g/sq m (9 oz/sq yd) weight, glass fabric.
 - .2 Vinyl emulsion type acrylic, compatible with insulation, black colour.

2.3 JACKETS

- .1 Canvas Jacket: UL listed.

- .1 Fabric: ASTM C921, 220 g/sq m (6 oz/sq yd), plain weave cotton treated with dilute fire retardant lagging adhesive.
- .2 Lagging Adhesive:
 - .1 Compatible with insulation.
- .2 Mineral Fibre (Outdoor) Jacket: Asphalt impregnated and coated sheet, 2.45 kg/sq m (50 lb/square ft).
- .3 Aluminum Jacket: ASTM B209M.
 - .1 Thickness: 0.40 mm (0.016 inch) sheet.
 - .2 Finish: Smooth.
 - .3 Joining: Longitudinal slip joints and 50 mm (2 inch) laps.
 - .4 Fittings: 0.4mm (0.016 inch) thick die shaped fitting covers with factory attached protective liner.
 - .5 Metal Jacket Bands: 10 mm (3/8 inch) wide; 0.015 mm thick aluminum.

Part 3 Execution

3.1 EXAMINATION

- .1 Division 01 - Examination and Preparation: Verification of existing conditions before starting work.
- .2 Verify that duct work has been tested before applying insulation materials.
- .3 Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- .1 Division 01 - Quality Assurance: Manufacturer's written instructions.
- .2 Install to NAIMA National Insulation Standards.
- .3 All duct sizes on the drawings refer to inside duct dimensions. On all acoustically lined ductwork, the external duct dimensions shall be increased by the thickness of the lining.
- .4 Insulated duct work conveying air below ambient temperature:
 - .1 Provide insulation with vapour barrier jackets.
 - .2 Finish with tape and vapour barrier jacket.
 - .3 Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - .4 Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- .5 Insulated duct work conveying air above ambient temperature:
 - .1 Provide with or without standard vapour barrier jacket.
 - .2 Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

- .6 Duct Work Exposed in Mechanical Equipment Rooms or Finished Spaces below 3 metres (10 feet) above finished floor: Where insulated finish with canvas jacket sized for finish painting.
- .7 External Duct Insulation Application:
 - .1 Secure insulation with vapour barrier with wires and seal jacket joints with vapour barrier adhesive or tape to match jacket.
 - .2 Secure insulation without vapour barrier with staples, tape, or wires.
 - .3 Install without sag on underside of duct work. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct work off trapeze hangers and insert spacers.
 - .4 Seal vapour barrier penetrations by mechanical fasteners with vapour barrier adhesive.
 - .5 Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3.3 SCHEDULES

3.4 EXTERNAL DUCT WRAP, GLASS FIBRE, FLEXIBLE

DUCT SERVICE	DUCT SIZE <Inch><mm>	THICKNESS <mm><Inch>
Round exhaust ducts, outdoor air intake ducts, relief ducts from external wall or roof back for length of 3000mm (10 feet) or to insulated damper, whichever is greater	All	50mm (2")

3.5 EXTERNAL GLASS FIBRE RIGID INSULATION BOARD

DUCT SERVICE	DUCT SIZE <Inch><mm>	THICKNESS <mm><Inch>
Rectangular exhaust ducts, outdoor air intake ducts, relief ducts from external wall or roof back for length of 3000mm (10 feet) or to insulated damper, whichever is greater	All	50mm (2")
Fresh-air intake from the intake louver at outside wall or roof to the air handler or mixed air plenum	All	75mm (3")

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Piping insulation.
- .2 Jackets and accessories.

1.2 RELATED SECTIONS

- .1 Section 23 05 53 - Mechanical Identification.

1.4 REFERENCES

- .1 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .2 ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .3 ASTM C195 - Mineral Fibre Thermal Insulating Cement.
- .4 ASTM C449/C449M - Mineral Fibre Hydraulic-setting Thermal Insulating and Finishing Cement.
- .5 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .6 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- .7 ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .8 ASTM C547 - Mineral Fibre Pipe Insulation.
- .9 ASTM C552 - Cellular Glass Thermal Insulation.
- .10 ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.
- .11 ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- .12 ASTM C591 - Unfaced Preformed Cellular Polyisocyanurate Thermal Insulation.
- .13 ASTM C610 - Moulded Expanded Perlite Block and Pipe Thermal Insulation.
- .14 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- .15 ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
- .16 ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).

- .17 ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
- .18 ASTM E84 - Surface Burning Characteristics of Building Materials.
- .19 ASTM E96 - Water Vapour Transmission of Materials.
- .20 CAN/ULC-S102-M88 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .21 NFPA 255 - Surface Burning Characteristics of Building Materials.
- .22 UL 723 - Surface Burning Characteristics of Building Materials.

1.5 QUALITY ASSURANCE

- .1 Materials: Flame spread/smoke developed rating of 25/50 or less to ASTM E84: NFPA 255; UL 723.

