AG-TQS-IAQ-00
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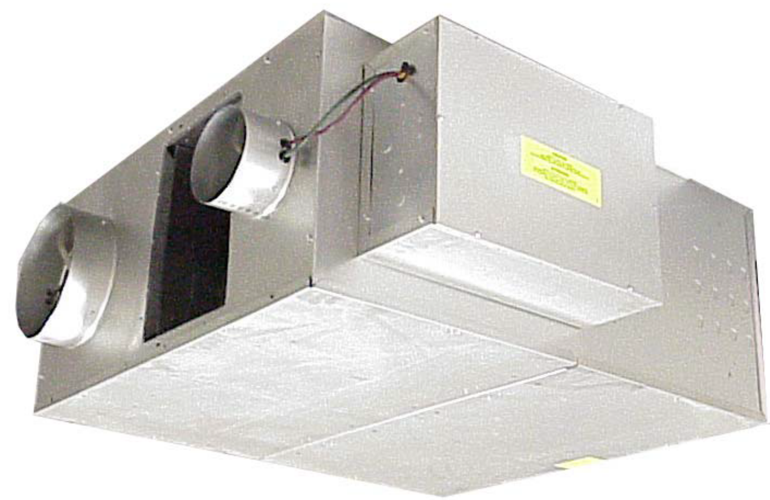
Application Guide

TQS with IAQ Inlet



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Introduction

The demand for fresh air inlets on series fan powered terminals has been growing to address the growing IAQ concerns. Titus introduces the IAQ inlet option on the TQS premiere fan powered terminal.

Building owners are becoming more aware of the health concerns related to poor indoor air quality (IAQ). Indoor air is a combination of outside air and indoor air distributed throughout a building. Indoor air pollution is caused by an accumulation of contaminants that primarily come from inside the building.

Carbon dioxide can accumulate in building spaces if a sufficient amount of outdoor air is not brought in to the building. Building material, furniture, cleaners, and copy machines can all add to the accumulation of pollutants in a building.

Studies have shown that poor IAQ can contribute to building-related illnesses and sick building syndrome. The World Health Organization estimates that as many as 30% of new buildings have unusually high rates of sick building complaints. The National Institute for Occupational Safety and Health reports that poor ventilation is a major contributing factor to these sick building complains. Increasing the supply of outside air to a zone decreases indoor air problems.

Outside air control is typically handled by the central air handling unit. Due to varying conditions in individual zones, the outside air supplied by the air handler may not meet the minimum requirement for the zone. By supplying outside air directly to the zone using the TQS with IAQ inlet, the minimum ventilation requirement for the zone can be maintained.

ASHRAE Standard 62

ASHRAE Standard 62, Ventilation for Acceptable Indoor Air Quality, specifies the minimum ventilation rates and indoor air quality that will be acceptable to human occupants. The standard is intended to minimize the potential for adverse health effects.

ASHRAE defines acceptable indoor air quality as air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction.

The standard defines the outdoor air quality acceptable for ventilation, outdoor air treatment when necessary, ventilation rates for residential, commercial, institutional, vehicular, and industrial spaces, the criteria for reduction of outdoor air quantities when recirculated air is treated by contaminant-removal equipment, and the criteria for variable ventilation when the air volume in the space can be used as a reservoir to dilute contaminants.

Table 1 is a summary of the Outdoor Air Requirements For Ventilation For Commercial Buildings from the standard.

Table 1.

Application	Estimated Maximum Occupancy	Outside Air Requirement		
	People / 1000 sq.ft	cfm / Person	cfm / sq.ft.	cfm / Room
Dry Cleaners				
Commercial laundry	10	25		
Commercial dry cleaner	30	30		
Storage, pick up	30	35		
Coin-operated laundries	20	15		
Coin-operated dry cleaner	20	15		
Food and Beverage Service				
Dining rooms	70	20		
Cafeteria, fast food	100	20		
Bars, cocktail lounges	100	30		
Kitchens (cooking)	20	15		
Hotels, Motels, Resorts, Dormitories				
Bedrooms				30
Living rooms				30
Baths				35
Lobbies	30	15		
Conference rooms	50	20		
Assembly rooms	120	15		
Dormitory sleeping areas	20	15		
Gambling casinos	120	30		
Offices				
Office space	7	20		
Reception areas	60	15		
Telecommunication centers and data entry areas	60	20		
Conference rooms	50	20		
Public Spaces				
Corridors and utilities			0.05	
Public restrooms		50		
Locker and dressing rooms			0.5	
Smoking lounge	70	60		
Elevators			1	
Retail Stores, Sales Floors, and Show Room Floors				
Basement and street	30		0.3	
Upper floors	20		0.2	
Storage rooms	15		0.15	
Dressing rooms			0.2	
Malls and arcades	20		0.2	

