# Suggested Specifications

# Fan Powered Terminal Units, Series Flow – Standard Profile

# 35S Series

## Model 35S • Series Flow (Constant or Variable Volume)

1. Furnish and install constant or variable volume series fan powered terminal units of the sizes and capacities as indicated on the drawings. Units shall be pressure independent with (digital electronic, analog electronic, pneumatic) controls. Units shall be manufactured by **Nailor Industries Inc.** model **35S**.

2. The entire terminal unit shall be designed and built as a single unit. The units shall be provided with a primary variable air volume damper that controls the air quantity in response to a (electronic, pneumatic) thermostat. The space limitations shall be reviewed carefully to ensure that all units will fit into the space allowed.

3. Unit casings shall be space frame construction utilizing 18 ga. (1.31) galvanized steel corner structural members and 20 ga. (1.00) galvanized steel panels. Unit shall be fully lined with fiberglass insulation which shall be at least 3/4" (19) thick dual density insulation complying with NFPA 90 for fire and smoke resistivity and UL 181 for erosion. Any cut edges of insulation shall be coated with NFPA 90 approved sealant.

4. Unit casing shall have four access panels, one on each side of the unit and one on the bottom and top for easy access to motor and blower assembly and for maintenance and replacement of parts without disturbing duct connections. The unit shall be rated to operate in left hand or right hand mode by turning the unit over. Access panels shall be attached to casing with (screws, quick acting latches, hinges). Casing leakage shall not exceed 2% of terminal rated airflow at 0.5" w.g. (125 Pa) interior casing pressure. All high side casing joints shall be sealed with approved sealant and high side casing leakage shall not exceed 2% of terminal rated airflow at 3" w.g. (750 Pa).

5. Units shall have round inlets for the primary air connections and shall have a 6" (152) deep inlet duct collar for field connection. The outlets shall be rectangular and suitable for flanged duct connections. Casing shall have mounting area for hanging by sheet metal straps from a concrete slab.

6. The damper shall be of rectangular, multiple inclined opposed blade construction and designed to operate on a 45° arc. Blades shall be minimum 16 ga. (1.61) galvanized steel, single thickness construction with heavy duty gasket glued to the blades. The blades shall be screwed through the damper shaft to ensure that no slippage occurs. Blade shafts shall pivot on corrosion free bearings. Damper leakage shall not exceed 2% of the terminal rated cfm at 3" w.g. (750 Pa) inlet static pressure.

7. Entire terminal unit shall be factory assembled with (electronic, pneumatic) controls. All components including all controls except the room thermostat and (pneumatic piping, field wiring) shall be factory installed and mounted with the unit.

8. Provide a (digital electronic, analog electronic, pneumatic) flow control device that will limit the maximum and minimum airflow to that scheduled on the drawings. Airflow limits shall be factory set. Thermostat signal shall reset the flow control device to adjust primary airflow to match load requirements. Control of the terminal unit shall be pressure independent.

9. The terminal unit shall be capable of operation as described herein with inlet static pressure of 0.05" w.g. (12 Pa) at full cooling with no mixing of induced and primary air. (The sequence of operation should be described here, if not part of the temperature controls specifications). Mixing of the primary and secondary airstreams shall be such that no more than 2.5° F (1.4°C) variation shall exist in the discharge airstream for each 20° F (11.1°C) of difference between the primary and secondary airstreams.

10. Blower casings shall be constructed of heavy gauge coated steel. Blower wheel shall be forward curved centrifugal type, dynamically balanced and driven by direct drive, single speed split capacitor motors. Motors shall be suitable for 120 or 208 or 240 or 277 volt single phase power. Motors shall have built-in overload protection, bearings capable of low rpm oiling, permanently oiled bearings and a built-in anti-backward rotation device. Fan assembly shall be mounted so as to isolate the casing from the motor and blower vibration at no less than four points. Isolation shall be supplied at the motor and at the blower mounting points.

11. An electronic motor speed controller sized and designed for the specific blower motor combination shall be provided to allow infinitely adjustable fan speed from the minimum voltage stop to the line voltage signal to the motor. A minimum voltage stop shall be employed to ensure that fan cannot run in stall mode.

