

PART 1 - GENERAL

1.1 Trial Usage

- .1 Departmental Representative/Owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

1.2 Protection of Openings

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.
Standard 90.1- 1989

1.3 Spare Parts

- .1 Furnish spare parts in accordance with Section 01 78 00 as follows:
 - .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

1.4 Special Tools

- .1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00.

1.5 Demonstration and Operating and Maintenance Instructions

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Where specified elsewhere in this Division, manufacturers to provide demonstrations and instructions.
- .3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Where deemed necessary, Owner may record these demonstrations on video tape for future reference.

1.6 Closeout Submittals

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.
- .2 Operation and maintenance manual to be approved by, and final copies deposited with, Departmental Representative and Owner before final inspection.
- .3 Operation data to include:
 - .1 Control schematics for each system including environmental controls.
 - .2 Description of each system and its controls.
 - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
 - .4 Operation instructions for each system and each component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram
 - .7 Colour coding chart
- .4 Maintenance data shall include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
 - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified elsewhere.

- .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing.
- .6 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Project Manager for approval. Submission of individual data will not be accepted unless so directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

1.7 Shop Drawings and Product Data

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings and product data shall show:
 - .1 Mounting Arrangements.
 - .2 Operating and Maintenance Clearances. Eg. Access door swing spaces.
- .3 Shop drawings and product data shall be accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify as to current model
 - .5 Certification of compliance to applicable codes.
- .4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.8 Cleaning

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

1.9 As-Built Drawings

- .1 Site records
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur. This shall include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 On a weekly basis, transfer information to reproducible, revising reproducible to show all work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection at all times.
- .2 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 TAB to be performed using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .3 Submit copies of as-built drawings for inclusion in final TAB report.

PART 1 - GENERAL

1.1 References

- .1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1- 1989, Power Piping, (SI Edition).
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 125- 81(1988), Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A 307- 94, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A 563- 94, Specification for Carbon and Alloy Steel Nuts.
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP-58- 19 93, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP-69-19 91, Pipe Hangers and Supports - Erection and Application.
 - .3 MSS SP-89-1991, Pipe Hangers and Supports - Fabrication and Installation.

1.2 Design Requirements

- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP-58.
- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP-58.

1.3 Shop Drawings and Product Data

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.

PART 2 – PRODUCTS

2.1 General

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- .3 For Hydrogen tubing mounting refer to Section 22 15 01.

2.2 Pipe Hangers

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.
 - .2 Use electro-plating galvanizing process hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated epoxy coated.
- .2 Shop and field-fabricated assemblies.
- .3 Hanger rods: threaded rod material to MSS SP-58.
 - .1 Ensure that hanger rods are subject to tensile loading only.

- .4 Adjustable clevis: material to MSS SP-69 UL listed, clevis bolt with nipple spacer and adjustable clevis: vertical adjustment nuts above and below clevis

PART 3 – EXECUTION

3.1 Installation

- .1 Install in accordance with:
 - .1 manufacturer's instructions and recommendations.

3.2 Hanger Spacing

- .1 Plumbing piping: most stringent requirements of Canadian Plumbing Code, Provincial Code, or authority having jurisdiction.
- .2 Hydrogen piping: support every 1.8 m maximum
- .3 Within 300mm of each elbow

3.3 Hanger Installation

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.4 Horizontal Movement

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4° from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.5 Final Adjustment

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
- .2 Adjustable Clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.

END

PART 1 - GENERAL

1.1 References

- .1 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.60-M89, Interior Alkyd Gloss Enamel.
 - .1 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .2 Canadian Gas Association (CGA).
- .3 CAN/CGA B149.1-M95.
- .4 CAN/CGA B149.2-M91.

1.2 Product Data

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Product data to include paint colour chips, all other products specified in this section.

