**HOW TO SPECIFY**

# Suggested Baseline Specification

## Model Series 3000 • Basic Unit

1. Furnish and install **Nailor Model Series 3000 Single Duct Variable Volume Terminal Units** of the sizes and capabilities as indicated on the drawings. Units shall be pressure independent with (pneumatic, analog electronic, DDC) controls. Units shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.
2. The entire terminal unit shall be designed and built as a single unit. The unit shall be provided with a primary variable air volume damper that controls the air quantity in response to a (pneumatic, electric, analog electronic, or DDC) thermostat. The unit shall also include all options such as electric or hot water heating coils, attenuators and access doors. The space limitations shall be reviewed carefully to insure that all units will fit into the space allowed.
3. Unit casing shall be 22 ga. (.86) galvanized steel with round, flat oval or rectangular inlets with 5 1⁄2" (140) deep inlet duct collar for field connection. Outlets shall be rectangular and configured for slip and drive connections. Casing leakage downstream of the damper shall not exceed 1% @ 1" w.g. (249 Pa). High side casing leakage shall not exceed 2% @ 3" w.g. (746 Pa).
4. Damper assemblies of 16 ga. (1.63) galvanized steel shall be multiple opposed blade construction arranged to close at 45 degrees from full open to minimize air turbulence and provide near linear operation. Damper blades shall be fitted with flexible seals for tight closure and minimized sound generation. Damper blades shall be screwed through the shaft to insure that no slippage occurs. Blade shafts shall pivot on corrosion free Celcon® bearings. In the fully closed position, air leakage past the closed damper shall not exceed 2% of the nominal catalog rating at 3" w.g. (746 Pa) inlet static pressure as rated by ASHRAE Standard 130.
5. The terminal units shall be capable of operation as described herein with a minimum inlet static pressure that shall not exceed

.18" w.g. (45 Pa) @ 2000 fpm (10.2 m/s) inlet velocity. (The sequence of operations should be described here, if not part of the temperature controls specifications.) Each unit shall be complete with factory mounted (pneumatic, electric, analog electronic, or DDC) controls. Gauge tap ports shall be supplied in the piping between the flow pick up and the controller.

1. Each unit shall be constructed with single point electrical or pneumatic connection. All electrical components shall be ETL or UL listed or recognized and installed in accordance with the National Electrical Code. All electrical components shall be installed in a control box. The entire assembly shall be ETL listed and so labeled.
2. Each unit shall be internally lined with 3⁄4" (19) dual density fiberglass insulation. Edges shall be sealed against airflow erosion. Units shall meet NFPA 90A and UL 181 standards.
3. All sound data shall be compiled in an independent laboratory and in accordance with the latest version of AHRI Standard 880 and ANSI/ASHRAE Standard 130. All units shall be AHRI certified and bear the AHRI certification label.

# OPTIONS

## Electric Heat:

### Model: 30RE Staged

#### (Substitute the following paragraphs:)

**1.** Furnish and install **Nailor Model 30RE Single Duct Variable Volume Terminal Units** of the sizes and capabilities as indicated on the drawings. Units shall be pressure independent with (pneumatic, analog electronic, DDC) controls. Units shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.

##### 9. Single Duct VAV Terminal Unit Staged Electric Heating Coils:

1. Electric heating coils shall consist of open coils of high grade nickel and chromium resistance wire or nichrome elements and insulated with ceramic insulators in galvanized steel brackets, supported in heavy gauge galvanized steel frames. Each unit employing an electric heating coil shall be constructed and installed in accordance with the requirements of the local authorities and shall be UL or ETL listed specifically with the heater as a component of the terminal unit device.
2. Coils shall have the capacities indicated in Contract Documents. Coils rated up through 16.5 kW shall be single phase, 347 volt, 60 hertz and coils larger than 16.5 kW shall be three phase, four wire, 208, 480 or 600 volt, 60 hertz. Coils shall be available in one, two or three stages.
3. Terminal bolts, nuts and washers shall be of corrosion resistant materials. Coils shall be constructed so the installation may be accomplished in accordance with the provisions of the National Electrical Code, for zero clearance. Coils shall be given a 2000 volt dielectric test at the factory.
4. Automatic reset thermal cutouts shall be furnished for primary protection with manually resettable limit switches in power circuits for secondary protection. Both devices shall be serviceable through terminal box without removing heating element from the terminal device. The air pressure safety cutout pickup probe shall be remotely mounted near the volume control damper for maximum fidelity.
5. Heating coils shall have a terminal box and cover, with quiet type built-in magnetic step controlled contactors for each circuit, branch circuit fusing for each branch circuit on heaters over 48 amps per the NEC and an air flow safety interlock switch for installation in the heater control enclosure. Provide a 120 or 24 VAC control power transformer with an integral or separately mounted primary and/or secondary overcurrent protection device in accordance with NEC requirements.
6. All wiring of built-in devices shall be brought to clearly marked terminal strips. A complete wiring diagram shall be permanently attached to the heating coil panel cover.
7. Electric heating coils shall be designed for operation with the DDC controller and control system.
8. Electric heating coils and the associated control panels shall be constructed as a component of the entire terminal unit and mounted in the discharge attenuator downstream of the terminal unit. The resulting unit, including the heater and the VAV damper, shall be no longer than 37" (940) in length.
9. The manufacturer shall prove adequate even airflow over the electric heating coil under the full range of airflow scheduled (minimum to maximum) to prevent uneven heating of the electric coils. The terminal device shall be listed in accordance with UL 1995 as a composite assembly consisting of the VAV terminal device and the electric heating device.

# Suggested Baseline Specification

## Model Series 3000 • Basic Unit

**OPTIONS (continued)**

1. Shop Drawings shall be submitted for review. Shop Drawings shall indicate specifically the exact construction, materials, internal wiring, NEC working clearances, etc., of the terminal units and electric heating coils to be furnished under these Specifications.

## Proportional Heat (SCR):

#### (Substitute the following paragraphs:)

**1.** Furnish and install **Nailor Model 30RE Single Duct Variable Volume Terminal Units** of the sizes and capabilities as indicated on the drawings. Units shall be pressure independent with (pneumatic, analog electronic, DDC) controls. Units shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.

