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User Manual



ATM2400

Multi-Channel Airflow and Temperature Instrument

PRELIMINARY RELEASE. SEE DEGREE C WEBSITE FOR THE LATEST VERSION



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ATM2400 Instrument Series User Manual

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Prefice A: Customer Service Information

This section provides information about Degree Controls, Inc.'s Customer Service policy, installation policy, and warranty. Degree Controls, Inc.'s policies on warranty returns and consumable parts are also explained. To determine which policies apply to your system, consult Degree Controls, Inc.

A1. Customer Service Policy

Degree Controls, Inc. has established a Customer Service department to meet the service needs of its customers. A Customer Service Representative is available from 9:00 a.m. to 5:00 p.m. (EST) to:

A1.1 Take an order
A1.2 Track a shipment
A1.3 Determine availability
A1.4 Request technical support
A1.5 Request product and procedure training
A1.6 Record a problem
A1.7 Coordinate return of products
A1.8 Record a complaint or general feedback

For technical assistance, contact TechnicalSupport@Degree Controls, Inc.(1-877-DEGREEC):

Telephone troubleshooting with technical experts
Technical assistance to solve specific application questions

A2. Warranty Information

Degree Controls, Inc. products purchased in the USA or Canada are warranted to be free from defects in materials or workmanship for a period of ninety days from the date of their original purchase. If a sensor or instrument fails to perform to this warranty, we will, at our own option and at no cost to the customer, replace or repair it within a reasonable timeframe. This warranty does not cover defects, malfunction, or failures resulting from shipping or transit accidents, misuse, operation contrary to furnished instructions, modification, tampering, or normal wear and tear.

A3. Returns

Within the above period, any part of the goods that prove to be defective in material or workmanship may be repaired or replaced on an exchange basis with a new or equivalent part free of charge.
After such warranty period, any labor, travel time, transportation and subsistence expense shall be borne by the Buyer. If preferred, Buyer may return goods to Degree Controls, Inc.'s manufacturing plant with shipment both ways at Buyer's expense for repair work. Parts returned damaged due to poor or insufficient packaging by the Buyer will not be accepted for service unless otherwise agreed.

Parts returned with no manufacturing defects found, will incur a service/handling charge.

In no event shall Degree Controls, Inc. be liable for incidental or consequential damages, including, but not limited to, costs, or removal and reinstallation or such goods, good will, overhead expenses, loss of profit, and loss of use.
The remedies are available only to the original Buyer. Buyer agrees to accept billing for service expense for service call resulting from other than a Degree Controls, Inc. goods failure or other Degree Controls, Inc. fault.

A4. Consumables

Consumables can be ordered from Degree Controls, Inc. or from your Degree Controls, Inc. authorized distributor. Use only Degree Controls, Inc. products or Degree Controls, Inc. approved products with your ATM2400. Degree Controls, Inc. shall not be liable for damage to or malfunction of the system, which it deems was caused by the use of unauthorized materials. Please refer to the Parts List in Appendix A when ordering.

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About this Manual

This User Manual provides the information necessary to obtain the maximum benefits from the Cambridge Accusense Brand ATM2400 Instrument Series. All operating instructions, functional descriptions, illustrations, and other relevant information are contained in this manual. Descriptions of the system hardware and user-interface operating software are included. You will also find the theory of operation for the instruments and sensors they employ. Systematic instructions guide you through all installation procedures, and tables identify and describe all software operating menus.

Starting Out

If you are placing your ATM2400 in service for the first time, Degree Controls, Inc. recommends working through this Manual following the step-by-step instructions provided. If you need additional help at your site as you move through these procedures, contact your regional Degree Controls, Inc. representative or Degree Controls, Inc.'s Technical Support for assistance in properly installing and starting up your ATM2400 Series instrument(s).

Operator Assistance:

If you experience difficulty in running your ATM2400 Series instrument, sensors or software, please contact your Degree Controls, Inc. Representative or Degree Controls, Inc. Tech Support. This Manual includes a "Frequently Asked Questions" list that discusses many common system problems, possible causes, and corrective operator actions. The information given there is general.

Degree Controls, Inc.'s Customer Service is available weekdays from 9:00 AM to 5:00 PM Eastern Time. Please contact Degree Controls, Inc. Tech Support at **1-877-DEGREEC** or visit our website www.degreec.C.com for additional information.
Technical assistance is also available from Degree Controls, Inc. Sales Representatives and Distributors throughout the world. Please check our web site for the representative or distributor in your area.

Design Change Notice

Due to design changes and product improvements, information in this manual is subject to change without notice. Degree Controls, Inc. reserves the right to change hardware and/or software design at any time, which can affect the contents of this manual.
Degree Controls, Inc. assumes no responsibility for errors of omission or content in this manual. We will make every reasonable effort to ensure that this user manual is up to date and corresponds with your shipped instrument(s) and sensors.

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Types of Messages



NOTES, *WARNINGS* ***and*** *CAUTIONS*:

Below are important notices and safety instructions. Please read carefully, and follow all warnings and instructions marked on the sensor and in this manual.



DANGER: ***INDICATES SITUATIONS THAT COULD RESULT IN THE INJURY OR DEATH OF A HUMAN OPERATOR OR BYSTANDER. WARNINGS ARE PRINTED IN ALL UPPER CASE CHARACTERS IN BOLDFACE TYPE, BETWEEN TWO HEAVY HORIZONTAL RULES, AS IN THE FOLLOWING EXAMPLE:***

CAUTION: ***Indicates situations that could damage the Instrument and/or Sensors, or cause injury to an operator. Cautions are printed in mixed upper- and lower-case characters in boldface type, between two heavy horizontal rules, as in this example:***

CAUTION: ***Failure to connect the instrument to the proper electrical voltage as specified herein could result in damage to the power supply and instrument.***

NOTES: ***indicate miscellaneous information. Notes are printed in mixed case characters, in normal type, between two heavy horizontal rules, as in this example:***

NOTE: ***For details on Degree Controls, Inc. customer service policies, refer to Preface A.***

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Dangers,Cautions, and Notes

Below are important safety instructions. Please read carefully, and follow all warnings and instructions.



Front View

DANGER; NEVER INSTALL OR OPERATE DEGREE CONTROLS, INC. INSTRUMENTS AND SENSORS WHILE IN CONTACT WITH WATER. YOU MAY BE ELECTROCUTED!

DANGER: DO NOT TRY TO REPAIR AN INSTRUMENT OR SENSOR YOURSELF. THERE ARE NO CUSTOMER-SERVICEABLE PARTS INSIDE. OPENING THE CASE PRESENTS A DANGER OF ELECTRIC SHOCK, AND VOIDS THE DEGREE CONTROLS, INC. WARRANTY.



DANGER: IF ANY OF THE FOLLOWING CONDITIONS OCCURS, TURN OFF THE INSTRUMENT IMMEDIATELY, UNPLUG THE POWER CORD FROM THE ELECTRICAL OUTLET, AND CONTACT DEGREE CONTROLS, INC.:

If smoke, abnormal noise, or any strange odor is present.
If liquid has been spilled over or into the instrument.
If the instrument has been dropped or damage is visible.

WHEN EXPERIENCING MALFUNCTIONS,CONTINUING TO USE INSTRUMENTS OR SENSORS IN THE EVENT OF ANY OF THE ABOVE CONDITIONS CAN RESULT IN DAMAGE TO THE EQUIPMENT AND INJURY TO HUMAN OPERATORS!

CAUTION: Avoid exposing the Instrument and sensors to dust, rain, and (condensing) water. Water can cause shorts, corrosion, and, at a minimum, inaccurate readings.

CAUTION: Use a power cable that is properly grounded. Always use AC power cords that meet the local safety standards, such as those listed below.

CAUTION: The ATM2400 and Sensors are ESD sensitive devices. When shipped, the units are packaged in ESD safe bags. The instrument and sensors should be returned to their respective ESD safe bags when they are placed back into the carrying case.

