GE
Measurement & Control

Moisture

Aurora Trace

High Definition Laser Spectroscopy Moisture Analyzer

User's Manual

imagination at work

910-293 Rev. B
May 2013

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Information Paragraphs

- **Note** paragraphs provide information that provides a deeper understanding of the situation, but is not essential to the proper completion of the instructions.
- **Important** paragraphs provide information that emphasizes instructions that are essential to proper setup of the equipment. Failure to follow these instructions carefully may cause unreliable performance.
- **Caution!** paragraphs provide information that alerts the operator to a hazardous situation that can cause damage to property or equipment.
- **Warning!** paragraphs provide information that alerts the operator to a hazardous situation that can cause injury to personnel. Cautionary information is also included, when applicable.

Safety Issues

WARNING! It is the responsibility of the user to make sure all local, county, state and national codes, regulations, rules and laws related to safety and safe operating conditions are met for each installation.

Auxiliary Equipment

Local Safety Standards

The user must make sure that he operates all auxiliary equipment in accordance with local codes, standards, regulations, or laws applicable to safety.

Working Area

WARNING! Auxiliary equipment may have both manual and automatic modes of operation. As equipment can move suddenly and without warning, do not enter the work cell of this equipment during automatic operation, and do not enter the work envelope of this equipment during manual operation. If you do, serious injury can result.

WARNING! Make sure that power to the auxiliary equipment is turned OFF and locked out before you perform maintenance procedures on the equipment.

Qualification of Personnel

Make sure that all personnel have manufacturer-approved training applicable to the auxiliary equipment.

Personal Safety Equipment

Make sure that operators and maintenance personnel have all safety equipment applicable to the auxiliary equipment. Examples include safety glasses, protective headgear, safety shoes, etc.

Unauthorized Operation

Make sure that unauthorized personnel cannot gain access to the operation of the equipment.

Environmental Compliance

Waste Electrical and Electronic Equipment (WEEE) Directive

GE Measurement & Control is an active participant in Europe's *Waste Electrical and Electronic Equipment* (WEEE) take-back initiative, directive 2002/96/EC.

The equipment that you bought has required the extraction and use of natural resources for its production. It may contain hazardous substances that could impact health and the environment.

In order to avoid the dissemination of those substances in our environment and to diminish the pressure on the natural resources, we encourage you to use the appropriate take-back systems. Those systems will reuse or recycle most of the materials of your end life equipment in a sound way.

The crossed-out wheeled bin symbol invites you to use those systems.

If you need more information on the collection, reuse and recycling systems, please contact your local or regional waste administration.

Visit **http://www.ge-mcs.com/en/about-us/environmental-health-and-safety/1741-weee-req.html** for take-back instructions and more information about this initiative.

Chapter 1. Features and Capabilities

1.1 Overview

The **Aurora Trace** is the next generation of laser moisture analyzer to measure moisture content in natural gas at sub part per million by volume (ppmv) levels. Based on tunable diode laser absorption spectroscopy (TDLAS), the Aurora Trace uses a patented technique to overcome the difficulties of background gas interference at very low moisture levels encountered by traditional TDLAS and differential spectroscopy. GE refers to this improved technology as high-definition laser absorption spectroscopy (**HDLAS**)™.

Aurora Trace's HDLAS™ delivers a sharper signal (better spectral resolution) and more detail (better spectral specificity) for higher quality measurements. Its non-contact measurement technique provides the fastest response of any moisture measurement technology.

Enhanced precision and reliability at trace moisture levels mean that operators are assured that processes consistently meet specifications. If moisture content exceeds user-determined threshold levels due to a process upset, Aurora Trace responds instantly. Once process upsets get fixed, it enables definitive documentation that the process meets contractual and internal moisture specifications. From process alert to process back on line, **HDLAS™** responds more quickly than any other type of moisture technology.

CLASS 1 LASER PRODUCT

WARNING!

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous laser exposure.

1.2 Features

- Optical response: <2 seconds once flow cell is purged.
- HDLAS increases measurement resolution and reduces background gas interference.
- No cross sensitivity to glycols or amines.
- Direct readout in lbs/mmscf, mg/m^3 or ppm.
- Reads process pressure dewpoint (with user programmable constant or live auxiliary input for process pressure).
- Turnkey sampling system specifically designed for natural gas applications ensures measurement integrity.
- Magnetic Stylus enables through-glass programming – hot permit not required to field program.
- Explosionproof/Flameproof design
- 4-20 mA signals and RS-232/485 MODBUS RTU for connection to SCADA or plant monitoring system.
- Supplied with **AuroraView** software for remote configuration, data logging and data retrieval capacity.
- NIST traceable calibration.
- In conformance with IEC 60825-1 Edition 2.0, Safety of Laser Products.

