

SECTION TABLE OF CONTENTS

DIVISION 15 - MECHANICAL

SECTION 15840

AIR TERMINAL UNITS

06/04

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 GENERAL REQUIREMENTS

PART 2 PRODUCTS

- 2.1 HIGH-PRESSURE DUAL-DUCT MIXING BOXES
 - 2.1.1 Construction
 - 2.1.2 Casing Leakage
 - 2.1.3 Inlet Valve Leakage
 - 2.1.4 Mixed-Air Temperature Requirements
 - 2.1.5 Volume Control Requirements
 - 2.1.6 Sound Level Requirements
 - 2.1.7 Control Requirements
- 2.2 LOW-PRESSURE DUAL-DUCT MIXING BOXES
 - 2.2.1 Casing Leakage
 - 2.2.2 Inlet Valve Leakage
 - 2.2.3 Mixed-Air Temperature Requirements
 - 2.2.4 Sound Level Requirements
 - 2.2.5 Control Requirements
- 2.3 SINGLE DUCT, CONSTANT VOLUME, TERMINAL REHEAT UNITS
 - 2.3.1 Casing
 - 2.3.2 Regulators
 - 2.3.3 Coils
 - 2.3.4 Controls
- 2.4 VARIABLE CONSTANT-VOLUME BOXES
 - 2.4.1 Low Velocity Boxes
 - 2.4.2 Medium and High Velocity Boxes
 - 2.4.3 Control Requirements

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 TESTS
- 3.3 OPERATION AND MAINTENANCE

-- End of Section Table of Contents --

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SECTION 15840

AIR TERMINAL UNITS
06/04

NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers mixing boxes and terminal units for air handling systems.

Drawings and schedules shall portray system dynamics so that equipment functions as required.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.

The publications listed below form a part of this section to the extent referenced:

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)
ARI 880 (1998) Air Terminals

AIR DIFFUSION COUNCIL (ADC)
ADC-01 (2001) Directory of ADC Certified Products

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
ANSI S12.23 (1989; R 2001) Method for the Designation of Sound Power Emitted by Machinery and Equipment

ASTM INTERNATIONAL (ASTM)
ASTM A 527/A 527M (1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the

Hot-Dip Process, Lock-Forming Quality

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 90A (2002) Standard for the Installation of Air Conditioning and Ventilating Systems
- NFPA 90B (2002) Standard for the Installation of Warm Air Heating and Air Conditioning Systems

1.2 SUBMITTALS

 NOTE: Review submittal description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Materials, Equipment, and Fixture Lists and Records of Existing Conditions shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

SD-02 Shop Drawings

Fabrication drawings shall be submitted for the following items consisting of fabrication and assembly details to be performed in the factory.

- High-Pressure Dual-Duct Mixing Boxes
- Low-Pressure Dual-Duct Mixing Boxes
- Terminal Reheat Units
- Variable Constant-Volume Boxes
- Spare Parts

Installation drawings shall be submitted for the following items in accordance with paragraph entitled, "Installation," of this section.

- High-Pressure Dual-Duct Mixing Boxes
- Low-Pressure Dual-Duct Mixing Boxes
- Terminal Reheat Units
- Variable Constant-Volume Boxes

Outline drawings for the following shall indicate overall physical features, dimensions, ratings, service requirements, and equipments weights.

High-Pressure Dual-Duct Mixing Boxes
Low-Pressure Dual-Duct Mixing Boxes
Terminal Reheat Units
Variable Constant-Volume Boxes

As-Built Drawings shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

SD-03 Product Data

Equipment and performance data shall be submitted for the following items consisting of use life, system functional flows, safety features, and mechanical automated details. Curves indicating tested and certified equipment responses and performance characteristics shall also be submitted.

High-Pressure Dual-Duct Mixing Boxes
Low-Pressure Dual-Duct Mixing Boxes
Terminal Reheat Units
Variable Constant-Volume Boxes
Spare Parts

Manufacturer's catalog data shall be submitted for the following items:

High-Pressure Dual-Duct Mixing Boxes
Low-Pressure Dual-Duct Mixing Boxes
Terminal Reheat Units
Variable Constant-Volume Boxes
Spare Parts

SD-04 Samples

Manufacturer's standard color charts shall be submitted for the following items showing the manufacturer's recommended color and finish selections.