CAUTION: The ATM2400 Series Instruments and Sensors are designed for room air velocity and room temperature measurement only. Air containing chemicals (for example, hazardous gases) may damage the UAS sensor head. Note: Chemicals may change the heat capacity of the air so that the calibration of the UAS sensor is no longer accurate.

NOTE: Avoid exposing the Instrument to direct sunlight or other heat sources. Do not store the equipment in an extreme hot or cold environment.

NOTE: Keep the Instrument and Sensors away from magnets, motors, transformers, speakers, and televisions.

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1. *ATM2400 Series Instruments*

1.1 General Description

The Cambridge Accusense ATM2400 Instrument Series is a family of sophisticated, self-contained instruments designed for accurate, cost-effective multi-point evaluation of air velocity and air temperature measurements. Simultaneous, real-time data collection is supported for over 100 sensors.

The ATM2400 Series is designed for laboratory applications. It can take measurements much more quickly than conventional, single-point measuring instruments.

The ATM2400 Series embodies the proven accuracy, reliability, and versatility that are characteristic of Cambridge Accusense systems. Frequent returns and field recalibration are not required, because the user can easily verify operation and accuracy of any one sensor (and its channel) by comparing it against any other sensors (and their channels).

1.2 Applications

The ATM2400 is a stand alone USB Hub that interfaces with Cambridge Accusene airflow & air temperature sensors. Each ATM2400 can accept up to 36 sensors simultaneously.
The ATM2400 can be used in a wide range of applications and industries. Some examples follow:

1.2.1 Electronics Cooling Design

1.2.2 Fume Hood and Biosafety Cabinet Design and Testing

1.2.3 Process Control

1.2.4 HVAC

1.2.5 Medical Applications

1.2.6 Food Processing

1.2.7 Automotive

1.3 General Respnsibities

1.3.1 Customer's Responsibilities

When your Instrument arrives, you are required to:

1.3.1.1 Check the exterior of the shipping container(s) for any exterior damage, then the interior of the container(s).

1.3.1.2 If any damage is found, immediately notify both the carrier and Degree Controls, Inc. on the straight bill of lading (supplied by the carrier), both verbally and in writing; you may also request an inspection by the carrier. Such requests must usually be made within a specified period from date of shipment.

1.3.1.3 If no damage is found, compare the contents of the Inventory List against the contents of the shipping container(s), to ensure receipt of all components.

CAUTION: The ATM2400 and sensors are ESD sensitive devices. The units are shipped packed in ESD safe bags. When returning the devices to the carrying case, the units should be placed back in their ESD safe bags to prevent any potential ESD damage to the devices.

1.3.2 Degree Controls, Inc.'s Responsibilities

1.3.2.1 A Degree Controls, Inc. service engineer is available via telephone, fax, or e-mail to assist customers in performing the initial installation of your ATM2400 Instrument. Information about how to contact Degree Controls, Inc. is available on page 4. Assistance is also available from sales representatives and distributors throughout the world. Please check our web site for the Degree Controls, Inc. representative or distributor in your area.

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1.4 Environmental Requirements

Excessive moisture in the air might affect the instrument's performance by changing the electrical conductivity on the surface of the electrical components and circuit boards. Relative humidity in the operating environment between 5% and 95% (non-condensing) is acceptable.

Avoid placing the Instrument and Sensors near heating outlets or other hot devices. Acceptable temperatures are:

1.4.1 Calibration temperature range: 0-70°C for standard UAS airflow and air temperature sensors. This is the range where the sensor accurately reads airflow and temperature according to its specification.

1.4.2 Operational temperature range for sensor head: -20-70°C. The sensor head and sensor cable will not be damaged if exposed to these temperatures.

1.4.3 Operational temperature range for ATM2400: 10-60°C. To prevent permanent damage to the ATM2400, UAS or UTS sensors, connectors, USB cable, and power supply do not expose them to temperatures outside of this range. Do not store in extreme hot or cold environments.

1.5 Using Multiple Instruments

1.5.1 Some applications require more than 36 airflow and air temperature channels; others require surface temperature readings in addition to airflow and air temperature readings. For such cases, multiple ATM2400 instruments can be used simultaneously on one Personal Computer. Degree Controls, Inc.'s AccuTrac 2005 software allows use of multiple instruments or channels.

1.5.2 Each ATM2400 instrument requires its own USB port.

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2. *ATM2400 Airflow and Air Temperature Monitor*

Multipoint measurement of air velocity as well as air and surface temperature are crucial steps in the new product development process. These measurements, however, have traditionally been inexact, labor-intensive, repetitive, and tedious. The new AccuSense ATM2400 has been designed to reduce cost, increase efficiency, improve accuracy and compress testing and evaluation time. Furthermore, the ATM2400 expands on the capabilities of its predecessor, the ATM24, with the inclusion of thermocouple sensors, improved airflow sensor accuracy, enhanced AccuTrac 2005 software, as well as an additional 12 channels.

2.1 General Information

The ATM2400 now allows you to perform simultaneous measurement of air velocity and of airflow and surface temperatures at 36 locations. Multiple ATM´s can be connected together to measure up to 100 points. The information is recorded in real-time, and can be analyzed as data is being collected. The ATM2400 uses the UAS Series of Airflow Sensors and UTS Series of Thermocouple Sensors. Improved air velocity accuracy to ±5% of reading from 15°C to 35°C, with ±8% accuracy at the operating limits of 0°C and 70°C further enhances the ATM2400´s performance.

2.2 Components

The ATM2400 kit contains the following:

- ***2.2.1 ATM2400 USB Hub***
- ***2.2.2 AC power cord (US/Canada only)***
- ***2.2.3 USB Cable***
- ***2.2.4 Carrying case***
- ***2.2.5 UAS and/or UTS probes (as ordered) with Certificates of Calibration***
- ***2.2.6 Accutrac 2005 Installation CD***
- ***2.2.7 ATM-2400 Manual***
- ***2.2.8 25 mounting clips (HDW-000072)***

2.3 Electrical Power

Power is supplied to the ATM2400 through an internal universal power supply, which accepts electrical power from standard wall outlets that meet the following requirements:

- ***2.3.1 100-250 V_{AC}***
- ***2.3.2 Frequency: 50-60 Hz***

WARNING: DO NOT ATTEMPT TO POWER THE INSTRUMENT WITH ANYTHING OTHER THAN THE ORIGINAL POWER SUPPLY.

NOTE: If you are using the ATM2400 in countries other than the United States and Canada, you will need a country specific power cord. please contact your Degree Controls representative for more information.

2.4 Technical Specifications

Parameter	***Technical Data***
Input voltage	***100-250VAC, 50-60 Hz***
Power consumption	***50 Watt max***
Operating temperature range: Sensors	***0° to 70°C***
Operating temperature range: Instrument	***0° to 70°C***
Calibration temperature range:	***0° to 70°C***
Storage temperature range:	***-40° to 85°C***
Dimensions (LxWxH)	***235 mm X 300 mm X 35mm***
Weight	***2.5 Kg (4.97 lb)***

Table 2.4ATM-2400 Technical Specifications

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3. *Hardware Installation and Initial Power Up*

3.1 ***On the top of the ATM2400 unit (Figure 36 channels to connect up to 36 Sensors. On the back is the USB connector for linking the system to the USB Port of the Computer.***

3.2 ***Turning the instrument over, you will find the system information label on the bottom. It contains the instruments' part number and serial number.***



Fig. 2-1 Connectior locations to the ATM2400

Figure 3 Connector Locations to the ATM-2400

3.3 ***After verifying that the ATM2400 instrument and sensors are complete as described earlier in this chapter, you are ready to assemble the system.***

- ***3.3.1*** ***Connect the external power cable to the ATM2400.***
- ***3.3.2*** ***Connect the power cable to a wall outlet. For safety reasons a three-pin (grounded) outlet is required. The power supply automatically adjusts for voltages between 100-250VAC, 50-60Hz.***
- ***3.3.3*** ***Attach the desired number of sensors to the ATM2400. The sensors have USB connectors and plug in only one way. Sensors can be plugged into any channel; empty slots may be left between sensors and will be ignored.***
- ***3.3.4*** ***Plug the USB cable into the USB connector on the back of the ATM2400, and the opposite end into the USB port on your PC.***

NOTE: CHECKING CALIBRATION: UAS and UTS Sensor calibration information is contained in the sensor memory. The information is available for review in Accutrac 2005.

