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PART 1 - GENERAL

1.1 GENERAL

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

.2 All air distribution systems shall meet Manitoba Building Code, ASHRAE and SMACNA Standards.

1.2 WORK INCLUDED

.1 Heating, outside air, supply air ductwork.
.2 Grilles, diffusers, louvres and filters.
.3 Assistance to TAB contractor.
.4 Fans: supply

1.3 RELATED WORK SPECIFIED ELSEWHERE

.1	Mechanical General Provisions:	Section 15010
.2	Insulation:	Section 15100
.3	Plumbing:	Section 15430
.4	Liquid Heat Transfer	Section 15600
.4	Testing & Balancing:	Section 15990

1.4 REFERENCE STANDARDS

.1 SMACNA: HVAC Duct Construction Standards, Metal and Flexible HVAC Duct Leakage Test Manual.
  .1 Low velocity duct construction standards.
  .2 NFPA 90A-Latest Revision: National Fire Protection Association -Installation of Air Conditioning and Ventilating.
  .3 UL-151: Underwriters' Laboratories Air Duct.
  .4 ADC 106R2: Air Diffusion Equipment Test Code.
  .5 AMCA 201-73, AMCA 300-67, AMCA 301-77, AMCA 302-73, AMCA 303-73, AMCA 2408-69.
  .6 Ashrae: Handbook, Fundamentals and Systems Volumes.
    .1 Air duct design.
    .2 Duct construction.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

.1 Manitoba Building Code, local Authority having Jurisdiction.

1.6 ALTERNATIVES

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

PART 2 - PRODUCTS

2.1 DUCT SEALING

.1 Seal all joints on all supply, return and exhaust ductwork with high pressure duct sealant.
- .1 Foster 30-02 Duro-Dyne S-2

.2 Cover all joints with high pressure duct tape polyvinyl treated, open weave fibreglass, 50mm (2")
- .1 Duro-Dyne FT-2

2.2 LOW PRESSURE DUCTWORK

.1 Ductwork: Galvanized Steel
- .1 Lock forming quality: to ASTM A525M, Z90 zinc coating.
- .2 Thickness: to SMACNA, ASHRAE
- .3 Fabrication: to SMACNA, ASHRAE

.2 Joints: Galvanized Steel
- .1 SMACNA or properietary manufactured duct joint. Propietary manufactured flanged duct joint shall be considered to be a class A seal.
  - .1 Ductmate Canada Ltd. system for propriety joints; Exanno Nexus.

.3 Fittings: Galvanized Steel
- .1 Fabrication: SMACNA
- .2 Radiused elbows: standard radius.
- .3 Square elbows: to 400mm (16") with single thickness vanes.
- .4 Square elbows: over 400mm (16") with double thickness vanes.
- .5 Provide branch and main duct balancing dampers.
- .6 Sub branch duct with 45° entry and balancing damper on branch and or Sub branch duct with square connection, volume extractor and branch duct balancing damper.
- .7 Transitions:
  - .1 Diverging: 20° maximum included angle.
  - .2 Converging: 30° maximum included angle.
- .8 Offsets: radiused elbows.
- .9 Obstruction deflectors: maintain full cross sectional area. Maximum included angles as tranitions.

2.3 DUCT OPENINGS

.1 Use 1.2 mm (18 ga.) galvanized sleeves where ductwork passes through rated floor assemblies. Sleeves to extend 150 mm (6") above floor. Use watertight mastic between sleeved and floor material. (See Section 15010, OPENINGS IN FIRE SEPARATIONS).

.2 Seal area between ducts and openings with mineral wool and ULC firestop system. Testing to meet ASTM E814: Fire Test of Through-Penetration Firestops. UL 1479: Through-Penetration Firestop Systems. (See Section 15010, OPENINGS IN FIRE SEPARATIONS).

2.4 WALL OPENINGS

.1 Provide 1.2 mm (18 ga.) galvanized sleeve 50 mm (2") wider than wall thickness. Opening located in fire rated walls to have sleeve c/w louvred fire damper to meet code requirements. (See Section 15010, OPENINGS IN FIRE SEPARATIONS).

.2 Provide 300 mm (12") duct extension in mechanical room openings, where smoke detectors are noted on Electrical drawings, to support detector and provide proper sensing plenums.

2.5 HANGERS AND SUPPORTS

.1 Fabricate strap hangers to same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger 500mm (20"). Hanger configuration to SMACNA details. Hanger not to interrupt exterior duct insulation (See Section 15100 WORKMANSHIP).

