

# Suggested Specifications

## Price Single Duct Terminal Units

### Division 23 – Heating, Ventilating, and Air Conditioning

#### Section 23 36 00 – Air Terminal Units

The following specification is for a defined application. Price would be pleased to assist in developing a specification for your specific need.

#### PART 1 – GENERAL

##### 1.01 Section Includes

- A. Single-duct terminal units.

##### 1.02 Related Requirements

- A. Section 01 40 00 - Quality Requirements
- B. Section 01 74 19 - Construction Waste Management and Disposal
- C. Section 01 78 00 - Closeout Submittals
- D. Section 01 79 00 - Demonstration and Training
- E. Section 23 09 93 - Sequence of Operations for HVAC Controls.
- F. Section 23 21 13 - Hydronic Piping: Connections to heating coils.
- G. Section 23 21 14 - Hydronic Specialties: Connections to heating coils.
- H. Section 23 31 00 - HVAC Ducts and Casings.
- I. Section 23 33 00 - Air Duct Accessories.
- J. Section 23 37 00 - Air Outlets and Inlets.
- K. Section 23 82 00 - Convection Heating and Cooling Units: Air coils.
- L. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

##### 1.03 Reference Standards

- A. All referenced standards and recommended practices in this section pertain to the most recent publication thereof, including all addenda and errata.
- B. AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.
- C. AHRI 880 - Performance Rating of Air Terminals.
- D. AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.
- E. ASHRAE 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- F. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.
- G. ASHRAE 130 - Methods of Testing for Rating Ducted Air Terminal Units.
- H. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- I. ASTM C1338 Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- K. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements.
- L. CSA C22.2 No. 236 – Heating and Cooling Equipment.
- M. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- N. NFPA 70 - National Electrical Code.
- O. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.
- P. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
- Q. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.
- R. UL 1995 – Standards for Heating and Cooling Equipment.

##### 1.04 Administrative Requirements

- A. Pre-installation Meeting: Conduct a pre-installation meeting one week prior to the start of the work of this section, and require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and efficient manner.

##### 1.05 Submittals

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data shall be provided with data indicating configuration, general assembly, and materials used in fabrication, including catalog performance ratings that indicate air flow, static pressure, NC designation, electrical characteristics, and connection requirements.
- C. Shop Drawings shall indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
  - 1. Manufacturer shall include schedules listing discharge and radiated sound power level for each of the second through seventh octave bands (125 – 4000 Hertz) at specified differential static pressures.
- D. Manufacturer shall include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures from 1 to 4 inch water gauge.

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- E. Certificates shall be issued to certify that the air coil capacities, pressure drops, and selection procedures meet or exceed specified requirements or coils are tested and rated in accordance with AHRI 410.
- F. Manufacturer's Installation Instructions shall indicate support and hanging details, installation instructions, recommendations, and service clearances required.
- G. Project Record Documents shall record actual locations of units and controls components and locations of access doors.
- H. Operation and Maintenance Data shall include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
- I. Maintenance Materials shall be furnished for the Owner's use in maintenance of the project.

## 1.06 Quality Assurance

- A. Manufacturer Qualifications shall be specified in this section, with minimum ten years of documented experience.
- B. Product Listing Organization Qualifications: The manufacturer shall be listed with an organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.07 Warranty

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide 18 month manufacturer warranty from date of shipment for air terminal units, integral sound attenuators, integral heating coils, and integral controls.

## PART 2 – PRODUCTS

### 2.01 Single-Duct Terminal Units

- A. Basis of Design: Price Industries, Inc.
  - 1. Single-Duct Terminal Unit: SDV (direct digital controls).
  - 2. Quiet Single-Duct Terminal Unit: SDVQ (direct digital controls).
  - 3. Low Profile Single-Duct Terminal Unit: SDVLP (direct digital controls).
- B. Performance Requirements:
  - 1. The assemblies shall be pressure independent and shall reset to any air flow between zero and the maximum cataloged air volume. Sound ratings of air distribution assemblies: Not to exceed \_\_\_\_ NC at \_\_\_\_ inlet static pressure, with a downstream static pressure of \_\_\_\_.
  - 2. Use attenuation values found in AHRI 885 Appendix E.
- C. General:
  - 1. The terminal units shall be factory-assembled, AHRI 880 rated and bearing the AHRI seal for an air volume control terminal with damper assembly and flow sensor.