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4. *UAS Series Airflow Sensors*

4.1 Sensor Descriptions

The UAS1000 Series is an air velocity and air temperature sensor used with the ATM2400 Measurement System. The UAS1000 Series offers many improvements with regards to accuracy and sensor ranges. With a variety of sensor ranges from 0.15 m/s to 20 m/s (30-4000 fpm), the UAS1000 Series offers such features as miniature device size for multiple mounting configurations, improved measurement accuracy with ±5% of reading from 15°C to 35°C, and 8% accuracy at the operating limits of 0°C and 70°C, ease of installation, multipoint measurement, rugged construction, and probe interchangeability.

Three (3) unique sensor head styles, remotely located on a 5 meter shielded cable, allow access in distant and compact locations such as between semiconductor devices, heat sinks, and inside ducts and plenums. These small heads cause minimal distortion of the true airflow picture, and air velocity and airflow temperature measurements are obtained at the same time. Each one is designed and optimized for certain types of applications. Please refer to the UAS Datasheets for more information on these sensors.

The UAS1000 Series sensors are also fully interchangeable with one another, as each sensor has its own in-line circuitry that normalizes the performance of the sensor.

Simultaneous use of up to 36 UAS sensors with the ATM2400 data hub allows the user to have a snapshot of the airflow environment at any given time. Multiple ATM2400's can also be connected to a PC to obtain up to 100 data points. For surface temperature measurement, please refer to the UTS1000/2000 Thermocouple Sensors datasheet. Both the UAS1000 and UTS1000/2000 can be used simultaneously with the ATM2400 data hub to obtain airflow, air temperature, and surface temperature in one instrument.

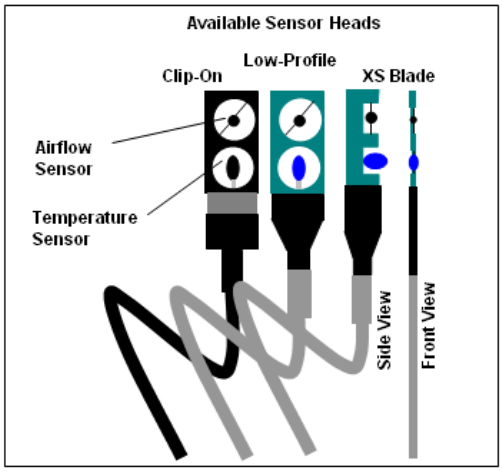


Figure 4

Plastic Case Sensor heads are contained in a plastic cover to protect them from being damaged under rough laboratory and cleanroom environments. This sensor type is used perpendicular to the flow, with the air moving through both holes.

Low-Profile Sensors are designed for electronic cooling applications, where sensors are mounted on circuit boards, heat sinks and components, and where size matters. This sensor type is used perpendicular to the flow, with the air moving through both holes.

XS (Extra Small) Sensors are shaped like the blade of a knife. They are designed to measure airflow and air temperature in tight spots, e.g., between fins of a wider heat sink. The XS are arranged parallel to the flow, compared to the Clip-On and Low-Profile Sensors, which are arranged perpendicular to the flow.

The standard medium is air at standard pressure (101.3 kPa, 29.95" Hg). For use with other gases, please contact Degree Controls. Altitude compensation is available in the AccuTrac 2005 software package.

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4.2 Technical Specifications

Parameter	Technical Data
Measurement Ranges	UAS1100 0.15 – 1.0 m/s UAS1200 0.50 – 5.0 m/s UAS1300 4.50 - 20 m/s
Sensor head options	LP - Low-profile Sensor PC – Plastic case Sensor XS - Blade Style Sensor
Standard cable length	5 meters unshielded
Operating temperature range	0 to 70°C
Storage temperature range	-40 to 85°C
Weight (UAS Head)	25 g (0.053 lb)
Air Velocity Accuracy	15°-35°C, ±5%. ±8% at operating limits (0°C and 70°C)
Airflow Temperature Accuracy	0-70°C ± 1°C

Table 4.2: UAS 1000 Series Sensors Technical Specification

All three sensor heads are small in order to minimize disturbing the airflow. Air always takes the path of least resistance, which makes it important not obstruct airflow.

Sensors are delicate and sensitive precision devices, but they are not unreasonably fragile. When not using the probes, put the protective rubber caps back on. Always hold a sensor by the black heat shrink. Avoid directly touching the head itself, for it could damage the thermistor beads, or disrupt their accuracy.

CAUTION: ***Thermistor beads are very hot. Touching them could cause burns to personnel.***

4.3 Theory of Operation

Degree Controls, Inc. uses thermal anemometer technology for its airflow sensors. As illustrated in Fig. 3-6, a typical UAS sensor has two thermistors (thermal resistor) mounted to each sensor. The smaller thermistor (or "bead") measures airflow while simultaneously the larger thermistor detects air temperature.

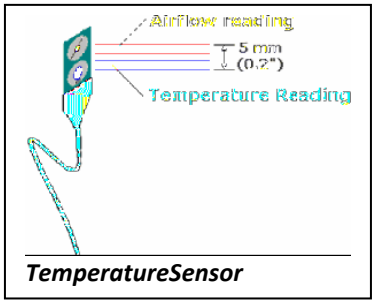


Fig. 4.3 Degree Controls, Inc. sensors measure airflow and air temperature simultaneously.

Using CTA (Constant Temperature Anemometer) technology, the airflow thermistor is heated; the amount of power required to maintain the airflow thermistor at a constant temperature is equivalent to the heat lost due to the airflow passing by the thermistor. The UAS sensor uses this information to calculate the velocity of the air passing by the sensor.

The ATM2400 can measure signals from up to 36 UAS sensors simultaneously. The data formatted by the ATM2400 is then available for transfer to a personal computer.

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***CAUTION:* Do not attempt to measure surface temperatures using the UAS Sensors. When attached to a surface, the heated airflow sensor could cause false readings.**

4.4 Mounting the Sensors on Flat Surfaces

For mounting Low Profile and XS-blade sensors in the air stream, Degree Controls, Inc. provides small self-adhesive mounting clips. To attach the sensor to the plastic clip: Hold the sensor by the black heat shrink in one hand, the clip in the other. Insert the cable 2-3" down from the sensor head through the two brackets of the clip. Turn the sensor in its intended position and slide the clip towards the sensor head until it is approximately in the center of the heat shrink. Now peel the backing off the clip, and position the clip at the predetermined location. To remove the sensor from the clip, slide it out from the clip 2-3" down the cable, and then carefully pull the cable out from the prongs of the clip. If this is done carefully, the clip can be reused at its location.

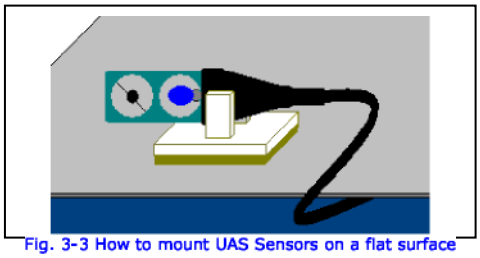


Figure 4.4 How to mount UAS Sensors on a flat surface

***CAUTION:* Hold the sensor head only by the heat shrink and avoid touching the sensor beads.**

Similar mounting clips are available from different vendors. For reordering Degree Controls, Inc. mounting clips, please contact the Customer Service Department for part number HDW-000072.