1.6 QUALIFICATIONS

- .1 Applicator: Company specializing in performing the work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Division 01 Transport, handle, store, and protect products.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- .3 Store insulation in original wrapping and protect from weather and construction traffic.
- .4 Protect insulation against dirt, water, chemical, and mechanical damage.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- .2 Maintain temperature during and after installation for minimum period of 24 hours.

Part 2 Products

2.1 GLASS FIBRE PRE-FORMED PIPE INSULATION WITH ALL-SERVICE JACKET

- .1 Manufacturers:
 - .1 Johns Manville Micro-Lok.
 - .2 Knauf Earthwool 1000.
 - .3 Owens Corning FIBREGLAS.

- .4 Substitutions: Refer to Division 01.
- .2 Insulation: ASTM C547; rigid moulded, non-combustible.
 - .1 'ksi' ('K') value : ASTM C335, 0.035 at 24 degrees C (0.24 at 75 degrees F).
 - .2 Minimum Service Temperature: -28.9 degrees C (-20 degrees F).
 - .3 Maximum Service Temperature: 454 degrees C (850 degrees F).
 - .4 Maximum Moisture Absorption: 0.2 percent by volume.
- .3 Vapour Barrier Jacket
 - .1 ASTM C921, White kraft paper reinforced with glass fibre yarn and bonded to aluminized film.
 - .2 Moisture Vapour Transmission: ASTM E96; 0.03 ng/(Pa s sq m) (0.02 perm inches).
 - .3 Secure with self sealing longitudinal laps and butt strips.
 - .4 Secure with outward clinch expanding staples and vapour barrier mastic.
- .4 Tie Wire: 1.3 mm (18 gauge) stainless steel with twisted ends on maximum 300 mm (12 inch) centres.
- .5 Vapour Barrier Lap Adhesive
 - .1 Compatible with insulation.

2.2 JACKETS

- .1 PVC Plastic
 - .1 Jacket: ASTM C921, One piece moulded type fitting covers and sheet material, off white colour.
 - .1 Minimum Service Temperature: -40 degrees C (-40 degrees F).
 - .2 Maximum Service Temperature: 66 degrees C (150 degrees F).
 - .3 Moisture Vapour Transmission: ASTM E96; 0.002 perm inches.
 - .4 Maximum Flame Spread: ASTM E84; 25.
 - .5 Maximum Smoke Developed: ASTM E84; 50.
 - .6 Connections: installed in accordance with manufacturer's recommendations using PVC adhesive to seal joints, and tape or butt strips where joined to adjacent pipe covering. Use staples and insulation coating as specified at circumferential joints.
 - .2 Covering Adhesive Mastic
 - .1 Compatible with insulation.
- .2 Canvas Jacket: UL listed
 - .1 Fabric: ASTM C921, 220 g/sq m (6 oz/sq yd), plain weave cotton treated with dilute fire retardant lagging adhesive.
 - .2 Lagging Adhesive
 - .1 Bakelite 120-18 white fire retardant lagging adhesive.

- .3 Coating
 - .1 Finish with two full brush coats of Bakelite 120-09 white fire retardant paint.
- .3 Aluminum Jacket: ASTM B209.
 - .1 Thickness: 0.40 mm (0.016 inch) sheet.
 - .2 Finish: Embossed.
 - .3 Joining: Longitudinal slip joints and 50 mm (2 inch) laps.
 - .4 Fittings: 0.4 mm (0.016 inch) thick die shaped fitting covers with factory attached protective liner.
 - .5 Metal Jacket Bands: 10 mm (3/8 inch) wide; 0.38 mm (0.015 inch) thick aluminum.
- .4 Stainless Steel Jacket: Type 304 stainless steel.
 - .1 Thickness: 0.25 mm (0.010 inch).
 - .2 Finish: Smooth.
 - .3 Metal Jacket Bands: 10 mm (3/8 inch) wide; 0.25 mm (0.010 inch) thick stainless steel.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that piping has been tested before applying insulation materials.
- .2 Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- .1 Install materials to manufacturer's written instructions.
- .2 On exposed piping, locate insulation and cover seams in least visible locations.
- .3 Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
 - .1 Provide vapour barrier jackets, factory applied or field applied.
 - .2 Insulate fittings, joints, and valves with moulded insulation of like material and thickness as adjacent pipe.
 - .3 Finish with glass cloth and vapour barrier adhesive.
 - .4 PVC fitting covers may be used.
 - .5 Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
 - .6 Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- .4 For insulated pipes conveying fluids above ambient temperature:
 - .1 Provide standard jackets, with or without vapour barrier, factory applied or field applied.

