GUIDE SPECIFICATION

Pressure Independent Variable Air Volume Terminal Unit

Variable air volume terminal units (also known as VAV boxes) shall be DDC controlled pressure independent type. The complete VAV terminal unit including airflow sensor, controller and actuator and temperature controller shall be fully supplied by the VAV manufacturer to ensure one source responsibility for its performance. Each VAV terminal unit complete with transducers/controllers and/or actuators shall be fully factory assembled, wired, configured and tested prior to delivery for the following properties and functions.

a) Minimum and maximum airflow controllability
b) Air leakage across damper and casing
c) Pressure compensation

Factory Acceptance Test (FAT)

During FAT, the following tests shall be carried out for each size of VAV terminal unit to be supplied.

a) Test to verify that the accuracy of the VAV terminal unit complete with the required DDC controller/transducer shall not exceed +/-5% at an inlet velocity from 2.0 m/s to 12.0 m/s. Verification shall be carried out with a calibrated flow measuring station from a recognized laboratory.

b) Test to verify the controllability of the VAV terminal unit with the required DDC controller/transducer at the design minimum and maximum airflows. This test shall be conducted in group of VAV terminal units

c) Test to verify that the VAV terminal unit with the required DDC controller/transducer is able to response to changes in upstream pressure. This test shall be conducted in group of VAV terminal units

d) Test to verify the proportional band of the temperature controller.

Method statement detailing how the type tests are to be carried out is to be submitted for approval before the FAT. The results of the tests will be submitted and form part of the testing and commissioning report of the complete VAV terminal unit.

VAV Box Construction

The terminal unit casing shall be round in shape of double-casing construction with the annular space filled with 25 mm thick and 32 kg/m^3 density fiberglass insulation The double-casing prevents fiberglass insulation from erosion and reduces radiated noise. Insulation shall be fire resistance meeting class "O" requirement according to BS 476 part 6 and 7. Casing shall be constructed of minimum 0.7 mm thick galvanized steel.

Damper blade shall be fixed with two "U" bolts to the aluminium shaft. Nylon bush shall be used for all internal damper pivot points for quiet operation and no lubrication is required. The damper blade shall be constructed of double-skin galvanized steel plate with silicone seal all round to give a tight

seal when closed. Damper blade shall be designed to operate over a range of 60 degrees so as to provide more linear flow characteristic and, hence, better control of airflow.

Controller, damper actuator and transformer shall be mounted externally on the VAV terminal unit for ease of maintenance. Pressure signal chart shall be provided on each box for use during testing and commissioning and maintenance in the field.

Airflow Sensor

The VAV terminal unit shall have a precision multiple point differential airflow sensor for accurate monitoring and control of airflow. Airflow sensor shall be constructed of special aluminium profile capable of amplifying the velocity signal by at least 2 times to improve flow accuracy and maintain controllability at minimum design airflow without incurring noise at maximum design airflow.

Each airflow sensor shall have 12 sets of test points for size 5 to size 10 boxes and 16 sets of points for size 12 and larger boxes. The position of the test point shall be arranged to ensure a true average measurement signal. The airflow sensor shall have a center reservoir that collects and averages the high- and low-pressure signals producing an average high and low output signals that gives accurate airflow reading through the VAV controller.

There shall be only one calibration point required for the full range of airflow measurement and the accuracy shall be maintained throughout the full airflow range.

Test reports/certificates shall be submitted to verify the airflow sensor accuracy.

Performance Data

Air Leakage through the closed VAV damper shall be less than 1.0 cmh or 16.5 L/min at 250 Pa pressure differentials for all VAV box sizes. The minimum pressure drop across the VAV terminal unit shall not exceed 40 Pa.

VAV terminal unit performance data submitted shall be tested in accordance to BS EN ISO 5135. The minimum static pressure required at the inlet shall not exceed 125 Pa at full open position.

VAV equipment manufacturer shall submit a computerized program for sizing of VAV terminal unit and the air distribution system. VAV Terminal units selected shall conform to airflow rate, static pressure and designated noise criteria.

Multiple Outlet Plenum

Factory installed multiple outlet plenum (MOP) shall be provided at the discharged of the VAV terminal unit for distribution of airflow to air diffusers. The MOP shall be constructed of 1.0 to 1.2 mm thick galvanized steel depending on VAV box size and internally lined with 25 mm thick and 32kg/m^3 semi-rigid fiberglass laminated with acoustically transparent fire-resistant fabric to
prevent erosion. The MOP outlet shall have radius spigot to minimize pressure loss. Each spigot shall have a manual throttling damper for balancing airflow to each diffuser. The length of MOP depends on the noise attenuation required to achieve the required room noise criteria. However, the MOP length should not less than 600 mm to minimize pressure loss and noise regeneration. VAV box manufacturer shall submit noise and pressure loss analysis and MOP length for approval. MOP shall be manufactured by the VAV box manufacturer to ensure compliance to specified room noise criteria.

