

Part 1 General

1.1 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to Contract administrator within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 CO-ORDINATION

- .1 Schedule time required for TAB including repairs, re-testing into project construction and completion schedule 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.

1.5 PRE-TAB REVIEW

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

1.6 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

1.7 OPERATION OF SYSTEMS DURING TAB

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

1.8 START OF TAB

- .1 Notify City of Winnipeg's Representative, Contract administrator 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
- .3 Pressure, leakage, other tests specified elsewhere Division 23.

- .4 Provisions for TAB installed and operational.
- .5 Start-up, verification for proper, normal and safe operation of 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 Outlets installed, volume control dampers open.

1.9 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5 %, minus 5 %.

1.10 INSTRUMENTS

- .1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

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 TAB REPORT

- .1 TAB report to show results to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .2 Submit two copies of tab report to Contract administrator for initial review. Do changes and comments thru resubmit. 6 copies of TAB Report to Contract administrator for verification and approval, in English in D-ring binders, complete with index tabs.

1.13 VERIFICATION

- .1 Reported results subject to verification by City of Winnipeg's Representative Contract administrator.

- .2 Number and location of verified results as directed by Contract administrator.
- .3 Pay costs to repeat TAB as required to satisfaction of Contract administrator.

1.14 SETTINGS

- .1 After TAB is completed to satisfaction of Contract administrator, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.15 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Contract administrator.

1.16 AIR SYSTEMS

- .1 Standard: TAB to most stringent of TAB standards of AABC.
- .2 Do TAB of exhaust, supply air and return air systems, equipment, components, controls specified Division 23.
- .3 Qualifications: personnel performing TAB current member in good standing of AABC.
- .4 Measurements: to include 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.
- .5 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
- .6 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1-01, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B209M-02, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C335-95, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-97, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C547-00, Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553-00, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612-00a, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C795-92, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .9 ASTM C921-92(1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-M88(R2000), Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-01, Thermal Insulation Polyotrene, Boards and Pipe Covering.
- .6 Canadian Standards Association (CSA International)
 - .1 CSA Z317.2-01, Special Requirements for Heating, Ventilation, and Air Conditioning (HVAC) Systems in Health Care Facilities.

1.2 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.

1.3 MANUFACTURERS' INSTRUCTIONS

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

1.4 QUALIFICATIONS

- .1 Installer: specialist in performing work of this section, and have at least 5 years successful experience in this size and type of project, qualified to standards.

Part 2 Products

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, 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 ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to ASTM C553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

- .1 Canvas:

- .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .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 C449.
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .5 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .6 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .7 Contact adhesive: quick-setting
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation one face of insulation with expanded metal lath on other face.
- .12 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

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

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.

- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses: Conform to following table:

	<u>TIAC Code</u>	<u>Vapour Retarder</u>	<u>Thickness (mm)</u>
Exhaust duct inside building	C-2	no	50

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for piping, valves and fittings for gas fired equipment.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ASME B16.22-01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
 - .4 ASME B18.2.1-96 Square and Hex Bolts and Screws Inch Series.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM B75M-99, Standard Specification for Seamless Copper Tube Metric.
 - .4 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
- .4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
 - .1 CAN/CSA B149.1HB-00, Natural Gas and Propane Installation Code Handbook.
 - .2 CAN/CSA B149.2-00, Propane Storage and Handling Code.

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
 - .2 NPS2 1/2 and over, plain end.
- .2 Copper tube: to ASTM B837.

2.2 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste.

- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.
- .4 Brazing: to ASTM B837.

2.3 FITTINGS

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150.
 - .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
 - .3 Welding: butt-welding fittings.
 - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
 - .5 Bolts and nuts: to ASME B18.2.1.
 - .6 Nipples: schedule 40, to ASTM A53/A53M.
- .2 Copper pipe fittings, screwed, flanged or soldered:
 - .1 Cast copper fittings: to ASME B16.18.
 - .2 Wrought copper fittings: to ASME B16.22.

2.4 VALVES

- .1 Provincial Code approved, lubricated plug ball type.

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 PIPING

- .1 Install in accordance with Provincial Codes, CAN/CSA B149.1, CAN/CSA B149.2, supplemented as specified.
- .2 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.

3.3 VALVES

- .1 Install valves with stems upright or horizontal unless otherwise approved by Contract administrator.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Test system in accordance with CAN/CSA B149.1 CAN/CSA B149.2 and requirements of authorities having jurisdiction.

3.5 ADJUSTING

- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.1 CAN/CSA B149.2.
- .2 Pre-Start-Up Inspections:
 - .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
 - .2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.6 CLEANING

- .1 Perform cleaning operations in accordance with manufacturer's recommendations.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A480/A480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A653/A653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 96-01, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
 - .3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C

Maximum Pressure Pa
125

SMACNA Seal Class
Unsealed

- .2 Seal classification:
 - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
 - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.
 - .3 Class C: transverse joints and connections made air tight with gaskets sealant. Longitudinal seams unsealed.
 - .4 Unsealed seams and joints.