### 2.02 Single-Duct Terminal Units, Standard

- A. Description:
  - 1. Furnish and install Price model [SDV] single duct terminal units in the sizes and configurations as indicated on the plans.
- B. Unit Casing:
  - 1. The unit casing shall be constructed of a minimum 22 gauge, 0.032 inch galvanized steel.
    - a. The casing shall be assembled with longitudinal lock seam construction.
    - b. Casing leakage shall be tested in accordance with ASHRAE 130.
    - c. Casing leakage for the basic assembly shall not exceed 1.0 percent of the maximum rated airflow at 1.0 inches of water gauge.
    - d. Casing leakage for the basic assembly shall not exceed 2.0 percent of the maximum rated airflow at 3.0 inches of water gauge.
- C. Unit Discharge:
  - 1. Manufacturer shall provide rectangular unit discharges with slip-and-drive connections.
- D. Liners:
  - 1. Standard:
    - a. Fiberglass Liner - FG.
      - 1. Insulation shall comply with the requirements of UL 181 (erosion), ASTM C1338 (fungi resistance), ASHRAE 62.1, and ASTM C1071, having a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
      - 2. The insulation shall be secured with adhesive.
      - 3. Insulation edges exposed to the airstream shall be coated with NFPA 90A approved sealant.
      - 4. Insulation thickness shall be (**select one**):

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- a. 1/2 inch thick, R-value of 2.1.
  - b. R-value of 3.2.
  - c. 1 inch thick, R-value of 4.1.
5. Optional:
- a. Fiber-Free Foam Insulation - FF.
    1. Insulation shall comply with the requirements of UL 181 (erosion, mold growth and humidity) and ASHRAE 62.1, and shall have a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
    2. The insulation shall be secured with adhesive.
    3. Insulation thickness shall be (**select one**):
      - a. 1/2 inch thick, R-value of 2.0.
      - b. 3/4 inch thick, R-value of 3.0.
      - c. 1 inch thick, R-value of 4.0.
  - b. Foil Board Liner - FB.
    1. Insulation shall comply with the requirements of UL 181 (erosion, mold growth and humidity) and ASHRAE 62.1, and shall have a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
    2. The insulation shall be secured with adhesive.
    3. Insulation edges exposed to airstream shall be coated with NFPA 90A approved sealant.
    4. Insulation thickness shall be (**select one**):
      - a. 5/8 inch thick, R-value of 2.6.
      - b. 1 inch thick, R-value of 4.2.
- E. Primary Air Damper Assembly:
1. The damper assembly shall be heavy-gauge, galvanized steel with a solid shaft rotating in bearings.
  2. The damper shaft shall incorporate a visual position indicator etched into the end of the damper shaft to clearly indicate damper position over the full range of 90 degrees.
  3. The damper shaft shall be mounted on the [left], [right], [top], or [bottom] of the damper when looking in the direction of airflow.
  4. The 18 gauge damper assembly shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.
  5. Air leakage past the closed damper shall not exceed 2 percent of the unit maximum rated airflow at 3.0 inch water gauge inlet static pressure, tested in accordance with ASHRAE 130.
  6. The damper, seal, and bearing system shall be tested to 1.25 million cycles, or the equivalent of 100 full open/closures per day for 35 years, with no visible signs of wear, tear, or failure of the damper assembly after such testing.
- F. Airflow Sensor:
1. The airflow sensor shall be a differential pressure airflow device measuring total and static pressures, and mounted to the inlet valve.
  2. Plastic parts shall be fire-resistant, complying with UL 94.
  3. The airflow sensor shall be RoHS (Restriction of Hazardous Substances) compliant. Material containing polybrominated compounds shall not be acceptable.
  4. Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.
  5. The airflow sensor shall be furnished with twelve total pressure sensing ports and four static pressure sensing ports, and shall include a center averaging chamber that amplifies the sensed airflow signal.
  6. After balancing, the airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.
- G. Inlet Valve - Standard:
1. The inlet valve shall be a consistent diameter to retain flex duct and provide a stop for hard duct.
  2. The inlet valve shall include a 1/8 inch raised single bead weld for added strength.
  3. The gasket seal shall be a low leakage continuous piece with a peripheral gasket for tight airflow shutoff.
  4. The inlet valve shall include two heavy duty stop pins to accurately position the damper in the closed and open positions.
- H. Options:
1. Bottom Access Door:
    - a. The unit shall be supplied with a 4 inch x 6-3/4 inch bottom access door, secured to the casing with (**select one**):
      1. Screws.
      2. Snap latches.
      3. Quarter turn sash latches.
  2. Hot Water Heating Coil:
    - a. The hot water coil casing shall be constructed from a minimum 22 gauge, 0.032 inch galvanized steel, factory-installed on the terminal discharge with slip-and drive attachment for downstream ductwork.
      1. An optional gasketed access door shall be provided, located on bottom of unit.
      2. Coil handing shall be specified as [right hand] or [left hand] when looking into the coil inlet in the direction of airflow.
      3. The water coil shall be supplied with an access door located:

