

1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 ASTM C411-82 (1992), Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .2 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S102-M88, Surface Burning Characteristics of Building Materials and Assemblies.
- .3 National Fire Protection Association (NFPA).
 - .1 ANSI/NFPA 90A-1989, Installation of Air Conditioning and Ventilating Systems.
 - .2 ANSI/NFPA 90B-1989, Installation of Warm Air Heating and Air Conditioning Systems.
- .4 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-51.10-92, Mineral Fibre Board Thermal Insulation.
 - .2 CAN/CGSB-51.11-92, Mineral Fibre Thermal Insulation Blanket.
 - .3 CGSB 51-GP-52Ma-89, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 10 01 – General Requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation.

1.3 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.
 - .3 Insulation systems - insulation material, fasteners, jackets, etc.

1.4 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction waste management plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
- .2 Recycled Content.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for "List of Products Requiring Recycled Content".
 - .2 If products within this section are indicated on the "List of Products Requiring Recycled Content", only products with recycled content will be acceptable.
 - .3 For products not identified on list, source products with highest recycled content available when practical.

- .4 Include following information with product data submission.
 - .1 Percentage of pre-consumer and post-consumer recycled content for each product.
- .3 Regional Materials.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for “List of Products Required to be Locally Sourced”.
 - .2 If products within this section are indicated on the “List of Products Required to be Locally Sourced”, include following information with Product Data submission:
 - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.
- .4 Adhesives and Sealants.
 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer’s certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California’s SCAQMD #1168.
- .5 Paints and Coatings.
 - .1 Provide low VOC Products as specified herein and complying with local regulations regarding toxic and hazardous materials.
 - .2 Ensure primers, paints and coatings used onsite and within building envelope meet or exceed requirements of following standards:
 - .1 Interior and Exterior Paints: GS-11
 - .2 Anti-Corrosive Paint: GS-11
 - .3 Clear Wood Finishes and other coating not covered in GS-11: SCAQMD #1113.
 - .3 Submit manufacturer’s certification indicating VOC limits of Products.
- .6 If requesting substitute product, ensure proposed substitution achieves above stated goals.

1.5 MAX. VOC CONTENT FOR SOLVENT CLEANING ACTIVITIES

- .1 Following are some of the Maximum allowed VOC Content for following activities, as per SCAQMD Rule 1171-9 (refer to SCAQMD manual for complete list and updates):
 - .1 Product cleaning during onsite surface preparation for coatings or adhesives application, and repair and maintenance cleaning:
 - .1 General maximum VOC 25g/L.
 - .2 Electrical apparatus components and electronic components.
 - .3 Cleaning of coatings or adhesives application equipment max. VOC 25g/L.
 - .2 Refer to SCAQMD for additional information and clarification and complete list of applications.

- 1.6 Any discrepancies are to be approved by Departmental Representative. Obtain written approval prior to use on site.
- 2 Products
 - 2.1 GENERAL
 - .1 Components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN/ULC-S102.
 - .2 Materials to be tested in accordance with ASTM C411.
 - 2.2 D-1 MINERAL FIBER RIGID WITH VAPOUR BARRIER TO 65°C
 - .1 Application: on cold or dual temperature rectangular ducting.
 - .2 Material:
 - .1 CAN/CGSB 51-10-92, rigid mineral fiber based; CGSB 51-GP-52Ma vapour barrier, jacket and facing material.
 - .2 Acceptable material: Manville Spin-Glas FSK-AP; Manson A.K. Board FSK; Knauf Insulation Board FSK.
 - .3 Thickness:
 - .1 Two 25 mm layers on:
 - .1 Outdoor Air and Exhaust Air Plenums
 - .2 All HRVs :
 - .1 all outdoor air from plenum to HRV
 - .2 all exhaust air from HRV to plenum
 - .3 supply air ductwork to duct reheat coil
 - .3 All exhaust air of exhaust fans from exhaust plenum to first motorized damper
 - .4 Room 163 Outdoor air intake ducts from louvre to motorized damper
 - .2 One 25 mm layer on:
 - .1 Variable Refrigerant Flow (VRF) terminal units supply air ductwork.
 - .2 HRV supply air from duct reheat coil to diffuser.
 - 2.3 D-2 MINERAL FIBER BLANKET WITH VAPOUR BARRIER MINUS 40 TO PLUS 65°C
 - .1 Application: on round or oval ducting, either cold or dual temperature.
 - .2 Material
 - .1 CGSB 51-GP-11M, mineral fiber blanket; CGSB 51-GP-52M for vapour barrier.
 - .2 Standard of Acceptance: Schuller Microlite Duct Wrap FSK; Manson Alley Wrap FSK; Knauf Duct Wrap FSK.
 - .3 Thickness:
 - .1 As per Type D-1.
 - 2.4 FASTENINGS
 - .1 Tape: self adhesive, 100 mm wide, ULC labelled for less than 25 flame spread and less than 50 smoke developed.
 - .1 Acceptable material: Fattal Insultape, Venture Tape.

- .2 Contact adhesive: quick-setting.
 - .1 Acceptable material: Armstrong 520, Childers CP82, Foster 85-20 asbestos free 5 m²/L, Bakor 230-06.
- .3 Pins:
 - .1 Weld pins 4 mm diameter, with 35 mm diameter head for installation through insulation. Length to suit thickness of insulation.
 - .1 Acceptable Material: Duro Dyne, Clip-Pin.
 - .2 Weld pins, 2 mm diameter, for installation prior to applying insulation. Length to suit thickness of insulation. Galvanized retain clips 32 mm square.
 - .1 Acceptable material: Duro Dyne spotter pins with spotter clips or stop clips on 300 mm centres.

2.5 JACKETS

- .1 For indoor exposed ductwork in mechanical rooms and penthouses:
 - .1 FSK Foil scrim vapor barrier
 - .2 Finish all corners with corner bead and cover with foil tape

3 Execution

3.1 APPLICATION

- .1 Apply insulation after required tests have been completed and approved by the Departmental Representative.
- .2 Surfaces shall be clean and dry during application of insulation and finishes.
- .3 Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations and as specified.
- .4 Vapour barriers and insulation to be unbroken over full length of duct or surface, without penetration for hangers, standing duct seams and without interruption at sleeves and supports.
- .5 Use stand-offs for duct mounted control accessories.
- .6 Apply 1.0 mm thick galvanized sheet metal corners (nosings) in traffic areas to ductwork in mechanical rooms and spaces.

3.2 INSTALLATION

- .1 General:
 - .1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.
 - .2 Adhere and seal vapour barrier using vapour seal adhesives.
 - .3 Stagger longitudinal and horizontal joints on multilayered insulation.
- .2 Mechanical fastenings:
 - .1 On rectangular ducts, use 50% coverage of insulating cement and weld pins at not more than 300 mm centres, but not less than 2 rows per side and bottom.

END OF SECTION

2016-Jan-29

1 General

1.1 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 1995.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985.
- .2 Canadian Standards Association (CSA).
 - .1 CSA B228.1-1968, Pipe Ducts and Fittings for Residential Type Air Conditioning Systems.
- .3 American Society for Testing and Materials (ASTM).
 - .1 ASTM A480/A480M-90, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A525M-87, Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process. (Metric).
 - .3 ASTM A621/A621M-82 (1988), Specification for Steel Sheet and Strip, Carbon, Hot-Rolled, Drawing Quality.
- .4 National Fire Protection Association (NFPA).
 - .1 ANSI/NFPA 90A-1989, Installation of Air Conditioning and Ventilating Systems.
 - .2 ANSI/NFPA 90B-1989, Installation of Warm Air Heating and Air Conditioning Systems.
 - .3 ANSI/NFPA 96-1991, Vapour Removal from Cooking Equipment.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 01 10 01 – General Requirements.
- .2 Indicate following:
 - .1 Sealants
 - .2 Tape
 - .3 Proprietary Joints

1.3 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.4 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction waste management plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
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2016-Jan-29

- .3 For products not identified on list, source products with highest recycled content available when practical.
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 - .1 Include following information with Product Data submission for materials specified under this section:
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- .5 Paints and Coatings.
 - .1 Provide low VOC Products as specified herein and complying with local regulations regarding toxic and hazardous materials.
 - .2 Ensure primers, paints and coatings used onsite and within building envelope meet or exceed requirements of following standards:
 - .1 Interior and Exterior Paints: GS-11
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 - .3 Clear Wood Finishes and other coating not covered in GS-11: SCAQMD #1113.
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1.5 MAX. VOC CONTENT FOR SOLVENT CLEANING ACTIVITIES

- .1 Following are some of the Maximum allowed VOC Content for following activities, as per SCAQMD Rule 1171-9 (refer to SCAQMD manual for complete list and updates):
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 - .2 Electrical apparatus components and electronic components.
 - .3 Cleaning of coatings or adhesives application equipment max. VOC 25g/L.
 - .2 Refer to SCAQMD for additional information and clarification and complete list of applications.

1.6 Any discrepancies are to be approved by Departmental Representative. Obtain written approval prior to use on site.

2 Products

2.1 SEAL CLASSIFICATION

Ductwork classification as follows:

Pressure Class (Pa)	Seal Class	Leakage Class		Systems Applicability
		Rectangular	Round	
250	C	24	12	All systems

.1 Seal classification:

.1 Class C: transverse joints and connections made air tight with sealant. Longitudinal seams unsealed.

2.2 SEALANT

.1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C.

.1 Standard of Acceptance: Foster 30-02, Duro Dyne SWB.

2.3 TAPE

.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

.1 Standard of Acceptance: Duro Dyne FT-2.

2.4 DUCT LEAKAGE

.1 New ductwork only in accordance with SMACNA HVAC Duct Leakage Test Manual.

2.5 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

.1 Rectangular: standard radius or short radius with single thickness turning vanes.

.2 Round: smooth radius piece. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 To 400 mm: with single thickness turning vanes.

.2 Over 400 mm: with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45° entry on branch.

.2 Round main and branch: enter main duct at 45°.

.3 Provide balancing dampers as indicated.

- .5 Transitions:
 - .1 Diverging: 20° maximum included angle.
 - .2 Converging: 30° maximum included angle.
- .6 Offsets:
 - .1 Short radiused elbows as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

2.6 FIRESTOPPING

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

2.7 GALVANIZED STEEL

- .1 To ASTM A525M, ASTM A90, ASTM G90 zinc coating.
- .2 Lock forming quality: to ASTM A527.
- .3 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA.
- .4 Joints: to ASHRAE and SMACNA and proprietary manufactured duct joint. Proprietary manufactured flanged duct joint shall be considered to be a class A seal.
 - .1 Standard of Acceptance: Ductmate Canada Ltd., Namasco Ductmate, Exanno Nexus.

2.8 CLOTHES DRYER DUCTWORK

- .1 Secure all joints with clamps and duct tape. Do not use sheet metal screws or other fastening means which extend into duct to attach exhaust joints. Refer to dryer manufacturer's installation manual for correct installation method. Ductwork to be rigid galvanized steel.