12. Units shall incorporate a single point electrical (and pneumatic) connection for the entire unit. All electrical components shall be UL or ETL listed or recognized and installed in accordance with the National Electrical Code. All electrical components shall be mounted in a control box. the entire assembly shall be ETL listed

(cETL in Canada) and so labeled.

13. All sound data shall be compiled in an independent laboratory and in accordance with the latest version of AHRI Standard 880. All units shall be AHRI certified and bear the AHRI certification label.

14. Unit maximum radiated sound power levels at 1.0" w.g. (249 Pa) inlet pressure and 0.25" w.g. (63 Pa) discharge static pressure shall not exceed the values in Tables 1 and 2 at the specified airflow. No credit or reduction shall in any way be considered for room, plenum, ceiling and/or similar item effects.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Unit**  **Size** | **Airflow** | | **Sound Power Octave Band Center Frequency (Hz.)** | | | | | |
| **cfm** | **l/s** | **2** | **3** | **4** | **5** | **6** | **7** |
| **125** | **250** | **500** | **1000** | **2000** | **4000** |
| **1** | 400 | 189 | 66 | 61 | 56 | 52 | 54 | 54 |
| **2** | 550 | 260 | 62 | 58 | 53 | 50 | 53 | 54 |
| **3** | 700 | 330 | 61 | 59 | 56 | 54 | 54 | 55 |
| **4** | 1200 | 566 | 68 | 64 | 60 | 59 | 57 | 56 |
| **5** | 1600 | 755 | 69 | 65 | 60 | 57 | 57 | 57 |
| **6** | 2100 | 991 | 74 | 70 | 63 | 62 | 60 | 59 |
| **7** | 2800 | 1321 | 70 | 68 | 64 | 58 | 55 | 55 |

**Table 1.** Maximum Radiated Sound Power Levels

Full Cooling (Fan on and 100% primary air)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Unit**  **Size** | **Airflow** | | **Sound Power Octave Band Center Frequency (Hz.)** | | | | | |
| **cfm** | **l/s** | **2** | **3** | **4** | **5** | **6** | **7** |
| **125** | **250** | **500** | **1000** | **2000** | **4000** |
| **1** | 400 | 189 | 64 | 60 | 55 | 48 | 44 | 40 |
| **2** | 550 | 260 | 60 | 55 | 50 | 45 | 39 | 34 |
| **3** | 700 | 330 | 59 | 55 | 52 | 48 | 43 | 38 |
| **4** | 1200 | 566 | 65 | 60 | 55 | 53 | 50 | 48 |
| **5** | 1600 | 755 | 68 | 63 | 57 | 54 | 51 | 47 |
| **6** | 2100 | 991 | 72 | 69 | 62 | 60 | 59 | 57 |
| **7** | 2800 | 1321 | 70 | 67 | 61 | 55 | 50 | 49 |

**Table 2.** Maximum Radiated Sound Power Levels

Full heating (Fan only)

15. Unit maximum discharge sound power levels at 1.0" w.g. (249 Pa) inlet pressure and 0.25" w.g. (63 Pa) discharge static pressure shall not exceed the values in Table 3 at the specified airflow. No credit or reduction shall in any way be considered for room, downstream duct, elbows and/or similar item effects.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Unit**  **Size** | **Airflow** | | **Sound Power Octave Band Center Frequency (Hz.)** | | | | | |
| **cfm** | **l/s** | **2** | **3** | **4** | **5** | **6** | **7** |
| **125** | **250** | **500** | **1000** | **2000** | **4000** |
| **1** | 400 | 189 | 71 | 69 | 63 | 60 | 57 | 53 |
| **2** | 550 | 260 | 70 | 67 | 61 | 57 | 54 | 50 |
| **3** | 700 | 330 | 68 | 65 | 62 | 58 | 54 | 50 |
| **4** | 1200 | 566 | 78 | 75 | 70 | 68 | 65 | 63 |
| **5** | 1600 | 755 | 79 | 75 | 71 | 69 | 67 | 66 |
| **6** | 2100 | 991 | 79 | 79 | 76 | 78 | 75 | 74 |
| **7** | 2800 | 1321 | 79 | 75 | 71 | 70 | 68 | 66 |