4.5 Sensor Head Acceptance Angle

Typically, anemometer sensors are not uniformly shaped, which causes them to be direction-sensitive. It is therefore important to know the orientation at which a sensor was calibrated, and what errors to expect if certain acceptance angles are exceeded.

Fig. 4.5.1 shows the acceptance angle of the Low Profile and Plastic Case airflow sensor heads. For calibration, sensors are installed in the Degree Controls, Inc. wind tunnel perpendicular to the oncoming air stream. The air moves through the two holes in the sensor head (Fig. 4.5.2), across the sensor beads. Due to the aerodynamics of the sensor head, misalignment can cause the airflow to go around the sensor head rather than across the beads, which can lead to errors.

To learn about the limits of the technology, and to find the influence that the acceptance angle had on airflow sensor readings, Degree Controls, Inc. performed the following experiment. Both a Plastic Case and Low-Profile Sensor were inserted into the airflow of Degree Controls, Inc.'s wind tunnel at room temperature. Readings were then recorded with the sensors turned in increments of 5° from the original perpendicular position. This experiment was performed multiple times and at different speeds to ensure repeatability.

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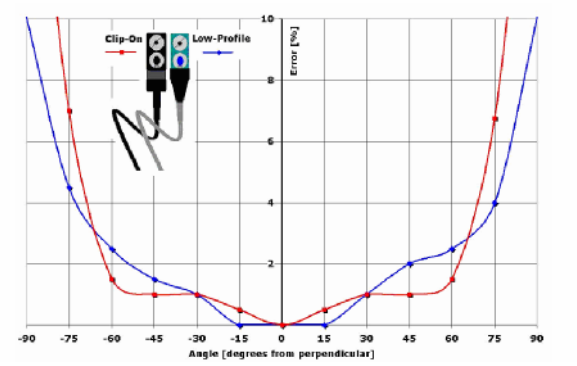


Fig. 4.5.1 Accuracy sensors vs. angle from perpendicular of oncoming airflow

Figure 4.5.1 shows the results for Plastic Case and Low Profile sensors. The horizontal axis represents the angle, in degrees from perpendicular, at which the sensor head was facing the oncoming airflow. On the vertical axis, the error in percent compared to the sensor in ideal (perpendicular) position to the flow is displayed. This example shows how important it is to know the characteristics of a sensor, which should be considered when interpreting results. It also shows that thermal anemometers are well suited for applications where the direction of flow varies, like in electronics cooling applications, where the air moves irregularly and it is difficult to predict the angle at which it approaches a sensor.

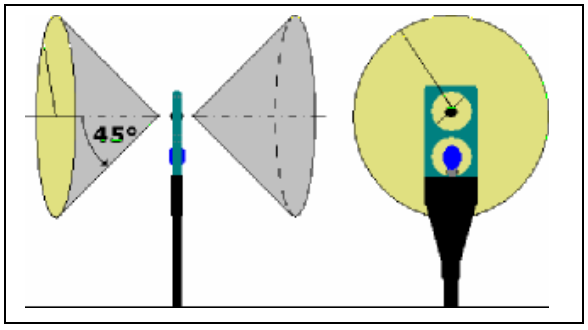


Fig. 4.5.2 Airflow acceptance angle as recommended by Degree Controls, Inc.

Fig. 4.5.2 shows the airflow acceptance angle as recommended by Degree Controls, Inc.. As long as this angle lies within an imaginary cone with a 90° angle at the tip for Low Profile sensors, and 120° angle for Plastic Case sensors, the error from the acceptance angle will not exceed 2% compared to a reading taken perpendicular to the airflow.

Table 4.5 shows the acceptance angle for three different sensor heads available.

Sensor head options	***Acceptance Angle***
Low-profile Sensor	***±45°***
Plastic Case Sensor Head	***±60°***
Extra Small Blade Style Sensor	***±90°***

Table 4.5 UAS Sensors Acceptance Angle

4.6 General Information on Measuring Airflow

Because air is invisible, measuring the speed of airflow has always presented a challenge. The ATM2400 is a useful tool for tracking down air currents.

Most ATM2400 instruments are used in electronics cooling design, because air is the most commonly used medium to remove heat from electronics enclosures. Knowledge of the air velocity plays an important role, as it provides information on the heat removal rate and the thermal characteristics of the entire electronics system.

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When air is used to remove heat from electronics enclosures, it is important to know the flow rate. The goal is to achieve the most cooling effect with as little air as possible. Pumping enough air through the system to ensure an acceptable temperature even under worst conditions, but at the same time keeping flow rates down to avoid acoustic noise requires careful planning. Space is a premium, causing fan placement and fan size to be critical decisions in the design process. Knowing flow rates is essential for gathering required parameters for CFD (Computational Fluid Dynamics) software, and for validating the results from the CFD software.

Measuring airflow means tracking an invisible and compressible moving medium, which shows different characteristics depending on conditions. According to theory, in a laminar flow all particles move in parallel tracks (layers) and in the same direction. In turbulent flows the exchange is macroscopic and detectable, because the main current is superimposed by additional components in x, y, and z directions (eddy-currents). The change from laminar to turbulent flow happens when the Reynolds Number reaches critical levels, which depends on a number of parameters such as shape and cross section of flow.

Airflow in electronics cooling is usually very turbulent due to fans, obstacles, and heat sources. Therefore measuring velocities requires sensors that are capable of sensing accurately under such conditions, while minimizing further disturbance of the flow.

For many reasons, thermal anemometers are the best tools available for measuring airflow in electronics cooling. Thermal sensors' small size minimizes obstructions in a crowded enclosure. They have a fast response time and high sensitivity, allowing measurement of turbulence intensity. Thermal sensors are available with most standard interfaces, are very reliable, and relatively low-cost.
Thermal anemometry is a method of determining fluid velocities by measuring the heat transfer rate from a heated small object like a wire, film, or thermistor located in the flow. The rate at which heat is removed from the sensor is directly related to the velocity of the fluid flowing past the sensor. Constant Temperature Thermal anemometers (CTA) work like a finger held up in the wind. Kept at a constant temperature above ambient, the device is cooled by passing air. The power required to maintain a constant temperature is then used to calculate the air speed.

Thermal anemometry is a flexible, accurate, and almost entirely automated method of flow measurement. It can be applied to nearly any flow, where the physical presence of a sensor does not adversely affect the current, or where contaminants in the flow do not damage the sensor. It is particularly appropriate for applications requiring rapid response to flow changes (turbulence measurements), and where cost limitations are a factor.

Heated anemometers are best characterized by the heat transfer rate, which describes the heat loss dependent on multiple factors: temperature, pressure, content of gas, and nature of flow. Not all of the above have the same influence on measurement, but each one should be considered to achieve accurate readings.

Temperature: Thermal anemometers require temperature compensation because the heat transfer rate depends on the temperature differential between the heated sensor and ambient air. The greater the temperature differential, the greater the heat loss and, consequently, the greater the signal. However, a hot device can also alter the nature of the flow by adding heat, or causing warm air to rise.

Pressure: Molecules carry heat. Below standard pressure (760mm Hg, 101.3kPa), e.g. at high altitude or in a vacuum chamber, a lower number of molecules is available to carry away heat from the heated sensor, which will then read low. Above standard pressure, additional cooling is provided due to an increased number of molecules, and the heated sensor would read high. Heated anemometers therefore need to be pressure compensated.

Content of gas: Thermal anemometers usually are calibrated for air in human environments. When such a sensor is used with gases different from room air, the calibration might no longer be accurate due to different heat capacity and heat transfer rate of the medium. Aggressive chemicals could damage the probe, and deposits on the probe head may alter aerodynamics and affect the accuracy of readings. Humidity does not necessarily change heat transfer rates significantly. Studies show that there is less than a 3% change in the velocity reading while relative humidity changes from 5 to 95% in air at room temperature. However, water condensing on the sensor can cause calibration errors.