2.2 SEALANT

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

2.3 TAPE

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

2.4 DUCT LEAKAGE

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

2.5 FITTINGS

- .1 Fabrication: to SMACNA .
- .2 Radiused elbows.
 - .1 Rectangular: standard radius short radius with single thickness turning vanes
Centreline radius: 1.5 times width of duct .
 - .2 Round: smooth radius five 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 degrees entry on branch .
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection .
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.

- .6 Offsets:
 - .1 Full short radiused elbows as indicated .
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions .

2.6 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping .
- .2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA .
- .3 Joints: to SMACNA.

2.8 STAINLESS STEEL

- .1 To ASTM A480/A480M, Type 304.
- .2 Finish: No. 4.
- .3 Thickness, fabrication and reinforcement: to SMACNA.
- .4 Joints: to SMACNA.

2.9 BLACK STEEL

- .1 To ASTM A635/A635M.
- .2 Thickness: 1.2 mm or as indicated .
- .3 Fabrication: ducts and fittings to ASHRAE SMACNA.
- .4 Reinforcement: as indicated .

2.10 HANGERS AND SUPPORTS

- .1 Hangers and Supports:
 - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct .
 - .1 Maximum size duct supported by strap hanger: 500 .
 - .2 Hanger configuration: to ASHRAE and SMACNA.
 - .3 Hangers: black galvanized steel angle with black galvanized steel rods to ASHRAE and SMACNA 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.
 - .2 For steel joist: manufactured joist clamp.
 - .3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with NFPA 90A NFPA 90B ASHRAE, SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct Ensure diffuser is fully seated .
- .3 Support risers in accordance with SMACNA as indicated .
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions .
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining .

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 SMACNA and as follows:

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

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Outdoor air intake.

- .2 Minimum 3000 mm from duct mounted humidifier in all directions.
- .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 Solder joints of bottom and side sheets.
 - .2 Seal other joints with duct sealer.
- .3 Slope horizontal branch ductwork down towards hoods served.
 - .1 Slope header ducts down toward risers.
- .4 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and discharging to open funnel drain or as indicated.

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 one coat of sealant to manufacturers recommendations.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

Part 2 Products

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame 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 degrees C to plus 90 degrees C, density of 1.3 kg/m².

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 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.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks.
 - .2 301 to 450 mm: four sash locks.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 Hold open devices.

2.4 TURNING VANES

- .1 Factory or shop fabricated single thickness double thickness with trailing edge , to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

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 data sheet.

3.2 INSTALLATION

- .1 Access Doors and Viewing Panels:
 - .1 Size:
 - .1 600 x 600 mm for person size entry.
 - .2 600 x 600 mm for servicing entry.
 - .3 300 x 300 mm for viewing.
 - .4 As indicated.
 - .2 Locations:
 - .1 Devices requiring maintenance.
 - .2 Required by code.
 - .3 Manual dampers and elsewhere as indicated.
 - .4 As indicated.
- .2 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 Ducted inlets to roof and wall exhausters.

- .2 Inlets and outlets of other fan systems.
- .3 Main and sub-main ducts.
- .4 And as indicated.
- .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Contract administrator .
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .3 Turning vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

- .1 Perform cleaning operations as specified in Section and in accordance with manufacturer's recommendations.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.

1.2 REFERENCES

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

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness .
- .4 Inside and outside nylon 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 self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

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 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems. Keep dampers out of residence rooms.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ductwork take offs. Keep dampers out of residence rooms.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible. Keep dampers out of residence rooms.
- .7 Corrections and adjustments conducted by Contract administrator.

3.3 FIELD QUALITY CONTROL

- .1 Tests:
 - .1 Tests to cover period of not less than days and demonstrate that system is functioning as specified.

3.4 CLEANING

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

END OF SECTION

Part 1 General

1.1 GENERAL

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

1.2 WORK INCLUDED

- .1 Labour, materials, plant, tools, equipment and services necessary and reasonably incidental to completion of air conditioning and/or ventilation work.

Part 2 Products

2.1 TUBULAR CENTRIFUGAL FANS

- .1 Greenheck TCBRU Inline Centrifugal Roof Upblast Fan, with continuously welded steel or aluminum housing. Aluminum rub ring. Meet AWCA type B spark resistance. Wind band with aluminum gravity butterfly damper. Weather protective motor cover. Curb cap with venture inlet and prepunctured mounting holes. Structural steel parts are phosphatised and coated with permatector.
- .2 Bearings, shaft, and wheel: heavy duty, self-aligning ball or roller pillow block bearings with extended lubrication lines. Polished, solid steel shafts. Backward inclined aluminum wheel.
- .3 Provide 12" roof curb.
- .4 Refer to Fan Schedule.