Terminal Reheat Units
High-Pressure Dual-Duct Mixing Boxes
Low-Pressure Dual-Duct Mixing Boxes
Variable Constant-Volume Boxes

SD-06 Test Reports

Test reports shall be submitted showing the following:

High-Pressure Ductwork
Duct Mixing Boxes
Low Pressure Ductwork
Variable and Constant Volume Boxes
Terminal Reheat Units

SD-07 Certificates

Listing of Product Installations for the following items shall be submitted in accordance with paragraph entitled, "Installation," of this section.

Duct Mixing Boxes

Terminal Reheat Units

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

- High-Pressure Dual-Duct Mixing Boxes
- Low-Pressure Dual-Duct Mixing Boxes
- Terminal Reheat Units
- Variable Constant-Volume Boxes

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

1.3 GENERAL REQUIREMENTS

NOTE: If Section 15003 GENERAL MECHANICAL PROVISIONS is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

Section 15003 GENERAL MECHANICAL PROVISIONS applies to work specified in this section.

Materials, Equipment, and Fixture Lists shall be submitted for all materials, equipment, and fixtures to be incorporated in the work. Lists shall include manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

Records of Existing Conditions shall be submitted consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work shall constitute acceptance of existing conditions.

As-Built Drawings shall be submitted providing current factual information, including deviations and amendments to the drawings, and concealed and visible changes in the work.

Units shall be provided with the configuration, capacity, and static-pressure characteristics indicated.

Where dimensional data are given, these shall constitute nominal sizing, which shall be adjusted by the manufacturer when necessary to accommodate acoustic material thickness.

Units identical to the proposed units shall have at least 2 years of proven satisfactory field service.

NOTE: Select or delete the following paragraph after checking current "Directory of Air Diffusion Council (ADC-01) Certified Products."

Units and spare parts shall be certified as having been ADC-01 tested and rated.

PART 2 PRODUCTS

2.1 HIGH-PRESSURE DUAL-DUCT MIXING BOXES

Units shall be mechanical constant-volume control type with a mechanical controller that is operated by the entering mixed-airstream and maintains a constant airflow through the unit.

[Units shall be factory preset to deliver air volumes indicated.]

2.1.1 Construction

Unit shall be factory assembled, complete with casing, air mixing valve assembly, single air mixing valve operator, and mechanical constant-volume control, ready for field mounting and connection to control.

Casing exterior shall be not less than 0.040-inch 1 millimeter thick aluminum, or 20-gage mill-galvanized steel with not less than 1.25 ounces of zinc per square foot 380 grams per square meter of two-sided surface, conforming to ASTM A 527/A 527M.

Casing interior shall be acoustically baffled and lined with fibrous glass thick enough to attain required sound power level performance and preclude condensation on any exterior surface, but in no case less than 1 inch 25 millimeter. Air side of fibrous glass shall be chloroprene-impregnated and manufactured to resist delamination or surface erosion at air velocities to 4,000 feet per minute 20 meter per second. Liner edges exposed to airstream shall be protected by metal turnovers. Liner and fibrous-glass baffle material shall conform to NFPA 90A.

Inlet valves and connecting linkage shall be constructed for modulation by a single operator. Hot inlet valve shall be normally open, and the cold inlet valve shall be normally closed. Hot and cold inlet ports shall be field reversible.

[Mechanical constant-volume control shall be externally adjustable and shall have a cubic feet-per-minute meter per second graduated capacity scale, which also indicates minimum/maximum range of the unit.]

[Mechanical constant-volume control shall be externally adjustable. A calibration chart shall be provided with each unit indicating capacity per revolution of mechanical constant-volume device. Each unit shall be labeled with minimum/maximum volume range to facilitate field adjustment.]

