Indoor Air Quality Measurements

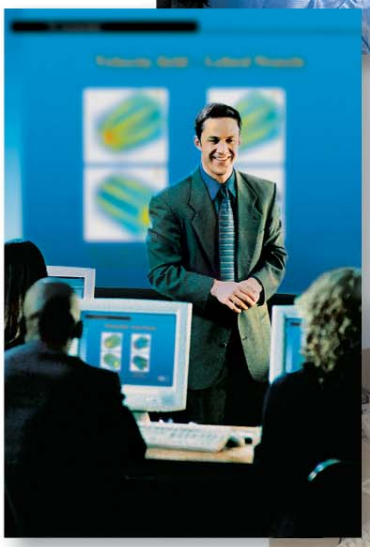
Enhancing the Comfort, Health and Safety of People in Indoor Environments

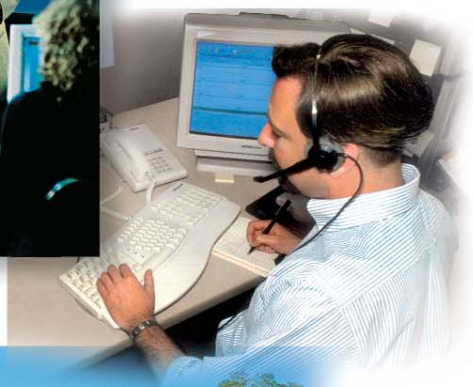
TSI®

TSI Incorporated...

TSI was founded in 1961 as a manufacturer of fluid flow research instruments based on thermal anemometry, a technology still in wide use today. Over the next several decades, TSI developed and brought to market numerous other technologies. Today, TSI technologies are incorporated in research and industrial instrumentation designed to increase productivity and improve the comfort and health of people. Some of the diverse applications for these products include:

- Ventilation testing and balancing
- Exposure monitoring
- Controlling critical environments
- Particle measurement and analysis
- Fluid flow measurements
- Environmental testing
- Respirator fit testing
- Combustion analysis
- Indoor air quality





TSI is well-recognized for developing instruments that are accurate, reliable and easy to use. Our wide range of products sets the standard for assessing indoor air quality parameters and solving some of the most elusive IAQ problems seen today.

... and Indoor Air Quality

Indoor air quality is a growing concern. The problems associated with tighter building construction in the interest of conserving energy are exacerbated by the expanding amount of time we spend indoors—over 90% according to a U.S. Environmental Protection Agency study. In response, building owners, facility personnel, industrial hygienists and others are increasingly focused on IAQ in terms of both comfort and health.

Comfort. Measures of comfort typically include temperature, humidity, ventilation and draft. TSI offers several instruments that help you quickly and accurately assess basic IAQ parameters.

Maintaining proper comfort can significantly improve occupant satisfaction, as shown through increased concentration and productivity, and help reduce absenteeism. Poor IAQ has been linked to increased health insurance and disability payments, although the exact costs are difficult to quantify.

While controlling and improving air quality does improve productivity, it often adds to building operating costs. In these cases, a clear understanding of building air quality is necessary to manage the delicate balance between optimizing conditions for occupants and keeping costs in check.

Health. In addition to comfort issues, health and safety concerns are also part of assessing air quality. Airborne biological substances, gases, vapors and particles can cause adverse reactions in certain individuals, depending on their sensitivity to particular substances and concentrations. Some of these ever-present unwanted contaminants are potentially toxic, infectious, allergenic, irritating or otherwise harmful. Most of us are able to tolerate modest levels of exposure, but adverse reactions can occur when concentrations exceed a "trigger" threshold.

Poor indoor air quality is listed as a top five health concern by most major associations and agencies worldwide. Recent studies claim that over one-third of the buildings in the United States have air quality problems. Now more than ever, it is increasingly important to take a proactive stance, identify and resolve potential problems before they get out of control. TSI instruments are designed to help you identify and manage these tough problems.

TSI Meets Your Measurement Needs...

Indoor air quality affects the comfort, safety and health of building occupants and directly impacts concentration and productivity.

Maintaining a comfortable environment includes making measurements and taking corrective action for thermal comfort involving temperature, humidity, draft and ventilation. Providing a healthy and safe environment starts with locating and controlling sources of unwanted contamination from chemicals, biological substances and airborne particles.

Be proactive in assessing air quality so that you are prepared for occupant concerns.

General Comfort. Indoor air quality monitors provide accurate measurement and data logging of temperature, humidity, CO_2 and CO. Some can also perform calculations, including dew point, wet bulb and percentage of outside air. More than half of IAQ complaints can be attributed to comfort problems.