##### Single Duct VAV Terminal Unit Proportional Electric Heating Coils:

* 1. Electric heating coils shall consist of open coils of high grade nickel and chromium resistance wire or nichrome elements and insulated with ceramic insulators in galvanized steel brackets, supported in heavy gauge galvanized steel frames. Each unit employing an electric heating coil shall be constructed and installed in accordance with the requirements of the local authorities and shall be UL or ETL listed specifically with the heater as a component of the terminal unit device.
	2. Coils shall have the capacities indicated in Contract Documents. Coils rated up through 15.5 kW shall be single phase, 347 volt, 60 hertz and coils larger than 15.5 kW shall be three phase, four wire, 208, 480 or 600 volt, 60 hertz.
	3. Terminal bolts, nuts and washers shall be of corrosion resistant materials. Coils shall be constructed so the installation may be accomplished in accordance with the provisions of the National Electrical Code, for zero clearance. Coils shall be given a 2000 volt dielectric test at the factory.
	4. Automatic reset thermal cutouts shall be furnished for primary protection with manually resettable limit switches in power circuits for secondary protection. Both devices shall be serviceable through terminal box without removing heating element from the terminal device. The air pressure safety cutout pickup probe shall be remotely mounted near the volume control damper for maximum fidelity.
	5. Heating coils shall have a terminal box and cover, with proportional heat control for the single circuit, branch circuit fusing on heaters over 45 amps per the NEC and an air flow safety interlock switch for installation in the heater control enclosure. Provide a 120 or 24 VAC control power transformer with an integral or separately mounted primary and/or secondary overcurrent protection device in accordance with NEC requirements
	6. An electric heater shall be factory mounted and pre-wired as an integral package with single duct variable volume terminal unit. Heaters shall be sized as shown on the drawings. The entire assembly including the electric heater shall be ETL listed for zero clearance and so labeled and shall meet all requirements of the latest National Electrical Code, (CSA C22.2 No.236). The unit shall have a single point electrical and/or pneumatic connection (dual point electrical on 600V). Heater casing and panel shall be a minimum of 20 ga. (1.00) galvanized steel. Each heater shall be complete with automatic reset high limit thermal cut-outs, control voltage transformer as required, ground terminal and high grade nickel chrome alloy wire.

Element wires shall be supported by ceramic isolators. 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, pneumatic electric switches) for heater control.

Heater shall be capable of providing proportional control of heater capacity from an input signal of 4 – 20 mA, 2 –10 VDC or 0 –10 VDC. The SCR controller shall provide a 1 – 24 VDC pulsed output to SSR(s) [solid state relay(s)] in proportion to zone heating demand. The SSR’s shall switch with zero cross over to reduce system noise and thermal shock on heater coils.

* 1. All wiring of built-in devices shall be brought to clearly marked terminal strips. A complete wiring diagram shall be permanently attached to the heating coil panel cover.
	2. Electric heating coils shall be designed for operation with the DDC controller and control system.
	3. Electric heating coils and the associated control panels shall be constructed as a component of the entire terminal unit and mounted in the discharge attenuator downstream of the terminal unit. The resulting unit, including the heater and the VAV damper, shall be no longer than 37" (940) in length.
	4. The manufacturer shall prove adequate even airflow over the electric heating coil under the full range of airflow scheduled (minimum to maximum) to prevent uneven heating of the electric coils. The terminal device shall be listed in accordance with UL 1995 as a composite assembly consisting of the VAV terminal device and the electric heating device.
	5. Shop Drawings shall be submitted for review. Shop Drawings shall indicate specifically the exact construction, materials, internal wiring, NEC working clearances, etc., of the terminal units and electric heating coils to be furnished under these Specifications.

## Proportional Heat with Discharge Temperature Control (DTC):

#### (Substitute the following paragraphs:)

**1.** Furnish and install **Nailor Model 30RE Single Duct Variable Volume Terminal Units** of the sizes and capabilities as indicated on the drawings. Units shall be pressure independent with (pneumatic, analog electronic, DDC) controls. Units shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.

##### 9. Single Duct VAV Terminal Unit Proportional Electric Heating Coils:

1. Electric heating coils shall consist of open coils of high grade nickel and chromium resistance wire or nichrome elements and insulated with ceramic insulators in galvanized steel brackets, supported in heavy gauge galvanized steel frames. Each unit employing an electric heating coil shall be constructed and installed in accordance with the requirements of the local authorities and shall be UL or ETL listed specifically with the heater as a component of the terminal unit device.
2. Coils shall have the capacities indicated in Contract Documents. Coils rated up through 15.5 kW shall be single phase, 347 volt, 60 hertz and coils larger than 15.5 kW shall be three phase, four wire, 208, 480 or 600 volt, 60 hertz.
3. Terminal bolts, nuts and washers shall be of corrosion resistant materials. Coils shall be constructed so the installation may be accomplished in accordance with the provisions of the National Electrical Code, for zero clearance. Coils shall be given a 2000 volt dielectric test at the factory.

# Suggested Baseline Specification

## Model Series 3000 • Basic Unit

**OPTIONS (continued)**

1. Automatic reset thermal cutouts shall be furnished for primary protection with manually resettable limit switches in power circuits for secondary protection. Both devices shall be serviceable through terminal box without removing heating element from the terminal device. The air pressure safety cutout pickup probe shall be remotely mounted near the volume control damper for maximum fidelity.
2. Heating coils shall have a terminal box and cover, with proportional heat control for the single circuit, branch circuit fusing on heaters over 45 amps per the NEC and an air flow safety interlock switch for installation in the heater control enclosure. Provide a 120 or 24 VAC control power transformer with an integral or separately mounted primary and/or secondary overcurrent protection device in accordance with NEC requirements
3. An electric heater shall be factory mounted and pre-wired as an integral package with the single duct variable volume terminal unit. Heaters shall be sized as shown on the drawings. The entire assembly including the electric heater shall be ETL listed for zero clearance and so labeled and shall meet all requirements of the latest National Electrical Code, (CSA C22.2 No.236). The unit shall have a single point electrical and/or pneumatic connection (dual point electrical on 600V). Heater casing and panel shall be a minimum of 20 ga. (1.00) galvanized steel. Each heater shall be complete with automatic reset high limit thermal cut-outs, control voltage transformer as required, ground terminal and high grade nickel chrome alloy wire.

Element wires shall be supported by ceramic isolators. 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, pneumatic electric switches) for heater control. Heater shall be capable of providing proportional control of heater capacity from an input signal of 4 – 20 mA, 2 – 10 VDC or 0 – 10 VDC. The SCR controller shall provide a 1 – 24 VDC pulsed output to SSR(s) [solid state relay(s)] in proportion to zone heating demand. The SSR’s shall switch with zero cross over to reduce system noise and thermal shock on heater coils.

The SCR controller shall contain a discharge temperature sensor capable of limiting leaving air temperature to a user defined setpoint. The SCR controller shall pulse the coil to maintain zone demand while providing the set maximum discharge air temperature. Upon measuring a discharge air temperature above the user defined setpoint, the controller shall reduce heater capacity to maintain maximum allowable discharge air temperature. The discharge air temperature setpoint shall be adjustable from 80

–120°F (27 –49°C) by use of a controller mounted potentiometer.