- .2 Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
 - .3 Finish with glass cloth and adhesive.
 - .4 PVC fitting covers may be used, except on steam and condensate piping systems.
 - .5 For hot piping conveying fluids 60 degrees C (140 degrees F) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
 - .6 For hot piping conveying fluids over 60 degrees C (140 degrees F), insulate flanges and unions at equipment.
- .5 Inserts and Shields:
- .1 Application: Piping 40 mm (1-1/2 inches) diameter or larger.
 - .2 Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - .3 Insert Location: Between support shield and piping and under the finish jacket.
 - .4 Insert Configuration: Minimum 150 mm (6 inches) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - .5 Insert Material: hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- .6 Finish insulation at supports, protrusions, and interruptions.
- .7 Pipe supports:
- .1 All piping shall be supported in such a manner that neither the insulation nor the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing shall be such that the circumferential joint may be made outside the hanger. On cold systems, vapor barrier shall be continuous, including material covered by the hanger saddle.
 - .2 Piping systems 3" (75 mm) in diameter or less may be supported by placing saddles of the proper length and spacing under the insulation as designated by the insulation manufacturer.
 - .3 For hot or cold piping systems larger than 3" (75 mm) in diameter, operating at temperatures less than +200F (93C) and insulated with fiber glass, high density inserts such as fiberglass or foam with sufficient compressive strength shall be used to support the weight of the piping system. At temperatures exceeding +200F (93C), high temperature pipe insulation shall be used for high density inserts.
 - .4 Where pipe shoes and roller supports are required, insulation shall be inserted in the pipe shoe to minimize pipe heat loss. Where possible, the pipe shoe shall be sized to be flush with the outer pipe insulation diameter.
 - .5 On vertical runs, insulation support rings shall be used as required
- .8 For pipe exposed in mechanical equipment rooms or in finished spaces below 3 metres (10 feet) above finished floor, finish with canvas jacket sized for finish painting.
- .9 For exterior piping applications, provide vapour barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapour barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- .10 Insulate all storm drain pipe, and all vent piping and exposed horizontal and vertical storm drain pipe within 3000 mm (10'-0") developed length from roof opening or pipe discharge.

.11 Fittings and Valves

- .1 Shall be insulated with pre-formed fiberglass fittings, fabricated sections of fibreglass pipe insulation. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers or as otherwise specified on contract drawings.
- .2 Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low-density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with suitable weather or vapor resistant mastic as dictated by the system location and service. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.
- .3 On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems shall be sealed with caulking to allow free movement of the stem but provide a seal against moisture incursion. Valve handle extensions are recommended.

.12 ACCESSORY MATERIALS

- .1 All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards."

3.3 TOLERANCE

- .1 Substituted insulation materials: Thermal resistance within 10 percent at normal conditions, as materials indicated.

3.4 FIBROUS GLASS INSULATION SCHEDULE

	PIPING SYSTEMS	PIPE SIZE <Inch><mm>	THICKNESS <Inch><mm>
Plumbing Systems			
	Domestic Hot Water Supply & Domestic Hot Water Recirc	=< 2" (50mm)	1" (25mm)
	Domestic Hot Water Supply & Domestic Hot Water Recirc	> 2" (50mm)	1 ½" (38mm)
	Tempered Domestic Water Supply	=< 2" (50mm)	1" (25mm)
	Tempered Domestic Water Supply	> 2" (50mm)	1 ½" (38mm)
	Domestic Cold Water, medical gas piping	=< 2" (50mm)	1" (25mm)
	Domestic Cold Water, medical gas piping	> 2" (50mm)	1 ½" (38mm)
	Vent piping and medical and/or lab vacuum exhaust piping for	all	2" (50mm)

	PIPING SYSTEMS	PIPE SIZE <Inch><mm>	THICKNESS <Inch><mm>
	developed length of 3000 mm (10 ft) from all roof and/or wall terminals.		
	Roof Drain Bodies	all	2" (50mm)
	Roof Drain piping above floor within 10 Feet (3 Metres) of the Exterior	all	2" (50mm)
	Plumbing Vents Within 10 Feet (3 Metres) of the Exterior	all	2" (50mm)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Metal duct work.
- .2 Nonmetal duct work.

1.2 RELATED SECTIONS

- .1 Section 23 05 29 - Supports And Anchors
- .2 Section 23 33 00 - Duct Work Accessories.
- .3 Section 23 37 00 - Air Outlets And Inlets.
- .4 Section 23 05 93 - Testing, Adjusting, And Balancing.

1.3 REFERENCES

- .1 ASTM A36/A36M - Carbon Structural Steel.
- .2 ASTM A90/A90M - Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- .3 ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .4 ASTM A480/A480M - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- .5 ASTM A568/A568M - General Requirements for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
- .6 ASTM A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .7 ASTM A1008/A1008M - Steel, Sheet, Cold-Rolled Carbon, Structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability.
- .8 ASTM A1011/A1011M - Standard Specification for Steel, Sheet, and Strip Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy with Improved Formability.
- .9 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .10 ASTM C14/C14M - Concrete Sewer, Storm Drain, and Culvert Pipe.
- .11 ASTM C443 - Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- .12 AWS D9.1 - Sheet Metal Welding Code.