Ventilation. Air movement or draft will have a significant effect on how people perceive comfort. Too much and people sense that it is "drafty," too little and it is stuffy. Ensuring that the proper level of outdoor air is supplied will help dilute odors and other pollutants. ASHRAE Standard 62 recommends that a certain minimum amount of outdoor or "fresh" air be supplied to each individual in an area based on the activity taking place.

Air Quality Guidelines

Parameter	Limit/Range	Reference	TSI Instrument
Temperature	Summer 73–79˚ F 23–26˚ C Winter 68–74.5˚ F 20–23.5˚ C	ASHRAE Standard 55	Q-Trak Q-Trak Plus IAQ-Calc TH-Calc
Relative Humidity	30%–65%	ASHRAE Standard 55	Q-Trak Q-Trak Plus IAQ-Calc TH-Calc
Air Movement	0.8 ft/s or 0.25 m/s	WHO	VelociCalc VelociCheck DP-Calc AccuBalance AccuBalance Plus
Ventilation (air changes)	15 to 60 cfm/person minimum depending on type of space	ASHRAE Standard 62	Q-Trak Plus IAQ-Calc
Ventilation (CO_2)	About 700 ppm over outdoor ambient	ASHRAE Standard 62	InspectAir Q-Trak Q-Trak Plus IAQ-Calc
Particulates in Cleaned HVAC System	1.0 µg /100 cm^3	NADCA 1992-01	P-Trak DustTrak
Ultrafine Particles <1.0 micron	n.a.	n.a.	P-Trak
Carbon Monoxide	**8-hr TWA** 50 ppm 35 ppm 9 ppm 9 ppm (peak) 25 ppm 9 ppm	**1-hr TWA** - - 35 ppm - - 26 ppm	**Reference** OSHA NIOSH EPA ASHRAE ACGIH WHO	Q-Trak Q-Trak Plus IAQ-Calc

Aerosols. Respiration of gases and particles can challenge the body's natural defenses by causing reactions ranging from relatively mild to severe. Conditions where these respirable substances need to be monitored include certain industrial processes like welding, grinding and cutting; construction; and other situations where dust, smoke, fumes and mist are produced. In some situations, the practice of monitoring aerosol material is a critical health concern. Specific regulations must be followed, and personal protective equipment such as respirators may be needed.

Pressure. Small airborne particles and gases are transported by air movement and can also migrate from areas of relatively high to low differential pressure. Managing differential pressure between the inside and outside and between different areas of the building by regulating supply and return air volumes is a key means of controlling the migration of unwanted contaminants. This becomes especially critical in health care facilities where infectious, contagious or toxic substances need to be contained and controlled.

Ultrafine Particles. Unless air is specially filtered, any given sample contains many airborne particles. In terms of numbers, the vast majority are classified as ultrafine or less than one-tenth of a micron in diameter. Combustion and other chemical reactions are responsible for generating these very tiny particles. Monitoring them can be a challenge. Some people are sensitive to exposure and may react in a variety of ways from mild annoyance to incapacity. A technology known as condensation particle counting allows a user to "see" these particles that are invisible to conventional particle counters. Instrumentation permits a user to follow pathways of particles directly to their source where they can be controlled by repair, removal or replacement of the source.

Velocity. To ensure that the proper volumes of air are being supplied to each individual occupied area, measurements should be taken at air diffusers. Air velocity through a ducted system does not flow uniformly. Therefore it is necessary to use an average velocity measurement across the cross-sectional area of the duct to determine flow. This can be accomplished using a duct traverse procedure with an air velocity meter or using a capture hood that compensates for differences in velocity.

Indoor Air Quality Solutions From TSI

Q-TRAK™ Plus IAQ Monitors

Models 8552, 8554

- Industry standard for IAQ studies
- Advanced sensors measure temperature, relative humidity, CO_2 and CO
- Menu-driven display with large, easy-to-read graphics
- Large data logging capacity for in-depth analysis with TRAKPRO™ Data Analysis Software
- Optional accessory probes for secondary temperature and velocity

Shown with the optional Air Velocity Probe.