Components subject to friction shall have oil-impregnated bronze bearings, graphite-impregnated or lubricant-impregnated nylon bearings; and lubricant-impregnated elastomers, corrosion-resistant steel, and similar materials.

Casing shall be fitted with rigid, airtight access panels, easily removable and of ample size to give free access to interior parts. Closure shall be achieved by spring-retained, quarter-turn, slotted-cam captive devices, or similar operating fasteners.

Calking compounds shall be chloroprene, polyurethane polysulfides, or silicone elastomers. Gaskets shall be chloroprene, polyurethane, or vinyl.

2.1.2 Casing Leakage

Casing joints shall be sealed to prevent leakage of more than 2 percent of rated capacity with all connections sealed and with an internal static pressure of 1 inch wg 250 pascal.

2.1.3 Inlet Valve Leakage

Leakage in fully closed valve position shall not exceed 2 percent of unit rated capacity against inlet pressure of 8 inches wg 2000 pascal.

2.1.4 Mixed-Air Temperature Requirements

A thermometer traverse of all unit outlets shall show variation of not more than 5 percent of the difference, at the time, between the temperatures of equal quantities of cold and warm airstreams entering the unit.

2.1.5 Volume Control Requirements

Mechanical constant-volume control shall maintain design volume within plus or minus 5 percent, regardless of the modulation position of inlet valves or the fluctuation of inlet or outlet pressure, within limits of indicated minimum pressure.

2.1.6 Sound Level Requirements

NOTE: Select the first of the two paragraphs pertaining to airborne noise only when acceptable NC levels or space attenuation requirements are not a part of the specification.

Select the second of the two paragraphs pertaining to airborne noise as well as casing radiated noise when acceptable NC levels or space attenuation requirements are not a part of the specification.

Rewrite if ceiling construction sound transmission loss is different from that specified. NC 40 shall be specified as a limiting factor when no criteria are specified.

[When determining equipment sound-power level performance and when no space-attenuation criteria are given, 18-dB space attenuation shall be assumed in all octave bands. Manufacturer shall take into account sound correction factors for equipment, such as multiple-terminal air device outlets and attenuation due to any duct lining using sound absorption values specified in Section 15083 DUCT INSULATION paragraph entitled, "Acoustic Duct Lining."]

[Unit shall meet the airborne and radiated sound-power level (PWL) requirements scheduled, to attain the specified NC levels. An 18-dB space attenuation shall be assumed in all octave bands with consideration given to downstream duct construction and configuration in determining airborne NC levels.]

The following ceiling sound-transmission loss (TL) characteristics, based on 1-inch 25 millimeter acoustic lay-in panels and T-bar suspension, shall be assumed in computing resultant space radiated NC levels:

<u>OCTAVE BAND</u>	<u>2ND</u>	<u>3RD</u>	<u>4TH</u>	<u>5TH</u>	<u>6TH</u>	<u>7TH</u>
PWL-TL	-2	-4	-9	-10	-13	-15

[NC40 shall be the limiting factor.]

2.1.7 Control Requirements

Operating-control power source shall be dry, compressed air of instrument quality at 15 pounds per square inch, gage 100 kilopascal, unless otherwise approved.

Air mixing valve operator shall be provided by the automatic temperature control manufacturer and installed by the unit manufacturer, unless field installation for specific construction is approved. Operator shall be controlled by a direct-acting thermostat.

Pneumatic control tubing shall be copper and shall be brought to the exterior of the casing for connection to automatic temperature control system.

2.2 LOW-PRESSURE DUAL-DUCT MIXING BOXES

NOTE: Drawings and schedules shall portray system dynamics so that equipment functions as required.

Units shall be manual-damper volume control type. A calibration chart shall be provided with each unit. Each unit shall be labeled with capacity minimum/maximum range to facilitate field adjustment.

Volume control damper shall be externally adjustable over an inlet pressure range of 0.05 to 1 inch wg 12 to 250 pascal.

Components subject to friction shall have oil-impregnated bronze bearings, graphite-impregnated nylon bearings, and lubricant-impregnated elastomers, corrosion-resistant steel, and similar materials.

