TCS Series Flow Fan Powered Terminal
Guide Specification

GENERAL
Furnish and install Johnson Controls Model TCS, or equal, Series Flow Constant Volume Fan Powered Terminals of the sizes and capacities scheduled. Units shall be ETL listed. Terminals with electric heat shall be listed as an assembly. Separate listings for the terminal and electric heater are not acceptable. Terminals shall include a single point electrical connection. Terminal units shall be ARI certified and bear the ARI 880 seal.

The entire unit shall be designed and built as a single unit. Field-assembled components or built-up terminals employing components from multiple manufacturers are not acceptable.

CONSTRUCTION
Terminals shall be constructed of not less than 22 gauge galvanized steel with a minimum G90 zinc coating, able to with-stand a 125 hour salt spray test per ASTM B-117. Stainless steel casings, or galvannealed steel casings with a baked enamel paint finish, may be used as an alternative. The terminal casing shall be mechanically assembled (spot-welded casings are not acceptable).

Casing shall be internally lined with 1/2" thick, 4 pound per cubic foot skin, dual density fiberglass insulation, rated for a maximum air velocity of 3600 f.p.m. In addition to using adhesive complying with NFPA 90A, the insulation shall incorporate a secondary mechanical fastener attached to the unit casing wall (clench nail). Adhesive as the only method of fastening the insulation to the casing is not acceptable. Maximum thermal conductivity shall be 0.24. Insulation must meet all requirements of ASTM Standards C1071, (fibrous glass duct lining insulation), G21, (Resistance of synthetic polymers to fungi), UL 181, (materials for the fabrication of air duct and air connector systems) and NFPA 90A, (Installation of air conditioning and ventilating systems). Raw insulation edges on the discharge of the unit must be covered with metal liner to eliminate flaking of insulation during field duct connections. Simple "buttering" of raw edges with an approved sealant is not acceptable.

Casing shall have full bottom access to gain access to the primary air valve and fan assembly. The opening shall be sufficiently large to allow complete removal of the fan if necessary. The casing shall be constructed in a manner to provide a single rectangular discharge collar. Multiple discharge openings are not acceptable. All appurtenances including control assemblies, control enclosures, hot water heating coils, and electric heating coils shall not extend beyond the top or bottom of the unit casing.

SOUND
The terminal manufacturer shall provide ARI certified sound power data for radiated and discharge sound. The sound levels shall not exceed the octave band sound power levels indicated on the schedule. If the sound data does not meet scheduled criteria, the contractor shall be responsible for the provision and installation of any additional equipment or material necessary to achieve the scheduled sound performance.

PRIMARY AIR VALVE
The primary air valve shall consist of a minimum 22 gauge cylindrical body that includes embossment rings for rigidity. The damper blade shall be connected to a solid shaft by means of an integral molded sleeve which does not require screw or bolt fasteners. The shaft shall be manufactured of a low thermal conducting composite material, and include a molded damper position indicator visible from the exterior of the unit. The damper shall pivot in self lubricating bearings. The damper actuator shall be mounted on the exterior of the terminal for ease of service. The valve assembly shall include internal mechanical stops for both full open and closed positions. The damper blade seal shall be secured without use of adhesives. The air valve leakage shall not exceed 1% of maximum inlet rated airflow at 3” W.G. inlet pressure.

©October, 2004 Johnson Controls, Inc. • Page 1 of 4
TCS Series Flow Fan Powered Terminal
Guide Specification

PRIMARY AIRFLOW SENSOR
Differential pressure airflow sensor shall traverse the duct using the equal cross sectional area or log-linear traverse method along two perpendicular diameters. Single axis sensor shall not be acceptable for duct diameters 6" or larger. A minimum of 12 total pressure sensing points shall be utilized. The total pressure inputs shall be averaged using a pressure chamber located at the center of the sensor. A sensor that delivers the differential pressure signal from one end of the sensor is not acceptable. The sensor shall output an amplified differential pressure signal that is at least 2.5 times the equivalent velocity pressure signal obtained from a conventional pitot tube. The sensor shall develop a differential pressure of 0.03" w.g. at an air velocity of < 450 FPM. Documentation shall be submitted which substantiates this requirement. Brass balancing taps and airflow calibration charts shall be provided for field airflow measurements.

FAN ASSEMBLY
The unit fan shall utilize a forward curved, dynamically balanced, galvanized wheel with a direct drive motor. The motor shall be permanent split capacitor type with three separate horsepower taps. Single speed motors with electronic speed controllers are not acceptable.

The fan motor shall be un-pluggable from the electrical leads at the motor case for simplified removal (open frame motors only). The motor shall utilize permanently lubricated sleeve type bearings, include thermal overload protection and be suitable for use with electronic and/or mechanical fan speed controllers. The motor shall be mounted to the fan housing using torsion isolation mounts properly is to be mechanically isolated to minimize vibration transfer.

The terminal shall utilize an electronic (SCR) fan speed controller for aid in balancing the fan capacity. The speed controller shall have a turn down stop to prevent possibility of harming motor bearings.