Nature of Flow: Air forced through tight openings or nozzles shows different characteristics than a current moving along a straight duct. Fans can generate heavily turbulent flows in a corkscrew-like pattern even far downstream. Components on a circuit board or obstacles in ducts are likely to redirect flow, which tends to follow the path of least resistance. Rapid pressure changes are likely where gases are forced through nozzles, tight openings or close to fast-turning fans. Air is a compressible medium, and due to its invisibility may exhibit unforeseeable behavior that could affect readings of thermal anemometers. It is therefore always advisable to verify results.

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4.7 Temperature Compensation

The calibration of all thermal anemometers is profoundly affected by the ambient temperature of the air flowing past them. Unless an anemometer is compensated for this, it will be correct only at the temperature at which it was calibrated. Therefore, temperature compensation is essential, and typically incorporated with such products. To do this, the ambient temperature of the flowing air is measured and used as part of the compensation algorithm, to provide a compensated air velocity measurement.

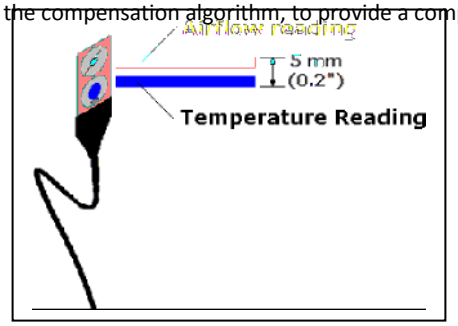


Fig. 4.7 Degree Controls, Inc.'s 2-sensor approach

There are different ways to do this. Degree Controls, Inc. uses two separate sensors for airflow and temperature (Fig. 4.7). The temperature sensing thermistor and the airflow sensing thermistor are mounted in close proximity to one another. Airflow and temperature signals are sampled virtually simultaneously, and read into the system. The small displacement in position (5 mm / 0.2") between the two is immaterial for most purposes, since flow inside cooling systems typically is very turbulent and is not markedly isothermal in most cases.

4.8 Detecting Low Air Speeds

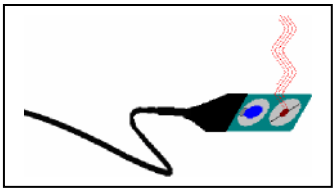


Fig. 4.8 Heated sensors may cause convection at very low flows

There is one limitation to thermal anemometers. At low velocities, below 0.15 m/s (30 fpm), hot air rises upwards from the heated sensor (convection). This thermal convection can be detected by the hot bead, and produce erroneous airflow readings. This problem is typical of all heated anemometer sensors, and users should question accuracy claims of 0 m/s (0 fpm).

The ATM2400/UAS temperature reading is always calibrated for 0-70°C. It is independent of airflow above 60 fpm. Below 60 fpm the sensor experiences self-heating which leads to an elevated temperature reading.

4.9 Sensor Mounting

When mounting thermal anemometer sensors in electronics enclosures, on circuit boards, heat sinks and close to fans, it is advisable to keep the following issues in mind to avoid inaccurate readings:

- ***4.9.1 Air always takes the path of least resistance. That's usually the widest opening.***
- ***4.9.2 Sensors might block or redirect flow if placed close to tight openings or obstacles.***
- ***4.9.3 Close to fans the airflow is usually extremely turbulent and eddies might cause a reversed airflow.***
- ***4.9.4 Always use sensors within their specified calibration range only, and have sensors recalibrated asrecommended by the manufacturer.***

If you have further questions or comments, please contact Degree Controls, Inc. Technical Support

5. *UTS1000 Series Temperature Sensors*

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The Cambridge AccuSense UTS1000 are thermocouple sensors for use with the ATM2400 Measurement System. The ATM2400 data hub holds up to 36 UTS1000 sensors. Now, users of the ATM2400 can obtain thermocouple measurements as well as airflow measurements (see UAS1000 Series) with one instrument.

5.1 General Information

With a measurement range of –50°C to 250°C and an accuracy of ±1°C, the UTS Series has a 30 AWG thickness and T type thermocouple. Standard thermocouple length is 5 meters. The thermocouple wires are welded at the factory, eliminating the need for the user to solder their own thermocouple tips.

AccuTrac 2005 software allows you to collect, analyze and store the data quickly and easily. Data is collected for each sensor in spreadsheet format, with choice of statistical calculations of each sensor available.

NOTE: The ATM2400 only supports T-Type Thermocouples

5.2 Technical Specifications

Operating temperature	***0°C to 70°C***
Storage temperature	***-40°C to 85°C***
Relative humidity (non-	***5-95%***
TC measurement range	***-50°C to 250°C***
Warm-up time after power up	***5 seconds max***
Accuracy	***±1°C***
Supply voltage	***Supplied by the ATM2400 data hub***
Thermocouple length and typ	***5 meters, T type thermocouple, 30***
Connector dimensions (LxWxL	***100 mm X 17 mm X 8 mm***

Table 5.2 UTS Technical Specifications

5.3 Thermocouple Basics

Thermocouples (TC) are sensors for measuring temperature. A thermocouple consists of two wires of dissimilar metals, joined together at one end, generating a small unique voltage (mV) at a given temperature (called the Seebeck Voltage). This voltage is measured and interpreted by a thermocouple instrument, which is a voltmeter.

There are eight letter-designated standardized thermocouple types:

Noble metal types B, R and S, and
Base metal types E, J, K, N, and T.

Different TC types use different combinations of metals for the two dissimilar wires. Examples:

J-type: Iron vs. Copper-Nickel alloy (Constantan)
K-type: Nickel-Chromium alloy vs. Nickel-Aluminum alloy
T-type: Copper vs. Copper-Nickel alloy (Constantan)

TC types can be recognized by the color code used on their insulation and jacket.

Type	***Material***	***USA***	***UK***	***Germany***	***Japan***	***France***
J(+)	***Fe***	***White***	***Yellow***	***Red***	***Red***	***Yellow***
J(-)	***Cu-Ni***	***Red***	***Blue***	***Blue***	***White***	***Black***

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K(+)	Ni-Cr	Yellow	Brown	Red	Red	Yellow
T(-)	Ni-Al	Red	Blue	Green	White	Purple
T(+)	Cu	Blue	White	Red	Red	Yellow
T(-)	Cu-Ni	Red	Blue	Brown	White	Blue

Table 5.3: Color coding of lead wires of thermocouple types

T-type thermocouples should not be used above 400°C or where moisture is present, because copper oxidizes quickly. K-type is more resistant against oxidation (important only above 400°C).

Each thermocouple type requires a different calibration curve to interpret the thermocouple-generated voltages. A wide range of temperature measurement is offered, from almost absolute zero to above a thousand degrees Celsius. Thermocouples can be calibrated for high accuracy in fractions of degrees if needed.

Criteria for choosing thermocouple types:

5.3.1 Sensing air, liquid or surface temperature Temperature range

5.3.2 Chemical, physical resistance Abrasion resistance

5.3.3 Vibration resistance

5.3.4 Galvanic or electric insulation Immersion

5.3.5 Fast response time (wire gage)

Thermocouples are widely available from local and mail order vendors. There are different wire gauges (AWG) available, shielded, electrically insulated, or coated to be chemicals resistant.

5.4 Mounting Thermocouples

Thermocouples measure the temperature at the measurement junction. They do not necessarily measure the temperature of an adjacent surface or object, unless an excellent thermal contact has been established, which brings the measurement junction to the same temperature.

Embedding the measurement junction in a hole or grove in the surface to be measured provides best heat transfers. Soldering or welding a thermocouple to the surface offers good heat transfer. Glue (plastic) may not be as good a heat conductor as metals. Heat conductive glue and paste are available from vendors of thermal management tools.