PART 2 – PRODUCTS

2.1 Manufacturer's Equipment Nameplates

- .1 Metal or plastic laminate nameplate
- .2 Lettering and numbers to be raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: Manufacturer's name, model,
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 System Nameplates

- .1 Colours:
 - .1 Hazardous: red letters, white background
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction
 - .1 3mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes
 - .1 Conform to following table:

Size #	mm	Sizes (mm)	No. of Lines	Height of Letters
1		10X50	1	3
2		13X75	1	5
3		13X75	2	3
4		20X100	1	8
5		20X100	2	5
6		20X200	1	8
7		25X125	1	12
8		25X125	2	8
9		35X200	1	20

- .2 Use maximum of 25 letters/numbers per line

- .4 Locations
 - .1 Terminal cabinets, control panels: use size #5
 - .2 Equipment in Mechanical Rooms: Use size #9
- .5 Identification for PWC Preventive Maintenance Support System (PMS):
 - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
 - .2 Equipment in Mechanical Room:
 - .1 Main identifier: Size #9.
 - .2 Source and Destination identifiers: Size #6.
 - .3 Terminal cabinets, control panels: Size #5.
 - .3 Equipment elsewhere: Sizes as appropriate.

2.3 Identification of Piping Systems

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.
- .3 Arrows showing direction of flow
 - .1 Outside diameter of pipe or insulation less than 75mm: 100mm long x 50mm high.
 - .2 Outside diameter of pipe or insulation 75mm and greater: 150mm long x 50mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .4 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .5 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20mm and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 All other pipes: Pressure sensitive plastic-coated cloth vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.
- .6 Colours and Legends:
 - .1 Where not listed, obtain direction from Departmental Representative.
 - .2 Colours for legends, arrows: To following table:

<u>Background Color:</u>	<u>Legend, arrows:</u>
Yellow	Black
Green	White
Red	White
 - .3 Background colour marking and legends for piping systems:

<u>Contents</u>	<u>Background colour marking</u>	<u>Legend</u>
Hydrogen	Blue	Hydrogen

2.4 Identification Ductwork Systems

- .1 50mm high stenciled letters and directional arrows 150mm long x 50mm high.
- .2 Colours: Black, or co-ordinated with base colour to ensure strong contrast

2.5 Valves, Controllers

- .1 Brass tags with 12mm stamped identification data filled with black paint
- .2 Include flow diagrams for each system, of approved size, showing chars and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.6 Controls Components Identification

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail- safe position.

2.7 Language

- .1 Identification to be in English and French

PART 3 – EXECUTION

3.1 Timing

- .1 Provide identification only after all painting specified Section 09 91 00 has been completed.

3.2 Installation

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and or CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.

3.3 Nameplates

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces
- .3 Protection
 - .1 Do not paint, insulate or cover in any way.

3.4 Location of Identification on Piping and Ductwork Systems

- .1 On long straight runs in open areas in mechanical rooms, equipment rooms: At not more than 17m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification to be easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

PART 1 - GENERAL

1.1 Related Sections

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this section.
- .2 Provide air system TAB, for supply, and heat recovery ventilator systems within the building.

1.2 Qualifications of Tab Personnel

- .1 Names of all personnel it is proposed to perform TAB to be submitted to and approved by Departmental Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.

1.3 Co-Ordination

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.4 Pre-Tab Review

- .1 Review contract documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Departmental Representative in writing all proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of all TAB devices, equipment, accessories, measurement ports and fittings.

1.5 Start-up

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in this Division.

1.6 Operation of System during Tab

- .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.7 Start of Tab

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB only when building is essentially completed, including:
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weatherstripping, sealing, caulking.
- .5 All pressure, leakage, other tests specified elsewhere this Division.
- .6 All provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of all mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.

- .7 Access doors, installed, closed.
- .8 All outlets installed, volume control dampers open.

1.8 Application Tolerances

- .1 Do TAB to following tolerances of design values:
 - .1 Supply fan: plus/minus 5%.

1.9 Accuracy Tolerances

- .1 Measured values to be accurate to within plus or minus 2% of actual values.

1.10 Instruments

- .1 Prior to TAB, submit to Departmental Representative list of instruments to be used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.11 Submittals

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.12 Preliminary Tab Report

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.13 Tab Report

- .1 Format to be in accordance with referenced standard.
- .2 TAB report to show all results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.14 Verification

- .1 All reported results subject to verification by Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 30% of all reported results.
- .3 Number and location of verified results to be at discretion of Departmental Representative.
- .4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

1.15 Settings

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close all access doors, lock all devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark all settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.16 Completion of Tab

- .1 TAB to be considered complete only when final TAB Report received and approved by Departmental Representative.