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- a. Upstream of the water coil in the terminal casing.
    - b. Downstream of the water coil in a common casing with the coil.
  4. The water coil access door shall be secured to the casing with **(select one)**:
    - a. Screws.
    - b. Snap latches.
    - c. Quarter turn sash latches.
  - b. The water coil fins shall be 0.0045 inch aluminum fins, mechanically-bonded to seamless 0.50 by 0.016 inch copper tubes.
    1. Fins shall be formed in a high heat transfer sine wave configuration.
    2. Standard coil shall be a 10 fins-per-inch fin construction.
    3. High capacity coil shall be a 12 fins-per-inch fin construction.
  - c. All water coils shall be hydrostatically tested to a minimum 390 pounds per square inch, with a minimum burst pressure of 1800 pounds per square inch at ambient temperature. All water coils are rated for a maximum of 300 pounds per square inch working pressure at 200 degrees Fahrenheit.
  - d. The water coil shall be certified in accordance with AHRI 410 and units shall bear an AHRI 410 label.
    1. An optional oversized casing shall be upsized to increase heat transfer with low supply water temperatures while reducing air side pressure drop.
3. Electric Heating Coil:
  - a. The electric heating coil shall be ETL listed to UL 1995 and CSA 22.2, and provided by the terminal unit manufacturer.
  - b. The electric coil casing shall be constructed from a minimum 20 gauge, 0.038 inch galvanized steel.
  - c. The heating elements shall be open wire nickel chrome construction, supported by ceramic insulators.
  - d. The integral control panel shall be a NEMA 250, Type 1 enclosure with hinged access door for access to all controls and safety devices.
  - e. The electric coils shall be provided with a primary automatic reset thermal cutout, a manual reset thermal cutout, and a differential pressure airflow switch for proof of airflow.
  - f. (Optional) The electric coils shall be provided with a non-fused door interlocking disconnect switch.
  - g. (Optional) The electric coils shall be provided with a silicon-controlled rectifier (SCR) controller.
  - h. (Optional) The electric coils shall be provided with insulation. Fiber free foam insulation not available.
4. Sound Attenuator:
  - a. The manufacturer shall supply sound attenuators to meet scheduled acoustical performance requirements. The attenuators shall be supplied in the following configuration **(select one)**:
    1. Three foot integral discharge attenuator (ATT).
    2. Three foot discharge attenuator supplied as a separate piece (ATTSP).
    3. Five foot integral discharge attenuator (ATT5).
    4. Five foot discharge attenuator supplied as a separate piece (ATT5SP).
5. Control Transformers:
  - a. The terminal unit shall be supplied with a factory mounted 50 VA control transformer.
6. Low Leakage Construction:
  - a. The terminals shall be provided with factory certified low leakage construction up to [three], [four], or [six] inches water gauge internal pressure.
  - b. Inlet dampers shall exhibit leakage rates of less than **(select one)**:
    1. 0.5% of maximum nominal catalog airflow for CLL3
    2. 0.75% of maximum nominal catalog airflow for CLL4
    3. 1% of maximum nominal catalog airflow for CLL6
  - c. Single duct casings shall exhibit external leakage rates of less than **(select one)**:
    1. 1% of maximum nominal catalog airflow for CLL3
    2. 1% of maximum nominal catalog airflow for CLL4
    3. 1.5% of maximum nominal catalog airflow for CLL6
  - d. Terminals with low leakage construction shall include the following design features:
    1. The access door shall be supplied with compression style gasketing and quarter turn latches.
    2. The unit casing shall be flanged and gasketed at all external casing seams.
    3. All production units shall be individually factory tested to ensure compliance with project specific leakage requirements.
    4. Leakage test results shall be documented on a label affixed to each certified low leakage unit.
- I. Electrical Requirements:
  1. Single duct terminal units shall be provided with single-point power connection.
  2. The terminal unit equipment wiring shall comply with the requirements of NFPA 70.
- J. Controls:
  1. See Section 23 09 13 - Instrumentation and Control Devices for HVAC: Thermostats and actuators for controls requirements.