1.2 Features (cont.)

The **Aurora Trace** is supplied with a turnkey sampling conditioning system which may be customized, based on the application.

The **Aurora Trace** is equipped with a display and a user interface which features magnetic induction keys, enabling it to be configured and programmed in a hazardous area without opening the increased-safety enclosure. The display can be set up to display moisture in mole ratio (ppm_v or ppb_v), dewpoint temperature (°C or °F), mass/volume (lbs/mmscf or mg/m^3) and pressure dewpoint. In addition, the sampled gas temperature and pressure, as well as the process pressure, may also be displayed in metric or English units. All of the parameters may be transmitted using three programmable analog output (0/4-20 mA) signals. The data may also be transmitted digitally using an RS-232 or RS-485 with Modbus and optional Foundation Fieldbus. Two digital ports are standard.

GE supplies AuroraView software which runs on a remote personal computer. From the PC setup and programming, commands may be sent back to the **Aurora Trace**. AuroraView also enables the data to be trend-graphed in real-time. The data can also be saved in tabular form for export to programs such as Microsoft excel. AuroraView provides the user with the ability to view and capture spectral scans.

A built-in verification system is optional. The verification module digitally interfaces with the **Aurora Trace** analyzer. The verification system may be initiated locally or remotely via MODBUS. The process gas is first dried by a gas purifier selective to the removal of water. The dried gas flows into the absorption to verify the ability of the analyzer to achieve it's lower detection level. The unit automatically switches to enable water vapor to combine with the dry gas by use of a permeation generator. The outlet of the permeation generator recombines with the dry stream to produce a concentration of approximately 1 $ppm_{v.}$ The actual value produced is certified with an NIST traceable hygrometer.

1.3 Certification and Safety Statements

1.3.1 Special Conditions for Safe Use:

1. In the event of repair or replacement of any components, the manufacturer, GE, shall be contacted for information on the controlled materials and dimensions of the flameproof characteristics of the Aurora Trace Moisture Analyzer.
2. The Laser Head Assembly of the Aurora Trace Moisture Analyzer shall be inside a tool-secured enclosure, with IP20 or better, to ensure the factory installed laser head assembly bolts are inaccessible from the outside.

1.4 Theory of Operation

The GE **Aurora Trace Moisture Analyzer** measures moisture in the range of 0-400 ppm_v (parts per million by volume) and provides a trending indication from 400-1000 ppm_v. It uses a tunable laser diode which it scans across a narrow band in the near infra-red spectrum. This technology produces very fast response to changes in moisture concentration. The system is very reliable as it does not use any sensor that comes in contact with the process gas. The technique is called wavelength modulated spectroscopy (WMS). The fundamental measurement principle is based on the Beer-Lambert law:

$$A = In\left(\frac{I_o}{I}\right)SLN$$

where
A = Absorbance
I = Light intensity transmitted through a sample gas
I_o = Incident light intensity
S = Absorption coefficient*
L = Absorption path length (a constant)
N = Concentration of the water vapor in the absorption cell

* The absorption coefficient is a constant at a specific temperature, pressure and background gas composition.

The concentration of the water is directly related to the partial pressure. At certain specific frequencies, light energy will be absorbed by water molecules. As the concentration of water increases, the absorption also increases. The **Aurora Trace** sweeps the diode laser output and, by measuring the light intensity with a photo detector, is able to provide a direct indication of the partial pressure of water. The partial pressure divided by the total pressure provides the volume or mole fraction.

Aurora Trace utilizes a long path length to achieve high sensitivity at trace moisture levels by employing an optical multi-pass cell. The multipass cell bounces the light back and forth by using special mirrors to effectively provide a long path length.

The **Aurora Trace** is equipped with a vacuum pump and by operating the absorption cell at vacuum pressure, an enhanced signal of refined resolution is produced. The application of vacuum pressure to provide higher resolution signals is a well-known technique that is used in laboratory spectrometers.