It is particularly important to attach a thermocouple as close to the surface as possible and to avoid air bubbles, as air insulates well.

5.5 Electrical Isolation

The UTS 1000 series sensors provide electrical isolation up to 1500 VRMS, which allows users to measure temperature on live electrical circuits; however care should be taken when connecting the thermocouple to live circuitry to prevent shock to personnel, or damage to equipment.



WARNING: LIVE ELECTRICAL CIRCUITS CARRY POTENTIALS THAT COULD INJURE PERSONNEL. ENSURE POWER IS REMOVED FROM CIRCUITS BEFORE ATTACHING THERMOCOUPLE LEADS.

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6. *ACCUTRAC™ 2005*

The Windows-based AccuTrac 2005 software package turns your PC into a powerful test and analysis center. Used with the new AccuSense ATM2400 USB-based airflow and temperature instrument, AccuTrac collects airflow and temperature data in real-time and displays, saves, reviews, graphs, and prints without the need to export to another program. The user-friendly AccuTrac software increases measurement versatility, reduces testing time, and improves testing flexibility. Users can choose whether all data are to be viewed and graphed real-time, or saved and reviewed later.

Increased flexibility is also achieved by adjusting sampling rates of the UAS & UTS sensors to better understand turbulence. AccuTrac 2005 is compatible with the ATM2400 Multipoint Airflow and Temperature Instrument which uses the UAS1000 Airflow and Airflow Temperature Sensors, and UTS1000 Thermocouple Sensors.

6.1 Setup and Installation

6.1.1 Before you can achieve full utilization of your new ATM2400 system, Accutrac 2005 must be installed on your PC.

6.2 Minimum System Requirements

6.2.1 Operating System: Windows 2000 or Windows XP Hard Disk Space: 50 MB of free space is required CPU: 1.0 GHz processor

6.2.2 RAM: 256 MB

6.3 Software Installation

6.3.1 By installing Accutrac 2005, the user shows that they have read, understood, and accepted the license agreement as stated in the license.txt file. Please also review the latest information about the product in the readme.txt file.

6.3.2 There are two methods of software installation: From the CD included with your product shipment or from the Degree Controls, Inc. website.

NOTE: Degree Controls, Inc. regularly updates its software. To ensure that you have the latest revision, visit the Degree Controls, Inc. web site http://www.DegreeC.com, where the latest version will always be available for free download.

NOTE: Remove previous installations of AccuTrac completely from the PC before installing a new version. To remove a previous installation, go to Control Panel, Add/Remove Programs and select the program you want to remove.

6.4 Software Installation from CD-ROM

6.4.1 To install the software from CD-Rom, insert the disk into the drive. If setup does not launch automatically, either click Start, and Run, to browse to the CD, or use the My Computer icon on your desktop to browse to the CD (figure 6.4), and double click on the .exe file.

6.4.2 The Accutrac Install Shield Wizard will guide you through the process of installing the software on your computer. The software can be installed either on your local hard disk, or on a network file share. Contact your local systems administrator for assistance.

6.4.3 Follow the directions until the installation is complete. You may be required to enter some information during the installation. When in doubt, it is advisable to use the default settings.

6.4.4 To complete the installation, you may be required to reboot your PC.

6.4.5 Should you run into problems, please contact Degree Controls, Inc. Tech Support.

6.5 Downloading Accutrac™ from the Degree Controls Website

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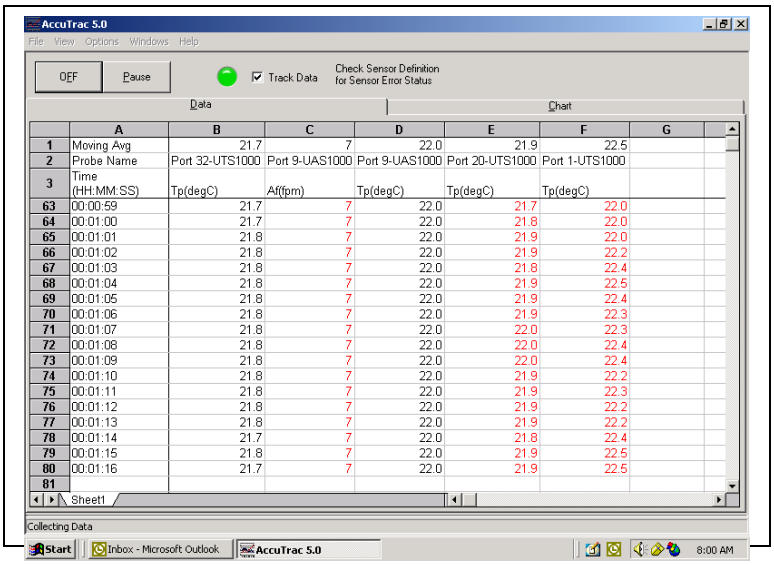
6.6 Using Accutrac™ 2005

6.6.1 During installation, Accutrac 2005 will place a shortcut on your start menu, as well as on your desktop. To launch Accutrac, use either of these shortcuts.

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6.7 Main Screen

6.7.1 Upon start-up, Accutrac will open to the main data collection screen (Figure 6.7). This screen is set up in a spreadsheet format, and will collect the data during a collection run.



	A	B	C	D	E	F	G
1	Moving Avg	21.7	7	22.0	21.9	22.5	
2	Probe Name	Port 32-UTS1000	Port 9-UAS1000	Port 9-UAS1000	Port 20-UTS1000	Port 1-UTS1000	
3	Time (HH:MM:SS)	Tp(degC)	Af(fpm)	Tp(degC)	Tp(degC)	Tp(degC)	
63	00:00:59	21.7	7	22.0	21.7	22.0	
64	00:01:00	21.7	7	22.0	21.8	22.0	
65	00:01:01	21.8	7	22.0	21.9	22.0	
66	00:01:02	21.8	7	22.0	21.9	22.2	
67	00:01:03	21.8	7	22.0	21.8	22.4	
68	00:01:04	21.8	7	22.0	21.9	22.5	
69	00:01:05	21.8	7	22.0	21.9	22.4	
70	00:01:06	21.8	7	22.0	21.9	22.3	
71	00:01:07	21.8	7	22.0	22.0	22.3	
72	00:01:08	21.8	7	22.0	22.0	22.4	
73	00:01:09	21.8	7	22.0	22.0	22.4	
74	00:01:10	21.8	7	22.0	21.9	22.2	
75	00:01:11	21.8	7	22.0	21.9	22.3	
76	00:01:12	21.8	7	22.0	21.9	22.2	
77	00:01:13	21.8	7	22.0	21.9	22.2	
78	00:01:14	21.7	7	22.0	21.8	22.4	
79	00:01:15	21.8	7	22.0	21.9	22.5	
80	00:01:16	21.7	7	22.0	21.9	22.5	
81							

Figure 6.7: Main data collection screen

6.7.2 To begin a data collection run, click the "On" button. The Red "LED" will turn green, and data collection will begin. Clicking the "Pause" button during a data collection run will pause the data collection until the "On" button is clicked again.

6.8 Accutrac Functions

6.8.1 If no sensors are connected, Accutrac will not attempt to log data, and a pop-up window will warn you that there are no sensors connected. Please connect sensors before attempting to collect data.

6.8.2 Accutrac will identify which port on the ATM2400 hub a sensor is connected to. This is useful for tracking multiple data points, and can be used to identify multiple locations being monitored. If sensors are being monitored by Accutrac without the use of an ATM2400 hub, channel identification is not available.