1. All wiring of built-in devices shall be brought to clearly marked terminal strips. A complete wiring diagram shall be permanently attached to the heating coil panel cover.
2. Electric heating coils shall be designed for operation with the DDC controller and control system.
3. Electric heating coils and the associated control panels shall be constructed as a component of the entire terminal unit and mounted in the discharge attenuator downstream of the terminal unit. The resulting unit, including the heater and the VAV damper, shall be no longer than 37" (940) in length.
4. The manufacturer shall prove adequate even airflow over the electric heating coil under the full range of airflow scheduled (minimum to maximum) to prevent uneven heating of the electric coils. The terminal device shall be listed in accordance with UL

1995 as a composite assembly consisting of the VAV terminal device and the electric heating device.

1. Shop Drawings shall be submitted for review. Shop Drawings shall indicate specifically the exact construction, materials, internal wiring, NEC working clearances, etc., of the terminal units and electric heating coils to be furnished under these Specifications.

## Hot Water Heating Coils:

### Model: 30RW

#### (Substitute the following paragraphs:)

**1.** Furnish and install **Nailor Model 30RW Single Duct Variable Volume Terminal Units** of the sizes and capabilities as indicated on the drawings. Units shall be pressure independent with (pneumatic, analog electronic, DDC) controls. Units shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.

##### Single Duct VAV Terminal Device Hot Water Heating Coils

* 1. Terminal unit hot water heating coils shall be mounted on the discharge of the unit with slip and drive connections. Provide an access door or panel on the bottom of the attenuator section of the terminal unit for servicing and cleaning the unit.
	2. Hot water heating coils shall be constructed with copper tubes and aluminum plate fins. Coils shall have a maximum of 10 fins per inch. Supply and return connections shall be on the same end of the coil. Fins shall be bonded to the tubes by means of mechanical expansion of the tubes. Fins shall be at least .0045" (.11) thick.
	3. Coils shall have galvanized steel casings on all sides no lighter than 20 ga. (1.0).
	4. Tubes shall be 1⁄2" (13) O.D. and shall be spaced approximately 1 1⁄4" (32) apart and shall have a minimum wall thickness of 0.016" (.41). Hot water shall be equally distributed through all tubes by the use of orifices or header design. Water velocity in the tubes shall not exceed five feet per second. The water pressure drop through the coil shall not exceed 10 feet. Heating coil face velocities shall not exceed the maximum face velocity indicated in the schedules on the Contract Documents.
	5. Coils shall be tested by air pressure under water. Coils shall be tested at 350 psig (2,413 kPa) air static pressure.
	6. Coil ratings, calculations and selection data shall be in accordance with the applicable AHRI Standards and shall be submitted with the Shop Drawings.

## Liner:

### Steri-Liner

#### (Substitute the following paragraph:)

**7.** Each unit shall be fully lined with non-porous, sealed liner which complies with NFPA 90A and UL 181. Installation shall be 1/2" (13) minimum thickness, 4 lb./cu. ft. (64 kg/m3) density with reinforced aluminum foil-scrim-kraft (FSK) facing. All cut edges shall be secured with steel angles or end caps to encapsulate edges and prevent erosion. Insulation shall be Nailor Steri-Liner or equal.

### Fiber-Free Liner

#### (Substitute the following paragraph:)

**7.** Each unit shall be fully lined with a non-porous closed cell elastomeric foam liner which complies with NFPA 90A, ASTM E84 and UL 181. Installation shall be 3/4" (19) minimum thickness and secured to the interior of the terminal with mechanical fasteners. No fiberglass is permitted. Insulation shall be Nailor Fiber-Free Liner or equal.

**Suggested Specifications Single Duct VAV Terminal Units – Models 3000, 30RE and 30RW Section 15840**

|  |  |  |
| --- | --- | --- |
| **Octave Band** | **NC-35** | **NC-40** |
| 2 | 67 | 71 |
| 3 | 64 | 69 |
| 4 | 67 | 72 |
| 5 | 66 | 71 |
| 6 | 67 | 72 |
| 7 | 67 | 72 |

#### PART 1 – GENERAL

##### RELATED DOCUMENTS

1. The requirements of the General Conditions, Supplementary Conditions and the following specification sections apply to all Work herein:
	1. Section 15 - - - General.
	2. Section 15 - - - Scope of Work.
	3. Section 15 - - - Design Conditions.
	4. Section 15 - - - Electric Motors and Controllers.
	5. Section 15 - - - Access Doors and Color Coded Identification in General Construction.
	6. Section 15 - - - Ductwork and Sheet Metal.
	7. Section 15 - - - Testing, Balancing and Adjusting.

##### SUMMARY

A. Furnish and install all air terminal units herein specified and as indicated on the Drawings.

##### REFERENCE STANDARDS

1. All air terminal units shall be designed, manufactured and tested in accordance with the latest applicable industry standards including the following:
	1. ANSI/ASHRAE Standard 130-2008.
	2. AHRI Standard 880-2011.
	3. Underwriters Laboratories UL Standard 1995.
	4. Underwriters Laboratories UL Standard 1996.

##### QUALITY ASSURANCE

1. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed, in accordance with the requirements of the authority having jurisdiction and suitable for its intended use on this Project. Space limitations shall be reviewed to ensure that the equipment will fit into the space allowed.
2. All equipment and material to be furnished and installed on this Project shall be run tested at the factory and results of that testing shall be tabulated and provided to the engineer when the equipment ships to the job site. See paragraph 2.03 G for specific requirements.

##### SUBMITTALS

1. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 1 Specifications and Section 15 - - - General and shall include but not be limited to:
	1. Single Duct Variable Air Volume Terminal Units, complete with capacity data, test data, construction details, physical dimensions, electrical characteristics, etc.

##### ACOUSTICS

This acoustical specification describes sound power levels as tested to AHRI 880 and ASHRAE 130.

1. Sound Power Acoustical Performance:
	1. Discharge Noise: Maximum permissible sound power levels in octave bands of discharge sound through discharge ducts from terminal units operated at an inlet pressure of 1.0" w.g. (249 Pa) and the maximum amount of air volume shown on the Project Mechanical Drawings leaving the terminal unit and entering the reverberant chamber shall be as follows:

**Table 1.** Maximum Discharge Sound Power Levels (dB re 10-12 Watts).

* 1. Radiated Noise: Maximum permissible radiated sound power levels in octave bands of radiated transmission from terminal units operated at an inlet pressure of 1.0" w.g. (249 Pa) and the maximum scheduled air quantity in an installed condition over occupied spaces shall be as follows:

|  |  |  |
| --- | --- | --- |
| **Octave Band** | **NC-35** | **NC-40** |
| 2 | 64 | 68 |
| 3 | 57 | 62 |
| 4 | 53 | 58 |
| 5 | 50 | 55 |
| 6 | 50 | 55 |
| 7 | 53 | 58 |

**Table 2.** Maximum Radiated Sound Power Levels (dB re 10-12 Watts).

##### WARRANTY

A. Manufacturer shall warrant equipment for one year from start up or 18 months from shipment.

##### PART 2 – PRODUCTS

* 1. **UNAUTHORIZED MATERIALS**

A. Materials and products required for the work of this section shall not contain asbestos, polychlorinated biphenyl’s (PCB) or other hazardous materials identified by the Engineer or Owner.