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## K. Controls Sequence:

1. See Section 23 09 93 - Sequence of Operations for HVAC Controls for controls sequence requirements.

## 2.03 Low Profile Single-Duct Terminal Units

### A. Description:

1. Furnish and install Price model [SDVLP] single duct terminal units in the sizes and configurations as indicated on the plans.

### B. Unit Casing:

1. The unit casing shall be constructed of a minimum 22 gauge, 0.032 inch galvanized steel.
  - a. The casing shall be assembled with longitudinal lock seam construction.
  - b. Low profile single-duct terminals units [SDVLP] shall have a maximum casing height of 10 inches.

### C. Unit Discharge:

1. Manufacturer shall provide rectangular unit discharges with slip-and-drive connections.

### D. Liners:

#### 1. Standard:

##### a. Fiberglass Liner - FG.

1. Insulation shall comply with the requirements of UL 181 (erosion), ASTM C1338 (fungi resistance), ASHRAE 62.1, and ASTM C1071, having a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
2. The insulation shall be secured with adhesive.
3. Insulation edges exposed to the airstream shall be coated with NFPA 90A approved sealant.
4. Insulation thickness shall be (**select one**):
  - a. 1/2 inch thick, R-value of 2.1.
  - b. 3/4 inch thick, R-value of 3.2.

#### 2. Optional:

##### a. Fiber-Free Foam Insulation - FF.

1. Insulation shall comply with the requirements of UL 181 (erosion, mold growth and humidity) and ASHRAE 62.1, and shall have a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
2. The insulation shall be secured with adhesive.
3. Insulation thickness shall be (**select one**):
  - a. 1/2 inch thick, R-value of 2.0.
  - b. 3/4 inch thick, R-value of 3.0.

##### b. Foil Board Liner - FB.

1. Insulation shall comply with the requirements of UL 181 (erosion, mold growth and humidity) and ASHRAE 62.1, and shall have a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
2. The insulation shall be secured with adhesive.
3. Insulation edges exposed to airstream shall be coated with NFPA 90A approved sealant.
4. Insulation thickness shall be (**select one**):
  - a. 5/8 inch thick, R-value of 2.6.

### E. Primary Air Damper Assembly:

1. The damper assembly shall be heavy-gauge, galvanized steel with a solid shaft rotating in bearings.
2. The damper shaft shall incorporate a visual position indicator etched into the end of the damper shaft to clearly indicate damper position over the full range of 90 degrees.
3. The damper shaft shall be mounted on the [left], [right], [top], or [bottom] of the damper when looking in the direction of airflow.
4. The 18 gauge damper assembly shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.
5. The damper, seal, and bearing system shall be tested to 1.25 million cycles, or the equivalent of 100 full open/closures per day for 35 years, with no visible signs of wear, tear, or failure of the damper assembly after such testing.