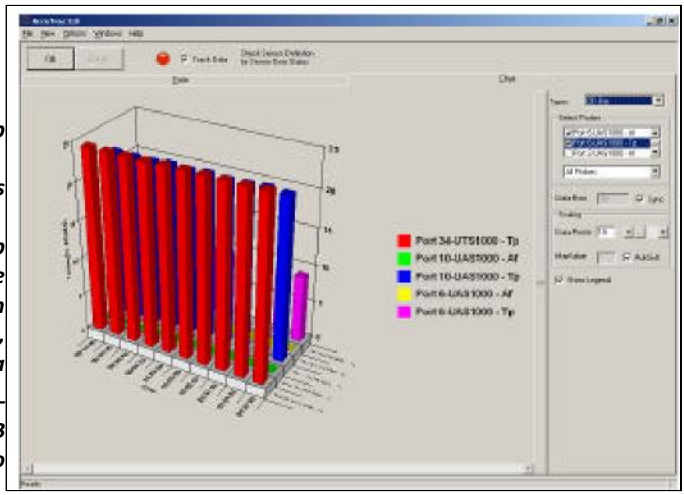
6.8.3 If you unplug a sensor during logging or Accutrac loses connection to a sensor, data collection will continue for remaining connected senors. The missing sensor will still be identified in the data log, however, no data will be collected or charted for this sensor until Accutrac recovers the connection to the sensor, or the sensor is reconnected to the hub.

6.8.4 If all connected sensors are unplugged during data logging, Accutrac will continue to log the time stamp, but not display any data. Sensors will continue to be identified in the log, and data logging will resume when at least one of the sensors is reconnected to the hub. Turning the ATM2400 hub off during data collection will cause similar results in the data log. Data collection will again resume when the ATM2400 is turned back on.

6.8.5 If a faulty sensor is connected to the ATM2400, and an attempt is made to start data logging, the faulty sensor will not appear in the data collection log. Data collection will continue on any functioning sensors connected to the hub. A sensor could be faulty for several reasons, ie.: Malfunctioning equipment, corrupted configuration data in the sensors memory, or a bad connection to the USB hub. Attempt to reconnect the sensor to the hub, or to a different port, to verify that the issue is not a bad connection. Any other issues with sensors will require the sensors to be returned to Degree Controls, for repair. Please contact your Degree Controls representative.

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6.8.6 ***Degree Controls does not recommend connecting new sensors to the hub during a data collection run. If a new sensor needs to be connected, the user should stop the data run and save the file to disk; then connect the new sensor, and begin a new data collection run.***



6.8.7 ***If a non-Degree Controls USB device is plugged into an ATM2400 hub, Accutrac will not log data from the device. It is not recommended to connect non-Degree Controls devices to the ATM2400 hub.***

6.8.8 ***If Accutrac hangs during operation, you will need to remove the executable from the Windows Task Manager, and restart the application. If Accutrac does not recover, try rebooting your computer. If you continue to have problems, please contact Degree Controls technical support.***

6.8.9 ***Clicking the "Chart" tab will show you a real time updating chart of the data you are collecting (Figure 6.8).***

Figure 6.8: Chart screen

6.8.10 ***On the "Chart" screen, you can select four different types of charts to display data: 2D line chart, 2D bar chart, 3D line chart, or 3D bar chart. You can select specific probes to display data from, based on their probe identification, or you can view only airflow probes, only thermocouple probes, or select all probes to view data from all probes connected to the system.***

6.8.11 ***In the scaling section you can select the number of data points to view on the graph (x-axis), and the maximum value to display on the y-axis. Or, select AutoSet, to allow Accutrac to automatically set the y-axis during graphing.***

6.9 Menu Bar

6.9.1 ***The menu bar at the top of the screen provides access to all of the features of Accutrac 2005.***

6.10 File Menu

6.10.1 *Open:* ***Opens an existing data collection file (*.xls) from disk***

6.10.2 *Save:* ***Stores the current spreadsheet to disk under the current file name***

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6.10.3 *Save As:* ***Saves the current spreadsheet to disk under a user assignable name and directory.*** *Print:* ***Allows the user to print the current spreadsheet or chart as displayed.***

6.10.4 *Exit:* ***Closes Accutrac.***

6.11 View Menu

6.11.1 *Normal View:* ***Allows you to view the spreadsheet in normal mode.***

6.11.2 *Zoom View:* ***Allows you to zoom in on the spreadsheet view.***

6.12 Options Menu

Sensor Definitions: Allows you to view sensor information contained in the sensor memory.

6.12.1 *AFS Sensor Identification:* ***Allows you to view sensor Serial number, model number, COM port assigned, the Custom Name, the Generic name, and the type of Unit.***

6.12.2 *AFS Data Settings:* ***Allows you to view the data settings for the sensors. The information that can be viewed is: Serial Number, Unit Type, Calibration Due Date, Velocity low and high values, Temperature low and high values, current Status, number of samples per reading, the Velocity moving average, and the temperature moving average. Some of these settings can be changed in the Preferences Menu.***

6.12.3 *Other Sensor Identification and Data Settings:* ***These tabs allow you to view the same information as the AFS views, but for other sensor types connected to the system.***

6.13 Preferences

6.13.1 ***The Preferences screen (Figure 6.13) allows you to set a number of different parameters for your data collection.***

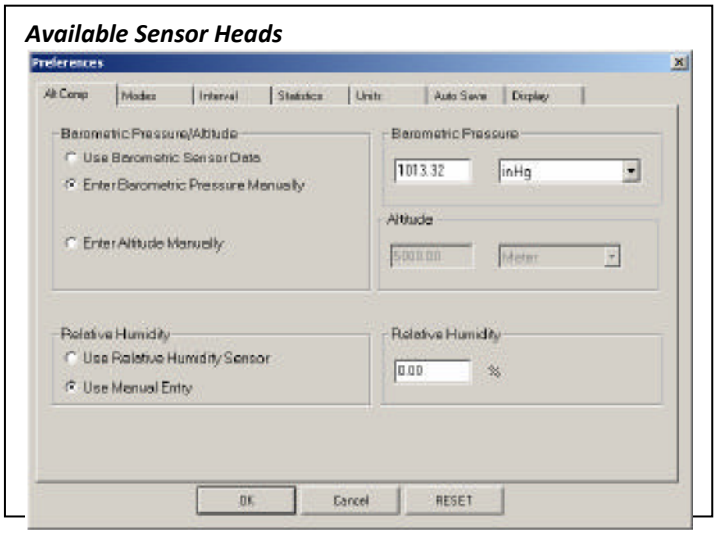


Figure 5-4: Preferences Screen

Figure 6.13 Preferences Screen

Altitude Compensation Tab

6.13.2 ***The Altitude Compensation tab allows you to enter barometric pressure information or altitude information manually, to allow your airflow sensor to compensate for air density changes at varying altitudes. You are also able to set the relative humidity manually, for the same purposes. In the future, humidity and barometric pressure sensors will be integrated into the ATM2400 product family, and you will be able to use data from these sensors for air density compensation.***

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6.13.3 ***Click OK to save your settings. Click Cancel to exit the Preferences Screen, or hit RESET to reset the pressure and humidity settings to the default settings (1013.32 inHg, and 0.00% RH).***

Modes Tab

6.13.4 ***The Modes Tab allows you to change the method of data collection. The following options are available:***

6.13.5 *Start and run until Stop:* ***Allows you to control start and stop of data collection with the "On" and "Pause" buttons on the main screen.***

6.13.6 *Start, take one reading with every keystroke:* ***Start data collection with the "On" button, and with every key stroke on your keyboard, a data point will be collected.***

6.13.7 *Start, run for:* ***Allows you to set a time frame to run the data collection in Hours, Minutes, and Seconds.***

6.13.8 *Start At/Stop At:* ***Allows you to schedule a start and stop time and date for data collection to run.***

6.13.9 ***Click OK to save your settings. Click Cancel to exit the Preferences Screen, or hit RESET to reset the default settings (Stat, and run until Stop).***