**Table 3.** Maximum Discharge Sound Power Levels

Full cooling (Fan on and 100% primary air)

## Motor:

## ECM

**(Substitute the following paragraphs:)**

10. Blower casings shall be constructed of heavy gauge coated steel. Blower wheel shall be forward curved centrifugal type, dynamically balanced and driven by Electronically Commutated Motor(s). Motor(s) shall be suitable for 120 or 208 or 240 or 277 volt single phase power. Fan airflow volume shall be factory set. Fan assembly shall be mounted so as to isolate the casing from the motor and blower vibration at no less than four points. Isolation shall be supplied at the motor and at the blower mounting points. A gasketed backdraft damper shall be included on the fan discharge to reduce primary air leakage back into the plenum space.

# OPTIONS

## "STEALTH™"

**(Substitute the following paragraphs:)**

1. Furnish and install series flow (constant or variable volume) fan powered terminal units of the sizes and capacities as indicated on the drawings. Units shall be pressure independent with (digital electronic, analog electronic, pneumatic,) controls. Units shall be manufactured by **Nailor Industries Inc. model 35SST "StealthTM"**.

4. Unit maximum radiated sound power levels at 1.0" w.g. (249 Pa) inlet pressure and 0.25" w.g. (63 Pa) discharge static pressure shall not exceed the values in Tables 4 and 5 at the specified airflow. No credit or reduction shall in any way be considered for room, plenum, ceiling and/or similar item effects.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Unit**  **Size** | **Airflow** | | **Sound Power Octave Band Center Frequency (Hz.)** | | | | | |
| **cfm** | **l/s** | **2** | **3** | **4** | **5** | **6** | **7** |
| **125** | **250** | **500** | **1000** | **2000** | **4000** |
| **1** | 400 | 189 | 63 | 61 | 53 | 46 | 43 | 41 |
| **2** | 550 | 260 | 60 | 59 | 51 | 45 | 43 | 42 |
| **3** | 700 | 330 | 58 | 58 | 50 | 45 | 42 | 41 |
| **4** | 1200 | 566 | 67 | 62 | 56 | 52 | 49 | 47 |
| **5** | 1600 | 755 | 68 | 63 | 56 | 51 | 48 | 46 |
| **6** | 2100 | 991 | 71 | 66 | 60 | 56 | 52 | 49 |
| **7** | 2800 | 1321 | 70 | 64 | 58 | 53 | 49 | 47 |

**Table 4.** Maximum Radiated Sound Power

Levels Full Cooling (Fan on and 100% primary air)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Unit**  **Size** | **Airflow** | | **Sound Power Octave Band Center Frequency (Hz.)** | | | | | |
| **cfm** | **l/s** | **2** | **3** | **4** | **5** | **6** | **7** |
| **125** | **250** | **500** | **1000** | **2000** | **4000** |
| **1** | 400 | 189 | 62 | 59 | 52 | 45 | 41 | 37 |
| **2** | 550 | 260 | 57 | 53 | 46 | 39 | 36 | 33 |
| **3** | 700 | 330 | 55 | 53 | 47 | 41 | 36 | 32 |
| **4** | 1200 | 566 | 63 | 58 | 52 | 48 | 45 | 44 |
| **5** | 1600 | 755 | 66 | 60 | 54 | 50 | 46 | 42 |
| **6** | 2100 | 991 | 70 | 65 | 59 | 55 | 51 | 47 |
| **7** | 2800 | 1321 | 69 | 65 | 56 | 53 | 50 | 46 |

**Table 5.** Maximum Radiated Sound Power Levels

Full heating (Fan only)