### F. Airflow Sensor:

1. The airflow sensor shall be a differential pressure airflow device measuring total and static pressures, and mounted to the inlet valve.
2. Plastic parts shall be fire-resistant, complying with UL 94.
3. The airflow sensor shall be RoHS (Restriction of Hazardous Substances) compliant. Material containing polybrominated compounds shall not be acceptable.
4. Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.
5. The airflow sensor shall be furnished with twelve total pressure sensing ports and four static pressure sensing ports, and shall include a center averaging chamber that amplifies the sensed airflow signal.
6. After balancing, the airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.

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## G. Inlet Valve – Low Profile:

1. The inlet valve shall be a consistent diameter to retain flex duct and provide a stop for hard duct for all units with inlet sizes four to eight inches in diameter. Inlets larger than eight inches in diameter shall be supplied as rectangular type inlets.
2. Round inlet valves shall include a 1/8 inch raised single bead weld for added strength.
3. The gasket seal shall be a low leakage continuous piece with a peripheral gasket for tight airflow shutoff.
4. The inlet valve shall include two heavy duty stop pins to accurately position the damper in the closed and open positions.

## H. Options:

### 1. Bottom Access Door:

- a. The unit shall be supplied with a 4 inch x 6-3/4 inch bottom access door, secured to the casing with **(select one)**:
  1. Screws.
  2. Snap latches.
  3. Quarter turn sash latches.

### 2. Hot Water Heating Coil:

- a. The hot water coil casing shall be constructed from a minimum 22 gauge, 0.032 inch galvanized steel, factory-installed on the terminal discharge with slip-and drive attachment for downstream ductwork.
  1. An optional gasketed access door shall be provided, located on bottom of unit.
  2. Coil handing shall be specified as [right hand] or [left hand] when looking into the coil inlet in the direction of airflow.
  3. The water coil shall be supplied with an access door located:
    - a. Upstream of the water coil in the terminal casing.
    - b. Downstream of the water coil in a common casing with the coil.
  4. The water coil access door shall be secured to the casing with **(select one)**:
    - a. Screws.
    - b. Snap latches.
    - c. Quarter turn sash latches.
- b. The water coil fins shall be 0.0045 inch aluminum fins, mechanically-bonded to seamless 0.50 by 0.016 inch copper tubes.
  1. Fins shall be formed in a high heat transfer sine wave configuration.
  2. Standard coil shall be a 10 fins-per-inch fin construction.
  3. High capacity coil shall be a 12 fins-per-inch fin construction.
- c. All water coils shall be hydrostatically tested to a minimum 390 pounds per square inch, with a minimum burst pressure of 1800 pounds per square inch at ambient temperature. All water coils are rated for a maximum of 300 pounds per square inch working pressure at 200 degrees Fahrenheit.
- d. The water coil shall be certified in accordance with AHRI 410 and units shall bear an AHRI 410 label.
  1. An optional oversized casing shall be upsized to increase heat transfer with low supply water temperatures while reducing air side pressure drop.

### 3. Electric Heating Coil:

- a. The electric heating coil shall be ETL listed to UL 1995 and CSA 22.2, and provided by the terminal unit manufacturer.
- b. The electric coil casing shall be constructed from a minimum 20 gauge, 0.038 inch galvanized steel.
- c. The heating elements shall be open wire nickel chrome construction, supported by ceramic insulators.
- d. The integral control panel shall be a NEMA 250, Type 1 enclosure with hinged access door for access to all controls and safety devices.
- e. The electric coils shall be provided with a primary automatic reset thermal cutout, a manual reset thermal cutout, and a differential pressure airflow switch for proof of airflow.
- f. (Optional) The electric coils shall be provided with a non-fused door interlocking disconnect switch.
- g. (Optional) The electric coils shall be provided with a silicon-controlled rectifier (SCR) controller.
- h. (Optional) The electric coils shall be provided with insulation. Fiber free foam insulation not available.

