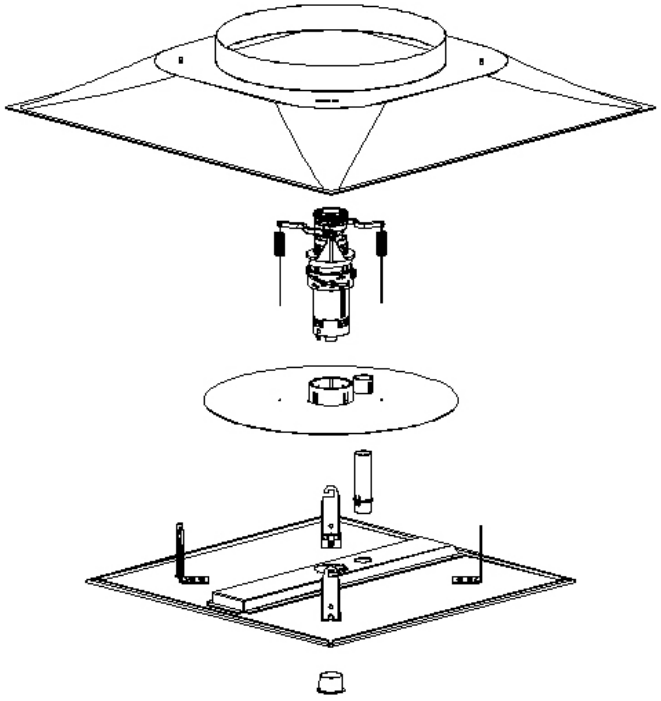
AG-T3SQ-07
March 31, 2007

T_3 Intelligent Comfort Control Products
T_3SQ VAV Diffusers
Application Guide



Titus
A Tomkins Company

990 Security Row
Richardson, Texas 75080
972.699.1030
www.titus-hvac.com

Contents Page

General

This document provides application highlights covering the T_3 Comfort Products T_3SQ thermally powered VAV diffuser.

Additional information may be found at the Titus website, www.titus-hvac.com.

Introduction

Thermal comfort is often cited as the number one complaint in office buildings today. Several studies over the last decade confirm that temperature control, or lack there of, is a big issue for building owners.

Studies have linked improved comfort to reduced absenteeism and therefore improved productivity. Labor costs are typically ten times the cost of property, so a slight premium for comfort is rewarded with large returns in productivity.

Individual comfort control would resolve the temperature control issues, but typically comes at a higher first costs. The Titus T_3SQ thermally powered VAV diffusers provide cost effective individual comfort control.

Description

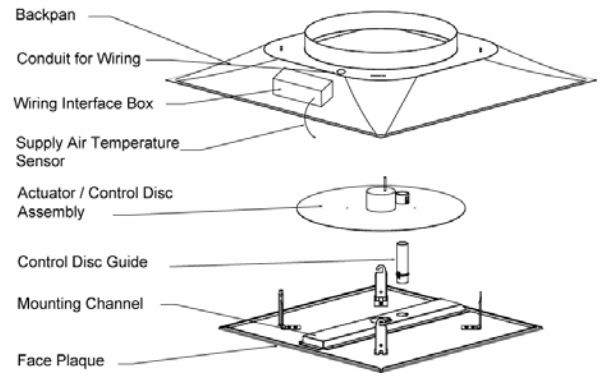
The T_3SQ VAV diffuser is available as a thermally power, self contained version and an analog version. The T_3SQ maintains space temperature by varying the volume of air delivered to the space. The amount of air delivered will depend on the supply air temperature (SAT), the room temperature setpoint, and the room temperature.

As the volume of air is decreased by the control disc, the velocity of air is increased, thereby maintaining the longest throw and best entrainment. This insures superior air distribution at all damper positions.

The curvature of the backpan works with the formed edges of the face panel to deliver a tight horizontal air pattern, without excessive noise or pressure drop over the full range of operation.

Analog Configuration

The analog T_3SQ (configuration -1) is a VAV heating / cooling diffuser. The diffuser consists of an analog electronic actuator, control disc, and wiring interface box with supply air temperature sensor mounted in the popular Titus OMNI diffuser.