Shipping and receiving	10		0.15	
Warehouses	5		0.05	
Smoking lounge	70	60		
Specialty Shops				
Barber	25	15		
Beauty	25	25		
Reducing salons	20	15		
Florists	8	15		
Clothiers, furniture			0.3	
Hardware, drugs, fabric	8	15		
Supermarkets	8	15		
Pet shops			1	
Sports and Amusement				
Spectator areas	150	15		
Game rooms	70	25		
Ice arenas (playing areas)			0.5	
Swimming pools (pool and deck area)			0.5	
Playing floors (gymnasium)	30	20		
Ballrooms and discos	100	25		
Bowling alleys (seating areas)	70	25		
Theaters				
Ticket booths	60	20		
Lobbies	150	20		
Auditorium	150	15		
Stages, studios	70	15		
Transportation				
Waiting rooms	100	15		
Platforms	100	15		
Vehicles	150	15		
Workrooms				
Meat processing	10	15		
Photo studios	10	15		
Darkrooms	10		0.5	
Pharmacy	20	15		
Bank vaults	5	15		
Duplicating, printing			0.5	
Education				
Classroom	50	12		
Laboratories	30	20		
Training shop	30	20		
Music rooms	50	15		
Libraries	20	15		
Locker rooms			0.5	

Corridors			0.1	
Auditoriums	150	15		
Smoking lounges	70	60		
Hospitals, Nursing and Convalescent Homes				
Patient rooms	10	25		
Medical procedure	20	15		
Operating rooms	20	30		
Recovery and ICU	20	15		
Autopsy rooms			0.5	
Physical therapy	20	15		
Correctional Facilities				
Cells	20	20		
Dining halls	100	15		
Guard stations	40	15		

EPA Report – Energy Costs and IAQ Performance of Ventilation Systems and Controls

In January 2000, the Environmental Protection Agency (EPA) released a report on the Energy Costs and IAQ Performance of Ventilation Systems and Controls. The report was broken into seven projects:

Project Report #1	Project Objectives and Methodology
Project Report #2	Assessment of CV and VAV Ventilation Systems and Outdoor Air Control Strategies for Large Office Buildings – Outdoor Air Flow Rates and Energy Use
Project Report #3	Assessment of CV and VAV Ventilation Systems and Outdoor Air Control Strategies for Large Office Buildings – Zonal Distribution of Outdoor Air and Thermal Comfort Control
Project Report #4	Energy Impacts of Increasing Outdoor Flow Rates from 5 to 20 cfm per Occupant in Large Office Buildings
Project Report #5	Peak Load Impacts of Increasing Outdoor Air Flow Rates from 5 to 20 cfm per Occupant in Large Office Buildings
Project Report #6	Potential Problems in IAQ and Energy Performance of HVAC Systems When Outdoor Flow Rates are Increased from 5 to 15 cfm per Occupant in Education Buildings, Auditoriums, and Other Very High Occupant Density Buildings
Project Report #7	The Impact of Energy Efficient Strategies on Energy Use, Thermal Comfort, and Outdoor Air Flow Rates in Commercial Buildings

(This Guide will discuss some of the issues discussed in the reports. A complete copy of the reports can be found at the Environmental Protection Agency's IAQ in Large Buildings website at http://www.epa.gov/iaq/largebldgs/eiaq_page.htm .)

The study looked at three climates (Minneapolis, Washington DC, and Miami) and three outdoor air control strategies (fixed outdoor air fraction, constant outdoor air, and air-side economizer) for both constant volume and variable air volume systems.