### 4. Sound Attenuator:

- a. The manufacturer shall supply sound attenuators to meet scheduled acoustical performance requirements. The attenuators shall be supplied in the following configuration **(select one)**:
  1. Three foot integral discharge attenuator (ATT).
  2. Three foot discharge attenuator supplied as a separate piece (ATTSP).
  3. Five foot integral discharge attenuator (ATT5).
  4. Five foot discharge attenuator supplied as a separate piece (ATT5SP).

### 5. Control Transformers:

- a. The terminal unit shall be supplied with a factory mounted 50 VA control transformer.

## I. Electrical Requirements:

1. Single duct terminal units shall be provided with single-point power connection.
2. The terminal unit equipment wiring shall comply with the requirements of NFPA 70.

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## J. Controls:

1. See Section 23 09 13 - Instrumentation and Control Devices for HVAC: Thermostats and actuators for controls requirements.

## K. Controls Sequence:

1. See Section 23 09 93 - Sequence of Operations for HVAC Controls for controls sequence requirements.

## 2.04 Quiet Single-Duct Terminal Units

### A. Description:

1. Furnish and install Price model SDVQ quiet single duct terminal units in the sizes and configurations as indicated on the plans.

### B. Unit Casing:

1. The unit casing shall be constructed of a minimum 22 gauge, 0.032 inch galvanized steel.
  - a. The casing shall be assembled with longitudinal lock seam construction.

### C. Unit Discharge:

1. Manufacturer shall provide rectangular unit discharges with slip-and-drive connections.

### D. Liners:

#### 1. Standard:

##### a. Fiberglass Liner - FG.

1. Insulation shall comply with the requirements of UL 181 (erosion), ASTM C1338 (fungi resistance), ASHRAE 62.1, and ASTM C1071, having a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
2. The insulation shall be secured with adhesive.
3. Insulation edges exposed to the airstream shall be coated with NFPA 90A approved sealant.
4. Insulation thickness shall be (**select one**):
  - a. 1/2 inch thick, R-value of 2.1.
  - b. 3/4 inch thick, R-value of 3.2.
  - c. 1 inch thick, R-value of 4.1.

#### 2. Optional:

##### a. Fiber-Free Foam Insulation - FF.

1. Insulation shall comply with UL 181 erosion, mold growth and humidity requirements in accordance with ASHRAE 62.1, and shall have a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
2. The insulation shall be secured with adhesive.
3. Insulation thickness shall be (**select one**):
  - a. 1/2 inch thick, R-value of 2.0.
  - b. 3/4 inch thick, R-value of 3.0.
  - c. 1 inch thick, R-value of 4.0.

##### b. Foil Board Liner - FB.

1. Insulation shall comply with UL 181 erosion, mold growth and humidity requirements in accordance with ASHRAE 62.1, and shall have a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
2. The insulation shall be secured with adhesive.
3. Insulation edges exposed to airstream shall be coated with NFPA 90A approved sealant.
4. Insulation thickness shall be (**select one**):
  - a. 5/8 inch thick, R-value of 2.6.
  - b. 1 inch thick, R-value of 4.2.

### E. Primary Air Damper Assembly:

1. The damper assembly shall be heavy-gauge, galvanized steel with a solid shaft rotating in bearings.
2. The damper shaft shall incorporate a visual position indicator etched into the end of the damper shaft to clearly indicate damper position over the full range of 90 degrees.
3. The damper shaft shall be mounted on the [left], [right], [top], or [bottom] of the damper when looking in the direction of airflow.
4. The 18 gauge damper assembly shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.
5. Air leakage past the closed damper shall not exceed 2 percent of the unit maximum rated airflow at 3.0 inches water gauge inlet static pressure, tested in accordance with ASHRAE 130.
6. The damper, seal, and bearing system shall be tested to 1.25 million cycles, or the equivalent of 100 full open/closures per day for 35 years, with no visible signs of wear, tear, or failure of the damper assembly after such testing.