2.9 HANGERS AND SUPPORTS

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 510 mm.
- .2 Hanger configuration: to ASHRAE and SMACNA.
- .3 Hangers: black steel angle with black steel rods to the following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .1 Standard of Acceptance: Myatt fig. 485.
 - .2 For steel joist: manufactured joist clamp or steel plate washer.
 - .1 Standard of Acceptance: Grinnell fig. 61 or 86.
 - .3 For steel beams: manufactured beam clamps:
 - .1 Standard of Acceptance: Grinnell fig. 60.

3 Execution

3.1 GENERAL

- .1 Do work in accordance with ASHRAE and SMACNA and as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Support risers in accordance with ASHRAE and SMACNA.
- .4 Install breakaway joints in ductwork on each side of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 of over	2500

3.3 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.4 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Outdoor air intake plenums and Exhaust air plenums.
 - .2 Minimum 3000 mm from duct mounted humidifier in all directions.
 - .3 Exhausts and reliefs from damper to exterior.
- .2 Form bottom of horizontal duct without longitudinal seams. Weld joints of bottom and side sheets. Seal all other joints with duct sealer.

3.5 LEAKAGE TESTS

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual for 312 and 250 Pa pressure class systems only.
- .2 Do leakage tests in sections.
- .3 Make trial leakage tests as instructed to demonstrate workmanship.
- .4 Install no additional ductwork until trial test has been passed.
- .5 Test section minimum of 10 m long with not less than 3 branch takeoffs and two 90° elbows.
- .6 Complete test before insulation or concealment.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Materials and performance criteria for sound attenuation for mechanical systems.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-07, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM C423-08, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .3 ASTM E90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - .4 ASTM E477-06A, Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 National Building Code (NBC)-2005
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.3 SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

.2 Shop Drawings:

- .1 Submit shop drawings in accordance with Division 01 - General Requirements.
- .2 Provide separate shop drawings for each piece of attenuation equipment and system shop drawings complete with product data.

.3 Quality assurance submittals:

- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.4 PERFORMANCE REQUIREMENTS

.1 Rating Data:

- .1 Provide performance rating data, certified by professional engineer or accredited test laboratory and supported by calculations and verified by test results in accordance with referenced standards as follows:
 - .1 Silencer: insertion loss, pressure drop at design conditions, generated noise level.

- .2 Acoustic plenums: transmission loss and acoustical absorption.
- .3 Acoustical performance measurements in accordance with ASTM E477, ASTM E90 and ASTM C423, except where specified otherwise.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction waste management plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
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 - .1 Provide low VOC Products as specified herein and complying with local regulations regarding toxic and hazardous materials.
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 - .2 Refer to SCAQMD for additional information and clarification and complete list of applications.

- 1.8 Any discrepancies are to be approved by Departmental Representative. Obtain written approval prior to use on site.

2 Products

2.1 ABSORPTION AND INSULATING MEDIA

- .1 Acoustic quality, glass fibre, bacteria and fungus resistant; free of corrosion causing or accelerating agents; packed to density to meet performance requirements; and meet NBC fire requirements or requirements of Departmental Representative for duct lining.

2.2 SILENCERS

- .1 Factory manufactured of prime coated or galvanized steel, compatible with ductwork specified elsewhere and to ASHRAE and SMACNA standards.
- .2 Double wall construction with welded outer casing and 26 ga. perforated steel inner to enclose acoustic media. Protect media from erosion with Tedlar or Mylar between media and perforated metal. Factory elbows for each end will be required where silencer is being used for transfer duct.
- .3 Plenum Silencers:
 - .1 PS-1 for rooms requiring STC of 50:
 - .1 Bank width and height to match duct size
 - .2 Silencer dimensions: width as required, maximum height 457 mm, length 3050 mm.
 - .3 Silencer Capacity: As indicated on schedule
 - .4 Silencer Pressure Drop: 50 Pa (0.20 wg).
 - .5 Silencer Dynamic Insertion Loss (dB):

Face Velocity (fpm)	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
500	16	28	37	55	55	55	55	40
-500	21	31	39	55	55	55	55	39

- .6 Standard of Acceptance: EH Price R-STC50.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Noise flanking: where indicated, install in wall sleeve with uniform clearance around to ensure no contact of silencer with wall sleeve. Pack with flexible, non-hardening caulking on both sides of sleeves.
- .2 Instrument test ports: install at inlet and outlet to permit measurement of insertion loss and pressure loss.
- .3 Suspension: to manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

- .1 Testing:
 - .1 Experienced and competent sound and vibration testing professional engineer to take sound measurement after start up and testing, adjusting and balancing of systems to Section 20 05 93 - Testing, Adjusting and Balancing.
 - .2 Sound measurements to extend over frequency range of 63 to 8000 and taken:
 - .1 Upstream and downstream of each silencer.
 - .2 In areas adjacent to mechanical equipment rooms, duct and pipe shafts.
 - .3 At 1800 mm above floor adjacent to first air terminal.
 - .3 Provide Departmental Representative with notice 24 h in advance of commencement of tests.
 - .4 Establish adequacy of equipment isolation, acceptability of noise levels in occupied areas, other conditions affecting acoustics and, where appropriate, recommendation for remedial measures and costs.
 - .5 Submit complete report of test results including sound curves.
- .2 Manufacturer's Field Services:
 - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
 - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
 - .1 After delivery and storage of products.
 - .2 After preparatory work is complete but before installation commences.
 - .3 Twice during the installation, at 50% and 75% completion stages.
 - .4 Upon completion of installation.
 - .3 Submit manufacturer's reports to Departmental Representative within 3 days of manufacturer representative's review.

3.4 ADJUSTING

- .1 Make adjustments and corrections in accordance with written report.
- .2 Provide Departmental Representative with notice 24 h in advance of visit.

3.5 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

2016-Jan-29

1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA).
 - .1 CSA B228.1-1968, Pipes, Ducts and Fittings for Residential Type Air Conditioning.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 10 01 – General Requirements.
- .2 Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.

1.3 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.4 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction waste management plan.
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- .4 Adhesives and Sealants.
 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer's certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California's SCAQMD #1168.
 - .5 Paints and Coatings.
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 - .2 Ensure primers, paints and coatings used onsite and within building envelope meet or exceed requirements of following standards:
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 - .6 If requesting substitute product, ensure proposed substitution achieves above stated goals.
- 1.5 MAX. VOC CONTENT FOR SOLVENT CLEANING ACTIVITIES
 - .1 Following are some of the Maximum allowed VOC Content for following activities, as per SCAQMD Rule 1171-9 (refer to SCAQMD manual for complete list and updates):
 - .1 Product cleaning during onsite surface preparation for coatings or adhesives application, and repair and maintenance cleaning:
 - .1 General maximum VOC 25g/L.
 - .2 Electrical apparatus components and electronic components.
 - .3 Cleaning of coatings or adhesives application equipment max. VOC 25g/L.
 - .2 Refer to SCAQMD for additional information and clarification and complete list of applications.
- 1.6 Any discrepancies are to be approved by Departmental Representative. Obtain written approval prior to use on site.
- 2 Products
 - 2.1 GENERAL
 - .1 Manufacture in accordance with CSA B228.1.
 - 2.2 FLEXIBLE CONNECTIONS
 - .1 Frame: galvanized sheet metal frame 1.6 mm thick with fabric clenched by means of double locked seams.
 - .2 Material:
 - .1 Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at minus 40°C to plus 90°C, density of 1 kg/m².

2016-Jan-29

2.3 ACCESS DOORS IN DUCTS

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene or foam rubber.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: 2 sash locks complete with safety chain.
 - .2 301 to 450 mm: 4 sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum 2 sash locks.
 - .4 Doors over 1000 mm: piano hinge and 2 handles operable from both sides.
 - .5 Hold open devices.
- .5 Standard of Acceptance: Nailer-Hart, Controlled Air, Ruskin.

2.4 TURNING VANES

- .1 Factory or shop fabricated single thickness or double thickness to the recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST PORTS

- .1 Plastic plugs fitted to holes to maintain integrity of duct leakage classification.

2.6 EXHAUST HOOD (EH-1 & EH-2)

- .1 Wall mounted, stainless steel construction with seamless corners and telescopic duct enclosure, two 20 watt halogen lights without blower.
- .2 Size: 900mm wide x 514mm deep
 - .1 Standard of Acceptance: Broan 61000 Series

3 Execution

3.1 INSTALLATION

- .1 Flexible connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to all HRV's and exhaust fans.
 - .2 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA.
 - .5 When fan is running:
 - .1 Ducting on each side of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access doors and viewing panels:
 - .1 Size:
 - .1 600 x 600 mm for person size entry.

2016-Jan-29

- .2 460 x 250 mm for servicing entry.
- .3 300 x 300 mm for viewing.
- .4 As indicated.
- .2 Location:
 - .1 At fire dampers.
 - .2 At control dampers.
 - .3 At devices requiring maintenance.
 - .4 At locations required by code.
 - .5 At reheat coils.
 - .6 At humidifier distributor.
 - .7 Access inside plenums
 - .8 Elsewhere as indicated.
- .3 Instrument test ports.
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 Locations.
 - .1 For traverse readings:
 - .1 At inlets and outlets of other fan systems.
 - .2 At main and sub-main ducts.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by the Departmental Representative.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .3 And as indicated.
- .4 Turning vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.
- .5 Exhaust Hoods:
 - .1 Install in accordance with manufacturer's recommendations.

END OF SECTION

1 General

1.1 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 10 01 – General Requirements.

2 Products

- .1 GENERAL
 - .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

- .1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 250 mm.
- .3 Locking quadrant.
- .4 Inside and outside nylon or bronze end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm.
- .4 Bearings: pin in bronze bushings.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

3 Execution

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 All dampers to be vibration free.

END OF SECTION

2016-Jan-29

1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 ASTM A525M-90, Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 10 01 – General Requirements.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 10 01 – General Requirements.

1.4 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency.

2 Products

2.1 MULTI-LEAF DAMPERS, INSULATED

- .1 Opposed blade type.
- .2 2.0 mm thick, minimum, extruded aluminum frame and interlocking blades. Frame to be 100 mm deep complete with 150 mm maximum width blades and extruded synthetic rubber blade and frame seals secured in integral slots in frame and blades. Hexagon rods shall be stamped into reinforced blades to form single units. Frame shall be insulated with polystyrene foam on 3 sides and each blade shall be thermally broken with a minimum thickness of 22 mm of polyurethane foam sandwiched within the blade extrusion.
- .3 Pressure - fit self lubricated bronze bearings or non-metallic polymer 2 piece bearings.
- .4 Linkage hardware shall be constructed of aluminum, brass or corrosion resistant zinc-plated steel complete with tie-rods, pivots, brackets and control rod, all mounted out of airstream.
- .5 Operator: by controls Contractor.
- .6 Performance: leakage in closed position to be less than 1% of rated airflow at 2.48 kPa differential across damper. Pressure drop at full open position to be less than 25 Pa differential at maximum air flow.
- .7 Dampers shall be designed and constructed for an operating temperature range of -40°C to 70°C.
- .8 Type: Dampers shall be flanged type to suit ductwork dimensions.
- .9 Locations:
- .10 All fresh air runs to each piece of air handling equipment
- .11 All exhaust from each piece of air handling equipment

2016-Jan-29

- .12 Acceptable Material: T.A. Morrison Tamco 9000 Series, DOWCO, Ruskin CD2000, Ruskin CD2000.