- .13 NBS PS 15 - Voluntary Product Standard for Custom Contact-Moulded Reinforced-Polyester Chemical Resistant Process Equipment.
- .14 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- .15 NFPA 90B - Installation of Warm Air Heating and Air-Conditioning Systems.
- .16 NFPA 91 - Exhaust Systems for Air Conveying of Vapours, Gases, Mists, and Noncombustible Particulate Solids.
- .17 SMACNA - HVAC Air Duct Leakage Test Manual.
- .18 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .19 SMACNA - Fibrous Glass Duct Construction Standards.
- .20 UL 181 - Factory-Made Air Ducts and Connectors.

1.4 PERFORMANCE REQUIREMENTS

- .1 No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.

1.5 SUBMITTALS

- .1 Division 01: Procedures for submittals.
- .2 Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.6 PROJECT RECORD DOCUMENTS

- .1 Division 01: Submittals for project closeout.
- .2 Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.7 QUALITY ASSURANCE

- .1 Perform Work to SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .2 Maintain one copy of document on site.

1.8 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.
- .2 Installer: Company specializing in performing the work of this section with minimum three years documented experience.

1.9 REGULATORY REQUIREMENTS

- .1 Construct commercial kitchen exhaust duct work to NFPA 96 standards.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- .2 Maintain temperatures during and after installation of duct sealants.

Part 2 Products

2.1 MATERIALS

- .1 Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G60 zinc coating of to ASTM A90.
- .2 Refer to drawing for gauge of ductwork in exposed areas.
- .3 Steel Ducts: ASTM A1008, A568.
- .4 Fasteners: Rivets, bolts, or sheet metal screws.
- .5 Sealant:
 - .1 Manufacturers:
 - .1 Duro-Dyne
 - .2 Substitutions: Refer to Division 01.
 - .2 Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
- .6 Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 DUCT WORK FABRICATION

- .1 Fabricate and support to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Unless otherwise indicated fabrication shall conform to standards for duct pressure class rating of +2" w.g. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- .2 Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centreline. Where not possible and where rectangular elbows are used, provide air-foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fibre insulation.

- .3 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- .4 Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints: minimum 100 mm (4 inch) cemented slip joint, brazed or electric welded. Prime coat welded joints.
- .5 Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- .6 All rectangular ducts shall be constructed by breaking the corners and grooving the longitudinal seams using Pittsburgh seam or other approved airtight seam.
- .7 All elbows and transformation pieces shall be constructed using Pittsburgh corner seams or double seam corners. All transverse joints shall be constructed using S-slips, Bar Slips, Drive Slips, etc. where recommended in ASHRAE guide. All slips shall be not less than one gauge heavier than duct material. Open corners will not be accepted.

2.3 MANUFACTURED DUCT WORK AND FITTINGS

- .1 Manufacture to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install to manufacturer's written instructions.
- .2 Install and seal ducts to SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- .3 Duct sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- .4 No variation of duct sizes will be permitted except by written permission of the Contract Administrator. In the event that additional offsets and changes in direction are required in the duct system, these changes shall be made by the Sheet Metal Trade without additional cost to the City of Winnipeg. All ductwork shall be to the recommended practices as laid down by the Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- .5 Where the width of the duct exceeds 450 mm (18") in its largest dimension such ductwork shall be suitably stiffened by breaking the sheets diagonally.
- .6 If ductwork is insulated, cross breaking may be omitted providing the ducts are 2 gauges heavier than shown on the above schedule.

- .7 All laps shall be in the direction of air flow. Rivets and bolts shall be used throughout. All edges and slips shall be hammered down to leave a smooth interior duct.
- .8 Where low pressure ductwork conflicts with mechanical and electrical piping and it is not possible to divert the ductwork or piping to stay within allowable space limitation, provide duct easements.
- .9 Easements are not required on pipes 100 mm (4") and smaller outside dimension, unless this exceeds 20% of the duct area. Any irregular or flat shaped intrusions require a duct easement. Hangers and straps in the ductwork shall be parallel to air flow. If this is not possible, provide an easement. If the easement exceeds 25% of the duct area, the duct shall be split into two ducts with the original duct area being maintained. All easements shall be approved by the Contract Administrator before installation.
- .10 Provide openings in duct work where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated duct work, install insulation material inside a metal ring.
- .11 Locate pitot tube test openings in ductwork at supply fan discharges, on intake of exhaust/and return air fans, in major duct branches and everywhere pitot tube openings are required for proper balancing of air conditioning, ventilation and exhaust systems. Do not place closer than 1829mm (72 inches) to elbows. Space every 150mm (6 inches) across air stream at each location. Refer to drawings for additional opening requirements.
- .12 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- .13 Use crimp joints with or without bead for joining round duct sizes 200 mm (8 inch) and smaller with crimp in direction of air flow.
- .14 Use double nuts and lock washers on threaded rod supports.
- .15 Connect terminal units to supply ducts with 300 mm (one foot) maximum length of flexible duct. Do not use flexible duct to change direction.
- .16 Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- .17 Where interior of duct is visible through grilles, registers or diffusers, paint interior of duct with flat black Tremco paint formulated for galvanized surfaces.
- .18 Set plenum doors 150 to 300 mm (6 to 12 inches) above floor. Arrange door swings so that fan static pressure holds door in closed position.
- .19 During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.
- .20 Seal ductwork so that it is sufficiently airtight to ensure economical and quiet performance of the system. All ductwork, except where otherwise indicated, shall have seams and joints sealed with Duro-Dyne S-2 duct sealer. Apply duct sealer and duct tape in strict accordance with manufacturer's recommendations, to joints and seams to provide an airtight, watertight installation. Prior to application, ductwork to be dry and free of grease, etc. Use 6mm bead