.2 Support vertical ducts at every floor with angle iron collar sized to provide proper bearing. Provide intermediate vertical support at ¼ and ¾ points in addition to angle iron collar at each floor.

.3 Support horizontal ducts on maximum 2.4 m (80") centres by non-perforated galvanized steel.

.4 Riveted strap for ductwork 900 mm (36") (either dimension) or less, and minimum 25 mm x 25 mm x 3 mm (1" x 1" x 1/8") galvanized angle iron passing under ducts 925 mm (37") or over (either dimension) with 9.4 mm (3/8") diam. threaded rods suspending angles from structure.

.5 Use universal concrete type inserts of black malleable iron, for threaded connection with lateral adjustment, top slot for reinforcing rods and lugs for attaching to forms.

.6 Hangers shall be galvanized steel angles with galvanized steel rods, locking nuts and washers to SMACNA following table:

Duct Size		Angle Size		Rod Size		Spacing	
Mm	In.	Mm	In.	Mm ∅	In. ∅	M	Ft.
up to 750	up to 30	25x25x3	1x1x1/8	6	1/4	3	10
775 to 1050	31 to 41	40x40x3	2x2x1/8	6	1/4	3	10
1075 to 1500	42 to 59	40x40x3	2x2x1/8	10	3/8	3	10
1525 to 2100	60 to 83	50x50x3	2x2x1/8	10	3/8	2.5	8
2125 to 2400	84 to 94	50x50x5	2x2x3/16	10	3/8	2.5	8
2425 and over	95 and over	50x50x6	2x2x1/4	10	3/8	2.5	8

2.6 TURNING VANES

.1 For duct dimensions 456 mm (18") or less:
In the plane of turn, Junior Vane Rails shall be supplied having the rails 57 mm (2 1/4") wide and vanes spaced on 50 mm (2") centres.

.2 For ducts larger than 456 mm (18"):
Duro Vane Rails shall be supplied having the rails 114 mm (4 1/2") Wide and vanes spaced on 114 mm (4 1/2") centres.

.3 Double thickness turning vanes shall be Duro-Dyne Vane Rails.

.4 Factory or shop fabricated single thickness and double thickness with trailing edge to recommendation of SMACNA.

2.7 FLEXIBLE COLLARS

.1 Provide flexible non-combustible neoprene connectors between "All" fans "each side" air moving devices, ducts or casings where required to prevent excessive movement of long ducts, at building expansion joints.

.1 Shall be galvanized sheet metal frame with fabric clenched by means of double locked seams. Fire resistant, self extinguishing neoprene coated glass fabric density of 1.3 kg/m^2.

2.8 INSTRUMENT TEST PORTS

.1 1.6mm (1/16") thick steel zinc plated after manufacture

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28mm ∅ (1 1/8"∅) minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

.5 Test ports installed in welded stainless duct to be of a compatible material, installed such that duct integrity is maintained regardless of whether connection is threaded, welded or gasketted.

.6 Locate in ductwork at supply fan discharges, on intake of exhaust and return fans, in hot and cold ducts coming off plenums, in major duct branches and everywhere pitot tube measurement is required for proper balancing of air condition, ventilation and exhaust systems. Do not place closer than six feet to elbows. Space very 150 mm (6") across the air stream at each location. Refer to drawings for additional opening requirements.

.1 Lawson-Taylor 1.2 mm (18 ga.) cadmium-plated deep drawn flange type with quic-lock cap retained with a ball chain, c/w gaskets. At insulated ductwork use a quick-loc extension c/w neoprene tipped prolite insulating plug.

2.9 DUCT ACCESS DOORS

.1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (1/4") thick complete with sheet metal angle frame.

.2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6mm (1/4) thick complete with sheet metal angle frame and rigid glass fibre insulation to match ductwork insulation thickness.

.3 Gaskets: neoprene or foam rubber.

.4 Hardware:

.1 Up to 300mm x 300mm (12" x 12"): 2 sash locks complete with safety chain.
.2 301mm to 450mm (12" to 18"): 4 sash locks complete with safety chain.
.3 451mm to 1000mm (18" to 40"): piano hinge and minimum two sash locks.
.4 Doors over 1000mm (40"): piano hinge and two handles operable from both sides.
.5 Hold open devices.
.6 300mm x 300mm (12" x 12") glass viewing panels.

.5 Acudor, Air-O-Metal, Lehage, Milcor, Titus, Controlled Air.

2.10 DAMPERS

.1 Single blade:

.1 One sheet metal thickness heavier than duct with V-grade stiffened size and configuration to recommendations of SMACNA, locking quadrants with inside and outside end bearings.