1.17 Air Systems

- .1 Standard: TAB to be to most stringent of this section or TAB standards of AABC, NEBB, SMACNA, ASHRAE.
- .2 Do TAB of following systems, equipment, components, controls:
 - .1 supply fans.
 - .2 exhaust fans
- .3 Qualifications: personnel performing TAB to be current member in good standing of qualified to standards of AABC.
- .4 Quality assurance: Perform TAB under direction of supervisor qualified to standards of AABC.
- .5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of each damper, filter, coil, fan, other
 - .2 At each controller, controlled device.
- .7 Locations of systems measurements to include, but not be limited to, following as appropriate: Each main duct, main branch, sub-branch, run-out (or grille, register or diffuser).
- .8 Adjust manual dampers on the mixing box of VU-1 so that a constant volume of 20 L/s of outside air is introduced into the Control Room.
- .9 Adjust and set the exhaust air, outside air and recirc dampers in the Hogen room to maintain a minimum outside air flow of 47 L/s during normal system operation of fans EF1 or EF2. Refer to spec section 25 90 01 EMCS Sequence of Operation for the overall operation of the ventilation system in the Hogen Room.

1.18 Other Tab Requirements

- .1 General requirements applicable to all work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for air systems specified this section.
 - .2 Quality assurance: as for air systems specified this section.

END

PART 1 - GENERAL

1.1 Related Sections

- .1 Section 23 05 29 – Bases Hangers and Supports.

1.2 References

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1- 1989.
- .2 American Society for Testing and Materials (ASTM).
 - .1 ASTM B 209M- 92a, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .2 ASTM C 335- 95, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411- 82(1992), Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449M- 88, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 795- 92, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .6 ASTM C 921- 89, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.2- 95, Thermal Insulation, Calcium Silicate, for Piping, Machinery and Boilers.
 - .2 CAN/CGSB-51.9- 92, Mineral Fibre Thermal Insulation for Piping and Round Ducting.
 - .3 CAN/CGSB-51.10- 92, Mineral Fibre Board Thermal Insulation.
 - .4 CAN/CGSB-51.11- 92, Mineral Fibre Thermal Insulation Blanket.
 - .5 CAN/CGSB-51.12- 95, Cement, Thermal Insulating and Finishing.
 - .6 CAN/CGSB-51.40- 95, Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
 - .7 CGSB 51-GP-52Ma- 89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102- M88, Surface Burning Characteristics of Building Materials and Assemblies.

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, and other accessories.
- .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork.
 - .2 CRF: Code Rectangular Finish.

1.4 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.5 Manufacturer's instructions

- .1 Submit manufacturer's installation instructions in accordance with Section 01 33 00.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.6 Qualifications

- .1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards TIAC.

1.7 Delivery, Storage and Handling

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

PART 2 – PRODUCTS

2.1 Fire and Smoke

- .1 In accordance with CAN/ULC-S102: RATING
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 Insulation

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code C-1: Rigid mineral fibre board to CAN/CGSB 51.10, with factory applied vapour retarder jacket to CGSB 51-GP- 52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to CAN/CGSB-51.11 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/CGSB-51.11.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/CGSB-51.11.

2.3 Jackets

- .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .2 Lagging adhesive: Compatible with insulation.

2.4 Accessories

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to
- .5 Tape: self-adhesive, aluminum, plain reinforced, 50 mm wide minimum.
- .6 Contact adhesive: quick-setting
- .7 Canvas adhesive: washable.
- .8 Tie wire: 1.5 mm stainless steel.
- .9 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .10 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on both faces of insulation.

- .11 Fasteners: 2 mm diameter pins with 35 mm diameter square clips, length to suit thickness of insulation.

PART 3 – Execution

3.1 Installation Requirements

- .1 Pressure testing of ductwork systems to be PRE- complete, witnessed and certified.
- .2 Surfaces to be clean, dry, free from foreign material.

3.2 Installation

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 25 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers in accordance with Section 23 05 29.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

3.3 Ductwork Insulation

- .1 Insulate all supply, return and exhaust ductwork with 25mm thick insulation complete with canvas jacket.
- .2 Insulate all outside air intake ductwork with 50mm thick insulation complete with canvas jacket.