##### ACCEPTABLE MANUFACTURERS

1. These Specifications set forth the minimum requirements for single duct VAV terminal units. If they comply with these Specifications, single duct VAV terminal units manufactured by one of the following manufacturers will be acceptable:
	1. Nailor Industries.

##### SINGLE DUCT AIR VOLUME TERMINAL UNITS

1. Furnish and install single duct VAV terminal units as indicated on the Drawings. The units shall be designed and built as a single unit and provided with a primary variable air volume damper that controls the primary air quantity in response to a temperature control signal. The damper construction shall be rectangular with multiple opposed blades designed to operate on a 45° arc. Blades shall be 16 ga. (1.63) galvanized steel, single thickness construction with heavy-duty gasket glued to the blades. Units shall be suitable for pressure independent operation with digital (DDC) controls. The units shall contain a damper assembly as described above and [electric or hot water] heating coils where scheduled and/or indicated on the Drawings. The space limitations shall be reviewed carefully to ensure all terminal units will fit into the space provided including National Electric Code clearances required in front of all panels containing electrical devices. Unit shall be fully lined with at least 3⁄4" (186) thick, dual density fiberglass insulation that complies with NFPA 90 for fire and smoke resistivity and UL 181 for erosion.

# Suggested Specifications

## Single Duct VAV Terminal Units – Models 3000, 30RE and 30RW (continued)

Any exposed edges shall be coated with approved sealant to prevent erosion. Casing leakage shall not exceed 2% of terminal rated airflow at 1.5" w.g. (373 Pa) interior casing pressure. All high side casing joints shall be sealed with approved sealant and high side casing and damper leakage shall not exceed 2% of terminal rated airflow at 3" w.g. (746 Pa). Unit casing shall be minimum 22 ga. (.86), galvanized steel with round or flat oval inlets and rectangular outlets.

Terminal unit manufacturer shall provide flow curves for the primary air sensor clearly labeled and permanently attached on the bottom or side of each terminal unit. At an inlet velocity of 2000 fpm, (10.2 m/s) the differential static pressure for any unit size, 4

– 16 shall not exceed 0.10" w.g. (25 Pa) for the basic unit.

The unit shall include all equipment and controls as required to provide a complete and operating system with at least the following:

* 1. Single point electrical connection for the voltage/phase as scheduled in the Contract Documents. See Electrical Drawings for power feeder arrangements. Units, heaters and/or transformers shall be rated at [**24, 120 or 277**] single phase as scheduled in the contract documents.
	2. A door interlocking disconnect switch for units with electric heaters. All disconnecting devices shall be sized and located as required to disconnect all ungrounded power conductors to all internal electrical components.
	3. Individual overcurrent protection devices as required to protect individual units and transformers.
	4. The primary inlet shall be equipped with an inlet collar sized to fit the primary duct size shown on the Drawings. The inlet collar shall provide at least a 5 1⁄2" (140) length with a 1⁄8" (3) high raised single or double bead located approximately 1 1⁄2" (38) from the inlet connection. The primary airflow (cfm) settings shall be clearly and permanently marked on the bottom of the unit along with the terminal unit identification numbers. Each terminal unit shall incorporate a Nailor Diamond Flow sensor with four pick up points on each side to insure that with typical duct turbulence, the controller fidelity shall be +/- 5% of set volume even with a hard 90° elbow at the inlet. Static variation of 0.5" w.g. (13 Pa) to 6.0"

w.g. (1492 Pa) shall not affect the flow reading. Provide a transformer with 24 VAC secondary to provide power for the unit’s controls and the Division 17 controls. The VAV terminal unit manufacturer and the Division 17 Building Controls Subcontractor shall verify compatibility of the multipoint flow sensors with transducer and DDC microprocessor furnished under Division 17 prior to bidding this Project.

* 1. The outlets shall be rectangular and suitable for slip and drive duct connections. Casing shall have mounting area for hanging by sheet metal straps from a concrete slab or shall be supplied with angle brackets for mounting on all thread rods.
	2. The terminal unit shall be listed in accordance with UL 1995 as a composite assembly consisting of the terminal unit with or without the electric or hot water heating device.
	3. Heating Options [**Insert Electric or Hot Water Coil specification**]
	4. The terminal unit shall be capable of operation as described herein with inlet static pressure of .18" w.g. (45 Pa) @ 2000 fpm (10.2 m/s) of primary air. [The sequence of operation should be described here if not part of the temperature controls specifications.] The primary air damper shall be of a design that

shall vary primary air supply in response to electronic signal. Primary air damper close-off leakage shall not exceed 2% of the maximum AHRI rated primary air cfm as shown in the manufacturer’s catalog for each size terminal unit at 3" w.g. (746 Pa) inlet static pressure.

Submit damper leakage test data to the Engineer for review. Damper connection to the operating shaft shall be a positive mechanical through bolt connection to prevent any slippage. Provide non-lubricated Celcon® or bronze oilite bearings for the damper shaft. The primary air damper in conjunction with the DDC microprocessor furnished under Division 17 shall be selected to provide accurate control at low primary air velocities. The total deviation in primary airflow shall not exceed ± 5% of the primary air cfm corresponding to a 300 fpm (91) air velocity through the primary air damper.

* 1. Provide duct inlet and outlet connections as indicated on the Drawings.
	2. The casing construction shall be a minimum 22 ga. (.86) galvanized sheet metal lined with a minimum 3⁄4" (19) thick, dual density, minimum 1 1⁄2 lb/cu. ft. (24 kg/m³) density fiberglass insulation. The terminal units shall not exceed the depth indicated on the Drawings. Mounting connections for hanging the unit by sheet metal straps shall be clearly identified on the housing. All components, including all controls and wiring, shall be factory installed, except the room sensor or thermostat. No field assembly will be allowed. The unit shall be complete and suitable to accept the following field connections:
		1. Primary duct.
		2. Secondary duct.
		3. Single point electrical connection. See Drawings for control box locations required for each terminal unit.
		4. DDC controller control signals and wiring.
		5. Room sensor connection.
1. The terminal unit shall be capable of operating throughout the full cataloged primary airflow range with an inlet static pressure of 0.10" w.g. (25) or less. See the schedules on the Contract Documents for static pressure requirements.
2. The control sequence shall be as specified in Division 17 (DDC by others).
3. Each size of each terminal unit to be used on this Project shall be completely laboratory tested for air performance and acoustics. The acceptability of the independent testing laboratory is subject to review by the Owner, Project Acoustical Consultant and the Engineer. The terminal unit manufacturer shall submit complete details, brochures, instrumentation information, etc., for review. The laboratory shall be capable of properly testing the largest terminal unit on this Project. See paragraph 1.06 A for acoustic guidelines. The air volume listed on the Drawings for the terminal units shall be supplied for the test with the primary cold duct supplying 55°F (13°C) air.