The fixed outdoor air fraction (FOAF) strategy maintained a constant percent of outdoor air regardless on supply volume. This is typically a fixed position outside air damper. The constant outdoor air (COA) strategy maintains a constant volume of outside air with respect to supply air volume. The air-side economizer strategy override the outdoor air flow called for by the FOAF or COA strategy when outside air temperature is lower than the return air temperature. Two air side economizer strategies were used, one based on temperature (T) and one based on enthalpy (E).

The study discusses the benefits (thermal and economic) of the various systems in the three climates, most of these issues will not be discussed in this Guide.

The study found that core zones consistently received less outdoor air than the perimeter zones. The core of a building is typically the zone with the largest occupancy levels and therefore would require more outdoor air than the perimeters.

Table 2 is Exhibit 6 from Report #3 showing occurrence of zone outside air flow, as a percentage of occupied hours, for VAV systems using COA strategies. The table shows the variation in outside air across the different zones in the building while the total building outside air flow was maintained at 20 cfm / person.

Table 2.

Climate and Zone	VAV (COA)					VAV (COA) Economizer (T)					VAV (COA) Economizer (E)				
	OA Flow Rate Achieved (cfm/person)					OA Flow Rate Achieved (cfm/person)					OA Flow Rate Achieved (cfm/person)				
	<=5	6-10	11-15	16-19	>=20	<=5	6-10	11-15	16-19	>=20	<=5	6-10	11-15	16-19	>=20
Minneapolis															
Core		0.1	48.7	51.2			0.1	29.0	9.5	61.4		0.1	18.5	8.1	73.3
East					100.0					100.0					100.0
North			0.7	22.5	76.8			0.1	2.3	97.7				0.4	99.6
West				0.5	99.5				0.4	99.6				0.1	99.9
South					100.0					100.0					100.0
Washington DC															
Core		0.2	51.5	48.3				39.0	10.4	50.6			27.1	5.0	67.9
East					100.0					100.0					100.0
North				14.4	85.6				4.1	95.9				0.4	99.6
West					100.0					100.0					100.0
South					100.0					100.0					100.0
Miami															
Core			80.7	19.3				78.8	15.4	5.8			70.8	12.3	16.9
East					100.0					100.0					100.0
North			5.5	7.5	86.9			1.5	6.2	92.3			1.1	2.9	96.1
West				2.1	97.9				1.2	98.8				0.7	99.3
South					100.0					100.0					100.0

ASHRAE Standard 62 recommends that offices have 15 to 20 cfm / person and education facilities have 12 to 20 cfm / person (see table 1). Table 2 shows that, depending on the control strategy, the core could never reach the 20 cfm / person requirement, or be below the requirement 25 to 40% of the occupied hours.

The study also looked at the annual cost impact of increasing outside air flow from 5 cfm / person to 20 cfm / person. For the VAV system without economizer, the increased outside air flow increased energy HVAC costs by 0-9% in Minneapolis, 1-14% in Washington DC, and 3-20% in Miami. For VAV systems with economizer, the increased outside air flow increased energy HVAC costs by 2-16% in Minneapolis, 2-19% in Washington DC, and 3-21% in Miami.

The study found that due to the introduction of warn outside air in the cooling season and cold outside air in the heating season, the peak cooling load increased by 15-20% and peak heating load increased by 5-20%. This load increase was based on increasing the total building outside air flow to 20 cfm / person. To increase the outside air flow in the core to 20 cfm / person, would further increase the load.

Providing outside air directly to the zones using a fan powered terminal could guaranty the outside air requirements are met in the core. Using the TQS with IAQ inlet allows you to increase the outside air flow on a zone-by-zone basis without increasing the outside air flow in zones that meet the 20 cfm / person requirement. This strategy would reduce the energy and load increase described above.

The study found that in cases of high occupant densities, such as classrooms, the cfm for outside air flow requirement could exceed the required cfm for thermal comfort. Because most VAV terminals are controlled by the thermal requirements of the zone, the terminals would reduce the volume of air supplied to the space, and therefore reduce the amount of outside air flow to the zone. Supplying outside air directly to the space using the TQS with IAQ inlet would address this issue without increasing the outside air supplied to low occupant density zones.

Suggested Control Sequence

The following control sequence details the series fan, with on/off constant IAQ air flow operation.