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.

END OF SECTION

Part 1 General

1.1 NOT USED

- .1 Not Used.

Part 2 Products

2.1 DIRECT GAS-FIRED MAKE-UP UNIT

- .1 Spray/Bake Make-Up Air unit shall be an outdoor Engineered Air direct fired design with pillow block bearings, down discharge, mixing section with bottom return, angle filter section with 1" permanent washable filters, inlet hood, inlet dampers c/w modulating operator, 1" 1-1/2" # insulation throughout, 18 gauge panel construction with 22 gauge solid liner, motor and bearings mounted outside of the airstream, grey enamel finish coat.
- .2 Make-up air units shall have a direct fired dual fuel (natural gas/propane) heating section and be ETL approved as a complete package including accessories and controls for both sea level and high altitude areas.
- .3 Operating natural gas pressure at unit manifold shall be 7" w.c. (1750 Pa). Burner assembly shall be a line type (Engineered Air Green burn burner) capable of modulating turn down ratio of 25:1. The assembly shall be constructed in a draw through arrangement. Outside air is drawn across the burner section at a constant velocity within the allowable limits of the burner design. All burner combustion air openings shall be located in stainless steel burner plates to maintain design combustion air requirements at all inputs. Combustion air openings in burner castings are not acceptable due to potential blockage from corrosion.
- .4 Burner assembly and piping to include modulating flow ratio valve, fail-safe shut off valve(s), main and pilot pressure regulators, manual shut off valves and electric pilot valve. Flame surveillance shall be with a solid-state programmed flame relay complete with flame rod. The gas train shall be in a cabinet enclosure.
- .5 Provide Maxitrol electronic controller to modulate the gas valve to maintain set point with a discharge air sensor
- .6 Unit manufacturer to provide a remote panel c/w
 - Summer/Off/Winter Switch
 - Spray Booth Light Switch
 - Emergency Shutdown Switch
 - Supply Fan 'On' Light
 - Exhaust Fan 'On' Light
 - Purge 'On' Light
 - Dry 'On' Light
 - Cool Down Light
 - TDM02 Temperature Selector
 - Dry 'On' Button
- .7 Provide a reverse interlock to exhaust fan.
- .8 Unit function:

- .1 Non-fused disconnect “on”, service switch ‘On”, remote panel is energized. Booth light switch closed, lights remain “on” in spray mode and cool down mode. In purge mode and dry mode, lights are “off”.
- .2 Spray mode operation:
Summer/Off/Winter switch in “Summer” position: Outside air damper opens to 100% position, return damper closed, switch closed which enables spray exhaust fan (interlocked) to start. Supply fan starts and runs continuously.
The low velocity air switch is proven closed, the compressed air solenoid valve is energized.
If supply air low velocity air switch is not closed within 1 min., or exhaust fan interlock opens, unit shut down.

Summer/Off/Winter switch in “Winter” position: The functions are the same as in the “Summer” position with exception that the burner circuit is energized. Flame safeguard relay is energized and discharge air controller modulates gas valve to maintain 70 degree F discharge air temperature.
- .3 Dry mode operation:
Dry mode can be activated in either summer or winter position. With the dry timer is set and the dry “On” button is depressed, the booth lights are de-energized. The paint booth is purged for 3 minutes (remains in spray mode). Once the purge mode is complete, dry mode is on. The compressed air solenoid valve is de-energized. Outdoor air damper revert back to 20% OA position (80% RA), the exhaust fan (VFD) remains on. Exhaust fan interlock remains closed, and supply air fan still run continuously.
Flame safeguard relay is energized and discharge air controller modulates gas valve to maintain 140 degree F discharge air temperature.
If exhaust fan interlock opens, unit shut down.
- .4 Cool down operation:
Outdoor air damper opens to 100% position, exhaust fan return to spray mode. The unit will run in the spray mode temperature setting until the cool down time expires. Upon completion of cool down time, the unit shuts down.
- .5 In order to start spray mode again, unit Summer/Off/Winter switch must be reset to “Off” position and return to desired Summer or Winter position to begin new cycle again.
- .6 Non-fused disconnect opens or service switch opens, or Summer/Off/Winter switch in “Off” position, or fire alarm contact open, or exhaust fan interlocks open, heating is locked out, supply and exhaust fan stops, outside air damper spring to closed position, return air damper 100% open, or a booth door is open,
- .9 Provide pre-wired remote program supervisor panel where noted on drawing or located as directed by Contract administrator.
- .10 Unit to be internally prewired to junction box with power and control wiring connection terminals.
- .11 Refer to MAU Schedule:

Part 3 Execution

3.1 DIRECT GAS-FIRED MAKE-UP UNIT

- .1 Installation to conform to C.G.A. and C.S.A. requirements and manufacturers published recommendations.
- .2 Interlock unit with exhaust system so that exhaust must be in operation before make-up air unit can be started.

END OF SECTION