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## F. Airflow Sensor:

1. The airflow sensor shall be a differential pressure airflow device measuring total and static pressures, and mounted to the inlet valve.
2. Plastic parts shall be fire-resistant, complying with UL 94.
3. The airflow sensor shall be RoHS (Restriction of Hazardous Substances) compliant. Material containing polybrominated compounds shall not be acceptable.
4. Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.
5. The airflow sensor shall be furnished with twelve total pressure sensing ports and four static pressure sensing ports, and shall include a center averaging chamber that amplifies the sensed airflow signal.
6. The airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.

## G. Inlet Valve - Standard:

1. The inlet valve shall be a consistent diameter to retain flex duct and provide a stop for hard duct.
2. The inlet valve shall include a 1/8 inch raised single bead weld for added strength.
3. The gasket seal shall be a low leakage continuous piece with a peripheral gasket for tight airflow shutoff.
4. The inlet valve shall include two heavy duty stop pins to accurately position the damper in the closed and open positions.

## H. Options:

### 1. Bottom Access Door:

- a. The unit shall be supplied with a 4 inch x 6-3/4 inch bottom access door, secured to the casing with (**select one**):
  1. Screws.
  2. Snap latches.
  3. Quarter turn sash latches.

### 2. Hot Water Heating Coil:

- a. The hot water coil casing shall be constructed from a minimum 22 gauge, 0.032 inch galvanized steel, factory-installed on the terminal discharge with slip-and drive attachment for downstream ductwork.
  1. An optional gasketed access door shall be provided, located on bottom of unit.
  2. Coil handing shall be specified as [right hand] or [left hand] when looking into the coil inlet in the direction of airflow.
  3. The water coil shall be supplied with an access door located:
    - a. Upstream of the water coil in the terminal casing.
    - b. Downstream of the water coil in a common casing with the coil.
  4. The water coil access door shall be secured to the casing with (**select one**):
    - a. Screws.
    - b. Snap latches.
    - c. Quarter turn sash latches.
- b. The water coil fins shall be 0.0045 inch aluminum fins, mechanically-bonded to seamless 0.50 by 0.016 inch copper tubes.
  1. Fins shall be formed in a high heat transfer sine wave configuration.
  2. Standard coil shall be a 10 fins-per-inch fin construction.
  3. High capacity coil shall be a 12 fins-per-inch fin construction.
- c. All water coils shall be hydrostatically tested to a minimum 390 pounds per square inch, with a minimum burst pressure of 1800 pounds per square inch at ambient temperature. All water coils are rated for a maximum of 300 pounds per square inch working pressure at 200 degrees Fahrenheit.
- d. The water coil shall be certified in accordance with AHRI 410 and units shall bear an AHRI 410 label.
  1. An optional oversized casing shall be upsized to increase heat transfer with low supply water temperatures while reducing air side pressure drop.

### 3. Electric Heating Coil:

- a. The electric heating coil shall be ETL listed to UL 1995 and CSA 22.2, and provided by the terminal unit manufacturer.
- b. The electric coil casing shall be constructed from a minimum 20 gauge, 0.038 inch galvanized steel.
- c. The heating elements shall be open wire nickel chrome construction, supported by ceramic insulators.
- d. The integral control panel shall be a NEMA 250, Type 1 enclosure with hinged access door for access to all controls and safety devices.
- e. The electric coils shall be provided with a primary automatic reset thermal cutout, a manual reset thermal cutout, and a differential pressure airflow switch for proof of airflow.
- f. (Optional) The electric coils shall be provided with a non-fused door interlocking disconnect switch.
- g. (Optional) The electric coils shall be provided with a silicon-controlled rectifier (SCR) controller.
- h. (Optional) The electric coils shall be provided with insulation. Fiber free foam insulation not available.