of material along joints. Material, when dry, to have 3.2mm depth extending 25mm on each side of joint or seam.

- .21 All ductwork located outdoors shall have seams and joints sealed with grey TREMCO 555 acrylic sealant applied with gun and levelled with putty knife. Use material in accordance with manufacturer's printed recommendations.
- .22 Stainless steel ductwork exposed in finished rooms shall not have duct tape or sealant application.
- .23 Install ductwork free from pulsation, chatter, vibration or objectionable noises.
- .24 Should any of these defects appear after the system is in operation, correct problems by removing, replacing, or reinforcing the work as directed by the Contract Administrator.

3.2 CLEANING

- .1 Clean work to Division 01.
- .2 Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- .3 Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into duct work for cleaning purposes.

3.3 SCHEDULES

3.4 DUCT WORK MATERIAL SCHEDULE

	AIR SYSTEM	MATERIAL
	Low Pressure Supply (Heating Systems)	Steel
	Low Pressure Supply (System with Cooling Coils)	Steel
	Return and Relief	Steel
	General Exhaust	Steel
	Outside Air Intake	Steel
	Combustion Air	Steel

3.5 DUCT WORK PRESSURE CLASS SCHEDULE

	AIR SYSTEM	PRESSURE CLASS
	Supply (Heating Systems)	250 Pa (1 inch)
	Return and Relief	250 Pa (1 inch)
	General Exhaust	125 Pa(1/2 inch)
	Outside Air Intake	125 Pa (1/2 inch)
	Intake and Exhaust	250 Pa (1 inch)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Air turning devices/extractors.
- .2 Backdraft dampers.
- .3 Duct access doors.
- .4 Duct test holes.
- .5 Fire dampers.
- .6 Flexible duct connections.
- .7 Volume control dampers.

1.2 RELATED SECTIONS

- .1 Section 23 05 48 - Vibration Isolation.
- .2 Section 23 31 00 - Duct Work.
- .3 Equipment Wiring: Electrical characteristics and wiring connections.

1.3 REFERENCES

- .1 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- .2 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .3 UL 33 - Heat Responsive Links for Fire-Protection Service.
- .4 UL 555 - Fire Dampers.

1.4 SUBMITTALS

- .1 Division 01: Procedures for submittals.
- .2 Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.

1.5 PROJECT RECORD DOCUMENTS

- .1 Division 01: Submittals for project closeout.
- .2 Record actual locations of access doors.

1.6 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

- .1 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., and testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Division 01: Transport, handle, store, and protect products.
- .2 Protect dampers from damage to operating linkages and blades.

Part 2 Products

2.1 AIR TURNING DEVICES/EXTRACTORS

- .1 Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with push-pull operator strap.

2.2 BACKDRAFT DAMPERS.

- .1 Gravity Backdraft Dampers, Size 450 x 450 mm (18 x 18 inches) or smaller, provided with Air Moving Equipment: Air moving equipment manufacturers standard construction.
- .2 Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 1.5 mm (16 gauge) thick galvanized steel, with centre pivoted blades of maximum 150 mm (6 inch) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 DUCT ACCESS DOORS

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .2 Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated duct work, install minimum 25 mm (one inch) thick insulation with sheet metal cover.
 - .1 Less Than 300 mm (12 inches) Square: Secure with sash locks.
 - .2 Up to 450 mm (18 inches) Square: Provide two hinges and two sash locks.
 - .3 Up to 600 x 1200 mm (24 x 48 inches): Three hinges and two compression latches.
 - .4 Larger Sizes: Provide an additional hinge.
- .3 Access doors with sheet metal screw fasteners are not acceptable.

- .4 Doors in insulated ductwork to be double panel construction with a 25mm (1") insulating filler.
- .5 In certain locations where it is inconvenient to swing access doors, removable doors with 4 cam locks will be accepted. However, all such locations shall be approved by the Contract Administrator prior to installation.