Operation of the flow control device shall be demonstrated to repeat under all conditions of operation of the primary air damper or valve and duct pressures as specified hereinbefore. If the single duct VAV terminal unit manufacturer has conducted the hereinbefore specified air performance and has demonstrated to the Engineer and Owner compliance with the specified criteria the previous testing will be accepted and will not need to be repeated. See Section 15 - - - titled "Design Conditions".

1. After the manufacturer has submitted certified copies of the laboratory air performance and acoustical performance test results to the Engineer, the Engineer may witness the laboratory tests to verify compliance with the Specifications. See Section 15

- - - for additional submittal and certification requirements.

# Suggested Specifications

## Single Duct VAV Terminal Units – Models 3000, 30RE and 30RW (continued)

1. All terminal units shall be identified on the bottom of the unit (minimum 1⁄2" (13) high letters) and on the shipping carton, with the floor and box number that identifies it along with the CFM settings. Every unit shall have a unique number combination that matches numbers on the contractor's coordination drawings as to its location and capacity and is coordinated with the DDC controller and the Division 17 Building Control System submittal drawings.
2. The terminal unit manufacturer will verify the operation of each single duct VAV terminal unit before shipment. Testing shall include at least the following:
	1. Apply electric power to the unit.
	2. Energize the electric heat through the electric heating coil relay. Verify the signal with a voltmeter and ammeter to ensure proper heater operation.
	3. De-energize the electric heating coil and verify the signal with a volt-meter to ensure the heater is de-energized.
	4. If DDC controls are mounted, disconnect the primary air damper actuator from the DDC terminal unit controller. Provide separate power source to the actuator to verify operation and rotation of damper. Drive the damper closed and verify by feel or observation that damper is driven fully closed. Return primary air damper to the fully open position prior to shipment.
	5. Provide a written inspection report for each terminal unit signed and dated by the factory test technician verifying all terminal unit wiring and testing has been performed per the manufacturer's testing and quality assurance requirements.

# OPTIONS

## Electric Heat:

### Model: 30RE

#### (Substitute the following paragraphs:)

##### 7 (A). Single Duct VAV Terminal Unit Electric Heating Coils:

1. Electric heating coils shall consist of open coils of high grade nickel and chromium resistance wire or nichrome elements and insulated with ceramic insulators in galvanized steel brackets, supported in heavy gauge galvanized steel frames. Each unit employing an electric heating coil shall be constructed and installed in accordance with the requirements of the local authorities and shall be UL or ETL listed specifically with the heater as a component of the terminal unit device.
2. Coils shall have the capacities indicated in Contract Documents. Coils rated up through 5 kW shall be single phase, 277 volt, 60 hertz and coils larger than 5 kW shall be three phase, four wire, 480Y/277 volt, 60 hertz. Electric heating coils up to and including 4 kW shall be single stage. Electric coils above 4 kW shall be two stage.
3. Terminal bolts, nuts and washers shall be of corrosion resistant materials. Coils shall be constructed so the installation may be accomplished in accordance with the provisions of the National Electrical Code, for zero clearance. Coils shall be given a 2000 volt dielectric test at the factory.
4. Automatic reset thermal cutouts shall be furnished for primary protection with manually resettable limit switches in power circuits for secondary protection. Both devices shall be serviceable through terminal box without removing heating element from the terminal device. The air pressure safety cutout pickup probe shall be remotely mounted near the volume control damper for maximum fidelity.
5. Heating coils shall have a terminal box and cover, with quiet type built-in magnetic step controlled contactors for each circuit, branch circuit fusing for each branch circuit on heaters over 48 amps per the NEC and an air flow safety interlock switch for installation in the heater control enclosure. Contactors mounted in terminal units that are located above the ceiling in tenant occupied spaces shall be mercury step type. Provide a 120 or 24 VAC control power transformer with an integral or separately mounted primary and/or secondary overcurrent protection device in accordance with NEC requirements.
6. All wiring of built-in devices shall be brought to clearly marked terminal strips. A complete wiring diagram shall be permanently attached to the heating coil panel cover.
7. Electric heating coils shall be designed for operation with the DDC controller and control system as specified in the Division 17 Specifications.
8. Electric heating coils and the associated control panels shall be constructed as a component of the entire terminal unit and mounted in the discharge attenuator downstream of the terminal unit. The resulting unit, including the heater and the VAV damper shall be no longer than 31 1⁄2" (800) in length.
9. The manufacturer shall prove adequate even airflow over the electric heating coil under the full range of airflow scheduled (minimum to maximum) to prevent uneven heating of the electric coils. The terminal device shall be listed in accordance with UL 1995 and UL 1996 as a composite assembly consisting of the VAV terminal device and the electric heating device.
10. Shop Drawings shall be submitted for review as specified in Section 15 - - -. These Shop Drawings shall indicate specifically the exact construction, materials, internal wiring, NEC working clearances, etc., of the terminal units and electric heating coils to be furnished under these Specifications.

## Hot Water Heating Coils:

### Model: 30RW

#### (Substitute the following paragraphs:)

##### 7 (B). Single Duct VAV Terminal Device Hot Water Heating Coils

1. Terminal unit hot water heating coils shall be mounted on the discharge of the unit with slip and drive connections. Provide an access door or panel on the bottom of the attenuator section of the terminal unit for servicing and cleaning the unit.
2. Hot water heating coils shall be constructed with copper tubes and aluminum plate fins. Coils shall have a maximum of 10 fins per inch. Supply and return connections shall be on the same end of the coil. Fins shall be bonded to the tubes by means of mechanical expansion of the tubes. Fins shall be at least .0045" (.11) thick.
3. Coils shall have galvanized steel casings on all sides no lighter than 22 ga. (.86).
4. Tubes shall be 1⁄2" O.D. (13) and shall be spaced approximately 1 1⁄4" (32) apart and shall have a minimum wall thickness of 0.016" (.406). Hot water shall be equally distributed through all tubes by the use of orifices or header design. Water velocity in the tubes shall not exceed five feet per second. The water pressure drop through the coil shall not exceed 10 feet. Heating coil face velocities shall not exceed the maximum face velocity indicated in the schedules on the Contract Documents.
5. Coils shall be tested by air pressure under water. Coils shall be tested at 350 psig (2,413 kPa) static pressure for 250 psig (1,724 kPa) working pressure or as indicated on the Contract Documents.
6. Coil ratings, calculations and selection data shall be in accordance with the applicable AHRI Standards and shall be submitted with the Shop Drawings.