Casing shall be fitted with rigid, airtight access panels, easily removable, and of ample size to give free access to interior parts. Closure shall be achieved by spring-retained, quarter-turn, slotted-cam captive devices or similar operating fasteners.

Calking compounds shall be chloroprene, polyurethane polysulfides, or silicone elastomers. Gaskets shall be chloroprene, polyurethane, or vinyl.

2.2.1 Casing Leakage

Casing joints shall be sealed to prevent leakage of more than 2 percent of rated capacity, with all connections sealed and with an internal static pressure of 1 inch wg 250 pascal.

2.2.2 Inlet Valve Leakage

Leakage in fully closed valve position shall not exceed 2 percent of unit rated capacity against inlet pressure of 1 inch wg 250 pascal.

2.2.3 Mixed-Air Temperature Requirements

A thermometer traverse of all unit outlets shall show variation of not more than 5 percent of the difference, at the time, between the temperatures of equal quantities of cold and warm airstreams entering the unit.

2.2.4 Sound Level Requirements

NOTE: When no acceptable noise criteria level is specified, NC 40 shall be specified as the limiting factor.

When determining equipment sound power level performance when no space-attenuation criteria are given, 18-dB space attenuation shall be assumed in all octave bands. Manufacturer shall take into account sound correction factors for equipment such as multiple-terminal air device outlets and attenuation due to any duct lining using sound absorption values specified in Section 15083 DUCT INSULATION paragraph entitled, "Acoustic Duct Lining."

2.2.5 Control Requirements

Operating-control power source shall be dry, compressed air of instrument quality at 15 psig 100 kilopascal, unless otherwise approved.

Air mixing valve operator shall be provided by the automatic temperature control manufacturer and installed by the unit manufacturer, unless field installation for specific construction is approved. Operator shall be controlled by a direct-acting thermostat.

Pneumatic control tubing shall be copper and shall be brought to the exterior of the casing for connection to automatic temperature control system.

2.3 SINGLE DUCT, CONSTANT VOLUME, TERMINAL REHEAT UNITS

Units shall include a casing, volume regulators, sound attenuating thermal insulation, and heating coils.

2.3.1 Casing

Unit casings shall be constructed of 0.040-inch 1 millimeter aluminum or 22-gage 0.76 millimeter mill-galvanized steel and shall contain removable panels for access to interior parts. Units shall be insulated internally with 1/2-inch 13 millimeter thick mineral-fiber thermal and acoustic insulation, conforming to NFPA 90A.

NOTE: Select or rewrite following paragraph to include limiting data.

[Unit shall contain sound-attenuation provisions including baffles to minimize unit-created noise.]

2.3.2 Regulators

NOTE: Coordinate with controls hereunder.

Units shall contain a mechanical constant-air volume control designed to operate by inlet air pressure without outside power. Regulators shall be constructed of nonferrous parts and shall be guaranteed to maintain delivered air volume at plus or minus 5 percent of unit rating.

2.3.3 Coils

Water coils shall be constructed of not less than 3/8-inch DN10 outside diameter seamless copper tubing with copper- or aluminum-plate fins mechanically bonded or soldered to the tubes, and with not less than 5/8-inch DN18 outside diameter female solder connectors and manual air vent on return. Provisions shall be made for coil removal in field.

Distance between coil and upstream inlet valve shall ensure uniform air velocities over face of coil.

Provide a maximum of four coil rows, and spaced ten fins per inch 25.4 millimeter maximum.

2.3.4 Controls

Reheat output shall be controlled by a room thermostat designed to modulate the water flow in the coil by positioning a three-way valve.

2.4 VARIABLE CONSTANT-VOLUME BOXES

Provide boxes of double wall construction with one inch thick insulation, which meets NFPA 90B, between the inner and outer walls. Outer casing shall be minimum 22-gage 0.76 millimeter galvanized steel. Inner layers shall be minimum 26 gage galvanized or phosphatized steel. The casings shall be provided with a double walled, insulated access door to allow inspection, maintenance and removal of the control valve/damper, actuator system, and heating coil.