HOT WATER COIL
Terminal shall include an integral hot water coil where indicated on the plans. The coil shall be manufactured by the terminal unit manufacturer and shall have a minimum 22 gauge galvanized sheet metal casing with a minimum G90 zinc coating. Stainless steel casings, or galvannealed steel casings with a baked enamel paint finish, may be used as an alternative. Coil to be constructed of pure aluminum fins with full fin collars to assure accurate fin spacing and maximum tube contact. Fins shall be spaced with a minimum of 10 per inch and mechanically fixed to seamless copper tubes for maximum heat transfer.

Each coil shall be tested at a minimum of 350 PSIG under water. Coils shall incorporate a built in, flush mounted access plate, allowing top and bottom access to the coil.

ELECTRIC HEATERS
Terminal shall include an integral electric heater where indicated on the plans. Heater shall be manufactured by the terminal unit manufacturer. The heater cabinet shall be constructed of not less than 20 gauge galvanized steel with a minimum G90 zinc coating. Stainless steel cabinets, or galvannealed steel casings with a baked enamel paint finish, may be used as an alternative. Heater shall have a hinged access panel for entry to the controls.

A power disconnect shall be furnished to render the heater non-operational. Heater shall be furnished with all controls necessary for safe operation and full compliance with UL 1995 and National Electric Code requirements.

©October, 2004 Johnson Controls, Inc. • Page 2 of 4
Heater shall have a single point electrical connection. It shall include a primary disc-type automatic reset high temperature limit, secondary high limit(s), Ni-Chrome elements, and fusing per UL and NEC. Heater shall have complete wiring diagram with label indicating power requirement and KW output. Heater shall be interlocked with fan terminal so as to preclude operation of the heater when the fan is not running.

Proportional electric heat shall utilize SSR control. (Solid State Relay) The SSR shall feature zero voltage switching, to avoid voltage transients which would be generated if the power is switched on or off at the peak of the AC voltage. The proportional electric heat shall be factory mounted and wired and ETL listed as an assembly.

**CONTROLS**

**DIRECT DIGITAL CONTROLS**

Terminal boxes are to be shipped with factory installed Johnson Controls VMA series or the Johnson Controls LN series direct digital controllers.

VMA 1400 series controller option is to communicate on the Johnson Controls N2 field network. Each controller is to utilize an integral stepper drive actuator, be self-tuning, and utilize PRAC. (Pattern Recognition Adaptive Control) All of the terminal box controllers are to be factory commissioned with all parameters set for the box operation. Parameters to be set must include minimum flow, maximum flow, inlet size, K-factor, and address. Each terminal box is to have a permanently affixed quality label certifying that the controller has been configured and tested.

LN-VAVL series LON controller option is to be factory installed. Each controller is to utilize an integral actuator and utilize an auto-zero function. This controller is to be LONMark certified, and ready for connection to a LON trunk when installed in the field.

Any terminal box including a hot water reheat coil shall have a factory furnished whip to connect the field mounted control valve with the controller.

**PNEUMATIC CONTROLS**

Units shall be controlled by a pneumatic differential pressure reset volume controller. Controller shall be capable of pressure independent operation down to 0.03 inches W.G. differential pressure and shall be factory set to the specified airflow (CFM). Controller shall not exceed 11.5 scim (Standard Cubic Inches per Minute) air consumption @ 20 PSIG.

Unit primary air valve shall modulate in response to the room mounted thermostat and shall maintain airflow in relation to thermostat pressure regardless of system static pressure changes. An airflow (CFM) curve shall be affixed to the terminal unit expressing differential pressure vs. CFM. Pressure taps shall be provided for field use and ease of balancing.

Terminal unit manufacturer shall supply and manufacture a 5 to 10 PSIG pneumatic actuator capable of a minimum of 45 in. lbs. of torque.

Actual sequence of operation is shown on the contract drawings. Terminal unit manufacturer shall coordinate, where necessary, with the Temperature Control Contractor.
OPTIONS

FOIL FACED INSULATION
Insulation shall be covered with scrim backed foil facing. All insulation edges shall be covered with foil or metal nosing. Insulation shall meet ASTM C1136 for low permeance vapor retarders and ASTM C665 for biological growth in mineral-fiber blanket thermal insulation.

DOUBLE WALL CONSTRUCTION
The terminal casing shall be double wall construction using a 22 gauge galvanized metal liner with a chromate finish covering all insulation.

LOW TEMPERATURE CONSTRUCTION
Terminals shall be designed for use with primary airflow temperatures as low as 46°F and maximum ceiling plenum conditions of 78°F and 60% R.H. In addition to other design criteria, the primary air valve shall be thermally isolated from the terminal casing. The damper shaft shall be made from non-conducting thermoplastic composite material. Metal shafts will not be acceptable.

ECM MOTOR
Fan motor shall be General Electric ECM™ electronically commutated motor. The motor shall be brushless DC controlled by an integrated controller / inverter that operates the wound stator and senses rotor position to electrically commutate the stator. Motor shall be permanent magnet type with near-zero rotor losses designed for synchronous rotation. The ECM™ motor shall maintain minimum 70% efficiency over the entire operating range.

FILTERS
Standard Option. Terminals shall include a 1” thick disposable fiberglass filter. Filter shall be secured with quick release clips, allowing removal without horizontal sliding.

Low Velocity Option. Terminal shall include an integral filter rack and 1” thick disposable fiberglass filter capable of removal without use of tools. Filter rack shall be V-bank or similar design to ensure filter air velocity less than 600 FPM. Field installed filter racks are not acceptable.