GE engineers have designed the system with an industrial high-reliability vacuum pump suitable for use in hazardous areas and designed to operate over a wide range of environmental conditions. When wavelength-modulation spectroscopy is applied to gas measurement, an increase of pressure and temperature results in a phenomenon known as “collision broadening.” In ideal gases, the partial pressure increase is directly proportional to the increase in pressure; however, the absorption signal decreases to a value less than predicted by the pressure increase due to increased intermolecular interactions. In addition, there may be overlap of absorption lines from other gases. By applying vacuum, the signal dramatically “sharpens” such that the signal and peaks associated with water are dramatically increased and are clearly defined. This method does not rely on the supply of a zero gas or any consumables to produce trace level moisture measurements.

1.5 System Components

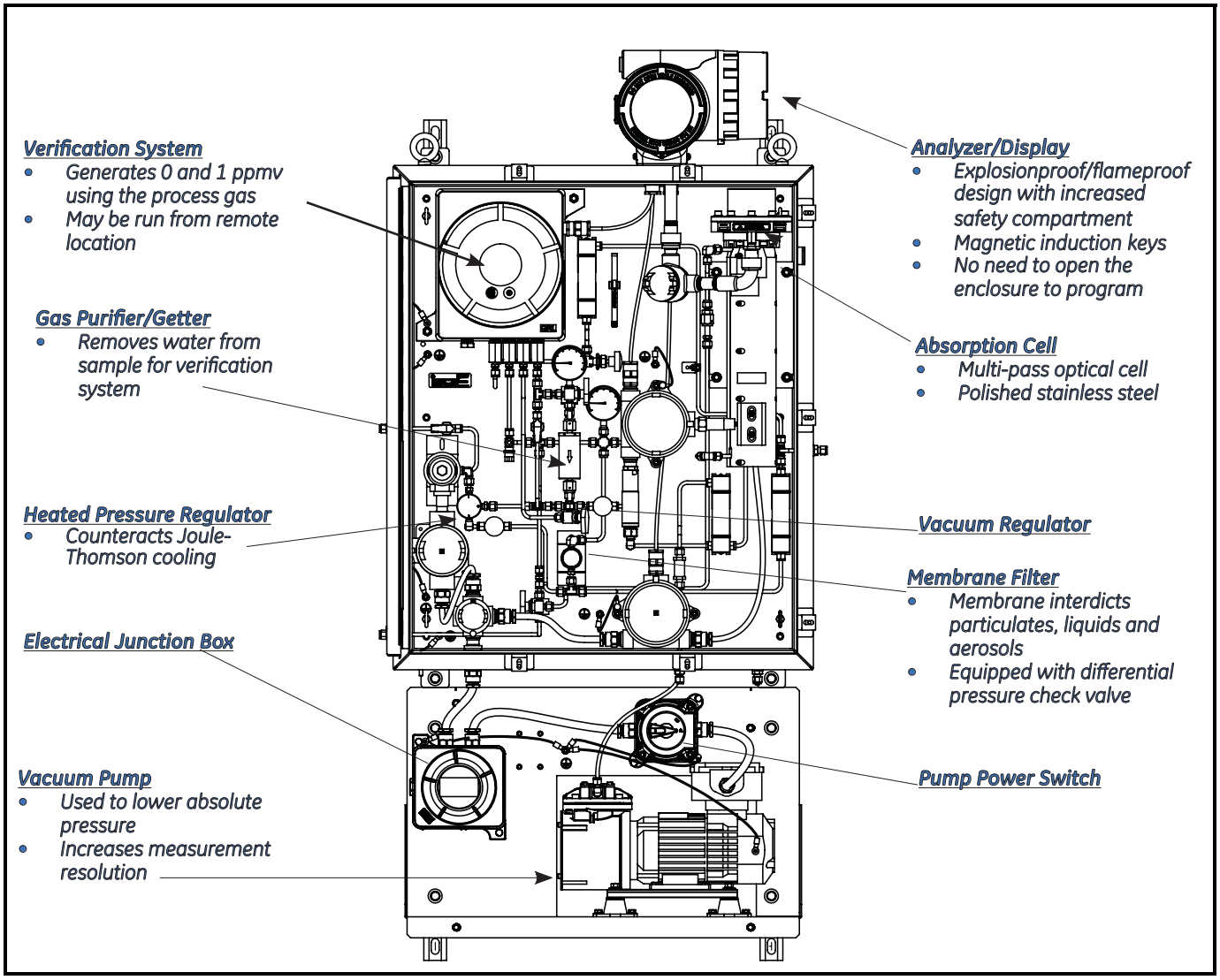


Figure 1: Aurora Trace Sample System Components

1.6 Specifications

Power
Analyzer: 100-240 VAC, 50-60 Hz
Vacuum pump: 115 VAC, 60 Hz or 230 VAC, 50 Hz