.2 Multi bladed:

.1 Factory manufactured or material compatible with duct. Opposed blade configuration to recommendation of SMACNA. Bearings: self-lubricating nylon. Linkage: Shaft extension with locking quadrant. Channel frame c/w angle stop.

.3 Splitter:

.1 One sheet metal thickness heavier than duct with appropriate stiffening. Double thickness air foil shape construction. Control rod with locking device and position indicator. Rod configuration to prevent end from entering duct. Pivot, piano hinge. Fold leading edge.

2.11 GRILLES/ DIFFUSER

.1 General:
- .1 Provide standard product to meet capacity, throw, noise level, throat and outlet velocity.
- .2 At ceiling diffusers, provide independent suspension from the basic structure and/or ceiling when indicated to maintain fire protection membrane integrity.
  - .1 Provide thermal blanket assembly (indicate UL/ULC index arrangement number) when used in conjunction with square, rectangular, round, square to round ceiling diffuser.
- .3 Where grilles, penetrate fire walls and fire partitions, provide approved steel sleeve secured to structure in accord with NFPA 90A Latest Edition.

.2 Grilles & Registers:
- .1 Louvered Face Supply:
  - .1 Double deflection type: Aluminium/Steel two sets of fully adjustable deflection airfoil blades. Blades shall run parallel to the long or short dimension.
    - .1 Where indicated provide integral volume control damper of the opposed blade type operable from the register face.
  - .2 Multiple deflection fixed type: Aluminium, reversible core shall be field removable from spring clips. Blades shall run parallel to the long dimension.
    - .1 Where indicated provide integral volume control damper of the opposed blade type operable from the register face.
  - .3 Linear bar type: Aluminium blades mechanically loaded with grille core with reinforcing support bars fixed to aluminium border. Blades shall run parallel to the long dimension.
    - .1 Where indicated provide integral volume control damper of the opposed blade type operable from the register face.
- .2 Frames:
  - .1 Steel: (See Schedule) standard with exposed welded joints and mitered corners.
  - .2 Aluminium: (See Schedule) extruded satin finish with mechanical fasteners and mitered corners.
  - .3 Provide full perimeter gaskets.
  - .4 Provide plaster frames as plaster stops where set into plaster or gypsum board at all locations.
  - .5 Provide concealed fasteners and operators.
- .3 Screws:
  - .1 Install with flat head cadmium plated screws in countersunk holes where fastenings are visible.

2.12 LOUVERS

.1 Stationary Louvres
- .1 Construction:
  - .1 Welded with exposed joints ground flush and smooth.
- .2 Material:
  - .1 Extruded aluminium alloy 6063-T5
- .3 Blade:
  - .1 Stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500mm.
- .4 Frame, head, sill jamb:
  - .1 100mm (4") deep one piece extruded aluminium, minimum 3mm (1/8") thick with approved caulking slot, integral to unit.
- .5 Mullions:
  - .1 At 1500mm (5 Ft.) maximum centres.
- .6 Fastenings:

.1 Stainless steel (Society of Automotive Engineers) SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminium and head of bolt, or between nut, ss washer and aluminium body.

.7 Screen:

.1 12mm (1/2") exhaust, 25mm (1") intake mesh, 2mm (3/16") dia. wire aluminium birdscreen on inside face of louvres in formed U-frame.

.8 Finish:

.1 Prepainted finish in accordance with Aluminium Association Designation Systems for Aluminium Finishes. Colour as selected by the architect.

.9 Airolite, Carnes, Nailor Industries Inc., Penn Ventilator Co.

2.13 SUPPLY FANS

.1 General:

.1 Standard of rating: AMCA 201 for Fan Application. AMCA 302 for application of Sone Loudness Ratings for non-ducted air moving devices. AMCA 303 for application of Sound Power Ratings for ducted air moving devices. Performance of fans to AMCA 210 and ANSI/ASHRAE 51. Power ratings to comply with AMCA 301, tested to AMCA 300.

.2 Maximum loudness: 3 sones.

.3 Supplier shall submit: matching fan frame size and not on scheduled performance.

.4 Forward curve centrifugal fan type inline cabinet

2.14 FILTERS

.1 General: 30% efficiency

.1 Filters shall be extended surface pleated filters as manufactured by

.2 Filter sizes and capacities shall be as scheduled.

.3 Filters shall be UL900 Class 2 listed.