15. Unit maximum discharge sound power levels at 1.0" w.g. (249 Pa) inlet pressure and 0.25" w.g. (63 Pa) discharge static pressure shall not exceed the values in Table 6 at the specified airflow. No credit or reduction shall in any way be considered for room, downstream duct, elbows and/or similar item effects.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Unit**  **Size** | **Airflow** | | **Sound Power Octave Band Center Frequency (Hz.)** | | | | | |
| **cfm** | **l/s** | **2** | **3** | **4** | **5** | **6** | **7** |
| **125** | **250** | **500** | **1000** | **2000** | **4000** |
| **1** | 400 | 189 | 71 | 68 | 63 | 59 | 55 | 52 |
| **2** | 550 | 260 | 70 | 66 | 61 | 57 | 53 | 50 |
| **3** | 700 | 330 | 70 | 65 | 62 | 58 | 54 | 50 |
| **4** | 1200 | 566 | 82 | 77 | 73 | 70 | 67 | 66 |
| **5** | 1600 | 755 | 80 | 76 | 71 | 70 | 68 | 67 |
| **6** | 2100 | 991 | 80 | 79 | 76 | 77 | 74 | 73 |
| **7** | 2800 | 1321 | 79 | 76 | 73 | 71 | 68 | 67 |

**Table 6**. Maximum Discharge Sound Power Levels

Full cooling (Fan on and 100% primary air)

## Electric Heat

**(Substitute the following paragraphs:)**

1. Furnish and install series flow (constant or variable volume) fan powered terminal units with integral electric heat of the sizes and capacities as indicated on the drawings. Units shall be pressure independent with (pneumatic, analog electronic, digital electronic) controls. Units shall be manufactured by **Nailor Industries Inc. model 35SE or 35SEST "StealthTM"** (select one).

12. An electric heater shall be factory mounted and pre-wired as an integral package with the fan powered terminal unit. Heaters shall be sized as shown on the drawings. The entire assembly including the electric heater shall be ETL listed (cETL in Canada) for zero clearance and so labeled and shall meet all requirements of the latest National Electrical Code (Canadian Electrical Code, CSA Standard C22.1). The unit with the heater mounted shall be listed and rated to be turned over for either left or right hand configuration. The unit shall have a single point electrical (and pneumatic) connection. Heater casing and panel shall be a minimum of 20 gauge galvanized steel. Each heater shall be complete with primary disc type automatic high limit, contactors as required, ground terminal, fan relay for interlocking the heater and fan and high grade nickel chrome alloy resistance wire. Element wires shall be suspended in insulators designed to expose the entire face area of the wire thereby eliminating hot spots. Each heater shall be supplied with factory supplied and pre-wired branch circuit fusing as required by NEC and UL. Circuiting and fusing shall also be in accordance with the circuiting requirements as shown on the plans. Additional accessories shall include (control transformer, circuit fusing, disconnect switch, electric step controller, pneumatic electric switches) for staging the heater.

(Additional performance requirements that you might want to include can be found in the electric heater section). The electric heater shall be located on the discharge side of the fan so as not to add heat to the motor and shorten its expected lifetime.

Heater voltage and stages to be as follows:

0 to 5.0 kW ..................................... 277V/1 phase, 1 Step

5.1 kW and up ................................ 480V/3 phase, 1 Step

## Hot Water Heating Coils

**(Substitute the following paragraphs:)**

1. Furnish and install series flow (constant or variable volume) fan powered terminal units with integral hot water coils of the sizes and capacities as indicated on the drawings. Units shall be pressure independent with (pneumatic, analog electronic, digital electronic) controls. Units shall be manufactured by **Nailor Industries Inc. model 35SW or 35SWST "StealthTM"** (select one).

12. A hot water coil shall be factory mounted as an integral package with the fan powered terminal unit. Hot water coils shall be sized as shown on the drawings. The entire assembly including the hot water coil shall be ETL listed (cETL in Canada) for zero clearance and so labeled and shall meet all requirements of the latest National Electrical Code. The unit shall have a single point electrical (and pneumatic) connection. Water coil casing and panels shall be a minimum of 20 ga. (1.00) galvanized steel. Access panels shall be supplied on the top and bottom of the unit for easy access to the coil for inspection and cleaning. All copper, including the headers and return bends, shall be encased to eliminate heat loss during heating sequence and heat gain during cooling sequence. Coils shall be 1, 2 or 3 row as required and heating capacities shall be as shown on the plans. Coils shall have aluminum plate fins spaced 10 per inch and bonded to 1/2" (13) O.D. copper tubes. Copper connections shall be sweat. All coils shall be tested at a minimum of 300 psi (2.1 MPa) under water to produce a guaranteed working pressure of 250 psi (1.7 MPa). Controls and valves for the hot water coils shall be field mounted. Heating coils shall be located on the discharge side of the fan so as not to add heat to the motor and shorten its expected lifetime.