Interval Tab

6.13.10 ***The Interval Tab allows you to set the time between readings from the sensors. You can also elect to change the format of the time stamp in the spreadsheet from the default (time in seconds) to a full date and time stamp.***

6.13.11 ***Click OK to save your settings. Click Cancel to exit the Preferences Screen, or hit RESET to reset the default settings of 1 second between readings, and time stamp displayed in seconds.***

Statistics Tab

6.13.12 ***The Statistics tab allows you to change the statistical averaging used and displayed on the chart screen. You can select between:***

6.13.13 *Average:* ***The* Average *over all readings per sensor taken since session start.***

6.13.14 *Minimum:* ***Displays the* Minimum *of all readings taken per sensor since session start.***

6.13.15 *RMS/Average:* ***Calculates the* Root Means Square divided by Average *over all readings taken per sensor since session start.***

6.13.16 *Maximum:* ***Displays the* Maximum *of all readings taken per sensor since session start.***

6.13.17 *Standard Deviation/Average:* ***calculates the* Standard Deviation divided by Average *over all readings taken per sensor since session start. This value is called Turbulence Intensity, and is an indication for turbulent or laminar flow.* NOTE: Turbulence Intensity calculated on air temperature and thermocouple readings are meaningless and should be ignored.**

6.13.18 *Standard Deviation:* ***calculates the* Standard Deviation *over all readings taken per sensor since session start.***

6.13.19 ***Click OK to save your settings. Click Cancel to exit the Preferences Screen, or hit RESET to reset the default setting (none).***

Units Tab

6.13.20 ***The units tab allows you to select different engineering units to display your data in. Temperature may be displayed in Degrees Celsius, Degrees Farenheit, or Kelvin. Airflow may be displayed in either meters/second, or feet/minute.***

6.13.21 ***Click OK to save your settings. Click Cancel to exit the Preferences Screen, or hit RESET to reset the default values (Degrees Celsius, and meters/second).***

Autosave Tab

6.13.22 ***The Autosave Tab allows you to select the autosave feature. When the autosave feature is selected, Accutrac will automatically save the data collected to hard disk at user definable intervals. The intervals available are 1, 2, 3, 5, 10, 20, 30, and 60 minutes.***

6.13.23 ***Click OK to save your settings. Click Cancel to exit the Preferences Screen, or hit RESET to reset the default setting (Autosave disabled).***

Display Tab

6.13.24 ***The Display tab allows you to select the data that is displayed in the data collection spreadsheet.***

6.13.25 *Display:* ***Allows you to select to display the sensor serial number, model number, calibration date, or calibration range. Or any combination of these options.***

6.13.26 *Probe Name:* ***Allows you to select to display either a Custom Probe name, or the Generic Probe Name.***

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6.13.27 *Warnings:* ***Allows you to select to enable warnings for Calibration Date and Calibration Range. When these options are selected, Accutrac™ will display warnings when sensors are past their calibration date, or when readings are outside of the sensor calibrated ranges.***

6.13.28 ***Click OK to save your settings. Click Cancel to exit the Preferences Screen, or hit RESET to reset the default settings (no Display data, Generic Probe name, and both warnings enabled).***

6.14 Settings

6.14.1 ***The settings screen allows you to view the following data related to connected sensors:***

Serial Number
Custom probe name
Parameter
Display

6.15 Windows Menu

6.15.1 *New Data Window:* ***Opens a new data collection session on your desktop.***

6.15.2 ***New*** *Chart Window:* ***Opens a new chart session on your desktop.***

6.16 Help Menu

6.16.1 *Contents:* ***Displays the on-line Help contents, and this manual.***

6.16.2 *About:* ***Displays version and release information for Accutrac software.***

7. *Maintenance & Troubleshooting*

Chapter 7 provides the maintenance procedures applicable to the Cambridge Accusense ATM2400 Series. In addition, a list of "***Frequently Asked Questions***" contains diagnostic and corrective information about common system problems.

Before calling Degree Controls, Inc. for service, you may find answers to your questions in this Manual, or on the Degree Controls, Inc. web site.

1. Are you using the latest software version?
2. Did you try restarting the instrument, computer, and software?
3. Visit Degree Controls, Inc.'s website for latest information on the unit, firmware upgrades, and FAQ.

Contact Degree Controls, Inc. Tech Support if you were unable to find answers to your questions above.

7.1 Frequently Asked Questions

1. ***Q****: Do the ATM2400 and Software indicate when the airflow exceeds the calibration range of the UAS sensor being used?*
   A: The user must compare the readings with the calibration range of the sensors (marked on sensor) and make sure it stays within range.
2. ***Q****: Can I connect UAS sensors with different calibration ranges at the same time?*
   A: Yes. The ATM2400 has the capability of detecting each UAS sensor's calibration information automatically, which is used when calculating readings.
3. ***Q****: What can you tell me about the accuracy of the UAS sensors beyond the calibration range?*
   A: Degree Controls, Inc. specifies the accuracy of each UAS sensor within the defined calibration range, marked on each sensor's connector. At higher velocities the sensors tend to underread, at velocities below the range readings should not be considered accurate. Velocities below 30 FPM result in convection at the heated sensor and should not be considered accurate.
4. ***Q****: Are there any limitations or prohibitions against using the instrument and sensors in noisy environments, such as close to power supplies?*
   A: Research to date on the influence of noisy environments has found little sensitivity to EMI radiation.
5. ***Q****: Does dust affect the readings?*
   A: As long as the UAS sensor head is not heavily covered or blocked with dust, the readings should still be accurate.
6. ***Q****: What does it mean when Accutrac reports that the data buffer is full?*
   A: Accutrac's data space is full. Save your current spreadsheet, and begin a new data run.

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7. ***Q**: What do I do when I get an error message in Windows saying that the Cambridge Accusense ATM2400 Sensor Device has exceeded the current limit of it's hub port?*
   A: Turn off the ATM2400, and shut down Accutrac. Turn the ATM2400 hub back on, and restart Accutrac.
8. ***Q**: How about chemicals or other gases in the air?*
   A: There are two issues worth noting:

   Hazardous chemicals like acids might damage the UAS sensor.

   UAS sensors are calibrated for air in human environments only (room air), so the readings may be inaccurate in other environments.
9. ***Q**: How can I clean a dusty UAS sensor?*
   A: Use an ultrasonic bath for cleaning UAS sensor heads. Be sure to unplug the sensor before cleaning!
10. ***Q**: My application requires measurements above 70°C (158°F).*
    A: The UAS sensor itself should not be damaged when used below 100°C (212°F). But measurement outside the sensor's temperature calibration range may cause the reading to be less accurate.

7.2 Maintenance Procedures

Degree Controls, Inc. guarantees the calibration of the ATM2400 Series instruments and the sensors for one (1) year starting the day of delivery.

7.2.1 Recalibration

7.2.1.1 To ensure that your ATM2400 always gives the most accurate readings, Degree Controls, Inc. recommends that the sensors be recalibrated once every year.

7.2.1.2 To recalibrate, contact Degree Controls, Inc. for an RMA-number and shipping instructions before returning the unit.

7.2.1.3 To check if a UAS sensor is still accurate, compare the readings to a sensor of the same type and location/flow. Ensure that the air velocity matches the sensor's calibration range.



WARNING: THERE ARE NO CUSTOMER SERVICEABLE PARTS INSIDE THE ATM2400, UAS, or UTS SENSORS. OPENING THE CASE AFFECTS THE DEGREE CONTROLS, INC. WARRANTY AND RISKS ELECTRIC SHOCK!

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7.2.2 Cleaning

7.2.2.1 To clean a unit or its cables, use a mild detergent applied to a clean cloth.

7.2.2.2 Do not use alcohol or ammonia based solutions.

7.2.2.3 To clean the sensor-heads, use an ultrasonic bath.

CAUTION: Unplug the sensor before putting it into the ultrasonic bath.

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