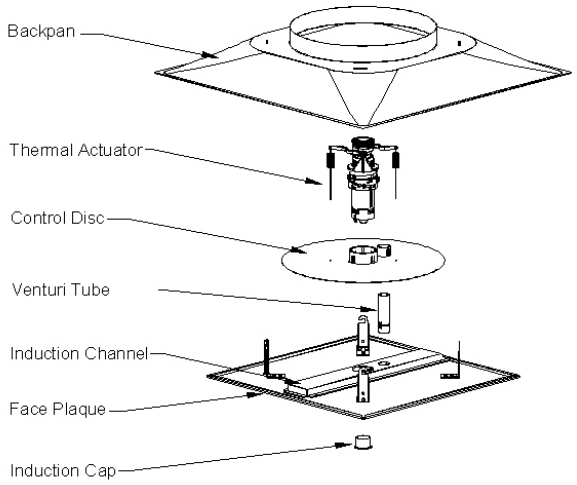
Master diffusers are created by connecting the T_3SQ -1 diffuser to a wall mounted controller / thermostat using the blue RJ-45 control cable. T_3SQ-1 drone diffusers are created by connecting the diffuser to a master unit using the blue RJ-45 control cable.

Up to six (6) T_3SQ-1 diffusers without optional electric heater or five (5) T_3SQ-1 diffusers with optional electric heater can be powered by a single power module using the white RJ-12 power cable. Plenum rated straight pinout RJ-12 (power)

and RJ-45 (control) cables are supplied in 25 foot lengths.

Thermal Configurations

The thermal T_3SQ is available in VAV heating and cooling. The diffuser consists of a thermal actuator, control disc, venture tube, induction channel, and a center mounted induction cap mounted in the popular Titus OMNI diffuser.



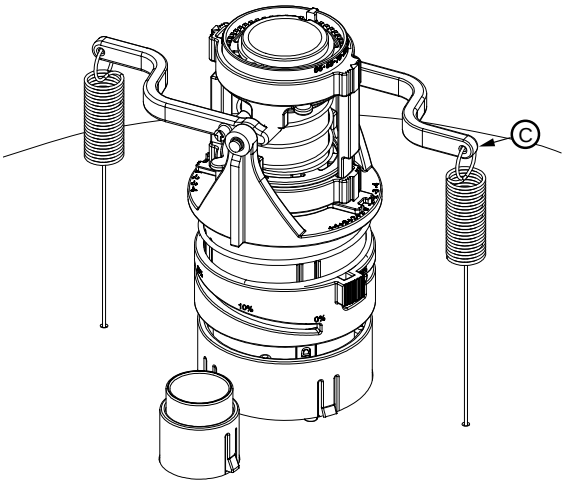
The thermal T_3SQ uses a center mounted induction cap to accurately measure the room temperature. This eliminates the need for a wall mounted thermostat or sensor and provides the fastest, most accurate way of measuring the room air temperature.

The position of the control disc is varied by means of a wax filled thermal element, which responds to changes in sensed temperature. The wax contained in the thermal element melts at the formulated temperatures to expand or contract the actuator assembly arms, modulating the control disc.

When the wax cools down the actuator assembly retracts under the action of a return spring, causing the control disc to move in the opposite direction to counter the change in sensed temperature.

Adjustment of the room temperature setpoint is achieved by rotating the adjustment ring. The adjustment ring has calibrated markings and the setpoint may be adjusted to suit individual requirements.

Adjustment of minimum airflow is achieved by rotating the grey minimum airflow adjustment ring located in the middle of the actuator assembly. The ring allows for minimum airflow adjustment from 0 to 30%.



Variable Geometry

The T_3SQ's variable geometry design maintains jet velocity at all flow rates, varying airflow pattern for optimal performance throughout its operating range.

A VAV terminal box should only be turned down within the performance range of the diffuser. An improperly selected or operated terminal box / diffuser combination may cause excessive drop, also known as dumping, of the supply air. The T_3SQ ensures good supply air distribution and effective room air movement when supplying as little as 25% of the maximum airflow.

As the control disc modulates inside the backpan of the diffuser, the air velocity increases or decreases which changes the airflow pattern to maintain the room air induction rate. Supply air is discharged horizontally in a uniform 360-degree radial pattern while the variable geometry design ensures that adequate room air movement is maintained throughout the full range of volume variation.

Individual Comfort Control

The T_3SQ provides occupants with their own temperature control unit. The T_3SQ will control each zone to the temperature preferences of the occupant. This eliminates temperature "battles" within the office.

In addition to providing individual comfort control, having individual sensors in each zone will allow each VAV diffuser to react to variations in the zone. For example, if an occupant is not in the zone and their equipment (load) is off, the diffuser will sense the lower zone temperature and adjust the control disc to reduce the supply to the zone.