2.2 MULTI-LEAF DAMPERS, UNINSULATED

- .1 Opposed blade type.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Operator: by controls supplier.
- .6 Performance:
 - .1 Leakage: in closed position to be less than 2% of rated air flow at 125 Pa differential across damper.
 - .2 Pressure drop: at full open position to be less than 25 Pa differential across damper at maximum air flow.
- .7 Type: Dampers shall be flanged type to suit full cross sectional area of ductwork.
- .8 Locations:
 - .1 AHU mixed air dampers.
 - .2 As indicated on all mechanical drawings
- .9 Standard of Acceptance: AutoDamp, Honeywell, T.A. Morrison, Ruskin CD50.

3 Execution

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

END OF SECTION

2016-Jan-29

1 General

1.1 REFERENCES

- .1 National Fire Protection Association (NFPA).
 - .1 ANSI/NFPA 90A-1989, Installation of Air Conditioning and Ventilating Systems.
- .2 Canadian Standards Association (CSA).
 - .1 CAN4-S112-M82 (R1987), Fire Test of Fire Damper Assemblies.
 - .2 CAN4-S112.2-M84, Fire Test of Ceiling Firestop Flap Assemblies.
- .3 Underwriters Laboratories of Canada (ULC).
 - .1 ULC-S505-1974, Fusible Links for Fire Protection Service.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 10 01 – General Requirements.
- .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Operators.
 - .3 Fusible links.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 10 01 – General Requirements.

1.4 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 10 01 – General Requirements.
- .2 Provide following:
 - .1 Six (6) fusible links of each type.

1.5 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

2 Products

2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement Type B or C, listed and bear label of ULC and ANSI/NFPA 90A. Fire damper assemblies to be fire tested in accordance with CAN4-S112.
- .2 Factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
 - .1 Construction;
 - .1 Galvanized ductwork – Mild steel
 - .2 Stainless steel ductwork – Stainless steel (same grade)

2016-Jan-29

- .3 Top hinged: Interlocking blade type; sized to maintain full duct cross section.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Acceptable material: Controlled Air, Maxam, Nailor, E.H. Price, Ruskin.

3 Execution

3.1 INSTALLATION

- .1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from Departmental Representative.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Coordinate with installer of fire stopping.

END OF SECTION

2016-Jan-29

1 General

1.1 REFERENCES

- .1 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S110-M86, Fire Tests for Air Ducts.
- .2 Underwriters Laboratories (UL).
 - .1 UL 181-1981, Factory Made Air Ducts and Connectors.
- .3 National Fire Protection Association (NFPA).
 - .1 ANSI/NFPA 90A-1989, Installation of Air Conditioning and Ventilating Systems.
 - .2 ANSI/NFPA 90B-1989, Installation of Warm Air Heating and Air Conditioning Systems.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 1985.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 10 01 – General Requirements.
- .2 Indicate the following:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.

1.3 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.4 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction waste management plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
- .2 Recycled Content.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for "List of Products Requiring Recycled Content".
 - .2 If products within this section are indicated on the "List of Products Requiring Recycled Content", only products with recycled content will be acceptable.
 - .3 For products not identified on list, source products with highest recycled content available when practical.
 - .4 Include following information with product data submission.
 - .1 Percentage of pre-consumer and post-consumer recycled content for each product.

2016-Jan-29

- .3 Regional Materials.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for “List of Products Required to be Locally Sourced”.
 - .2 If products within this section are indicated on the “List of Products Required to be Locally Sourced”, include following information with Product Data submission:
 - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.
 - .4 Adhesives and Sealants.
 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer’s certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California’s SCAQMD #1168.
 - .5 Paints and Coatings.
 - .1 Provide low VOC Products as specified herein and complying with local regulations regarding toxic and hazardous materials.
 - .2 Ensure primers, paints and coatings used onsite and within building envelope meet or exceed requirements of following standards:
 - .1 Interior and Exterior Paints: GS-11
 - .2 Anti-Corrosive Paint: GS-11
 - .3 Clear Wood Finishes and other coating not covered in GS-11: SCAQMD #1113.
 - .3 Submit manufacturer’s certification indicating VOC limits of Products.
 - .6 If requesting substitute product, ensure proposed substitution achieves above stated goals.
- 1.5 MAX. VOC CONTENT FOR SOLVENT CLEANING ACTIVITIES
- .1 Following are some of the Maximum allowed VOC Content for following activities, as per SCAQMD Rule 1171-9 (refer to SCAQMD manual for complete list and updates):
 - .1 Product cleaning during onsite surface preparation for coatings or adhesives application, and repair and maintenance cleaning:
 - .1 General maximum VOC 25g/L.
 - .2 Electrical apparatus components and electronic components.
 - .3 Cleaning of coatings or adhesives application equipment max. VOC 25g/L.
 - .2 Refer to SCAQMD for additional information and clarification and complete list of applications.
- 1.6 Any discrepancies are to be approved by Departmental Representative. Obtain written approval prior to use on site.
- 2 Products
- 2.1 GENERAL
- .1 Factory fabricated to CAN/ULC S110.

2016-Jan-29

- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 NON-METALLIC - INSULATED

- .1 Type 1: Non-collapsible, coated mineral base fabric type, and helically supported by steel wire and wrapped with fiberglass insulation blanket c/w fiberglass reinforced vapour barrier.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.
 - .3 Work pressure: 500 Pa negative to 500 Pa positive.
- .3 Acceptable material: Thermaflex M-KE, Flexmaster, Imperial Sheet Metal.

2.3 NON-METALLIC - UNINSULATED

- .1 Type 1: Non-collapsible, coated mineral base fabric type, and helically supported by steel wire.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.
 - .3 Work pressure: 500 Pa negative to 500 Pa positive.
- .3 Acceptable material: Thermaflex S-LP-10, Flexmaster, Imperial Sheet Metal.

3 Execution

3.1 DUCT INSTALLATION

- .1 Support in accordance with: SMACNA.
- .2 Maximum length of flexible duct: 1.5 m.
- .3 Install for final connection to diffusers, and in accordance with referenced standards.

END OF SECTION

2016-Jan-29

1 General

1.1 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.
- .2 American Society for Testing and Materials (ASTM).
 - .1 ASTM C177-85, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .3 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S102-M88, Surface Burning Characteristics of Building Materials and Assemblies.
- .4 Canadian General Standards Board (CGSB).
 - .1 CGSB 51-GP-10M-76, Thermal Insulation, Mineral Fibre, Block or Board, for Ducting, Machinery and Boilers.
 - .2 CGSB 51-GP-11M-76, Thermal Insulation, Mineral Fibre, Blanket, for Piping, Ducting, Machinery and Boilers.
- .5 National Fire Protection Association (NFPA).
 - .1 ANSI/NFPA 90A-1989, Installation of Air Conditioning and Ventilating Systems.
 - .2 ANSI/NFPA 90B-1989, Installation of Warm Air Heating and Air Conditioning Systems.
- .6 Thermal Insulation Association of Canada (TIAC).
 - .1 TIAC, Thermal Insulation Association of Canada, National Insulation Standards.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 10 01 – General Requirements.

1.3 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction waste management plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
- .2 Recycled Content.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for "List of Products Requiring Recycled Content".
 - .2 If products within this section are indicated on the "List of Products Requiring Recycled Content", only products with recycled content will be acceptable.
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 - .4 Include following information with product data submission.
 - .1 Percentage of pre-consumer and post-consumer recycled content for each product.

2016-Jan-29

- .3 Regional Materials.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for “List of Products Required to be Locally Sourced”.
 - .2 If products within this section are indicated on the “List of Products Required to be Locally Sourced”, include following information with Product Data submission:
 - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.
 - .4 Adhesives and Sealants.
 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer’s certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California’s SCAQMD #1168.
 - .5 Paints and Coatings.
 - .1 Provide low VOC Products as specified herein and complying with local regulations regarding toxic and hazardous materials.
 - .2 Ensure primers, paints and coatings used onsite and within building envelope meet or exceed requirements of following standards:
 - .1 Interior and Exterior Paints: GS-11
 - .2 Anti-Corrosive Paint: GS-11
 - .3 Clear Wood Finishes and other coating not covered in GS-11: SCAQMD #1113.
 - .3 Submit manufacturer’s certification indicating VOC limits of Products.
 - .6 If requesting substitute product, ensure proposed substitution achieves above stated goals.
- 1.4 MAX. VOC CONTENT FOR SOLVENT CLEANING ACTIVITIES
- .1 Following are some of the Maximum allowed VOC Content for following activities, as per SCAQMD Rule 1171-9 (refer to SCAQMD manual for complete list and updates):
 - .1 Product cleaning during onsite surface preparation for coatings or adhesives application, and repair and maintenance cleaning:
 - .1 General maximum VOC 25g/L.
 - .2 Electrical apparatus components and electronic components.
 - .3 Cleaning of coatings or adhesives application equipment max. VOC 25g/L.
 - .2 Refer to SCAQMD for additional information and clarification and complete list of applications.
- 1.5 Any discrepancies are to be approved by Departmental Representative. Obtain written approval prior to use on site.
- 2 Products
- 2.1 DUCT LINER
- .1 General:
 - .1 Closed cell, flexible elastometric roll insulation duct liner.

2016-Jan-29

- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.
- .3 Non-porous, non-fibrous, and mold resistant; adhesive one side.
- .2 Flexible:
 - .1 Use on flat, round, or oval surfaces and surfaces indicated.
 - .2 25 mm thick, to CGSB-51-GP-11M, closed cell roll insulation.
 - .3 Density: 48 kg/m³ minimum.
 - .4 Thermal resistance to be minimum 0.036 W/mK for 25 mm thickness when tested in accordance with ASTM C177, at 24°C mean temperature.
- .3 Standard of Acceptance: Armacell, K-Flex, Sound Vac.

2.2 ADHESIVE

- .1 Meet requirements of ANSI/NFPA 90A and ANSI/NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29°C to plus 93°C.
- .3 Standard of Acceptance: Armaflex 520.

2.3 FASTENERS

- .1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm square.
 - .1 Standard of Acceptance: Duro Dyne PN Series with NC or PC-1 Series clips.
- .2 Drive pins, length and diameter to suit thickness of insulation with pre-attached caps.
 - .1 Standard of Acceptance: Gripnail.

2.4 SEALER

- .1 Meet requirements of ANSI/NFPA 90A and ANSI/NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68°C to plus 93°C.
- .3 Standard of Acceptance: Duro Dyne S-2; Foster 30-35.

3 Execution

3.1 GENERAL

- .1 Do work in accordance with recommendations of SMACNA duct liner standards as indicated in SMACNA HVAC Duct Construction Standards, Metal and Flexible, except as specified otherwise.
- .2 Line the inside of the following locations:
 - .1 HRV Supply and Return air ductwork inside Mechanical rooms and Penthouses
 - .2 Return and exhaust grille plenum boxes.
 - .3 Cross talk air transfer ducts
 - .4 Where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.