**Suggested Specifications**

**HOW TO SPECIFY**

**Model Series 30HQ Hospital Grade Units**

**1.** Furnish and install **Nailor Model Series 30HQ Single Duct Variable Volume Hospital Grade Terminal Units** of the sizes and capabilities as indicated on the drawings. Units shall be pressure independent with (pneumatic, analog electronic, DDC) controls. Units shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.

2. The entire hospital grade terminal unit shall be designed and built as a single unit. The unit shall be provided with a primary variable air volume damper that controls the air quantity in response to a (pneumatic, electric, analog electronic, or DDC) thermostat. The unit shall include a factory installed dissipative silencer and include all options such as electric or hot water heating coils and access doors. The space limitations shall be reviewed carefully to insure that all units will fit into the space allowed.

3. Unit casing shall be 22 ga. (0.86) galvanized steel with round or flat oval inlets with 5 1⁄2" (140) deep inlet duct collar for field connection. Outlets shall be rectangular and configured for slip and drive connections. Casing leakage downstream of the damper shall not exceed 1% @ 1" w.g. (250 Pa). High side casing leakage shall not exceed 2% @ 3" w.g. (746 Pa).

**B**

4. Damper assemblies of 16 ga. (1.63) galvanized steel shall be multiple opposed blade construction arranged to close at 45 degrees from full open to minimize air turbulence and provide near linear operation. Damper blades shall be fitted with flexible seals for tight closure and minimized sound generation. Damper blades shall be screwed through the shaft to insure that no slippage occurs. Blade shafts shall pivot in corrosion free self-lubricating bronze oilite bearings. In the fully closed position, air leakage past the closed damper shall not exceed 2% of the nominal catalog rating at 3" w.g. (746 Pa) inlet static pressure as rated by ASHRAE Standard 130.

5. The terminal units shall be capable of operation as described herein with a minimum inlet static pressure that shall not exceed

0.28" w.g. (70 Pa) @ 2000 fpm (10.2 m/s) inlet velocity. (The sequence of operations should be described here, if not part of the temperature controls specifications.) Each unit shall be complete with factory mounted (pneumatic, electric, analog electronic, or DDC) controls. Gauge tap ports shall be supplied in the piping between the flow pick up and the controller.

6. Each unit shall be constructed with single point electrical (and pneumatic) connections. All electrical components shall be ETL or UL listed or recognized and installed in accordance with the National Electrical Code. All electrical components shall be installed in a control box. The entire assembly shall be ETL listed and so labeled.

7. Each VAV section shall be internally lined with 13/16” (21) thick, 4 lb. /cu. ft. (64 Kg/m3) density fiberglass insulation with a reinforced aluminum FSK facing. Units shall meet NFPA 90A and UL 181 standards.

8. All sound data shall be compiled in an independent laboratory and in accordance with the latest version of AHRI Standard 880 and ANSI/ASHRAE Standard 130. All units shall be AHRI certified and bear the AHRI certification label.

9. Dissipative silencer sections shall contain a unit casing constructed of 22 ga. (.86) galvanized steel. Inlet and discharge shall be rectangular and configured for slip and drive connections. Each silencer shall be internally lined with 13/16” (21) thick, 4 lb. density fiberglass insulation with a reinforced aluminum FSK facing, placed inside the top and bottom sides of the silencer,

thereby eliminating the requirement for field wrapping with thermal insulation. The silencer baffles shall be filled with fiberglass acoustical absorption media and encapsulated by 22 ga. (.86) perforated coated steel baffles. A mylar liner shall separate the fiberglass from the perforated metal baffle, with an acoustical spacer and isolate the fiberglass from the airstream. The perforated metal baffles shall be rigidly fastened to the casing of the silencer. Units shall meet NFPA 90A and UL 181 standards.

**OPTIONS Electric Heat: Model: 30HQE**

**Staged**

**(Substitute the following paragraphs:)**

1. Furnish and install **Nailor Model 30HQE Single Duct Variable Volume Hospital Grade Terminal Units** of the sizes and capabilities as indicated on the drawings. Unit shall be pressure independent with (pneumatic, analog electronic, DDC) controls. Unit shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.

**10. Single Duct VAV Hospital Grade Terminal Unit Staged**

**Electric Heating Coils:**

a. Electric heating coils shall consist of open coils of high grade nickel and chromium resistance wire or nichrome elements and insulated with ceramic insulators in galvanized steel brackets, supported in heavy gauge galvanized steel frames. Each unit employing an electric heating coil shall be constructed and installed in accordance with the requirements of the local authorities and shall be UL or ETL listed specifically with the heater as a component of the terminal unit device.

b. Coils shall have the capacities indicated in Contract

Documents. Coils rated up through 16.5 kW shall be single phase,

347 volt, 60 hertz and coils larger than 16.5 kW shall be three phase, four wire, 208, 480 or 600 volt, 60 hertz. Coil shall be available in one, two or three stages.

c. Terminal bolts, nuts and washers shall be of corrosion resistant materials. Coils shall be constructed so the installation may be accomplished in accordance with the provisions of the National Electrical Code, for zero clearance. Coils shall be given a 2000 volt dielectric test at the factory.

d. Automatic reset thermal cutouts shall be furnished for primary protection with manually resettable limit switches in power circuits for secondary protection. Both devices shall be serviceable through terminal box without removing heating element from the terminal device. The air pressure safety cutout pickup probe shall be remotely mounted near the volume control damper for maximum fidelity.

e. Heating coils shall have a terminal box and cover, with quiet type built-in magnetic step controlled contactors for each circuit, branch circuit fusing for each branch circuit on heaters over 48 amps per the NEC and an air flow safety interlock switch for installation in the heater control enclosure. Provide a 120 or 24

VAC control power transformer with an integral or separately mounted primary and/or secondary overcurrent protection device in accordance with NEC requirements.

f. All wiring of built-in devices shall be brought to clearly marked terminal strips. A complete wiring diagram shall be permanently attached to the heating coil panel cover.

g. Electric heating coils shall be designed for operation with the

DDC controller and control system.

**Suggested Specifications**

**Models Series 30HQ Options (continued)**

h. Electric heating coils and the associated control panels shall be constructed as a component of the entire terminal unit and mounted in the discharge attenuator downstream of the terminal unit. The resulting unit, including the heater, the VAV damper and the dissipative silencer shall be no longer than 79" (2007) in length.

i. The manufacturer shall prove adequate even airflow over the electric heating coil under the full range of airflow scheduled (minimum to maximum) to prevent uneven heating of the electric coils. The terminal device shall be listed in accordance with UL

1995 as a composite assembly consisting of the VAV terminal device and the electric heating device.

j. Shop Drawings shall be submitted for review. Drawings shall indicate specifically the exact construction, materials, internal wiring, NEC working clearances, etc., of the terminal units and electric heating coils to be furnished under these Specifications.