Thermal Accuracy

A VAV diffuser must be able to accurately determine the zone temperature and adjust the airflow to provide comfort control. Inaccurate zone temperature sensing will result in inefficient operation of the VAV diffuser and ineffective zone comfort control.

For a thermal VAV diffuser, the closer that the induction point of room air is to the thermal actuator, the less temperature loss the zone sensor will see. This temperature loss is known as the thermal dead band.

A centrally located induction port directly beneath the thermal actuator coupled with a venturi-based induction system, which draws room air immediately over the actuator, provides a narrower thermal dead band and allows faster response time than plaque diffusers with over-the-edge type induction channels that feed room air to the actuator.

The center induction port of the T_3SQ-4 provides the most accurate and efficient method of sensing room temperature and actuating the VAV mechanism making the T_3SQ, the industry's most effective thermal VAV diffuser

Green Buildings

The U.S. Green Building Council's (USGBC) LEED 2.2 rating system recognizes the benefits of individual comfort control. The Indoor Environmental Quality Credit 6.2, Controllability of Systems: Thermal Comfort states that one LEED point can be received for providing controls for each individual for airflow, temperature, or humidity for at least 50% of the occupants to suit individual task needs and preferences.

Providing individual comfort control potentially benefits the building owner in two ways: energy savings and productivity improvements.

Energy Savings

Thermally powered VAV diffusers require no input energy, where as a VAV terminal requires, at minimum, power to control the 24V actuator.

In addition to not requiring power, having individual zone control and temperature sensing in the zone allows the control disc to react faster to load changes in the zone eliminating over- and under-cooling of the zone.

The analog T_3SQ has a lower energy usage when compared to a typical VAV system with single duct and fan powered terminals. The T_3SQ is a low pressure VAV unit, needing only 0.2" of inlet pressure, compared to a typical single duct or fan powered terminal requires between 0.2" and 0.75" at the inlet.

Productivity Improvements

Labor costs are typically ten times the cost of property; therefore a slight improvement in productivity offsets any increased first cost of individual comfort control. A one percent (1%) productivity improvement is the equivalent of 22 hours, or almost three days, of gained productivity.

For example, a 1% gain in productivity for a company with 115 employees earning $35,000 a year, 30 employees earning $60,000 a year, and 5 employees earning $80,000 a year would be worth almost $70,000.

Several studies have linked green building features to improved productivity. A Herman Miller study found up to 7% increase in worker productivity when they moved to a green facility and a Lawrence Berkeley National Laboratory study found that US businesses could save as much as $58 billion in lost sick time and up to $200 billion in improved worker performance if IAQ was improved.

Applications

The T_3SQ can be used to provide individual comfort control to an entire building or any area of a building. The T_3SQ can be used to address challenging areas such as areas with varying load requirements like conference room and individual offices.

If the T_3SQ is used for an entire building, or if more than 30% of the system is utilizing VAV

diffusers, pressure control will need to be used. Titus offers the ZQCV and the ZECV for stand-alone pressure control in VAV diffuser systems.

The T_3SQ is ideal retrofit any zone into individual control VAV zone because it does not require any wiring. The T_3SQ is a simple, cost effective way to address an occupant area that has thermal comfort complaints.

Suggested Specification

T_3SQ-1 Heating / Cooling Analog VAV Diffuser

Furnish and install Titus model T_3SQ-1 analog VAV diffusers with heating / cooling changeover.

Each diffuser shall have a 24V AC electric actuator capable of infinitely varying the supply of conditioned air into the space by means of regulating a variable aperture damper, known as a control disc, vertically within the diffuser. Supply air from the variable geometry diffusers will be discharged horizontally in a 360° pattern and maintain constant air movement in the space throughout the range of volume variation from 100% down to 30%.

The T_3SQ-1 shall be configured as either a master or drone unit. Each shall have a wiring interface box mounted on the diffuser backpan with three RJ-45 and two RJ-12 receptacles for plug and play operation. Each master unit wiring interface box shall have a supply air temperature changeover sensor.

Each master unit shall have a thermostat / control module and each drone shall be connected to a master unit. The T_3SQ-1 diffusers shall be powered by a power module. Up to 6 non-reheat units can be connected to a power module.

Where needed, an electric inlet heater shall be fitted into the neck of each VAV diffuser and shall be protected by means of automatic and power reset overheat protection switches and a flow proving switch.

Optional heaters shall be SCR controlled. Control of the heaters must take place over a 2°F proportional band, energized automatically, in both cooling and heating modes. In cooling mode, the control disc shall drive to the minimum position before energizing the heater at 1°F below room setpoint. In heating mode, the control disc shall drive to the full open position before energizing the heater at 1°F below room setpoint.