.4 Filter Construction:

.1 Filters shall be constructed of reinforced, non-woven cotton/synthetic blend media laminated to an expanded metal grid on the air leaving side and formed into radial wedge pleats.

.2 Frame shall be moisture-resistant chipboard with perforated steel support grilles on the upstream and downstream sides.

.5 Performance:

.1 Initial and final resistances shall not exceed the scheduled values.

.2 Media area must equal or exceed that of the specified filter.

.3 The average atmospheric dust spot efficiency shall be 25-30% as determined by ASHRAE Standard 52.1 test methods.

.4 The manufacturer shall guarantee performance as stated in the literature within tolerances as outlined in Section 7.4 of ARI Standard 850.

PART 3 - EXECUTION

3.1 STANDARDS

.1 Maintain all standards of constructing and suspending ductwork as set forth in the 'ASHRAE' and SMACNA standards.

.2 Duct sizes are inside dimensions. If ducts are acoustically lined, outside duct size to be increased as required.

.3 Single thickness partitions between ducts is not acceptable.

.4 All ductwork shall seams and joints sealed with Duro-Dyne S2 duct sealers. Apply duct sealer in strict accordance with manufacturers recommendations, to joints and seams to provide a air-tight, water-tight installation. Prior to application, ductwork to be dry and free of greases, etc.

3.2 LOW PRESSURE DUCTWORK

.1 Duct Sizes shown on plans are a guide for duct runs only. Transition and change duct sizes and provide fittings at no extra cost to contract. Confirm site conditions and confer with Electrical drawings.

.2 Where duct width exceeds 450 mm (18") in largest dimension, stiffen by cross breaking sheets diagonally. Beaded ducts as per SMACNA catalogue Fig. 1.13 acceptable alternative.

.3 Duct sizes are inside dimensions. If ducts are acoustically lined, outside duct size to be increased as required.

.4 Provide ducturns in all elbows of ducts 1200 mm (48") wide and greater in segments of 600 mm (24") maximum.

.5 Single thickness partitions between ducts not acceptable.

.6 All ductwork shall have seams and joints sealed. Apply duct sealer in strict accordance with manufacturers recommendations, to joints and seams to provide an air-tight, water tight installation. Prior to application, ductwork to be dry and free of grease, etc. Use 6 mm (1/4") bead of material along joints. Material, when dry, to have 3.2 mm (1/8") depth extending 25 mm (1") one each side of joint or seam.

.7 Where ductwork conflicts with mechanical and electrical piping and it is not possible to divert ductwork or piping to stay within allowable space limitations, provide duct easements. Easements not required on pipes 100 mm (4") and smaller outside dimension, unless this exceeds 20% of duct area. Irregular or flat shaped piping requires duct easement. Hangers and stays in ductwork to be parallel to air flow. If easement exceeds 20% of duct area, duct to be split into two ducts with original duct area being maintained. Easements to be approved by Contract Administrator before installation.

.8 If ductwork is not adequately braced and/or supported to provide good installation, additional bracing and/or supports to be provided at no extra cost to City.

.9 Assemble round duct sections using beaded couplings attached with sheet metal screws.

3.3 AIR BALANCING

.1 Shall be done as part of section 15990.

.2 Section 15800 shall provide initial alignment and tension of all fan pulleys and belts supplied by them.

.3 Section 15800 shall work in co-ordination with the Air Balance and Testing Agency to assure the installation of all manual adjusting dampers and pitot tube enclosures are as required to allow proper adjustment of the air system.

.4 Section 15800 shall make any changes in the pulleys and belts, and any additional manual dampers for correct balance as recommended by the Air Balance Agency, at no additional cost to Owner.

3.4 DUCT ACCESS DOORS

.1 Install airtight, 25 mm (1") internal glass fibre insulated access doors in ductwork at all motorized dampers, fire dampers, all heating coils and locations noted on drawings. Where required match wall or ceiling rating.

.2 Locate properly for inspection and servicing. Doors and frame to be rigid, close-fitting, with rubber gaskets, galvanized hinges with brass pins and at least two galvanized cam locks. Rivet frame and hardware to ducts.

3.5 DAMPERS

.1 Manual:

.1 Install in manner acceptable to manufacturer where noted on drawings.

.2 Manual balancing dampers with quadrants and locks shall be installed in all branch ducts to facilitate a complete air balance for all systems including supply air, exhaust air and relief (except where grilles are specified to be supplied with key operated dampers).

.3 Balancing dampers shall generally be installed as far up-stream as possible and shall match the pressure rating of the duct system.