Casing shall be fabricated from galvanized steel and shall have internal thermal and acoustic insulation. Insulation shall be coated to prevent erosion and shall conform to NFPA 90A.

Sound baffles shall be provided within the box to provide sound levels within the limits scheduled. Sound levels shall be tested in accordance with ANSI S12.23. An 8-dB room attenuation shall be used in determining the NC level. Allowances shall be made for multiple outlets (power division) and duct attenuation.

Casing internal leakage shall be limited to 2 percent of nominal box capacity when the internal pressure is 1 inch wg 250 pascal.

Casing shall be constructed of 0.040-inch 1 millimeter aluminum or 22-gage 0.76 millimeter mill-galvanized steel and shall contain removable panels for access to interior parts. Units shall be insulated internally with

1/2-inch 13 millimeter thick mineral-faced thermal and acoustic insulation, conforming to NFPA 90A.

Casing shall be fitted with rigid, airtight access panels, easily removable, and of ample size to give free access to all interior parts.

Label each box with building location and factory-set air volume or field-set calibration curve.

Certify air terminal units and variable constant-volume boxes to meet ARI 880.

2.4.1 Low Velocity Boxes

Inlet valve shall be self-seating, and leakage in full closed position shall not exceed 2 percent of unit rated capacity against inlet pressure of 1 inch wg 250 pascal.

2.4.2 Medium and High Velocity Boxes

Box shall be supplied with variable constant-volume regulator consisting of aluminum and coated-steel frame with aluminum vanes, corrosion-resistant steel adjusting spring, and neoprene pulsation snubber.

Volume reset shall be by pneumatic operator mounted directly on the variable constant-volume regulator.

Variable constant-volume regulator shall be factory set for an air capacity within plus 5 percent of the indicated maximum and minimum air quantities, regardless of variations in inlet static pressure from minimum to 6 inches wg 1500 pascal.

Minimum air capacity shall be a percentage of the maximum air capacity indicated and shall be easily changed in the field.

A calibration chart indicating 100 percent air capacity versus adjusting screw shall be furnished with each box.

2.4.3 Control Requirements

Operating-control power source shall be dry, compressed air at 15 psig 100 kilopascal, unless otherwise approved.

Valve operator shall be provided by the automatic temperature control manufacturer and installed by the unit manufacturer, unless field installation for specific construction is approved. Operator shall be controlled by a thermostat.

Pneumatic control tubing shall be copper and shall be brought to the exterior of the casing for connection to automatic temperature control system.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed as shown on the drawings and in accordance with the manufacturer's recommendations.

Listing of Product Installations for the following items shall include identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. List shall include purchaser, address of installation, service organization, and date of installation.

3.2 TESTS

Coils shall be tested under water at 150 percent of the working pressure or 300 psig for 200 pounds per square inch 2050 kilopascal for 1400 kilopascal working pressure.

Reports for High-Pressure Ductwork, Duct Mixing Boxes, Low Pressure Ductwork and Variable and Constant Volume Boxes shall include sound ratings submitted in terms of discharge sound-power levels in each of the second through sixth octave bands for specified or indicated inlet pressure ranges. A nominal space Noise Criteria (NC) index shall be shown for at least three operating points, including ratings at design, maximum, and minimum volume operation.

Reports for Terminal Reheat Units shall include sound-power levels, decibel reference 10 to the minus 12 power watts for each of the second through seventh octave bands, and for inlet pressures of 1 through 6 inches water gage (wg) 250 through 1500 pascal for all operating conditions. A nominal space NC sound-pressure level index shall be shown for each of at least three volume ratings, including minimum and maximum. Index shall be the highest point of NC rating after deducting 18-decibel; (dB) room attenuation from the sound-power level in each octave band.

3.3 OPERATION AND MAINTENANCE

Contractor shall submit [6] [_____] copies of the Operation and Maintenance Manuals 30 calendar days prior to testing the following items. Data shall be updated and resubmitted for final approval no later than 30 calendar days prior to contract completion.

-- End of Section --