3.2 DUCT LINER

- .1 Install in accordance with manufacturer's recommendations, and as follows:
 - .1 Fasten to interior sheet metal surface with 100% coverage of adhesive.
 - .2 In addition to adhesive, install weld or drive pins not less than 2 rows per surface and not more than 425 mm on centres.

3.3 JOINTS

- .1 Seal all butt joints, exposed edges, weld pin and clip penetrations and all damaged areas of liner with adhesive. Install in accordance with manufacturer's recommendations.
- .2 Replace badly damaged areas of liner at discretion of the Departmental Representative.
- .3 Protect leading and trailing edges of each duct section with sheet metal nosing having 15 mm overlap and fastened to duct.

END OF SECTION

1 General

1.1 REFERENCES

- .1 Air Movement and Control Association International, Inc. (AMCA).
 - .1 AMCA 99-1986, Standards Handbook.
 - .2 ANSI/AMCA 210-1985, Laboratory Methods of Testing Fans for Rating.
 - .3 AMCA 300-1985 Revised 1987, Reverberant Room Method for Sound Testing of Fans.
 - .4 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 ANSI/ASHRAE 51-1985, Laboratory Methods of Testing Fans for Rating.
- .3 Canadian General Standards Board (CGSB).
 - .1 CGSB 1-GP-181M-77, Coating, Zinc Rich, Organic, Ready Mixed.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 - General Requirements.
- .2 Provide fan curves and sound rating data, showing point of operation, electrical data, dimensions, construction and accessories.

1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 10 01 - General Requirements.

1.4 MANUFACTURED ITEMS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.
- .2 Provide confirmation of testing.

2 Products

2.1 FANS GENERAL

- .1 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .2 Sound ratings: comply with AMCA (Air Moving and Conditioning Association) 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.
- .3 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit shall bear AMCA certified rating seal.
- .4 Factory primed before assembly in colour standard to manufacturer.
- .5 Vibration isolation: spring-type base and hanging isolators c/w mounting brackets.
- .6 Flexible connections: to Section 23 33 00 - Duct Accessories.

2016-Jan-29

2.2 IN-LINE CENTRIFUGAL FANS (EF-1, EF-2 & EF-4)

- .1 Fan wheels:
 - .1 Welded aluminum construction
 - .2 Maximum operating speed of centrifugal fans not more than 25% of first critical speed.
 - .3 Air foil and backward incline blade, as required
- .2 Bearings; heavy duty, split pillow-block grease lubricated ball or roller self-aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 200,000 hours.
- .3 Housings:
 - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel or aluminum for smaller wheels braced, and with welded supports.
 - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
 - .3 Provide bolted airtight access doors with handles.
 - .4 Belt guards to be three sided fabricated steel covering both motor and drive.
- .4 Performance:
 - .1 As indicated on drawings.

2.3 IN-LINE CENTRIFUGAL FANS (EF-3)

- .1 Fan wheels:
 - .1 High impact polypropylene construction
 - .2 Backward incline blade
- .2 Motor:
 - .1 Permanently sealed with self-lubricating bearings.
 - .2 Capable of operating in air stream temperatures up to 60°C.
- .3 Bearings; self lubricating type and .
- .4 Housings:
 - .1 Constructed of heavy gauge galvanized sheet steel
 - .2 Supplied with an externally mounted electrical terminal box with prewired strip connections.
- .5 Performance:
 - .1 As indicated on drawings.

3 Execution

3.1 FAN INSTALLATION

- .1 Install fans as indicated, complete with vibration isolators, flexible electrical leads and flexible connections.
- .2 Provide sheaves and belts required for final air balancing.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

END OF SECTION

1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.
- .2 Indicate the following:
 - .1 Capacity
 - .2 Throws
 - .3 NC level
 - .4 Material and Finish
 - .5 Static Pressure Loss
 - .6 Connection Size

1.2 SAMPLES

- .1 Submit samples in accordance with Section 01 10 01 – General Requirements.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 10 01 – General Requirements.

1.4 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 10 01 – General Requirements.
- .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.
 - .3 Provide qty 2 spanner tools for each type of tamper proof screw used.

1.5 MANUFACTURED ITEMS

- .1 Grilles, registers and diffusers shall be product of one manufacturer for generic type, i.e., grilles and registers by one, diffusers by one, or same.

1.6 CERTIFICATION OF RATINGS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

2 Products

2.1 GENERAL

- .1 Provide standard product to meet capacity, noise level and neck size as indicated. NC = 35 max., S.P. drop = 25 Pa max.
- .2 Where grilles and registers penetrate fire walls and fire partitions, provide approved steel sleeve secured to structure in accordance with NFPA 90A-2009.

- .3 Frames:
 - .1 Steel: standard with exposed welded joints and mitered corners.
 - .2 Aluminum: 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.
- .4 Sizes and capacities: as indicated.

2.2 SUPPLY DIFFUSER TYPE S

- .1 S-1, 610mm x 610mm Steel, square, non-adjustable cone type, complete with mounting frame as required. Off-white baked enamel finish. Face and neck sizes as indicated on drawings. (Note Room 180 to have a non-reflective finish)
 - .1 Standard of acceptance: E.H. Price SCD, Titus, Airvector, Nailor.
- .2 S-2, 305mm x 305mm Steel, square, non-adjustable cone type, complete with mounting frame as required. Off-white baked enamel finish. Face and neck sizes as indicated on drawings.
 - .1 Standard of acceptance: E.H. Price SCD, Titus, Airvector, Nailor.
- .3 S-3, Size as indicated on drawings, 14 ga steel, square, lattice face with mounting frame to suit ceiling or wall type. Off-white baked enamel finish.
 - .1 Standard of acceptance: E.H. Price MSL, Titus, Airvector, Nailor.
- .4 S-4, Size as indicated on drawings, duct barrier grille, 12mm diameter hot rolled steel bars welded to a 5mm sleeve. Supply complete with two each 64 x 64 x 6 angle frames to be welded to sleeve at each side of the wall or ceiling. For double wall plenums size sleeve to slide over outside of stc rated acoustical air plenums and stich weld to plenum.
 - .1 Standard of acceptance: E.H. Price MSBG, Titus, Airvector, Nailor.
- .5 S-5, Square, steel, 19mm blade spacing with 32mm border, blade oriented with long dimension or when grille is vertical, blades to be horizontal, white powder coat finish. Size as indicated on drawings.
 - .1 Standard of Acceptance: E.H. Price 530, Titus, Nailor
- .6 S-6, 305 mm wide x 2591 mm long, Extruded aluminum surface mount border and frame construction c/w adjustable internal air flow pattern and flow control slot diffuser and acoustically lined boot. Blank off sections as required to meet 61.9 l/s per meter based on the air flows shown on the drawings. Factory primed, to be ready for paint.
 - .1 Standard of Acceptance: E.H. Price SDS50 / SDAI, Titus, Nailor

2.3 RETURN GRILLE TYPE R

- .1 R-1, Square, aluminum, mounting frame to suit ceiling type, 12mm x 12mm x 12mm egg crate type. Sizes as indicated on drawings.
 - .1 Standard of Acceptance: E.H. Price, Titus, Nailor.
- .2 R-2, Square, steel, 19mm blade spacing with 32mm border, blade oriented with long dimension, white powder coat finish. Size as indicated on drawings.
 - .1 Standard of Acceptance: E.H. Price 535, Titus, Nailor

- .3 R-3, Size as indicated on drawings, 14 ga steel, square, lattice face with mounting frame to suit ceiling or wall type. Off-white baked enamel finish.
 - .1 Standard of acceptance: E.H. Price MSL, Titus, Airvector, Nailor.
- .4 R-4, Size as indicated on drawings, duct barrier grille, 12mm diameter hot rolled steel bars welded to a 5mm thick sleeve. Supply complete with two each 64 x 64 x 6 angle frames to be welded to sleeve at each side of the wall or ceiling. For double wall plenums size sleeve to slide over outside of STC rated acoustical air plenums and stitch weld to plenum.
 - .1 Standard of acceptance: E.H. Price MSBG, Titus, Airvector, Nailor.
- .5 R-5, 152mm x 152mm x 5mm thick hot rolled steel perforated with 8mm diameter holes staggered 60° on 11mm centres complete with 4-sided mounting frame and front operated opposed blade dampers.
 - .1 Standard of Acceptance: E.H. Price MSPG-3BF-MF4

2.4 EXHAUST GRILLE TYPE E

- .1 E-1, Size as indicated on drawings, 14 ga steel, square, lattice face with mounting frame to suit ceiling or wall type. Off-white baked enamel finish.
 - .1 Standard of acceptance: E.H. Price MSL, Titus, Airvector, Nailor.
- .2 E-2, Square, steel, 19mm blade spacing with 32mm border, blade oriented with long dimension, white powder coat finish. Size as indicated on drawings.
 - .1 Standard of Acceptance: E.H. Price 530, Titus, Nailor

2.5 FIRE DAMPER WITH DUCT BARRIER

- .1 When S-4 or R-4 are combined with a fire damper the complete unit shall be listed and bear label of ULC and ANSI/NFPA 90A. Galvanized steel and curtain type blades, fusible link actuated, weighted to close and locked in closed position when released. 10 gauge sleeve through wall, 13 mm round bar security bars welded into sleeve at maximum 150 mm centers vertically and horizontally. 65 mm x 65 mm x 6 mm angle welded to sleeve perimeter on outside of wall. Shipped loose for welding on site.
- .2 Size: free area of fire damper to match free area of ductwork. Transition as required.
 - .1 Standard of Acceptance: E.H. Price FD-150 Type A with security bars.

2.6 CELL SECURITY TYPE SUPPLY/RETURN/EXHAUST VENTILATING GRILLE

- .1 Steel construction white power coat finish security grille. 3 mm plenum section secured in place with minimum 3 x 50 x 50 steel angle both sides of ceiling penetration. Face plate 3.2 mm thick steel perforated with 3.2 mm staggered holes. 75mm x 6 mm face frame welded to face plate and secured with 8 mm dia flathead steel tamper resistant spanner screws. Use Chubb, S&C or approved equivalent screws. Supply with qty 2 spanner tools. All grilles must be stamped with manufacturer and model # on faceplate.

- .2 Size: As indicated on drawings.
Approved grilles (No Substitutions): Simpson Installations Ltd Model V-2 (Phone 902-664-6266), Chubb OP-20V((www.gunnebo.com), Eneround security type ventilating grille (Phone 709-754-9100), Virtucom SCO security(www.vitucom-inc.com).

3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install with flat head oval head SS cadmium plated screws in countersunk holes where fastenings are visible. Use tamper proof screws where indicated.
- .3 Use high yield grout to fill any space between the back of the face plate when installing cell security type grilles.

3.2 COMMISSIONING

- .1 Field adjust air pattern controllers in diffusers to suit comfort conditions and throw requirements.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM).
 - .1 ASTM B221-08, Specification for Aluminum and Aluminum-Alloy Bars, Rods, Wire, Profiles and Tubes.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 01 - General Requirements.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate fabrication and erection details, including anchorage, accessories, and finishes.
 - .2 Provide listing indicating louvre number with cross-reference to location.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 10 01 - General Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to the site in undamaged condition.
- .2 Storage and Protection:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Protect louvres from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 Products

2.1 MATERIALS

- .1 Wall louvers: complete with AMCA certified ratings program seal for air performance and water penetration.
- .2 Aluminum extrusions: to ASTM B221 alloy 6063-T5.
- .3 Fasteners: same material as fabricated items.
- .4 Steel angle: 25 mm x 25 mm steel angle; for securing air/vapour retarder to frame.