Moisture Range
Calibrated range: 0 to 400 ppm_v volume ratio H_2O (parts per million by volume)
Trending range: 400 to 4,000 ppm_v volume ratio H_2O (parts per million by volume)

Mass ratio (mass of water vapor/mass of carrier gas), absolute humidity (mass of water vapor/volume of carrier gas), dew/frost point temperature. Equivalent dew/frost point temperature measurements are derived from the fundamental water vapor, pressure and temperature measurements. Programmable for standard English and metric units.

Accuracy
±50 ppb_v (parts per billion by volume) or ±2% of reading, whichever is greater

Repeatability
±10 ppbv (parts per billion by volume)

Operating Pressure Range (Absorption Cell)
2.2-2.8 psia (17.2 KPa) ±4%

Temperature Range
-20 to +60°C (-4 to +140°F)

Response Time
Optical system <2 seconds
<60 seconds for 90% step change once system is purged)

Sample Flow Rate Through Absorption Cell
0.5-2 SCFH (1-4 LPM)

Weight
340 lb (154 kg)

Display
Backlit monochrome LCD display. Displays three simultaneous parameters. The main display is dedicated to moisture. The other displays can be programmed for any unit.

Local User Interface
“Through-the-glass” buttons. Ability to configure and scale unit in hazardous area without opening the enclosure.

User Interface
Programmable via magnetic stylus “through-the- glass” programming

Analog Outputs
Three 0/4-20 mA DC (source) with 500 Ω load. User programmable for any parameter and scalable. Complies with NAMUR protocol for analog signals.

1.6 Specifications (cont.)

Analog Input
4-20 mA. For inputs from pressure transmitters, Aurora supplies power (24 VDC nominal).

Digital Interface
Two digital ports programmable for RS-485 multi-drop or RS-232. Each unit addressable.

Digital Protocol
Modbus
RTU and Foundation Fieldbus (Optional)

Calibration Certification
NIST or equivalent NMI traceable certification

Ingress Rating
Enclosure: IP-67
Vacuum Pump: IP54, ATEX IP65, IECEx IP56

Hazardous Location Certifications

USA/Canada: Class I, Division 1, Groups C-D
Europe: ATEX Ex de IIB T6 Gb
Other Locations: IECEx Ex de IIB T6 Gb
Temperature range: -20 to 50°C (-4 to 122°F)

Chapter 2. Installation

2.1 Introduction

The **Aurora Trace** analyzer provides direct indication of moisture concentration in natural gas. Temperature and pressure sensors are used to provide high precision enhancement. It may be installed in a wide variety of environmental conditions, and meets the requirements for operation in hazardous areas.

2.2 Bill of Materials

The following should have been received with the shipment:

- **Aurora Trace** Unit
- **Aurora Trace** User's Manual on CD ROM
- **AuroraView** Software on CD ROM
- Quick Startup Procedure
- **Aurora Trace** Calibration Data Sheet
- Maintenance/Accessories Kit
- Sample Tap Instructions

2.3 Unpacking

The Aurora Trace will be shipped in a wooden crate. The Aurora Trace analyzer will be secured to the base with mounting bolts. Transport the shipping package with the base down, and according to the warning labels on the exterior package. To avoid injury, use two people, life and remove the crate cover. Remove the foam packing material. Collect piece parts such as AuroraView CD, the User Manual CD, and other items contained in the shipment and follow the following steps:

1. Remove the four mounting bolts at both ends of the mounting rails (see Figure 2 on page 8).
2. Remove the vacuum pump wedge, which is used to restrict pump movement during transportation (see Figure 2 on page 8).