**Proportional Heat (SCR)**

**(Substitute the following paragraphs:)**

1. Furnish and install **Nailor Model 30HQE Single Duct Variable Volume Hospital Grade Terminal Units** of the sizes and capabilities as indicated on the drawings. Unit shall be pressure independent with (pneumatic, analog electronic, DDC) controls. Unit shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.

**10. Single Duct VAV Hospital Grade Terminal Unit Staged**

**Electric Heating Coils:**

a. Electric heating coils shall consist of open coils of high grade nickel and chromium resistance wire or nichrome elements and insulated with ceramic insulators in galvanized steel brackets, supported in heavy gauge galvanized steel frames. Each unit employing an electric heating coil shall be constructed and installed in accordance with the requirements of the local authorities and shall be UL or ETL listed specifically with the heater as a component of the terminal unit device.

b. Coils shall have the capacities indicated in Contract

Documents. Coils rated up through 15.5 kW shall be single phase,

347 volt, 60 hertz and coils larger than 15.5 kW shall be three phase, four wire, 207, 480 or 600 volt, 60 hertz.

c. Terminal bolts, nuts and washers shall be of corrosion resistant materials. Coils shall be constructed so the installation may be accomplished in accordance with the provisions of the National Electrical Code, for zero clearance. Coils shall be given a 2000 volt dielectric test at the factory.

d. Automatic reset thermal cutouts shall be furnished for primary protection with manually resettable limit switches in power circuits for secondary protection. Both devices shall be serviceable through terminal box without removing heating element from the terminal device. The air pressure safety cutout pickup probe shall be remotely mounted near the volume control damper for maximum fidelity.

e. Heating coils shall have a terminal box and cover, with quiet type built-in magnetic step controlled contactors for each circuit, branch circuit fusing for each branch circuit on heaters over 45 amps per the NEC and an air flow safety interlock switch for installation in the heater control enclosure. Provide a 120 or 24

VAC control power transformer with an integral or separately mounted primary and/or secondary overcurrent protection device in accordance with NEC requirements.

f. All wiring of built-in devices shall be brought to clearly marked terminal strips. A complete wiring diagram shall be permanently attached to the heating coil panel cover.

g. Electric heating coils shall be designed for operation with the

DDC controller and control system.

f. 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 for zero clearance and so labeled and shall meet all requirements of the latest National Electrical Code, (CSA C22.2 No.236). The unit shall have a single point electrical and/or pneumatic connection (dual point electrical on

600V). Heater casing and panel shall be a minimum of 20 ga. (1.00) galvanized steel. Each heater shall be complete with automatic reset high limit thermal cut-outs, control voltage transformer as required, ground terminal, fan relay for interlocking the heater and fan and high grade nickel chrome alloy wire.

Element wires shall be supported by ceramic isolators. 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, pneumatic electric switches) for heater control.

**B**

Heater shall be capable of providing proportional control of heater capacity from an input signal of 4 – 20 mA, 2 – 10 VDC or 0 – 10

VDC. The SCR controller shall provide a 1 – 24 VDC pulsed output to SSR(s) [solid state relay(s)] in proportion to zone heating demand. The SSR’s shall switch with zero cross over to reduce system noise and thermal shock on heater coils.

h. Electric heating coils and the associated control panels shall be constructed as a component of the entire terminal unit and mounted in the discharge attenuator downstream of the terminal unit. The resulting unit, including the heater, the VAV damper and the dissipative silencer shall be no longer than 79" (2007) in length.

i. The manufacturer shall prove adequate even airflow over the electric heating coil under the full range of airflow scheduled (minimum to maximum) to prevent uneven heating of the electric coils. The terminal device shall be listed in accordance with UL

1995 as a composite assembly consisting of the VAV terminal device and the electric heating device.

j. Shop Drawings shall be submitted for review. Drawings shall indicate specifically the exact construction, materials, internal wiring, NEC working clearances, etc., of the terminal units and electric heating coils to be furnished under these Specifications.

**Proportional Heat with Discharge Temperature**

**Control (DTC)**

**(Substitute the following paragraphs:)**

1. Furnish and install **Nailor Model 30HQE Single Duct Variable Volume Hospital Grade Terminal Units** of the sizes and capabilities as indicated on the drawings. Unit shall be pressure independent with (pneumatic, analog electronic, DDC) controls. Unit shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.

**10. Single Duct VAV Hospital Grade Terminal Unit Staged**

**Electric Heating Coils:**

a. Electric heating coils shall consist of open coils of high grade nickel and chromium resistance wire or nichrome elements and insulated with ceramic insulators in galvanized steel brackets,

**Suggested Specifications**

**Models Series 30HQ Options (continued)**

supported in heavy gauge galvanized steel frames. Each unit employing an electric heating coil shall be constructed and installed in accordance with the requirements of the local authorities and shall be UL or ETL listed specifically with the heater as a component of the terminal unit device.

b. Coils shall have the capacities indicated in Contract

Documents. Coils rated up through 15.5 kW shall be single phase,

347 volt, 60 hertz and coils larger than 15.5 kW shall be three phase, four wire, 207, 480 or 600 volt, 60 hertz.

c. Terminal bolts, nuts and washers shall be of corrosion resistant materials. Coils shall be constructed so the installation may be accomplished in accordance with the provisions of the National Electrical Code, for zero clearance. Coils shall be given a 2000 volt dielectric test at the factory.

d. Automatic reset thermal cutouts shall be furnished for primary **B** protection with manually resettable limit switches in power circuits for secondary protection. Both devices shall be serviceable through

terminal box without removing heating element from the terminal device. The air pressure safety cutout pickup probe shall be remotely mounted near the volume control damper for maximum fidelity.

e. Heating coils shall have a terminal box and cover, with quiet type built-in magnetic step controlled contactors for each circuit, branch circuit fusing for each branch circuit on heaters over 45 amps per the NEC and an air flow safety interlock switch for installation in the heater control enclosure. Provide a 120 or 24

VAC control power transformer with an integral or separately mounted primary and/or secondary overcurrent protection device in accordance with NEC requirements.

f. All wiring of built-in devices shall be brought to clearly marked terminal strips. A complete wiring diagram shall be permanently attached to the heating coil panel cover.

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 for zero clearance and so labeled and shall meet all requirements of the latest National Electrical Code, (CSA C22.2 No.236). The unit shall have a single point electrical and/or pneumatic connection (dual point electrical on

600V). Heater casing and panel shall be a minimum of 20 ga. (1.00) galvanized steel. Each heater shall be complete with automatic reset high limit thermal cut-outs, control voltage transformer as required, ground terminal, fan relay for interlocking the heater and fan and high grade nickel chrome alloy wire.