VAV Electronic DDC Controller

The controller shall be of the BACnet compatible open protocol standalone Direct Digital Controller type. Each VAV terminal unit shall come with an intelligent DDC controller, actuator, flow transducer combined in a single VAV compact unit and a separate low voltage transformer. VAV Controllers that comes with an external actuators and flow transducer will not be accepted. All these components shall be installed in a metal enclosure. All external wiring into the VAV terminal unit shall be through a single terminal block connection with labelling.

For the actuator portion, the motor should be brushless DC motor actuator with non-blocking function and power save mode. The intelligent controlled DC motor will automatically identify end stops or

blockages, and will automatically reduce current draw. This feature will prevent the motor from overheating and cause premature failure.

There should be a lockable manual override button to manually move the actuator position when there is no power present. This is necessary when the damper is required to be fully open during air balancing. Lifetime of the actuator motor shall be minimum 100,000 full cycles or 1,000,000 part cycles loaded with rated torque. The actuator speed should be 60s (Boost, manual Override) and 150s (normal operation), full span.

For the flow transducer portion, the Delta P sensor accuracy shall be as follows:

±5% of Measured Value (20Pa to 500Pa), full span
±1Pa (-20Pa to +20Pa)

The flow transducer shall exhibit zero drift and the airflow sensor shall have 100% repeatability on-site measurements

For the VAV DDC Controller portion, all operating parameters and set point shall be stored in non-volatile memory to prevent memory loss during power failure. Each VAV terminal unit shall be capable of complete stand-alone pressure independent operation such that failure of any other component in the system will not cripple the operation of any individual VAV terminal unit.
Each VAV Controller shall be easily configured and programmed. Configuration of BACnet addresses, BACnet description and their baud rates setting should be able to be configured or programmed without power to the controller.

Configuration and settings of the VAV controller in the field during testing & commissioning using bulky propriety equipment, notebook computer, data cables will not be accepted. The VAV controller and the room unit (thermostat) should be equipped with NFC interface. NFC equipped smartphone can be used for communicating with the VAV controller actuator. The software app should be of free license and downloadable from the internet.

The software app for the smartphone shall support remote connections through the internet to a central data repository (Data Cloud). This central data repository shall host the project data and provide the latest update to all the users. Therefore multiple users (T&C personnel) with NFC equipped smartphones can simultaneously T&C at the project site. The project manager would have access to the data repository from a web browser and can remotely monitor the T&C progress.

VAV manufacturer shall provide access to the central data repository free of cost and after building handover, these central data repository access can be extended to the Facility Management Team and they can use it for maintenance of the VAV terminal units

The networking of the whole BAS/BMS architecture shall be through non-proprietary BACnet protocol capable of interfacing with other vendor's equipment. With this open protocol, it should be the responsibility of the BAS/BMS contractor to provide the interfacing software and hardware to interface the whole VAV system into the Building Automation / Management system

Room Unit – Temperature controller

The Room Unit shall have a LCD display with least 75mm screen size. The LCD should show the set-point temperature and actual temperature separately. The backlight of the LCD should be white. Other color backlighting will not be accepted.

The Room Unit should have the ability for the user to locally adjust the temperature set point. The Room Unit should also have additional features like Eco Mode and Boost Mode.

The Room Unit must also have the NFC interface built in. This is to provide ease of maintenance & diagnostic using the NFC equipped smartphone during the T&C and also for the facility management team after the project has been handed over.

For long-term precision operation, the Room Unit temperature sensor should have the ability to be calibrated. The sensor should be able to be calibrated up to (± 5C) with the smartphone app through NFC. Room Units without calibration ability will not be accepted.

VAV Ductwork and Air Distribution System

A manual pressure reducing damper shall be installed at each branch duct take-off to keep the pressure in the branch duct to the minimum required to supply required airflow to the furthest box downstream. Balancing contractor shall document each branch duct static pressure and lock the damper in position after balancing. All effort shall be carried out to ensure that upstream duct to the VAV box be kept straight as long as possible. The connecting duct internal dimension shall be fabricated within 3 mm from the VAV box outside diameter and the joint taped with 2 rounds of strong duct tape. No screw shall be allowed for duct-VAV box connection.

Flexible duct used for connecting MOP to the diffuser shall be straight and stretched for a distance of at least 2 duct diameter.

Diffuser used for the VAV system shall be as specified in the relevant section under air distribution system. However, 4-way louver diffuser shall not be allowed for VAV system. For diffuser with side inlet plenum, flexible duct velocity shall be limited to 3.5 m/s. For direct connection by flexible duct to the diffuser inlet, the flexible duct velocity shall be limited to 2.5 m/s.