2.3 Unpacking (cont.)

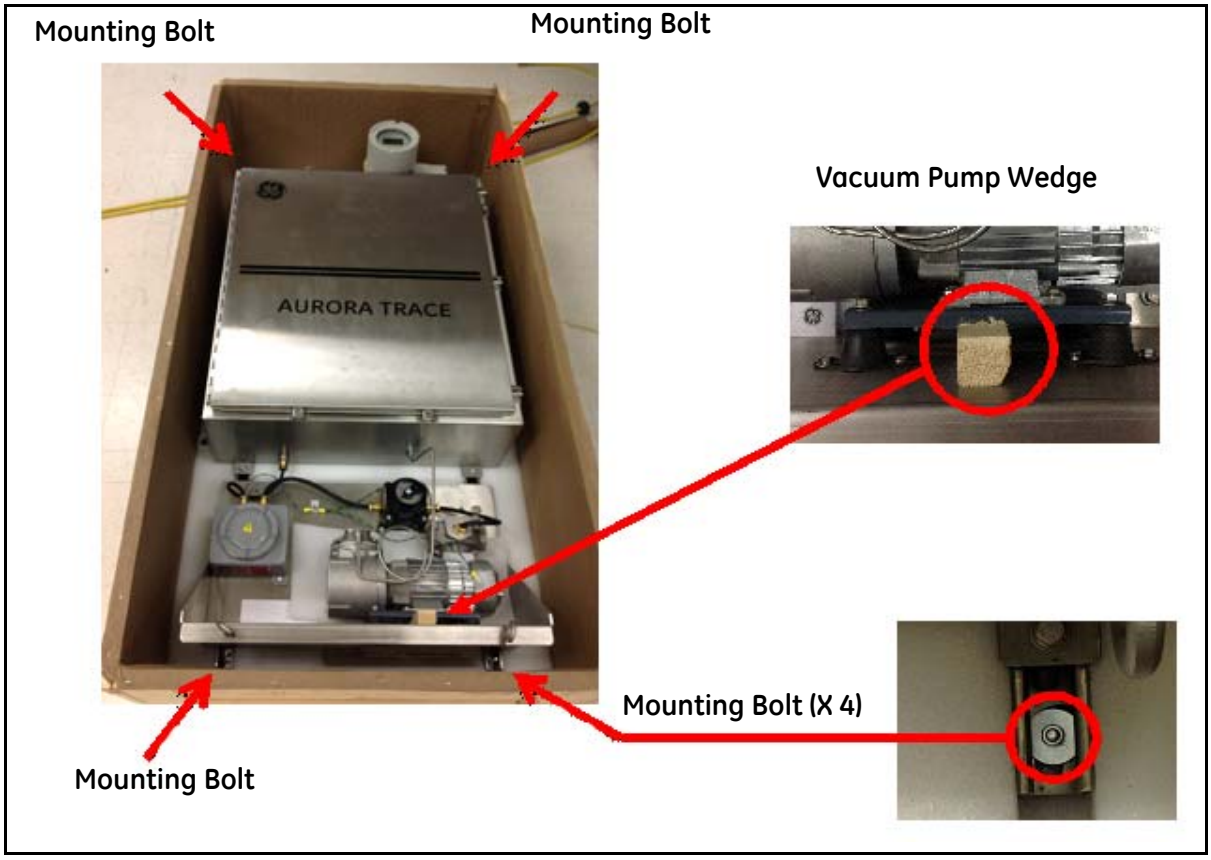


Figure 2: Aurora Trace Mounted on Base with Crate Cover Removed

3. A typical Aurora Trace weighs approximately 350 pounds (159kg). To avoid injury, using a proper lifting device, lift the Aurora Trace up above the ground on one side from the lifting hooks from the top of the enclosure where the analyzer electronics is located (see Figure 3). Move the Aurora Trace horizontally to the pre-determined location for installation.