2.4 DUCT TEST HOLES

- .1 Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- .2 Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation;

2.5 FIRE DAMPERS

- .1 Manufacturers:
 - .1 Price.
 - .2 Nailor.
 - .3 Ruskin.
 - .4 Substitutions: Refer to Division 01.
- .2 Depending on the rating of fire separation, rating, construction and testing of the fire damper will conform to most recent issue of all of following:
 - .1 N.B.C.
 - .2 ULC S 112
 - .3 NFPA 252
 - .4 ULC or ULI 10(b)
- .3 Use type 'B' fire dampers, i.e. blades out of air stream, to be used in all ducts passing through fire separations. Combination fire damper-balancing damper, with blades in air stream shall be used on sidewall or return, or floor mounted supply, up to maximum size of 0.372 sq.m (576 sq.in.). For sidewall return above 0.372 sq.m (576 sq.in.) in size, use a type 'A' fire damper, i.e. blades in air stream.
- .4 Horizontal Dampers: Galvanized steel, 0.76 mm (22 gauge) frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- .5 Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except at all locations unless otherwise indicated on the drawings, and for 250 Pa (1.0 inch) pressure class ducts up to 300 mm (12 inches) in height.
- .6 Multiple Blade Dampers: 1.5 mm (16 gauge) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 3.2 x 12.7 mm (1/8 x 1/2 inch) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

2.6 FLEXIBLE DUCT CONNECTIONS

- .1 Manufacturers:
 - .1 Duro-Dyne.
 - .2 Substitutions: Refer to Division 01.
- .2 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .3 Connector: Fabric crimped into metal edging strip.
 - .1 Fabric: UL listed fire-retardant neoprene coated woven glass fibre fabric to NFPA 90A, minimum density 1.0 kg/sq m (30 oz per sq yd).
 - .2 Net Fabric Width: Approximately 75mm (3 inches) wide.
 - .3 Metal: 75 mm (3 inch) wide, 0.6 mm thick (24 gauge) galvanized steel.

2.7 VOLUME CONTROL DAMPERS.

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .2 Splitter Dampers:
 - .1 Material: Same gauge as duct to 600 mm (24 inches) size in either direction, and two gauges heavier for sizes over 600 mm(24 inches).
 - .2 Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous hinge or rod.
 - .3 Operator: Minimum 6 mm (1/4 inch) diameter rod in self aligning, universal joint action, flanged bushing with set screw.
- .3 Single Blade Dampers: Fabricate for duct sizes up to 150 x 760 mm (6 x 30 inch).
- .4 Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 200 x 1825 mm (8 x 72 inch). Assemble centre and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- .5 End Bearings: Except in round duct work 300 mm (12 inches) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- .6 Quadrants:
 - .1 Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - .2 On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - .3 Where rod lengths exceed 750 mm (30 inches) provide regulator at both ends.

Part 3 Execution

3.1 PREPARATION

- .1 Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- .1 Install accessories to manufacturer's written instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- .2 Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- .3 Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust duct work to NFPA 96. Provide minimum 300 x 300 mm (12 x 12 inch) size for all fire dampers. Enlarge duct if necessary to accommodate properly sized access door.
- .4 Generally access doors at heating coils shall approximate width of coil for ease of cleaning.
- .5 Provide duct test holes where indicated and required for testing and balancing purposes.
- .6 Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- .7 Demonstrate re-setting of fire dampers to City of Winnipeg's representative.
- .8 Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators.
- .9 Use splitter dampers only where indicated.
- .10 Provide balancing dampers on high velocity systems where indicated.
- .11 Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
- .12 Do not locate single blade volume dampers immediately behind diffusers and grilles. This application does not allow uniform airflow across the outlet face.
- .13 To minimize generated duct noise, locate volume dampers at least two duct diameters from a fitting and as far away as possible from the outlet or inlet.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Diffusers.
- .2 Registers/grilles.
- .3 Louvers.
- .4 Louvered penthouses.

1.2 RELATED SECTIONS

- .1 Division 09 - Painting: Painting of duct work visible behind outlets and inlets.

1.3 REFERENCES

- .1 ADC 1062 - Air Distribution and Control Device Test Code.
- .2 AMCA 500 - Method of Testing Louvers for Ratings.
- .3 AMCA 511 – Certified Ratings Program
- .4 AMCA 5000 - Method of Testing Dampers for Ratings.
- .5 ARI 650 - Air Outlets and Inlets.
- .6 ASHRAE 70 - Method of Testing for Rating the Performance of Outlets and Inlets.
- .7 SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- .8 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.4 SUBMITTALS

- .1 Division 01: Procedures for submittals.
- .2 Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.5 PROJECT RECORD DOCUMENTS

- .1 Division 01: Submittals for project closeout.
- .2 Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

- .1 Test and rate air outlet and inlet performance to ADC Equipment Test Code 1062 and ASHRAE 70.
- .2 Test and rate louver performance to AMCA 500
- .3 Certified AMCA 511 – Certified Ratings Program

1.7 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

Part 2 Products

2.1 MANUFACTURERS

- .1 Price Industries.
- .2 Nailor Industries
- .3 Titus
- .4 Ventex.
- .5 Substitutions: Refer to Division 01.