END

PART 1 - GENERAL

1.1 References

- .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 1985.
- .2 SMACNA HVAC Duct Leakage Test Manual, 1985.
- .3 CSA B228.1-1968, Pipe Ducts and Fittings for Residential Type Air Conditioning Systems.
- .4 ASTM A 525M-87, Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process. (Metric).
- .5 ASTM A 621/A621M-82(1988), Specification for Steel Sheet and Strip, Carbon, Hot-Rolled, Drawing Quality.
- .6 ANSI/NFPA 90B-1989, Installation of Warm Air Heating and Air Conditioning Systems.

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.

PART 2 – PRODUCTS

2.1 Seal Classification

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
125	C
- .2 Seal classification:
 - .1 Class C: transverse joints and connections made air tight with sealant and tape. 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 Acceptable material: DURO Dyne S-Z, Foster 30-02.

2.3 Tape

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50mm wide.
 - .1 Acceptable material: Duro Dyne FT-2.

2.4 Duct Leakage

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

2.5 Fittings

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows: R/D = 1.5 at fan discharge, R/D = 1.0 elsewhere.
- .3 Square mitred elbows: with single thickness vanes.
- .4 Main supply duct branches without splitter damper. Provide branch duct balancing dampers.
- .5 Sub branch duct with 45 boot connection and branch duct balancing damper.
- .6 Transitions:
 - .1 Diverging: 45 maximum included angle.
 - .2 Converging: 60 maximum included angle.
- .7 Offsets: short radiused elbows as indicated.

- .8 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

2.7 Galvanized Steel

- .1 Lock forming quality: to ASTM A 525M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA and or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint shall be considered to be a class A seal.
 - .1 Acceptable material: Ductmate Canada Ltd.(system for proprietary joints).

2.8 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: 500mm.
- .2 Hanger configuration: to SMACNA.
- .3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA following table:

Duct Size(mm)	Angle Size(mm)	Rod Size(mm)
Up to 750	25x25x3	6

PART 3 – Execution

3.1 General

- .1 Do work in accordance with ANSI/NFPA 90A ANSI/NFPA 90B ASHRAE CSA B228.1 and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100mm beyond insulated duct.
- .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: in accordance with ASHRAE SMACNA

3.3 Watertight Duct

- .1 Provide watertight duct for:
 - .1 Fresh air intake.
- .2 Form bottom of horizontal duct without longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer.

3.4 Sealing and Taping

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

PART 1 - GENERAL

1.1 References

- .1 CSA B228.1-1968, Pipes, Ducts and Fittings for Residential Type Air Conditioning.

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.

PART 2 – PRODUCTS

2.1 General

- .1 Manufacture in accordance with CSA B228.1.

2.2 Flexible Connections

- .1 Frame: galvanized sheet metal frame 0.5mm 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 40C to plus 900C, density of 1.3kg/m²

2.3 Access Doors in Ducts

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6mm thick complete with sheet metal angle frame.
- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6mm thick complete with sheet metal angle frame and 25mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene or foam rubber.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .4 Hardware:
 - .1 Up to 300 x 300mm: 2 sash locks complete with safety chain.
 - .2 301 to 450mm: 4sash locks complete with safety chain.

PART 3 – EXECUTION

3.1 Installation

- .1 Flexible connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100mm.
 - .3 Minimum distance between metal parts when system in operation: 75mm.
 - .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 Location:
 - .1 At fire and smoke dampers.
 - .2 At control dampers.
 - .3 At devices requiring maintenance.
 - .4 At locations required by code.
 - .5 At reheat coils.

- .6 Elsewhere as indicated.
- .3 Turning vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

END

PART 1 - GENERAL

1.1 Summary

- .1 Section Includes:
 - .1 Mechanical intakes; vents; and reinforcement and bracing for air vents, intakes and gooseneck hoods.

1.2 References

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E 90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.3 System Description

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.6 Delivery, Storage, and Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 – PRODUCTS

2.1 Intake/Exhaust Hoods

- .1 Construction: galvanized metal
- .2 Galvanized flashing flanged base
- .3 Complete with aluminum mesh insect screen

PART 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 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

END