.2 Backdraft:

.1 Backdraft dampers shall be installed in all relief air outlets and exhaust outlets except where motorized dampers are specified. Where relief of exhaust air outlets terminate in a roof hood the dampers shall be installed at the top of the roof hood curb frame.

.2 Backdraft dampers shall be leaf-lite c/w neoprene tip.

3.6 MOTORIZED DAMPERS

.1 When Section 15900 is part of specification supplied by Section 15900 for installation by Section 15800, with exception of those supplied with factory assembled air conditioning units, heating and ventilating units, factory fabricated preheat coil and by-pass units and fan vortex dampers.

.2 Units in acoustically lined ducts are to be sized to suit clear dimensions of acoustic insulation and to suit sheet metal duct. Where units are located in acoustic lined ducting, install heavy gauge metal channel and fasten to metal duct to receive damper frame. Space between channel and duct to be filled with flexible insulation.

.3 On plenums and ducts with external insulation. Section 15900 to provide channel mounting frame of same thickness as insulation. Pack channel frame with loose fibreglass insulation.

3.7 FANS

.1 All fans to be base mounted or hung using spring vibration isolators.

.2 Duct connections to be made using 101 mm (4") neoprene, each side of fan.

.3 Fans mounted outdoors to be weatherproof.

.4 All exhaust fans to be c/w B.D. dampers, and with coating when noted.

.5 Allow for drive change to obtain final air quantity.

PART 4 - SCHEDULES

TABLE 19 - GRILLES DIFFUSERS LOUVER

Mark	Mfr.	Model	Core	Frame	Border	Blade	Fast	Finish	Remarks
D-3	Price	CVD	1 way		T1/T3	L		B12	
L-1	Price	HP609							A

Remarks:
A Extend border. Anodized aluminium. Colour selection approval by City.

TABLE 20 - SUPPLY FANS

Mark	Mfrs.	Model	CFM	S.P.	Motor	RPM	Remarks
WSF-1A, 2A	Greenheck	BDF-80	800	1"	1/3 Hp	1450	

TABLE 21 - AIR FILTERS

Mark	Model	Velocity Fpm	CFM	Size	Efficiency		APD	Serves	Remarks
					30%	85%			
WFIL-1A	Areopleat III	230	800	25"x20"x4"	√		.07"	ESF-1B, 2B	A, B, C

Remarks:
A Manufacturer: FARR.
B Alarm: Filter Status: Summer filter and winter filter. Filter differential pressure exceeds high limit setting (adjustable).
C Same filter used for summer winter arrangement. Note two separate insulated casings are required.

TABLE 22 – SUPPLY FAN CONTROL (THROUGH DDC)

Mark	Status	Start/Stop	Graphics	Filter Alarm	Alarm (Failure) / Time Delay Relay	Sup Air Temp	O/A Temp / Low Limit/Low Limit Over ride	Trending	Modulating Discharge
WSF-1A, 2A	√	√	√	√	√	√	√	√	√

Remarks: Sequence of Operation, To be read in conjunction with Section 15600.

.1 Outdoor adjustable sensor will activate the supply fan to operate. Provide hard wired double inter-lock between both (two supply fans) and associated glycol circ pump.
  .1 Provide soft start/ramp control over all equipment.
  .2 Provide a adjustable minimum time run and off setting (time delay relay) to override the low limit and low limit over ride for cold start.
  .3 Provide low limit, low limit over-ride, modulating discharge control, space over ride sensors (2 averaging) with automatic reset.

.2 Alarm: Supply Fan, Preheat Coil Valve, Motorized Damper, Circ Pump Failure: Commanded on, status is off. Failure: Commanded off, status is on. (HOA). Alarm: (1) High Supply Air Temp: adjustable. (2) Low Supply Air Temp: adjustable. (3) Space low temperature alarm. Filter alarm: Both summer and winter position.

.3 Freeze Protection: Low limit switch. The inter-locked system shall shut down upon receiving a freeze stat status. Motorized damper shall close when the low limit switch is tripped

.4 Heating: Controller shall maintain supply air temperature modulating the preheat coil control valve in sequence with the outlet temperature. Controlling high limit mounted in the supply air shall limit the supply air temperature (adjustable). A low temperature limit in the supply air to shut down the fan system should the temperature drop below 40°F (adjustable).

TABLE 23 – MOTORIZED DAMPER SCHEDULE

Mark	Outside Air Two position	Position	Graphics	Trending	Remarks
WSF-1A, 2A	√	√	√	√	A, B

Remarks
A - End switch to activate damper.
B - Tamco 7000 insulated.

----------END----------