The fan operates continuously in the occupied mode, providing constant volume to the zone. During occupancy of the zone, the IAQ inlet is open, providing constant volume isothermal air to the zone. If the zone is not occupied, the IAQ inlet damper can be closed. The primary inlet damper is modulated based on the zone sensor / thermostat. The primary inlet damper would modulate from full closed to the cfm equivalent to the fan cfm. Electric or hot water coils can be used for reheat. A DDC infrared sensor, by others, should be used to open the IAQ inlet damper during occupancy.

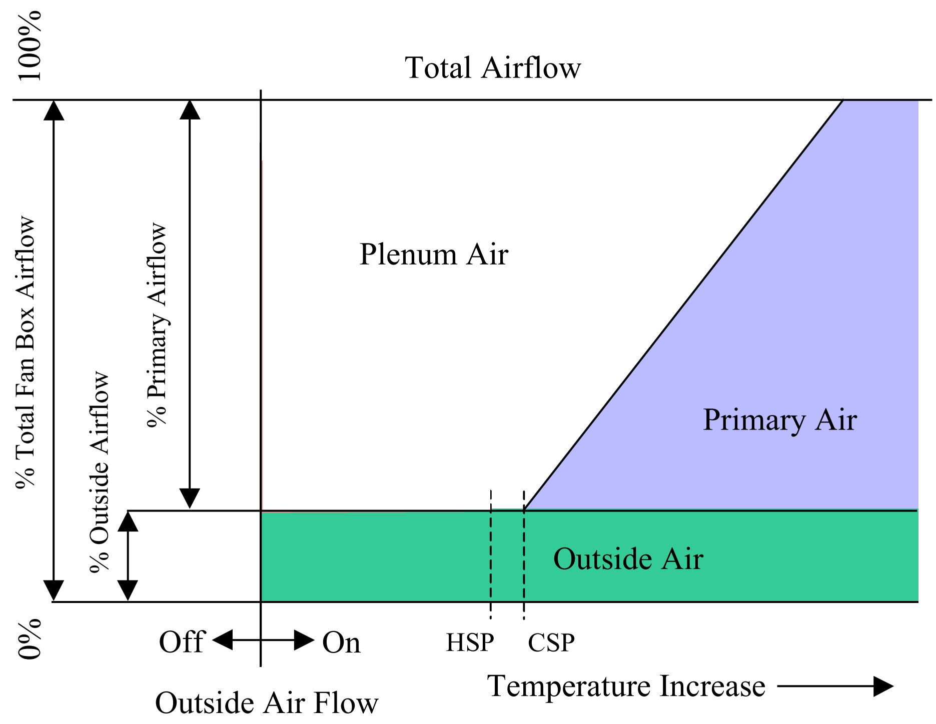

Figure 1. Constant Fan VAV Terminal with IAQ Inlet, Cooling Only

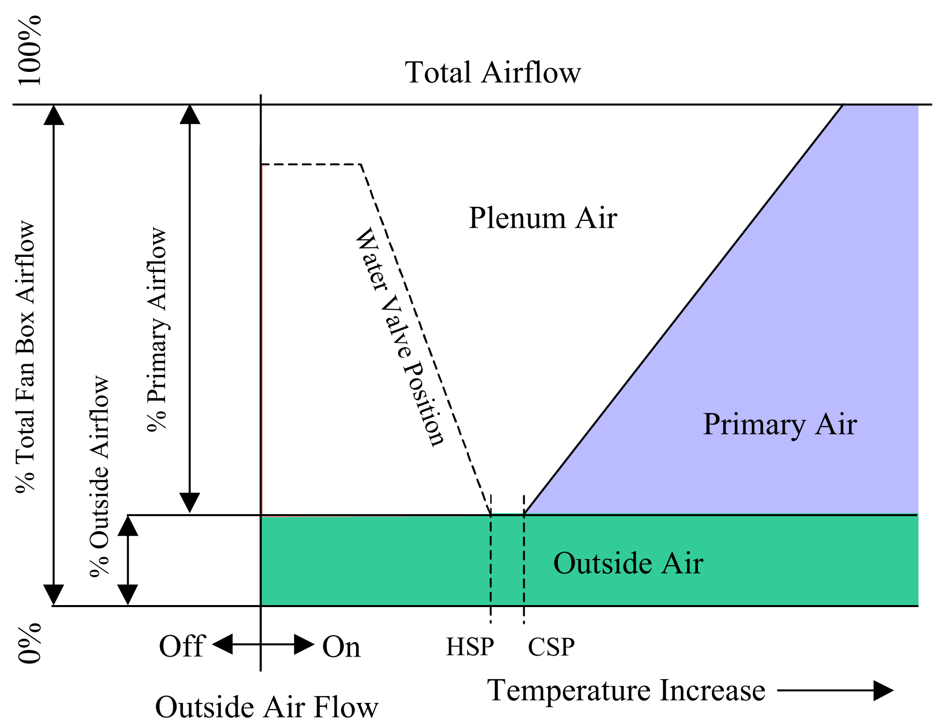

Figure 2. Constant Fan VAV Terminal with IAQ Inlet, with Proportional Water Reheat

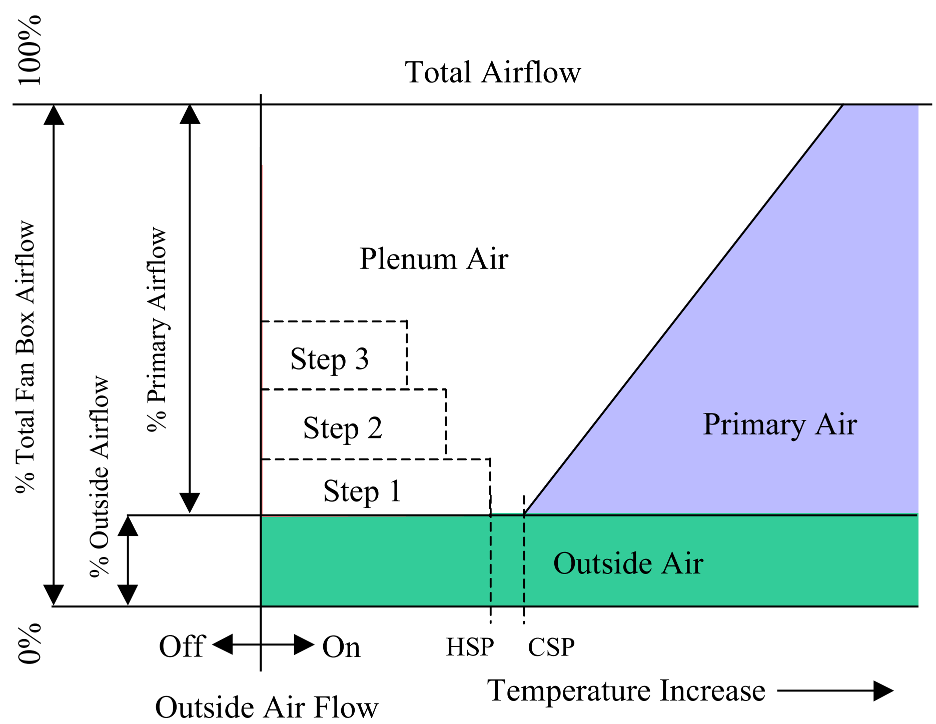

Figure 3. Constant Fan VAV Terminal with IAQ Inlet, with Electric Reheat

Suggested Specification

The following changes should be made to the standard TQS specification (see catalog for standard TQS specification) to include the IAQ Inlet:

4. The terminal casing shall be minimum 20 gauge galvanized steel, internally lined with dual density glass fiber insulation which complies with UL 181 and NFPA 90A. Any exposed insulation edges shall be coated with NFPA 90A approved sealant to prevent entertainment of fibers in the airstream. The terminal shall have a round duct collar for the primary and ventilation air connections and a rectangular discharge suitable for flanged duct connection. The ventilation inlet shall be integral to the unit casing. Add-on ventilation units are not acceptable. The casing shall be designed for hanging by sheet metal straps.

8. The primary and ventilation air damper assemblies shall be heavy gauge steel with shaft rotating in Delrin or bronze oilite self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking, and a synthetic seal to limit close-off leakage to the maximum values shown in Table B.