2.2 AIR / VAPOUR RETARDER INTERFACE SHEET

- .1 Provide strip of air / vapour retarder material for tying wall louvre frames into wall air / vapour retarder as follows:
 - .1 Material: identical to, or compatible with, building air barrier and vapour retarder materials to provide required air tightness and vapour diffusion control throughout exterior envelope assembly.
 - .2 Material width: adequate to provide required air tightness and vapour diffusion control to building air / vapour retarder from interior.

2.3 WALL LOUVRE

- .1 Louvres: aluminum, drainable stationary blade louvres; 150 mm deep.
- .2 Frames: minimum 2.0 mm thick, fabricated from one-piece structural aluminum members with integral caulking slot and retaining beads.
- .3 Blades: minimum 2.0 mm thick, one-piece aluminum extrusions with front lip gutter and multiple secondary gutters designed to catch and direct water to sill.
- .4 Performance:
 - .1 Size as indicated on the drawings
 - .2 Percent Free Area: 55.9%.
 - .3 Free area velocity at beginning point of water penetration: 375 m/min.
 - .4 Air Volume delivered at beginning point of water penetration: 313 m³/min.
 - .5 Pressure drop at beginning point of water penetration: 57 Pa.
- .5 Accessories:
 - .1 Security Bars:
 - .1 Security bars oriented both vertical and horizontal
 - .2 Bars: minimum 10 mm corrosion resistant steel at 150 mm centres
 - .3 Frame: 4.8 mm thick welded construction with plug weld bar ends
 - .2 Bird screen:
 - .1 Mesh: 15.9 mm square mesh, 1.27mm diameter thick expanded and flattened aluminum bird screen.
 - .2 Frame: secure mesh within 1.40 mm thick extruded aluminum frames. Frames to have mitered corners and corner locks.
 - .3 Finish: to match louvre.
 - .3 Sill flashing: 102 mm high by full depth sill; form from minimum 1.27 mm thick aluminum. Sill flashings to have welded side panels.
- .6 Finish: anodic oxide treatment to obtain an Aluminum Association, Architectural Class 1, AA-M10C22A41, clear anodized coating of 0.7 mm thickness. Colour by Departmental Representative.
- .7 Standard of Acceptance: Airolite K6776X, Price DE635, Ventex 2630

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.2 INSTALLATION

- .1 Install louvres where indicated.
- .2 Attach bird screen to inside face of wall louvre.
- .3 Repair damage to louvres to match original finish.
- .4 Install wall louvers from interior using anchors as appropriate for wall construction and in accordance with manufacturer's recommendations.
- .5 Air/vapour retarder to frame connection.
 - .1 Wall louvre frames require connection to air/vapour retarder to maintain continuity of air/vapour retarder assembly. Connection may be achieved by either of the following methods:
 - .1 Install interface sheet between frame and steel angle. Seal interface sheet to air/vapour retarder membrane or transition sheet as applicable.
 - .2 If installation of air/vapour retarder or transition membrane permits, extend air/vapour retarder or transition membrane between frame and steel angle.

3.3 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 PROTECTION

- .1 Where aluminum contacts metal other than zinc, paint dissimilar metal with primer and two coats of aluminum paint.
- .2 Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 ASHRAE 52-76, "Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter".
- .2 Underwriters Laboratories of Canada (ULC).
 - .1 ULC C710-1980, "Grease Extractors for Exhaust Ducts".
- .3 Canadian Standards Association (CSA).
 - .1 CAN4-S111-M80, "Fire Tests for Air Filter Units".
- .4 National Fire Protection Association (NFPA).
 - .1 ANSI/NFPA 96-1991, Vapour Removal from Cooking Equipment.
- .5 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-115.10-M90, Disposable Air Filters for Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.11-M85, Filters, Air, High Efficiency, Disposable, Bag Type (Reaffirmed April 1985).
 - .3 CAN/CGSB-115.12-M85, Filters, Air, Medium Efficiency, Disposable, Bag Type (Reaffirmed April 1985)
 - .4 CAN/CGSB-115.13-85, Filter Media, Automatic Roll (Reaffirmed April 1985)
 - .5 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for Removal of Particulate Matter from Ventilating Systems
 - .6 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems
 - .7 CAN/CGSB-115.16-M82, Activated Carbon for Odor Removal from Ventilating Systems
 - .8 CAN/CGSB-115.18-M85, Filter, Air Extended Area Panel Type, Medium Efficiency

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawing and product data in accordance with Section 01 10 01 – General Requirements.
- .2 Indicate the following: Construction material, ASHRAE efficiency rating, initial and final static pressure drop, dimensions and housings.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 10 01 – General Requirements.

1.4 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 10 01 – General Requirements.

- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.

1.5 CERTIFICATION OF RATINGS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards.

2 Products

2.1 GENERAL

- .1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 50°C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.
- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated.

2.2 PLEATED PANEL FILTERS

- .1 Disposal filter cartridges with cardboard frame and integral support retainers.
- .2 Media: cotton and synthetic fibres supported by metal pleat grid bonded to the air leaving side of the media.
- .3 Overall dimensions: 50 mm deep with dimensions as required in filter housings.
- .4 Average dust spot efficiency: 25-30%.
 - .1 Rated resistance at 2.54 m/s.
 - .2 Initial: 75 Pa.
 - .3 Final: 250 Pa.
- .5 Locations: Fresh and exhaust air streams in all HRV's
- .6 Acceptable Material: AAF AM-Air, Cambridge Aeropleat, Farr 30/30.

3 Execution

3.1 INSTALLATION GENERAL

- .1 Install in accordance with manufacturers recommendations and with adequate space for access, maintenance and replacement.

3.2 REPLACEMENT MEDIA

- .1 Replace all media with new upon acceptance and supply one full set of new media to Departmental Representative.
- .2 Filter media to be new and clean, as indicated by differential pressure sensor, at time of acceptance.

END OF SECTION

2016-Jan-29

1 General

1.1 References

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.2 No.46-M1998 (R2001), Electric Air-Heaters.

1.2 Submittals

- .1 Make submittals in accordance with Section 01 10 01 – General Requirements.
- .2 Submit product data and include:
 - .1 Element support details.
 - .2 Heater: total kW rating, voltage, phase.
 - .3 Number of stages.
 - .4 Rating of stage: rating, voltage, phase.
 - .5 Heater element watt/density and maximum sheath temperature.
 - .6 Maximum discharge temperature.
 - .7 Physical size.
 - .8 Unit support.
 - .9 Performance limitations.
 - .10 Clearance from combustible materials.
 - .11 Internal components wiring diagrams.
 - .12 Minimum operating airflow.
 - .13 Pressure drop operating airflow.

2 Products

2.1 Duct Heaters

- .1 Duct heaters: flange type.
- .2 Elements:
 - .1 Helical coils of nickel chrome alloy resistance wire.
- .3 Controls:
 - .1 Factory mounted and wired in control box. Use terminal blocks for power and control wiring to thermostat and sail switch.
 - .2 Controls mounted in a CSA enclosure and to include:
 - .1 Magnetic contactors.
 - .2 Control transformers.
 - .3 Duct heater shall be controlled via SCR. SCR by Division 25. Enclosure shall include space for SCR to be mounted. Duct heater shall be capable of fully modulating and include all necessary wiring to connect SCR.
 - .3 Where controls are mounted in heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.
 - .4 High temperature cutout and air proving switch.
- .4 Performance: See drawings for details.
- .5 Main isolation disconnect switch.
- .6 Standard of Acceptance: Thermolec, Nailor.

3 Execution

3.1 Installation

- .1 Make power and control connections to CSA C22.2 No.46.
- .2 Install in accordance with manufacturer's recommendations.

3.2 COMMISSIONING

- .1 After start-up, test, adjust and prove operation of all equipment and accessories to suit site conditions and 01 91 13 General Commissioning Requirements.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 ASHRAE 84-78, Method of Testing Air-to-Air Heat Exchangers.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.

1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 10 01 – General Requirements

2 Products

2.1 GENERAL

- .1 Comply with ASHRAE 84.
- .2 Units to come with factory installed starters and disconnects to allow for single point wiring connection. Provide two sets of auxiliary contacts in each starter for ties to the DDC and fire alarm systems. Upon call from the fire alarm signal, all exhaust fans to remain in operation and all supply fans to shut down. Manual override from fire alarm panel will allow fire fighters to start or stop each fan as required. Starters to meet all requirements in accordance with Section 26 29 10 - Motor Starters to 600V. This includes, but is not limited to, HOA switches, indicating lights, relays, transformers and auxiliary contacts.

2.2 AIR TO AIR HEAT RECOVERY VENTILATOR

- .1 Indoor direct drive fan unit with an enthalpy type heat recovery core. Supply fan and exhaust fan. Overall dimensions:
 - .1 HRV-1: 1537 mm long x 1054 mm wide x 921 mm high
 - .2 HRV-2: 1146 mm long x 876 mm wide x 1362 mm high
 - .3 HRV-3: 1762 mm long x 1581 mm wide x 1022 mm high
 - .4 HRV-4: 1121 mm long x 403 mm wide x 924 mm high
 - .5 HRV-5: 1121 mm long x 403 mm wide x 924 mm high
 - .6 HRV-6: 1537 mm long x 1054 mm wide x 921 mm high
- .2 Air Filter: to be equipped with factory supplied reticulated washable foam filters and disposable 30% medium efficiency filters.
- .3 Cabinet: 20 gauge painted steel frame. Removable access panels with locking door handles 25 mm thick neoprene coated 24.1 kg/m³ density glass fiber interior insulation on all surfaces.
- .4 Condensate drain: at base of drain pans on bottom of unit as required.
- .5 Electrical: As Indicated on drawings
- .6 Performance and Standard of Acceptance schedule: As indicated on drawings

3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of adjacent ductwork with flexible connections.
- .3 Manufacturer's representative to inspect HRV installations, start-up units and provide a written report of the results to the Departmental Representative.
- .4 Pipe drain pan to nearest floor drain.

3.2 COMMISSIONING

- .1 After start-up, test, adjust and prove operation of all equipment and accessories to suit site conditions and 01 91 13 General Commissioning Requirements.