2.2 CEILING GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES

- .1 Manufacturers:
 - .1 Price Industries Model 80
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Nailor.
 - .2 Titus.
 - .3 Substitutions: Refer to Division 01.
- .2 Type: Fixed grilles of 13 x 13 x 13 mm (1/2 x 1/2 x 1/2 inch) louvers.
- .3 Fabrication: Aluminum.
- .4 Frame: 25 mm (one inch) margin with countersunk screw mounting.

2.3 WALL SUPPLY REGISTERS/GRILLES

- .1 Manufacturers:
 - .1 Price Industries Model 520 and Model SDGE
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Nailor.

- .2 Titus.
- .3 Substitutions: Refer to Division 01.
- .2 Type: Streamlined and individually adjustable blades, 19 mm (3/4 inch) minimum depth, 19 mm (3/4 inch) maximum spacing with spring or other device to set blades, horizontal face, double deflection.
- .3 Frame: 25 (1 inch) margin with countersunk screw mounting and gasket.
- .4 Fabrication: Steel with 0.90 mm (20 gauge) minimum frames and 0.80 mm (22 gauge) minimum blades.
- .5 Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face, as scheduled.
- .6 Finish: See schedule.

2.4 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- .1 Manufacturers:
 - .1 Price Industries Model 530
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Nailor.
 - .2 Titus.
 - .3 Substitutions: Refer to Division 01.
- .2 Type: Streamlined blades, 19 mm (3/4 inch) minimum depth, 19 mm (3/4 inch) maximum spacing, horizontal face.
- .3 Frame: 32 (1-1/4 inch) margin with countersunk screw mounting and gasket.
- .4 Fabrication: Steel with 0.90 mm (20 gauge) minimum frames and 0.80 mm (22 gauge) minimum blades.
- .5 Finish: Refer to schedule.

2.5 LOUVER PENTHOUSE

2.6 LOUVERS

- .1 Manufacturers:
 - .1 Price Industries Model BCJE443
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Ventex.
 - .2 Ruskin
 - .3 Substitutions: Refer to Division 01.
 - .4 Refer to schedules.

Part 3 Execution

3.1 INSTALLATION

- .1 Install to manufacturer's written instructions.
- .2 Check location of outlets and inlets and make necessary adjustments in position to conform with Contract Administratorural features, symmetry, and lighting arrangement.
- .3 Install diffusers to duct work with air tight connection.
- .4 All diffusers, grilles and registers shall be free of fluttering, chattering and vibration. A felt or sponge rubber gasket shall be provided behind each outlet or inlet and adequate fastenings provided to prevent leakage between the outlet and duct, wall or ceiling.
- .5 Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- .6 Paint ductwork visible behind air outlets and inlets matte black.
- .7 Care should be taken to install diffusers as per the reflected ceiling plans where available so that the diffusers will fit properly in the ceiling suspension system. The sheet metal subcontractor shall co-ordinate this work with the General Contractor, the suspended ceiling subtrade and electrical subtrade.
- .8 Should there be any confliction in the location of grilles, registers and diffusers with lights, etc. the matter shall be referred to the Contract Administrator for directive. If requested by the Contract Administrator, his subcontractor shall relocate grilles, diffusers and registers and ductwork attached, within two feet of locations as indicated on the drawings, without extra cost to the City of Winnipeg.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Packaged air handling units.

1.2 RELATED SECTIONS

- .1 Section 23 05 48 - Vibration Isolation.
- .2 Section 23 07 13 - Duct Insulation.
- .3 Section 23 31 00 - Duct Work.
- .4 Section 23 33 00 - Duct Work Accessories: Flexible duct connections.
- .5 Equipment Wiring: Electrical characteristics and wiring connections.

1.3 REFERENCES

- .1 AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- .2 AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- .3 AMCA 99 - Standards Handbook.
- .4 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .5 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- .6 AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- .7 AMCA 500 - Method of Testing Louvres for Ratings.
- .8 AMCA 5000 - Method of Testing Dampers for Ratings.
- .9 ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- .10 ARI 430 - Fabrication of Central Station Air Handling Units.
- .11 ARI 435 - Application of Central-Station Air-Handling Units.
- .12 ARI 610 - Central System Humidifiers for Residential Applications.
- .13 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .14 UL 900 - Air Filter Units.

1.4 SUBMITTALS

- .1 Division 01: Procedures for submittals.