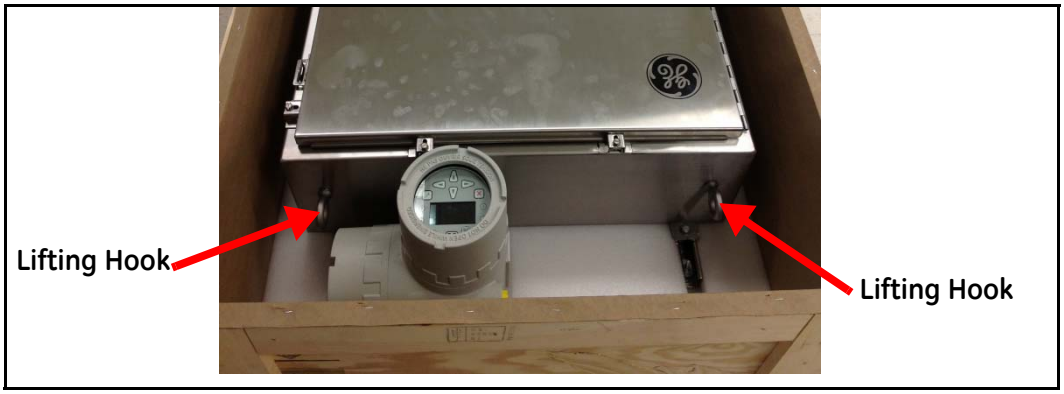


Figure 3: Lift Aurora Trace up Above the Ground from the Two Hooks Shown

Check all the received pieces and record the model numbers and serial numbers for your records. If anything is missing, contact GE immediately.

2.4 Choosing A Site for Installation

You should have discussed environmental and installation factors with a GE Sales, Applications or Service Engineer by the time you receive the analyzer.

Before installing the analyzer, read the guidelines below on installation recommendations for consideration:

1. Choose an installation site for the **Aurora Trace** analyzer as close to the actual sample point (sample take-off point) as possible, to minimize transport time to the analyzer.
2. Avoid unnecessarily long lengths of sample transport tubing to minimize transport time to the analyzer.
3. Avoid dead-legs in the sample transport tubing to minimize the possibility of liquid build-up.
4. Use stainless steel tubing. Avoid using copper tubing, as the water molecule has greater absorption capabilities for copper compared to stainless steel. Avoid rubber tubing at all costs, as water molecules interact with the rubber, and ambient moisture can permeate through the tube wall into the sample gas.
5. Mount the **Aurora Trace** analyzer at grade, or at a location that is easily accessible for maintenance (on a platform or other structure).
6. Be sure that the ambient temperature is at least 10°C higher than the maximum dew/frost point temperature you expect to measure. This will ensure that you will not have liquid condensation in the sample transport line nor in the **Aurora Trace**. Heat tracing the sample line will aid in elevating the sample temperature above the dewpoint.

An **Aurora Trace** system for monitoring moisture off a natural gas pipeline is shown in Figure 4 on page 10.