## EZvav Digital Controls

**1.1 ASC VAV BACnet CONTROLLERS**

A. Digital VAV Controllers shall be responsible for monitoring and controlling directly connected VAV Terminals as required. Controllers shall include fully adjustable analog outputs and digital outputs as required utilizing a proportional plus integral control loop to control damper, electric heat and hot water coils for the purpose of maintaining user setpoints. Each controller shall be classified as a native BACnet device, conforming to the BACnet Advanced Specific Controllers (B-ASC) profile, ANSI/ASHRAE BACnet Standard 135.

B. The VAV controller shall be available with integrated applications (based on model) for Single Duct, Dual Duct, and Fan Powered terminal units, including any of the following as required by the control sequence. For Single/Dual Duct terminals: Cooling Only, Cooling/Heating with Changeover and Morning Warm up. For Fan Powered terminals: Cooling with Reheat/Supplementary Heat, Heating coil operation may be with analog, floating or binary control as required.

C. The controller shall be fully configurable via the Digital Display Sensor, including communication parameters (instance, MAC, baud) and application settings (K-factor, flow limits, box configuration, reheat or fan type, default user setpoints, etc.), without any specific PC-based software. VAV controllers shall not require the use of a personal computer and PC based software and/or any interface modules.

D. The VAV controller shall be capable of being balanced from the Digital Room Sensor without any specific pc-based software.

E. The controller shall have integrated MS/TP communications. The communication port shall have network protection bulbs and integrated end-of-line (EOL) terminations.

F. The controller shall have an integrated actuator rated at 40 in-lbs. Connection to the damper shall be with a v-bolt clamp, accepting 3/8" to 5/8" damper shaft sizes. The actuator shall travel 0 to 95 degrees with adjustable end stops at 45 and 60 degrees of rotation. The actuator shall have an integrated gear disengagement mechanism.

G. The controller shall have an integrated transducer pressure sensor for airflow measurement. The sensor shall have a range or 0-2"wc, consuming and accurate to 4.5% of reading or 0.0008"wc, whichever is greater.

H. The controller shall have a Dedicated Room Sensor port for direct interface to a Digital Display Room Sensor or Discrete Room Sensor. The controller shall have the ability of detecting if a sensor has been connected to the port and identify its type, either digital display or discrete. Sensors shall be hot-swappable without powering down the controller. Sensor information via the ports shall not consume any of the devices terminated input capacity.

I. The controller shall have screw terminal blocks that can accommodate wire sizes 14-22 AWG. Terminals shall be color coded: black terminals for power, green terminals for input and outputs, and grey terminals for twisted-shielded-pair communication.

J. The power supply for the controller shall be 24 volts AC (-15%, +20%) power. Voltage below the operating range of the system shall be considered an outage.

**1.2 DIGITAL ROOM SENSOR**

A. The Digital Display Room Sensor (thermostat) shall provide space condition measurements and indications, including temperature and local motion/occupancy (optional), and user setpoint adjustments.

B. The Digital Room Sensor shall connect directly to the controller and shall not utilize any of the hardware I/O points of the controller. The Digital Display Room Sensor shall be able to be located up to 75' from the controller.

C. The Digital Display Room Sensor shall provide a Temporary Network Interface jack, field accessible without uninstalling the sensor, for connection to the BACnet MS/TP communication trunk to which the devices connected. The Digital Display Room Sensor, the connected controller, and all other devices on the BACnet network shall be accessible through the temporary communication jack. Microprocessor based sensors whose port only allows communication with the controller to which it is connected shall not be acceptable.

D. The Digital Display Room Sensor shall have an integrated sensor for temperature measurement as standard and a second integrated sensor for motion/occupancy (optional).

E. User/Occupant setpoints may be adjusted via the Digital Display Room Sensor.

F. The Digital Display Room Sensor shall have pre-configured menus for all control sequences allowing access to communication and application parameters.

G. The Digital Display Room Sensor shall have two levels of password protection: One level to protect user setpoint adjustment, and one level to protect configuration menu parameters. Passwords shall be at least 4 digits in length.