END OF SECTION

1 General

1.1 REFERENCES

- .1 Air Conditioning and Refrigeration Institutes (ARI):
 - .1 ARI 270, Standard for Sound Rating of Outdoor Unitary Equipment.
- .2 American National Standards Institute (ANSI):
 - .1 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilation Systems.
 - .2 ANSI/UL 465, Central Cooling Air Conditioners.
 - .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24, Cast Copper Pipe Flanges and Flanged Fittings.
 - .5 ANSI/ARI 210/240, Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - .6 ANSI/ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .7 ANSI/ASME B31.5, Refrigeration Piping.
- .3 American Society for Testing and Materials (ASTM):
 - .1 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - .2 ASTM B280, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .4 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
 - .1 ASHRAE 52, Method of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- .5 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-51.40, Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
 - .2 CAN/CGSB-115.10, Disposable Air Filters For Removal of Particulate Matter from Ventilating Systems.
 - .3 CAN/CGSB-115.15, High Efficiency, Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
- .6 Canadian Standards Association International (CSA):
 - .1 CSA B52, Mechanical Refrigeration Code.
 - .2 CAN/CSA-C656, Performance Standard for Single Package Central Air-Conditioners and Heat Pumps.
 - .3 CSA C22.1, Canadian Electrical Code, Part 1.
 - .4 CSA C746, Performance Standard for Rating Large Air Conditioners and Heat Pumps.
 - .5 CSA C273.3-M91, Performance Standard for Split System Central Air Conditioners and Heat Pumps.
 - .6 CSA C656-M92, Performance Standard for Single Package Central Air Conditioners and Heat Pumps.
- .7 EPS 1/RA/1, Code of Practice for the Reduction of Chlorofluorocarbons Emissions from Refrigeration and Air Conditioning Systems, Canadian Environmental Protection Act Code of Practice.

1.2 QUALIFICATIONS

- .1 Refrigerant piping systems shall be installed by certified refrigeration mechanic experienced in the installation of refrigerant piping systems for split air conditioning systems and must hold an environmental awareness certificate that is recognized by a minimum of three provinces or province in which the work is being completed. Refer to Federal Halocarbon 2003. These systems must be installed, maintained and disposed of in accordance with the Refrigeration Code of Practice.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.
- .2 Indicate:
 - .1 Type and quantity of refrigerant used for each complete system.
 - .2 Indicate BACNet interface capabilities and software used.
 - .3 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.
 - .4 Piping, tubing, valves, filter-dryers, sight glasses, fittings shipped loose showing final location in assembly.
 - .5 Control equipment shipped loose, showing final location in assembly.
 - .6 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting base details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
 - .7 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories, controllers.
 - .8 Details of vibration isolation.
 - .9 Estimate of sound levels to be expected across each individual octave band in dB referred to A rating.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 10 01 – General Requirements.
- .2 Indicate:
 - .1 Brief description of unit, indexed, with details of function, operation, control, and service for each component.
- .3 Manufacturer's installation instructions shall govern and unless otherwise noted, operation, maintenance and service of items. Include names and addresses of spare part suppliers.
- .4 Include following:
 - .1 Provide for each unit, manufacturer's name, type, year, number of units, and capacity.
- .5 Decommissioning and installation forms for the removal and installation of halocarbon equipment must be completed and submitted to the Departmental Representative with a copy to the Commissioning Agent. See forms at end of this Section.

1.5 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 10 01 – General Requirements.
- .2 Provide one spare set of filters for each evaporator.

1.6 MANUFACTURED ITEMS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.
- .2 Provide confirmation of testing.

1.7 WARRANTY

- .1 For refrigeration compressors, the contract mandated warranty period is extended from 12 months to 5 years on parts and one year warranty on labour from date of acceptance will remain as is.

1.8 Sustainable Design Submittals

- .1 Construction waste management plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
- .2 Recycled Content.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for "List of Products Requiring Recycled Content".
 - .2 If products within this section are indicated on the "List of Products Requiring Recycled Content", only products with recycled content will be acceptable.
 - .3 For products not identified on list, source products with highest recycled content available when practical.
 - .4 Include following information with product data submission.
 - .1 Percentage of pre-consumer and post-consumer recycled content for each product.
- .3 Regional Materials.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for "List of Products Required to be Locally Sourced".
 - .2 If products within this section are indicated on the "List of Products Required to be Locally Sourced", include following information with Product Data submission:
 - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.
- .4 Adhesives and Sealants.
 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer's certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California's SCAQMD #1168.

- .5 Paints and Coatings.
 - .1 Provide low VOC Products as specified herein and complying with local regulations regarding toxic and hazardous materials.
 - .2 Ensure primers, paints and coatings used onsite and within building envelope meet or exceed requirements of following standards:
 - .1 Interior and Exterior Paints: GS-11
 - .2 Anti-Corrosive Paint: GS-11
 - .3 Clear Wood Finishes and other coating not covered in GS-11: SCAQMD #1113.
 - .3 Submit manufacturer's certification indicating VOC limits of Products.
 - .6 If requesting substitute product, ensure proposed substitution achieves above stated goals.
- 1.9 MAX. VOC CONTENT FOR SOLVENT CLEANING ACTIVITIES
- .1 Following are some of the Maximum allowed VOC Content for following activities, as per SCAQMD Rule 1171-9 (refer to SCAQMD manual for complete list and updates):
 - .1 Product cleaning during onsite surface preparation for coatings or adhesives application, and repair and maintenance cleaning:
 - .1 General maximum VOC 25g/L.
 - .2 Electrical apparatus components and electronic components.
 - .3 Cleaning of coatings or adhesives application equipment max. VOC 25g/L.
 - .2 Refer to SCAQMD for additional information and clarification and complete list of applications.
 - .3 Any discrepancies are to be approved by Departmental Representative. Obtain written approval prior to use on site.
- 2 Products
- 2.1 GENERAL
- .1 The direct expansion split systems on this project include multiple indoor variable capacity ductless type evaporators piped their own specified air cooled outdoor condenser equipped with variable speed compressor.
 - .2 The same manufacturer is to provide the condensers, evaporators, condensate pumps, and where specified: controls and piping.
 - .3 Ensure all controls can be interfaced with the BACNet BMS directly or via gateway and fully integrated with ON/OFF, analog temperature signals and alarm status.
 - .4 Refrigerant shall be R-410A.
 - .5 All outdoor condensing units to be complete with test gauges ports and filters. Ensure each unit test gauge fittings, filters and all items where servicing personnel require access is readily accessible.
 - .6 Supply and install steel supports for all evaporators and condensers. Install all units as per manufacturer's instructions and recommendations.

2.2 VARIABLE REFRIGERANT FLOW (VRF) SYSTEM

.1 Condenser

- .1 Air cooled packaged unit completely assembled for Pad mounting. Unit to be weather-proofed, assembled on a corrosion protected steel base and to include inverter-driven compressor, condenser coils, built-in base pan heater, fans and motors, controls, holding charge of refrigerant R410A applied and sealed at factory and spring isolators for mounting on equipment supports. Units may be shipped with a factory sealed charge of nitrogen with proper refrigerant charging reserved for the field.
- .2 Casing to be assembled of heavy gauge galvanized steel with access panels for servicing unit. Finish colour to be factory standard.
- .3 Condensing unit to be single circuit type with a variable speed hermetic compressor and oil capture/collection system to isolate oil distribution to within condensing unit. Unit to be supplied with suction and discharge valves, crankcase heater and rubber in shear or spring isolators.
- .4 Condenser fans to be vertical discharge, direct drive and totally balanced with steel blades and zinc-plated steel hubs. Condenser coil to be slab type with aluminum fins, mechanically bonded to copper tubes, tested to 3100 kPa complete with louvered metal grilles.
- .5 Options to include low ambient wind baffle, run time compressor protection controls, freeze protection controls, gauge ports, disconnect switch, oil and refrigerant pressure controls, motor starter and overload protection and compressor speed modulation controls with power and control terminal blocks for interface to associated evaporators and related controllers. Coordinate with controls contractor for BACNet signal integration requirements
- .6 Performance, Electrical Ratings, and Standard of Acceptance:
 - .1 Nominal cooling capacity is based on entering return air at 27°C (80°F) dry bulb and 19°C (70°F) wet bulb to produce supply air at temperature of 13°C (55°F) with condenser entering air temperature at 35°C (95°F).
 - .2 Nominal heating capacity is based on entering return air at 21.1°C (70°F) dry bulb with condenser entering air temperature at 8.3°C (47°F) D.B. and 6.1°C (43°F) W.B. Heating only mode outdoor range down to -20°C (-4°F) is required.
 - .3 Table:

Tag #	Nominal Cooling Capacity (kW)	Nominal Heating Capacity (kW)	Electrical	Standard of Acceptance (Mitsubishi Model)
CU-1	42.2	46.9	208-230V/3Ø/60 Hz 34.5A	PURY-P144TKMU-A
CU-2	42.2	46.9	208-230V/3Ø/60 Hz 34.5A	PURY-P144TKMU-A

- .4 Acceptable Alternates: Daikin, Fujitsu, LG

.2 Ceiling Concealed Evaporator Fan Unit

- .1 Cabinet: slim line galvanized steel construction to include: DX cooling coil, fans, filters, unit control system and motor starters or contactors. Provide adequate access to components for servicing. Unit depth not to exceed 275mm.

- .2 Fan: statically and dynamically balanced, with self-aligning, permanently lubricated, 200,000 h minimum life ball or roller bearings. Fan motors to be high efficiency, single phase induction, five stage external static pressure settings to a maximum 150 Pa.
- .3 Cooling coil: Direct expansion type with modulating thermostatic expansion valve, aluminum fins mechanically bonded to copper tubes and stainless steel insulated condensate pan. Condensate pan to be designed to avoid any standing water, to be easily cleaned or removable for cleaning and equipped with condensate collection/lift pump unit for piping to remote drain.
- .4 Filters: Long life synthetic fiber unwoven cloth type, easily removable from access side of unit.
- .5 Options to include motor starter and overload protection, expansion valve modulation and fan speed control with power and control terminal blocks for interface to local controller, Air Zone valves, and associated condenser.
- .6 Air zone control valves capable of communicating with VRF unit zone controller and adjust air flow and reheat coil through the BMS for the sub zone comfort control.
- .7 Controls:
 - .1 Each unit to have a single wall mounted controller with start/stop, room temperature control, fan speed control, digital display, pushbutton operation.
 - .2 Refrigerant branch controllers (mounted in the Room 200) to be of sufficient capacity and size to control proper refrigerant flow and transfer of energy.
- .8 Performance:
 - .1 Nominal cooling capacity is based on entering return air at 27°C DB and 19°C WB to produce supply air at temperature of 13°C with condenser entering air temperature at 35°C DB.
 - .2 Nominal heating capacity is based on supply air at temperature of 21°C with condenser entering air temperature at 8°C DB / 6°C WB.