### 4. Silencer:

- a. Construction:
  1. Casing shall be constructed of material that matches terminal unit casing and attach to terminal unit with slip and drive connection.
  2. Casing seams and joints shall be lock-formed and sealed, to provide leakage-resistant construction.
  3. Perforated steel shall be adequately stiffened to insure flatness and form. Spot welds shall be painted as required.

# Suggested Specifications

4. Internal baffles shall be provided with a radiused inlet and sloped tail.
  - b. Principal Sound-Absorbing Mechanism:
    1. Packless (No-Media) Silencers:
      - a. Models shall not contain absorptive media. Attenuation shall be achieved with controlled impedance membranes and broadly tuned resonators.
    2. Absorptive (Dissipative) and Film Lined Silencers:
      - a. Standard Acoustic media:
        1. Media shall be of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin. Glass fiber density and compression shall be as required to insure conformance with laboratory test data.
        2. Media shall be packed with a minimum of 15% compression during silencer assembly.
        3. Media shall be resilient such that it will not pull apart during normal applications, and shall resist settling, breakdown, and sagging from vibration. Media shall not rot, mildew, or otherwise deteriorate, and shall have sufficient flexibility to readily form around corners and curved surfaces.
        4. Media shall not cause or accelerate corrosion of aluminum or steel.
        5. Mineral wool is not permitted as a substitute for glass fiber.
  - c. Media Protection:
    1. Dissipative silencers:
      - a. Where indicated on the silencer schedule, media shall be encapsulated in glass fiber cloth to help prevent shedding, erosion and impregnation of the glass fiber.
    2. Film Lined silencers:
      - a. The acoustic media shall be completely wrapped with polymer film to help prevent shedding, erosion and impregnation.
      - b. The wrapped acoustic media shall be separated from the perforated metal by a factory-installed acoustically transparent spacer.
      - c. The spacer shall be flame retardant and erosion resistant.
      - d. Mesh, screen or corrugated perforated liner will not be acceptable as a substitute for the specified spacer.
      - e. Silencer manufacturer shall provide a written test report showing silencer assemblies have Class 1 flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.
5. Control Transformers:
    - a. The terminal unit shall be supplied with a factory mounted 50 VA control transformer.
- I. Electrical Requirements:
    1. Single duct terminal units shall be provided with single-point power connection.
    2. The terminal unit equipment wiring shall comply with the requirements of NFPA 70.
  - J. Controls:
    1. See Section 23 09 13 - Instrumentation and Control Devices for HVAC: Thermostats and actuators for controls requirements.
  - K. Controls Sequence:
    1. See Section 23 09 93 - Sequence of Operations for HVAC Controls for controls sequence requirements.

# Suggested Specifications

## PART 3 – EXECUTION

### 3.01 Examination

- A. Verify that conditions are suitable for installation.
- B. Verify that field measurements are as shown on the drawings.

### 3.02 Installation

- A. Install the terminal units in accordance with the manufacturer's instructions.
- B. Install the inlets of the air terminal units with the air flow sensors a minimum of three duct diameters from elbows, transitions, and duct takeoffs.
- C. See drawings for the size(s) and duct location(s) of the air terminal units.
- D. Provide ceiling access doors or locate units above easily removable ceiling components.
- E. Support the terminal units individually from the structure.
- F. Embed anchors in concrete in accordance with ASTM E488/E488M.
- G. Do not support the terminal units from the ductwork.
- H. Connect the terminals to the ductwork in accordance with Section 23 31 00.
- I. Install heating coils in accordance with Section 23 82 00.
- J. Verify that electric power is available and of the correct characteristics.

### 3.03 Adjusting

- A. Ensure the damper operator attached to the assembly allows full modulation of flow range from 100 percent of design flow to zero.

### 3.04 Field Quality Control

- A. See Section 01 40 00 - Quality Requirements, for additional quality requirements.

### 3.05 Cleaning

- A. See Section 01 74 19 - Construction Waste Management and Disposal for additional cleaning requirements.

### 3.06 Closeout Activities

- A. See Section 01 78 00 - Closeout Submittals for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training for additional closeout requirements.