Each heater shall have a wiring interface box with three (3) RJ-45 and two (2) RJ-12 receptacles for plug and play operation.

Ceiling diffusers shall be square, architectural, panel face diffusers. The diffuser shall have an 18-gauge steel face panel mounted on an aerodynamically shaped, one piece, seamless back pan. The diffuser face panel must be field removable by means of four positive locking clips. The exposed surface of the face panel shall be smooth, flat, and free of visible fasteners. The face panel cannot project more than $^1/_8$-inch below the outside border of the diffuser back pan.

The face panel shall have an aerodynamically shaped, hemmed edge. A single metal thickness on the edges of the face panel is not acceptable. Ceiling diffusers with a 24 x 24-inch full face shall have no less than an 18 x 18-inch face panel. The entire diffuser shall be constructed of steel, with an integral drawn inlet. The diffuser neck shall have a minimum $1^1/_8$-inch depth available for duct connection.

Finish shall be a thermoset alky-melamine enamel paint, baked at 315℉. The paint hardness must be 2H to 3H. The paint must pass a 300-hour ASTM D1654 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass the 500-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with 50-inch pound applied.

Alternatives to the specified product must provide published performance ratings that meet or exceed the performance of the T_3SQ ceiling diffuser. All test data shall be obtained in accordance with ANSI/ASHRAE Standard 70–1991, and ARI Standard 880–98. A copy of the certified test results shall be provided upon request. The VAV diffuser shall be ARI certified.

T_3SQ-4 Heating / Cooling Thermally Powered VAV Diffuser

Furnish and install Titus model T_3SQ-4 thermally powered VAV diffusers with heating / cooling changeover.

Each diffuser shall be thermally powered to infinitely vary the supply of air into the space, in either heating or cooling mode, by means of regulating a variable aperture damper, known as a control disc, vertically within the diffuser. Supply air from the variable geometry diffusers will discharge horizontally in a 360° pattern and will maintain constant air movement in the space throughout the range of volume variation from 100% down to 30%.

The thermal room sensing element shall be located behind an induction cap in the center of the diffuser panel and shall provide no more than 1°F thermal deadband between induced temperature and zone temperature. Each diffuser shall be individually adjustable to sense room temperature within the space between 68°F and 77°F. Each diffuser shall be individually adjustable for minimum airflow from 0 to 30%.

Each diffuser is to be fitted with a single thermal supply air sensing element to automatically change from and to a cooling and heating mode and be able to infinitely vary the supply of air into the space in either mode. Each diffuser shall be self-contained and require no external power source to maintain space temperature throughout the range of operation. The diffusers shall carry the manufacturer's 10-year warranty.

Ceiling diffusers shall be square, architectural, panel face diffusers. The diffuser shall have an 18-gauge steel face panel mounted on an aerodynamically shaped, one piece, seamless back pan. The diffuser face panel must be field removable by means of four positive locking clips. The exposed surface of the face panel shall be smooth, flat, and free of visible fasteners. The face panel cannot project more than $^1/_8$-inch below the outside border of the diffuser back pan.

The face panel shall have an aerodynamically shaped, hemmed edge. A single metal thickness on the edges of the face panel is not acceptable. Ceiling diffusers with a 24 x 24-inch full face shall have no less than an 18 x 18-inch face panel. The entire diffuser shall be constructed of steel, with an integral drawn inlet. The diffuser neck shall have a minimum $1^1/_8$-inch depth available for duct connection.

Finish shall be a thermoset alky-melamine enamel paint, baked at 315°F. The paint hardness must be 2H to 3H. The paint must pass a 300-hour ASTM D1654 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass the 500-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with 50-inch pound applied.

Alternatives to the specified product must provide published performance ratings that meet or exceed the performance of the T_3SQ ceiling diffuser. All test data shall be obtained in accordance with ANSI/ASHRAE Standard 70–1991, and ARI Standard 880–98. A copy of the certified test results shall be provided upon request. The VAV diffuser shall be ARI certified.

Abbreviations

The following table lists abbreviations used within this document.

Abbrev.	Term
VAV	Variable Air Volume
USGBC	United States Green Building Council
LEED	Leadership in Energy & Environmental Design
ASTM	American Society for Testing and Materials
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating & Air Conditioning Engineers
ARI	Air-Conditioning and Refrigeration Institute
ADC	Air Diffusion Council