.3 Table:

Associated Condenser	Tag #	Nominal Cooling Capacity (kW)	Nominal Heating Capacity (kW)	Electrical	Standard of Acceptance (Mitsubishi Model)
CU-1	AC-1	3.5	4.0	208-230V/1Ø/60Hz 0.66 A Max.	PEFY-P12NMAU-E (Ceiling-concealed Ducted)
CU-1	AC-2	10.5	11.7	208-230V/1Ø/60Hz 1.5 A Max.	PEFY-P36NMAU-E (Ceiling-concealed Ducted)
CU-1	AC-3	10.5	11.7	208-230V/1Ø/60Hz 1.5 A Max.	PEFY-P36NMAU-E (Ceiling-concealed Ducted)
CU-1	AC-4	5.3	5.9	208-230V/1Ø/60Hz 0.77 A Max.	PEFY-P18NMAU-E (Ceiling-concealed Ducted)
CU-1	AC-5	10.5	11.7	208-230V/1Ø/60Hz 1.5 A Max.	PEFY-P36NMAU-E (Ceiling-concealed Ducted)
CU-1	AC-6	10.6	11.7	208-230V/1Ø/60Hz 1.5 A Max.	PEFY-P36NMAU-E (Ceiling-concealed Ducted)
CU-1	AC-7	4.4	5.0	208-230V/1Ø/60Hz 0.67 A Max.	PEFY-P15NMAU-E (Ceiling-concealed Ducted)
CU-2	AC-8	10.5	11.7	208-230V/1Ø/60Hz 1.5 A Max.	PEFY-P36NMAU-E (Ceiling-concealed Ducted)
CU-2	AC-9	4.4	3.5	208-230V/1Ø/60Hz 0.67 A Max.	PEFY-P15NMAU-E (Ceiling-concealed Ducted)
CU-2	AC-10	10.5	11.7	208-230V/1Ø/60Hz 1.5 A Max.	PEFY-P36NMAU-E (Ceiling-concealed Ducted)
CU-2	AC-11	14.1	3.5	208-230V/1Ø/60Hz 2.08 A Max.	PEFY-P48NMAU-E (Ceiling-concealed Ducted)
CU-2	AC-12	5.3	3.5	208-230V/1Ø/60Hz 0.77 A Max.	PEFY-P18NMAU-E (Ceiling-concealed Ducted)
CU-2	AC-13	10.5	11.7	208-230V/1Ø/60Hz 1.5 A Max.	PEFY-P36NMAU-E (Ceiling-concealed Ducted)

.4 Acceptable Alternates: Fujitsu, Daikin, LG

2.3 Room 119 Cooling System

.1 Condenser (CU-3)

- .1 Air cooled packaged unit completely assembled for pad mounting on a base stand. Unit to be complete with 24" high aluminum or hot dipped galvanized steel base stand. Unit to be weather-proofed, assembled on a corrosion protected steel base and to include hermetic compressor, condenser coils, fans and motors, controls, holding charge of refrigerant R410A applied and sealed at factory and spring isolators for mounting on equipment supports. Units may be shipped with a factory sealed charge of nitrogen with proper refrigerant charging reserved for the field.
- .2 Casing to be assembled of heavy gauge galvanized steel with access panels for servicing unit. Finish colour to be factory standard.

- .3 Condensing unit to be single circuit type with a variable speed hermetic compressor and oil capture/collection system to isolate oil distribution to within condensing unit. Unit to be supplied with suction and discharge valves, crankcase heater and rubber in shear or spring isolators.
- .4 Condenser fans to be horizontal discharge, direct drive and totally balanced with steel blades and zinc-plated steel hubs. Condenser coil to be slab type with aluminum fins, mechanically bonded to copper tubes, tested to 3100 kPa (450 psi) complete with louvered metal grilles.
- .5 Options to include: Low condenser ambient air operation down to -40°C , modular wind guards, snow baffle, run time compressor protection controls, freeze protection controls, gauge ports, oil and refrigerant pressure controls, motor starter and overload protection and compressor speed modulation controls with power and control terminal blocks for interface to associated evaporators and related controllers. Coordinate with controls contractor for BACNet signal integration requirements
- .6 Supply with built in local electrical disconnect mounted to condenser.
- .7 Performance, Electrical Ratings, and Standard of Acceptance:
 - .1 Nominal cooling capacity is based on entering return air at 26.7°C (80°F) dry bulb and 19.4°C (67°F) wet bulb to produce supply air at temperature of 12.8°C (55°F) with condenser entering air temperature at 35.0°C (95°F).
 - .2 Table:

Tag #	Nominal Cooling Capacity (kW)	Electrical	Standard of Acceptance
CU-3	3.5	208V/1Ø/60 Hz	Mitsubishi Mr Slim PUY-A12NHA4

- .3 Acceptable Alternates: Fujitsu, LG

.2 Evaporators

- .1 Cabinet: galvanized steel construction, corrosion protected, factory baked on external finish and to include: DX cooling coil, fans, filters, unit control system, motor starters or contactors and ducted inlet and outlet. Provide adequate access to components for servicing.
- .2 Fan: statically and dynamically balanced, with self-aligning, permanently lubricated, 200,000 h minimum life ball or roller bearings. Fan motors to be high efficiency, single phase induction, three or four-speed type.
- .3 Cooling coil: Direct expansion type with modulating thermostatic expansion valve, aluminum fins mechanically bonded to copper tubes and stainless steel insulated condensate pan. Condensate pan to be designed to avoid any standing water, to be easily cleaned or removable for cleaning and equipped with condensate collection/lift pump unit for piping to remote drain.
- .4 Filters: Long life synthetic fiber unwoven cloth type, easily removable from access side of unit.
- .5 Options to include motor starter and overload protection, expansion valve modulation and fan speed control with power and control terminal blocks for interface to local controller, local controller and associated condenser.
- .6 Controls: Room 119 to have a single wall mounted controller with start/stop, room temperature control, fan speed control, digital display, pushbutton operation.

.7 Performance, Electrical Ratings, Orientation, and Standard of Acceptance:

.1 Nominal cooling capacity is based on entering return air at 26.7°C (80°F) dry bulb and 19.4°C (67°F) wet bulb to produce supply air at temperature of 12.8°C (55°F) with condenser entering air temperature at 35.0°C (95°F).

.2 Table:

Tag #	Nominal Capacity (kW)	Electrical	Type	Standard of Acceptance (Mitsubishi Model)
AC-14	3.5	208V/1ph/60Hz	Wall Mounted	Mr Slim PKA-A12HA4

.3 Acceptable Alternates: Daikin, Fujitsu, LG

.3 Piping: to 2.3 Refrigerant Piping, Valves, Fittings and Accessories using branch joint and header piping specialties as recommended by the manufacturers installation instructions. Provide shop drawing data showing branch joint selection and selection criteria.

.4 The evaporator to be complete with condensate pump. Pump to be powered directly from evaporator power supply.

.1 Standard of Acceptance: Aspen Mini Aqua, Beckett, Franklin Electric.

2.4 SPLIT A/C SYSTEM (HRV-6)

.1 Condenser

.1 Air cooled packaged unit completely assembled for pad mounting. Unit to be weather-proofed, assembled on a corrosion protected steel base and to include hermetic compressor, condenser coils, fans and motors, controls, holding charge of refrigerant R410A applied and sealed at factory and spring isolators for mounting on equipment supports. Units may be shipped with a factory sealed charge of nitrogen with proper refrigerant charging reserved for the field.

.2 Casing to be assembled of heavy gauge galvanized steel with access panels for servicing unit. Finish colour to be factory standard.

.3 Condensing unit to be single circuit type with a variable speed hermetic compressor and oil capture/collection system to isolate oil distribution to within condensing unit. Unit to be supplied with suction and discharge valves, crankcase heater and rubber in shear or spring isolators.

.4 Condenser fans to be vertical discharge, direct drive and totally balanced with steel blades and zinc-plated steel hubs. Condenser coil to be slab type with aluminum fins, mechanically bonded to copper tubes, tested to 3100 kPa complete with louvered metal grilles.

.5 Options to include low ambient wind baffle, run time compressor protection controls, freeze protection controls, gauge ports, disconnect switch, oil and refrigerant pressure controls, motor starter and overload protection and compressor speed modulation controls with power and control terminal blocks for interface to associated evaporators and related controllers. Coordinate with controls contractor for signal requirements.

.6 Performance, Electrical Ratings, and Standard of Acceptance:

.1 Nominal cooling capacity is based on entering return air at 27°C dry bulb and 19°F wet bulb to produce supply air at temperature of 13°C with condenser entering air temperature at 35°C.

.2 Table:

Tag #	Nominal Capacity (kW)	Electrical	Standard of Acceptance
CU-4	8.8	208V/1Ø/60 Hz 17.3A	York LX Series

.3 Acceptable Alternates: Trane, ICP Commercial

.2 Duct Mounted DX Evaporator Coil

- .1 Cooling coil: Direct expansion type with modulating thermostatic expansion valve, aluminum fins mechanically bonded to copper tubes
- .2 Stainless steel insulated condensate pan: Condensate pan to be designed to avoid any standing water, to be easily cleaned or removable for cleaning and equipped with condensate collection/lift pump unit for piping to remote drain.
- .3 Maximum air pressure drop of 750 Pa through the coil
- .4 Performance, Air Flow, Orientation, and Standard of Acceptance:
 - .1 Nominal cooling capacity is based on entering return air at 27°C dry bulb and 19°C wet bulb to produce supply air at temperature of 13°C with condenser entering air temperature at 35°C.

.2 Table:

Associated Condenser	Tag #	Nominal Capacity (kW)	Air Flow	Standard of Acceptance (Johnson Controls Model)
CU-4	AC-15	8.8	471 L/s	BDX (DX)

.3 Acceptable Alternates: Trane, ICP Commercial

- .3 Piping: to 2.3 Refrigerant Piping, Valves, Fittings and Accessories using branch joint and header piping specialties as recommended by the manufacturers installation instructions.
- .4 All evaporators to be complete with condensate pumps.
 - .1 Standard of Acceptance: Aspen Mini Aqua.

2.5 REFRIGERANT PIPING, VALVES, FITTINGS AND ACCESSORIES

- .1 Tubing: Processed for refrigeration installations, factory cleaned, deoxidized, dehydrated and sealed seamless refrigeration grade copper tubing.
 - .1 Hard copper: to ASTM B280, type ACR.
 - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ANSI/ASME B31.5.
- .2 Fittings:
 - .1 Design pressure 2100 kPa and temperature 120°C
 - .2 Fabricated to CSA and ANSI standards, bear the mark of the manufacturer and be registered for use with refrigerant R410A in the Province of New Brunswick.
 - .3 Conform to ANSI/ASME B16.22, ANSI/ASME B16.24 and ANSI/ASME B16.26 and shall be wrought copper or forged brass solder type or flared fittings may be used for soft annealed copper tubing.
 - .4 Elbows and return bends to be long radius type.