Element wires shall be supported by ceramic isolators. 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, pneumatic electric switches) for heater control.

The SCR controller shall contain a discharge temperature sensor capable of limiting leaving air temperature to a user defined setpoint. The SCR controller shall pulse the coil to maintain zone demand while providing the set maximum discharge air temperature. Upon measuring a discharge air temperature above the user defined setpoint, the controller shall reduce heater capacity to maintain maximum allowable discharge air temperature. The discharge air temperature setpoint shall be adjustable from 80 – 100°F (27 – 149°C) by use of a controller mounted potentiometer.

g. Electric heating coils shall be designed for operation with the

DDC controller and control system.

h. Electric heating coils and the associated control panels shall be constructed as a component of the entire terminal unit and mounted in the discharge attenuator downstream of the terminal unit. The resulting unit, including the heater, the VAV damper and the dissipative silencer shall be no longer than 79" (2007) in length.

i. The manufacturer shall prove adequate even airflow over the electric heating coil under the full range of airflow scheduled (minimum to maximum) to prevent uneven heating of the electric coils. The terminal device shall be listed in accordance with UL

1995 as a composite assembly consisting of the VAV terminal device and the electric heating device.

j. Shop Drawings shall be submitted for review. Drawings shall indicate specifically the exact construction, materials, internal wiring, NEC working clearances, etc., of the terminal units and electric heating coils to be furnished under these Specifications.

**Hot Water Heating Coils:**

**Model: 30HQW**

**(Substitute the following paragraphs:)**

30HQW

**1.** Furnish and install **Nailor Model Series 30HQW Single Duct Variable Volume Hospital Grade Terminal Units** of the sizes and capabilities as indicated on the drawings. Units shall be pressure independent with (pneumatic, analog electronic, DDC) controls. Units shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.

10. Single Duct VAV Hospital Grade Terminal Device Hot

Water Heating Coils

a. Terminal unit hot water heating coils shall be mounted on the discharge of the unit with slip and drive connections. Provide an access door or panel on the bottom of the attenuator section of the terminal unit for servicing and cleaning the unit.

b. Hot water heating coils shall be constructed with copper tubes and aluminum plate fins. Coils shall have a maximum of 10 fins per inch. Supply and return connections shall be on the same end of the coil. Fins shall be bonded to the tubes by means of mechanical expansion of the tubes. Fins shall be at least .0045" (.11) thick.

c. Coils shall have galvanized steel casings on all sides no lighter than 22 ga. (1.0).

d. Tubes shall be 1⁄2" (13) O.D. and shall be spaced approximately

1 1⁄4" (32) apart and shall have a minimum wall thickness of 0.016" (.41). Hot water shall be equally distributed through all tubes by the use of orifices or header design. Water velocity in the tubes shall not exceed five feet per second. The water pressure drop through the coil shall not exceed 10 feet. Heating coil face velocities shall not exceed the maximum face velocity indicated in the schedules on the Contract Documents.

e. Coils shall be tested by air pressure under water. Coils shall be tested at 350 psig (2,413 kPa) air static pressure.

f. Coil ratings, calculations and selection data shall be in accordance with the applicable AHRI Standards and shall be submitted with the Shop Drawings.

**Suggested Specifications**

**Models Series 30HQX**

**1.** Furnish and install **Nailor Model 30HQX Single Duct Variable Volume Exhaust Terminal Units** of the sizes and capabilities as indicated on the drawings. Units shall be pressure independent with DDC controls. Units shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.

**2.** The entire terminal unit shall be designed and built as a single unit. The units shall be provided with a variable air volume damper that controls the air quantity in response to a control signal. The units shall also include dissipative silencers and access doors. Exhaust units shall feature a venturi valve inlet with integrated flow sensor for optimized airflow performance and reduced pressure drop. The space limitations shall be reviewed carefully to insure that all units will fit into the space allowed.

**3.** Unit casing shall be 22 ga. (0.86) galvanized steel with rectangular inlet and outlet connections, configured for slip and

**B** drive connections. Casing leakage downstream of the damper

shall not exceed 1% @ 1" w.g. (250 Pa). High side leakage shall

not exceed 2% @ 3" w.g. (746 Pa).

**4.** Damper assemblies of 16 ga. (1.61) galvanized steel shall be multiple opposed blade construction arranged to close at 45 degrees from full open to minimize air turbulence and provide near linear operation. Damper blades shall be fitted with flexible seals for tight closure and minimized sound generation. Damper blades shall be screwed through the shaft to insure that no slippage occurs. Blade shafts shall pivot on corrosion free Celcon® bearings. In the fully closed position, air leakage past the closed damper shall not exceed 2% of the nominal catalog rating at 3" w.g. (746 Pa) inlet static pressure as rated by ASHRAE Standard 130.

**5.** The terminal unit shall be capable of operation as described herein with a minimum inlet static pressure that shall not exceed

0.40" w.g. (100 Pa) at 2000 fpm (10.2 m/s) inlet velocity for unit sizes 4 through 16. (The sequence of operations should be described here, if not part of the temperature controls specifications.) Gauge tap ports shall be supplied in the piping between the flow pick up and the controller.

**6.** Each unit shall be constructed with single point electrical connections. All electrical components shall be ETL or UL listed or recognized and installed in accordance with the National Electrical Code. All electrical components shall be installed in a control box. The entire assembly shall be ETL listed and so labeled.

**7.** Each VAV section shall be internally lined with 13/16" (21) thick, 4 lb. density fiberglass insulation with a reinforced aluminum FSK facing. Units shall meet NFPA 90A and UL 181 standards.

**8.** All sound data shall be compiled in an independent laboratory and in accordance with the latest version of AHRI Standard 880 and ANSI/ASHRAE Standard 130. All units shall be AHRI certified and bear the AHRI certification label.

**9.** The unit shall be capable of being changed from Right Hand to Left Hand configuration by flipping the unit over. No controls, field adjustments, nor field re-assembly shall be required to accomplish this. The unit shall be listed by UL or ETL under UL

1995 to operate in either orientation.

**10.** Silencer sections shall contain a unit casing constructed of

22 ga (.86) galvanized steel. Inlet and discharge shall be rectangular and configured for slip and drive connections. Each silencer section shall be internally lined with 13/16” (21) thick, 4 lb./cu. ft. (64 kg/m³) density fiberglass insulation with a reinforced aluminum FSK facing, placed inside the top and bottom sides of the silencer, thereby eliminating the requirement for field wrapping with thermal insulation. The silencer baffles shall be filled with fiberglass absorption media and encapsulated by 22 ga. (.86) perforated coated steel baffles. A mylar liner shall separate the fiberglass from the perforated baffle with an acoustical spacer and isolate the fiberglass from the airstream. The perforated metal baffles shall be rigidly fastened to the casing of the silencer. Units shall meet NFPA 90A and UL 181 standards.