- .2 Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- .3 Product Data:
 - .1 Provide literature which indicates dimensions, weights, capacities, ratings, fan performance, gauges and finishes of materials, and electrical characteristics and connection requirements.
 - .2 Provide data of filter media, filter performance data, filter assembly, and filter frames.
 - .3 Provide fan curves with specified operating point clearly plotted.
 - .4 Submit sound power level data for both fan outlet and casing radiation at rated capacity.
 - .5 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- .4 Manufacturer's Installation Instructions.

1.5 OPERATION AND MAINTENANCE DATA

- .1 Division 01: Submittals for project closeout.
- .2 Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.6 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience, who issues complete catalogue data on total product.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Division 01: Transport, handle, store, and protect products.
- .2 Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- .3 Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.9 EXTRA MATERIALS

- .1 Division 01: Submittals for project closeout.
- .2 Provide two sets for each unit of fan belts and filters.

Part 2 Products

2.1 MANUFACTURERS

- .1 Engineered Air Product LM4/K/V
- .2 Substitutions: Refer to Division 01

2.2 AIR HANDLING UNIT, AHU-1

- .1 Unit Casing
 - .1 Unit casing shall be of minimum 18 (1.3mm) gauge satin coat galvanized sheet metal. All units shall be internally insulated with 1" (50mm) thick 1 1/2 lb./cu.ft. (24 kg./cu.m.) density, neoprene coated fibre glass thermal insulation. Provide hinged access doors with Camlock handles. Unit shall be finished with a grey enamel coating on unit exterior.
- .2 Fan
 - .1 Forward curved fans shall be equipped with greaseable pillow block bearings, supported on a rigid structural steel frame. Fan-motor assemblies shall be provided with vibration isolators. Fan motors shall be open drip proof, ODP type.
- .3 Electric Coil
 - .1 Heater elements shall be installed a minimum of 12" (300mm) downstream from air filters. Insulation in heating sections shall be fibre reinforced foil faced. Heater element wiring shall terminate in a full height enclosure at one end of the heater. All internal wiring shall terminate on clearly identified terminal blocks. Heaters shall be equipped with an automatic reset disc type thermal cut-out. Heater elements shall be open type nickel-chromium construction, (60% Ni, 16% Cr, 24% Fe). Coil terminal pins shall be mechanically secured and insulated from the frame by means of non-rotating ceramic bushings. Provide SCR complete with solid state discharge air controller to maintain 65 F discharge air temperature.
- .4 Filters
 - .1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings. Maximum face velocity allowable is 500 ft/min.
 - .2 The filter modules shall be designed to slide out of the unit. Side removal 2" (50mm) filters shall slide into a formed metal track, sealing against metal spacers at each end of the track. Filters shall be rated MERV 8.
- .5 Controls
 - .1 Air handling units shall be factory wired and tested, and shall be certified by C.G.A., with C.S.A. approved components. Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays.

- .2 Automatic controls shall be housed in a control panel mounted in or on the air handling unit, which will meet the C.S.A. standard of the specific installation.
- .3 Provide remote panel with unit on / off switch & light and heat on switch & light.

Part 3 Execution

3.1 INSTALLATION

- .1 Install to manufacturer's written instructions.
- .2 Install to ARI 435.
- .3 Assemble high pressure units by bolting sections together. Isolate fan section with flexible duct connections.
- .4 Install assembled unit on vibration isolators.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Electric coils.

1.2 RELATED SECTIONS

- .1 Section 23 31 00 - Duct Work: Installation of duct coils.
- .2 Equipment Wiring: Electrical characteristics and wiring connections.

1.3 SUBMITTALS FOR REVIEW

- .1 Section 22 05 01: Procedures for submittals.
- .2 Product Data: Provide coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
- .3 Shop Drawings: Indicate coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

1.4 SUBMITTALS FOR INFORMATION

- .1 Section 22 05 01: Submittals for information.
- .2 Certificates: Certify that coils are tested and rated to ARI 410.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- .1 Section 22 05 01: Submittals for project closeout.
- .2 Warranty: Submit manufacturer warranty and ensure forms have been completed in City of Winnipegs name and registered with manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Division 01 Transport, handle, store, and protect products.
- .2 Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.
- .3 Protect coils from entry of dirt and debris with pipe caps or plugs.

Part 2 Products

2.1 ELECTRIC COILS

- .1 Manufacturer: Thermolec

- .2 Assembly: UL listed and labelled, with terminal control box and cover, splice box, coil, casing, and controls.
- .3 Coil: Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings.
- .4 Controls: Automatic reset thermal cut-out, built-in contactors, manual reset thermal cut-out, air flow proving device, fused disconnect, SCR controller, discharge temperature sensor to maintain max 95F supply air.

Part 3 Execution

3.1 INSTALLATION

- .1 Install to manufacturers written instructions.
- .2 Install in ducts and casings to SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .3 Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- .4 Make connections to coils with unions and flanges.
- .5 Electric Duct Coils: Wire to NFPA 70.

END OF SECTION