- .5 Flanged:
 - .1 Bronze or brass, to ANSI/ASME B16.24, Class 150 and Class 300.
 - .2 Gaskets: suitable for service.
 - .3 Bolts, nuts and washers: to ASTM A307, heavy series.
- .6 Flared:
 - .1 Bronze or brass, for refrigeration, to ANSI/ASME 16.26.
- .3 Joints:
 - .1 Brazing materials shall conform to AWS A5.8 and be SIL-FOS-15 phosphor-copper-silver alloy for copper piping jointed by copper fittings, 24,656 psi silver solder for brass fittings and 95-5 solder for connections to equipment, coils and or accessories.
 - .2 Flexible connections at equipment coils NPS 3/8 nominal or less shall be made using coiled soft copper tubing. For larger sizes, seamless flexible bronze hose with bronze wire braid covering shall be used. Use factory sealed neoprene jacket unit where freezing may occur.
- .4 Service Valves:
 - .1 Valves shall meet ANSI B31.5 for valve construction.
 - .2 Service valves to be angle, ball or globe as per packaged split system manufacturer's recommendations and shall be installed strategically so as to facilitate system charging and servicing of refrigeration piping system components without the need to evacuate the entire system charge.
 - .3 NPS 7/8 and under: Class 500, 3450 kPa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
 - .4 Over NPS 7/8: Class 375, 2580 kPa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .5 Relief Valves:
 - .1 Safety relief type shall have fusible plug or rupture disc in forged brass body.
 - .2 Pressure relief type shall have forged brass body.
- .6 Check Valves:
 - .1 Spring operated, guided piston type with forged brass body in flare connection sized NPS 7/8 and under.
 - .2 Guided piston typed, spring operated with bolted bonnet or cover plate in sweat connections over NPS 7/8.
- .7 Solenoid Valves:
 - .1 Shall have field replaceable coil, serviceable without removing valve from line. Solenoid valves for pump down circuits shall each be supplied with a manual lift stem. Rate coils according to temperature service.
 - .2 Provide upstream of thermostatic expansion valves and strainers as indicated.
- .8 Expansion Valves:
 - .1 Expansion valves shall be thermostatic type with external equalizer, adjustable superheat setting, capacity and bulb charge and length to suit operating conditions.
 - .2 Acceptable material: Mueller Brass Co., Alco, Sporlan.
- .9 Filter - Dryers:
 - .1 Liquid line filter dryers shall meet ARI 710-standards, and shall be UL approved and rated to SWP-500 psi.

- .2 Size shall not be less than recommended by packaged split system manufacturer's for the nominal tonnage rating for R410A refrigerant.
- .3 All filter-dryers shall be replaceable cartridge type.
- .4 Acceptable material: Mueller Brass Co., Alco, Sporlan.
- .10 Sight Glass:
 - .1 Install a moisture indicating double sight glass upstream of each expansion valve and/or as recommended by packaged split system manufacturer.
 - .2 Acceptable material: Mueller Brass Co., Alco, Sporlan.

2.6 CONTROLS

- .1 Each controller to be capable of individually controlling and monitoring ON/OFF status, mode, setpoint, and fan speed of each indoor evaporators that it serves.
- .2 Provide all necessary components and devices, as required, to complete seamless interface.
 - .1 Standard of Acceptance: Mitsubishi, Slim Start Remote
 - .2 Acceptable Alternates; Fujitsu, Daikin, LG

3 Execution

3.1 GENERAL

- .1 Install in as indicated accordance with CSA B52, EPS 1/RA/1, ANSI/ASME B31.5, Federal Halocarbon Regulation 2003 and to manufacturers' recommendations.
- .2 Although the drawings clearly show a two pipe system, the use of three pipes are acceptable as long as no vales requiring maintenance are located within the occupied space.
- .3 The piping system designs including proposed piping, materials and components are to be reviewed and approved by the applicable packaged split system manufacturers prior to piping installation. Split system manufacturer approved piping, materials and component selections to be submitted to the Departmental Representative for review prior to installation. Manufacturer to certify completed installation prior to start-up.
- .4 Run drain line (per Section 22 11 18 Plumbing Piping Valves and Fittings) from cooling coil condensate drain pans and condensate pumps with deep seal trap to drain.
- .5 Connect to equipment with isolating valves and unions.
- .6 Provide space for servicing, disassemble and removal of equipment and components all as recommended by manufacturer.
- .7 Protect all openings in piping against entry of foreign material.

3.2 BRAZING PROCEDURES

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

3.3 INSTALLATION AND TESTING

- .1 Install and test in accordance with CSA B52.
- .2 Install pipe supports at each major component and per Section 20 05 00 for spacing on pipe runs, however, liquid and gas lines may be supported in vertical and horizontal runs as indicated using a cushion clamp in unistrut ladder. Unistrut shall be positioned 4" clear of the surface of, and off to one side of, the equipment served to permit service access. Piping shall be securely anchored to minimize vibration, however, flexible to accommodate thermal expansion.
- .3 Piping shall be installed straight and parallel to building lines whenever possible.
- .4 Grade horizontal pipe carrying gases 1:240 down in the direction of flow.
- .5 When multiple runs are installed, separate pipes by a minimum of 6" to allow for expansion and contraction.
- .6 Keep the number of elbows and fittings to a minimum.
- .7 Locate double risers and traps in vertical risers in accordance with packaged split system manufacturer's recommendations.
- .8 Install piping to prevent unwanted condensate or oil from flowing back into compressor or evaporator.
- .9 Connect branch suction lines from top of suction main using wye fitting.
- .10 Keep piping joints sealed except when fabricating.
- .11 Bleed dry nitrogen into piping when sweating connections.
- .12 Braze flexible pipe vibration isolators and stub connectors on sealed hermetic compressors using alloys which melt at 595°C or below unless stipulated otherwise by packaged split system manufacturer.

3.4 PRESSURE AND LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 1655 kPa and 1000 kPa on high and low sides respectively.
- .3 Test Procedure: Build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.5 DEHYDRATION AND CHARGING

- .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13°C for at least 12 h before and during dehydration.
- .3 Connect high vacuum hose or seamless copper tubing jumper lines to both high and low pressure sides. Jumper line size shall be not less than NPS 1/4 for systems up to 68 liters internal volume and NPS 3/8 or NPS 1/2 for larger systems. Use the largest line size as is practical for the installation to reduce evacuation time.
- .4 Use 2-stage vacuum pump with gas ballast on 2nd stage capable of pulling 50 microbar absolute and filled with dehydrated oil. Do not use refrigerant compressors to pull vacuum.

- .5 Install thermocouple vacuum gauge with Pa scale to measure system pressure. Locate manual isolating valve between pump and gauge and take readings only after the system has been isolated from the pump.
 - .6 Triple evacuate all system components containing gases other than correct refrigerant or having lost holding charge as follows.
 - .1 Twice to 50 microbar absolute and hold for 4 h.
 - .2 Break vacuum with refrigerant to 15 kPa.
 - .3 Final to 50 microbar absolute and hold for at least 12 h.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit all test results to the Departmental Representative.
 - .7 Charging.
 - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
 - .2 With compressors off, charge system by weight with only the amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close liquid charging valve and start up. With unit operating, observe sight glass near receiver outlet to recheck and add remainder of charge to system as necessary.
 - .8 Checks.
 - .1 Make all checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report all measurements to the Departmental Representative.
- 3.6 START-UP
- .1 Contractor shall provide all necessary instruments, gauges and testing equipment required.
 - .2 Ensure that insulation of refrigerant piping and accessories is complete in accordance with Section 20 05 00 and 20 07 00.
 - .3 Provide the services of a qualified technician to start-up the systems and put them into operation during commissioning.
 - .4 Adjust refrigerant piping system components and packaged split system controls to obtain the design requirements and meet packaged split system manufacturer's specifications and recommendations for the equipment.
 - .5 In co-operation with the Controls sub-contractor and the Departmental Representative set and adjust the controllers to achieve the required sequence of operation.
 - .6 During trial runs, check and make-up any loss of oil and/or refrigerant if necessary.
 - .7 The Departmental Representative shall be given 7 days advance notice of refrigerant piping system testing, evacuation, dehydration and charging.
- 3.7 EQUIPMENT PREPARATION AND START-UP
- .1 Manufacturer's representatives to inspect split system installations, start-up units, and provide a written report of the results to the Departmental Representative.
- 3.8 COMMISSIONING
- .1 After start-up, test, adjust and prove operation of all equipment and accessories to suit site conditions and 01 91 13 General Commissioning Requirements.



Halocarbon Installation and Commissioning Notice

Name of Owner or System:		
Name of Operator:		
Building Name:		
Building Address:		
City, Province:		
Equipment Information		
Equipment Tag Number:		
Location of the System Within Building:		
Type of System:		
Type of Halocarbon:		
Charging Capacity of System:		
Equipment Manufacturer:		
Equipment Model Number:		
Equipment Serial Number:		
Leak Test Pressure:		Pass
Date:	Pressure: _____ kPa	<input type="checkbox"/> Yes <input type="checkbox"/> No
Leak Re-test Pressure:		Pass
Date:	Pressure: _____ kPa	<input type="checkbox"/> Yes <input type="checkbox"/> No
Date Halocarbon Charged:		
Comments:		

Name of Service Company:		
Name of Technician:		
Technician Certificate Number:		

Technician Signature: _____ Date: _____

- * Place an O & M Commissioning Tag on the system.
- * No person shall remove the Tag except to replace it with another such notice.
- * The installing contractor shall keep a record of the information contained in this notice.

END OF SECTION

1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.

1.2 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 10 01 – General Requirements.

1.3 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 10 01 – General Requirements.

1.4 MANUFACTURED ITEMS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

2 Products

2.1 ELECTRIC EVAPORATIVE TYPE

- .1 CSA certified and ULC listed.
- .2 All components housed in factory fabricated cabinet with epoxy finish. Cabinet shall include top steam outlets, top condensate return connections, bottom wall hanger assembly and bottom water drain, bottom electrical access and inlet water filter.
- .3 Disposable or reusable cylinder type;
- .4 Controls:
 - .1 Cylinder replacement or maintenance indicator light or alarm.
 - .2 Solenoid valve on water and drain lines.
 - .3 Airflow proving switch, high limit duct humidistat, time proportioning electric modulating control. Water level control for automatic refill, low water cut-off and periodic drain down. Step-down transformer, contactor, numbered terminal strip and electronic control board. Self diagnostics with shut-off capability. Unit controls designed for full modulation operation set up to receive input from DDC system.

.4 Performance Schedule:

Tag	Capacity (kg/hr)	Electrical (kW)	Standard of Acceptance	Power Requirements
H-1	13.64	10.7	Nortec NH-EL Series, Neptronic, Carnes, with short absorption manifold distributor	575 V / 3Ø / 60Hz
H-2	9.09	7.7	Nortec NH-EL Series, Neptronic, Carnes, with short absorption manifold distributor	575 V / 3Ø / 60Hz
H-3	13.64	10.7	Nortec NH-EL Series, Neptronic, Carnes, with short absorption manifold distributor	575 V / 3Ø / 60Hz

3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions. Supply and install drains where required and pipe to drain as indicated. Insulate drains exceeding 40°C surface temperatures.
- .2 Humidifier and evaporator media to be new and clean upon acceptance. Contractor to supply one complete set of evaporative media for each unit upon acceptance.
- .3 Water service overflow drain: to manufacturers' recommendation.
- .4 Install in accessible location.
- .5 Install access doors or panels in adjacent ducting.
- .6 When installing in ducting, provide waterproof duct up and downstream in accordance with Section 23 31 14 - Ductwork.
- .7 Hardwire the duct mounted airflow switch and high humidity switch and the load side of the supply fan starter in series to the control circuit of the humidifier. Coordinate with controls contractor.
- .8 Manufacturer's representative to inspect humidifiers installation, start-up units and provide a written report of the results to Departmental Representative.
- .9 Install drain cooler where manifold does not have sufficient height to drain condensate back to humidifier.

3.2 COMMISSIONING

- .1 After start-up, test, adjust and prove operation of all equipment and accessories to suit site conditions and 01 91 13 General Commissioning Requirements.

END OF SECTION