IAQ-CALC™ Indoor Air Quality Meters

Models 8732, 8760, 8762

- Measures and data logs multiple IAQ parameters, including CO and CO_2
- Humidity calculations eliminate the need for psychrometric chart
- Statistics function for average, maximum and minimum values

DP-CALC™ Micromanometers

Models 8702, 8705

- Accurately measures differential and static pressure
- Electronic pressure transducer technology for stable measurements
- Calculates/displays velocity when used with Pitot tube

TH-CALC™ Thermohygrometers

Models 8720, 8722

- Cost-effective meter for thermal comfort studies
- Direct dew point calculation
- Advanced models provide convenient % outside air calculations

ACCUBALANCE® and ACCUBALANCE PLUS Air Capture Hoods

Models 8371, 8372, 8373

- Accurate direct air flow readings
- Reduces system balancing time and effort
- Automatically sums flow and calculates statistics for branches and systems

P-Trak™ Ultrafine Particle Counter

Model 8525

- Counts ultrafine particles less than 1 micrometer diameter
- Tracks unwanted particles to their source in real time
- Ideal for checking filters, finding gasket leaks and identifying other pollutants

VelociCalc® Air Velocity Meters

Models 8345, 8346, 8347, 8347(A)

- Easy-to-use meter for velocity, temperature and flowrate
- Telescoping and articulating probes available
- Optional humidity sensor for relative humidity and wet bulb temperature and dew point calculations

DustTrak™ Aerosol Monitor

Model 8520

- Measures aerosol mass concentrations in real time
- PM10, PM2.5, PM1.0 and respirable size fractions
- Analog output and adjustable alarm output for remote access

VelociCalc Rotating Vane Anemometers

Models 8321, 8322, 8324

- Large rotating vane head features sweep mode for single overall measurements
- Reliable air velocity, temperature and calculated flowrates
- Easy operation

VelociCheck® Air Velocity Meters

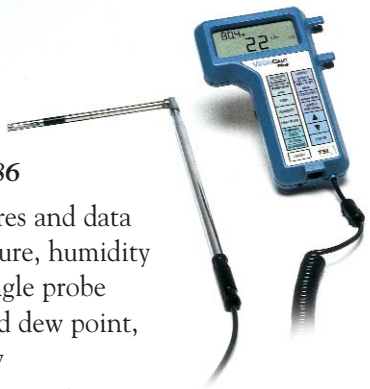
Models 8330, 8340

- Cost-effective meter for air velocity measurements
- Pocket-sized and easy-to-use
- Convenient temperature measurement

VelociCalc Plus Multi-Parameter Ventilation Meters

Models 8384, 8385, 8386

- Simultaneously measures and data logs velocity, temperature, humidity and pressure with a single probe
- Calculates flowrate and dew point, wet bulb and heat flow
- Statistics function for average, maximum and minimum values



Parameters and Features Chart

The chart below is a guide for selecting an instrument to best fit your measurement needs.

	Model	Data Logging/Downloading	TrakPro Data Analysis Software	Air Velocity	Temperature Reading	Flowrate	Differential Pressure	Humidity, Wet Bulb and Dewpoint	% Outside Air	Carbon Dioxide	Carbon Monoxide	PM10 Particles	PM2.5 Particles	Respirable Particles	Ultrafine Particles	Balancing Mode	Flow Direction Indicator	Density Correction & K Factor	Review Data	Statistics	Variable Time Constant	Field Calibration Adjustment
Q-Trak Plus	8552	●	●	O	●	O		●	●	●									●	●	●	●
	8554	●	●	O	●	O		●	●	●	●								●	●	●	●
IAQ-Calc	8732									●										●	●	●
	8760	●			●			●	●	●									●	●	●	●
	8762	●			●			●	●	●	●								●	●	●	●
TH-Calc	8720				●			H,D,P												●		●
	8722	●			●			●	●										●	●		●
VelociCheck	8330			T	●																●	
	8340			T																	●	
VelociCalc	8345			T	●	T														●	●	●
	8346			T	●	T														●	●	●
	8347			T	●	T		●												●	●	●
	8347A			T	●	T		●												●	●	●
VelociCalc RVA	8321			V	●	V																●
	8322			V	●	V														●	●	●
	8324	●		V	●	V													●	●	●	●
VelociCalc Plus	8384	●		T	●	T												●	●	●	●	●
	8385	●		T,P	●	T,P,Δ	●											●	●	●	●	●
	8386	●		T,P	●	T,P,Δ	●	●										●	●	●	●	●
AccuBalance	8371					D												●			●	●
AccuBalance	8372	●				D										●		●	●	●	●	●
Plus	8373	●			●	D										●	●	●	●	●	●	●
DP-Calc	8702			P			●														●	●
	8705	●		P		P,Δ	●											●	●	●	●	●
DustTrak	8520	●	●									●	●	●						●		●
P-Trak	8525	●	●											●	●				●	●		

●= Feature of Instrument **O**= Optional **Δ**= Calculated from Differential Pressure **D**= Direct Reading
P= Pitot Tube Reading **V**= Rotating Vane Anemometer **T**= Thermal Anemometer

All instruments include a NIST calibration certificate at no additional charge.

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