2.4 Choosing A Site for Installation (cont.)

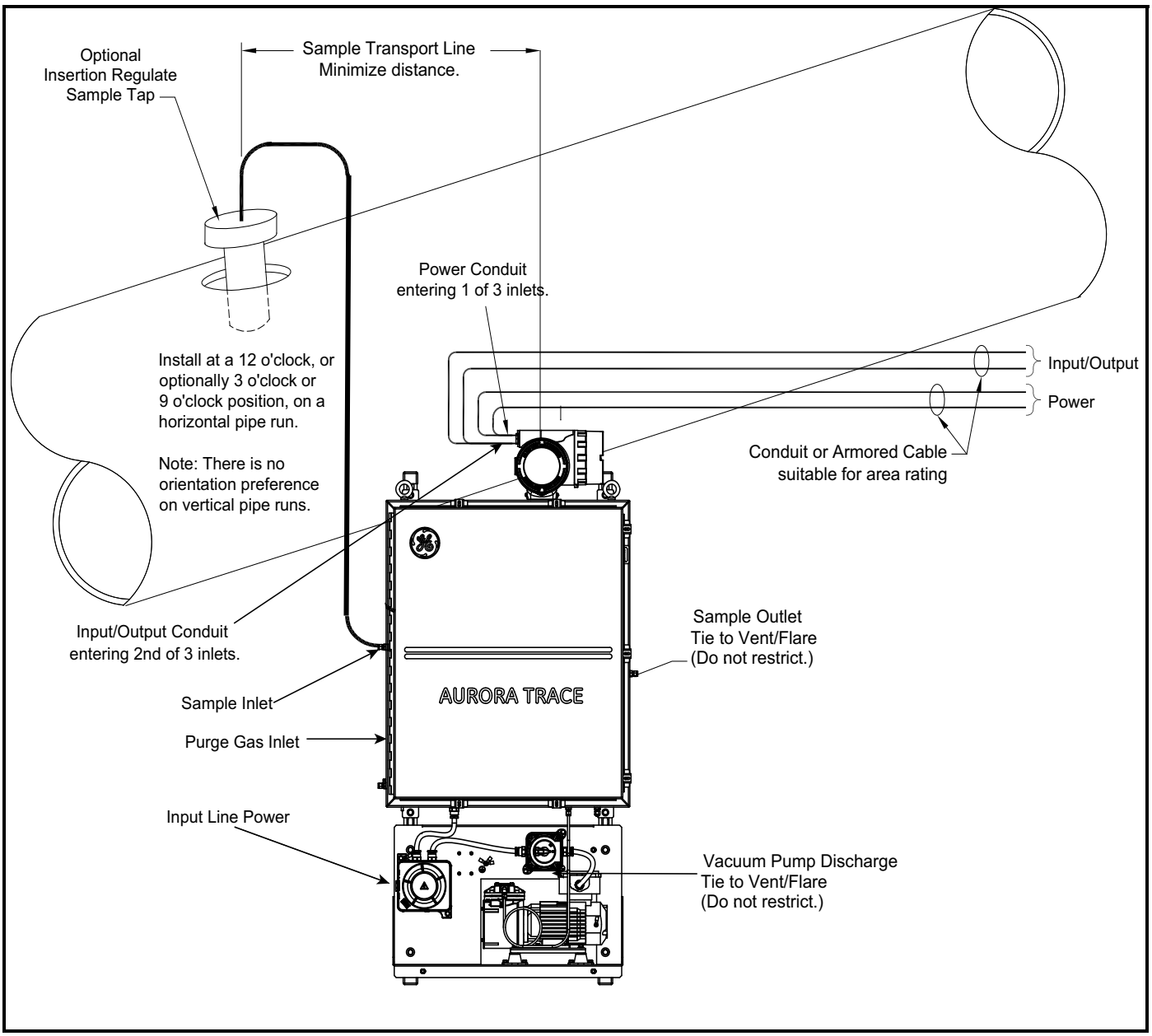


Figure 4: Aurora Trace Analyzer Monitoring Moisture Off a Natural Gas Pipeline

2.5 Low Voltage Directive

To comply with the Low Voltage Directive, you must install a switch or circuit breaker on the input power line. For greatest safety, locate the circuit breaker or power switch near the electronics console.

IMPORTANT: *Installation must be done in accordance with the National Electrical Code, the Canadian Electric Code, and/or any other applicable local codes.*

2.6 Mounting

Use the four mounting tabs to mount the **Aurora Trace** System Assembly in the desired location (see Figure 14 on page 25).

IMPORTANT: *The **Aurora Trace** should only be mounted* vertically.

2.7 Making Mechanical Connections

1. Remove cap and connect sample tubing to Sample Inlet of Aurora Trace enclosure. If a heated pressure regulator is installed, the maximum inlet pressure is 2500 psig. Otherwise, the maximum inlet pressure is 400 psig.
2. Purge gas is not required for most applications; if required, remove cap and connect to Purge Gas Inlet of Aurora Trace enclosure. Maximum pressure is 50 psig (345 kPa).
3. Remove cap and connect Sample Outlet of Aurora Trace enclosure to vent or flare, as appropriate for process gas. It should not be restricted and is designed for up to 15 psig of back pressure from venting.
4. Remove cap and connect Vacuum Pump Discharge to vent or flare, as appropriate for process gas. It should not be restricted and is designed for up to 15 psig of back pressure from venting.

2.8 Making Electrical Connections

Refer to Figure 15 on page 26 for wiring connections.

1. Aurora Trace has been supplied with a vacuum pump. There are three possible configurations: USA/CAN, EU or IECEX. Connect the AC power using a separate conduit from the power for the Aurora Trace analyzer. This will also power the heater for the multi-pass cell. Use 12-18 AWG (3.3 - 0.82 mm2) wires. The terminals are located within a junction box and the heated pressure regulator (if installed). Power consumption is as follows:

	Watts
US Motor	414
IECEx Motor	579
ATEX Motor	555
Heated Pressure Regulator	200
Heater	150

2. **Aurora Trace** has three ¾" NPT conduit inlet ports for power and I/O. These will normally be shipped plugged from the factory. Follow the applicable wiring code and requirements for wiring the unit.

Figure 5: Conduit Inlet Ports

Note: *Use one conduit inlet for power. Use the two other conduit inlets for input/output as needed. All unused conduit inlet ports should be sealed with suitable blanking elements.*

3. Use one conduit for inlet power to the **Aurora Trace** based on your configuration. The **Aurora Trace** comes with a universal power supply. Remove the wiring cover to view the wiring terminal block.

2.8 Making Electrical Connections (cont.)

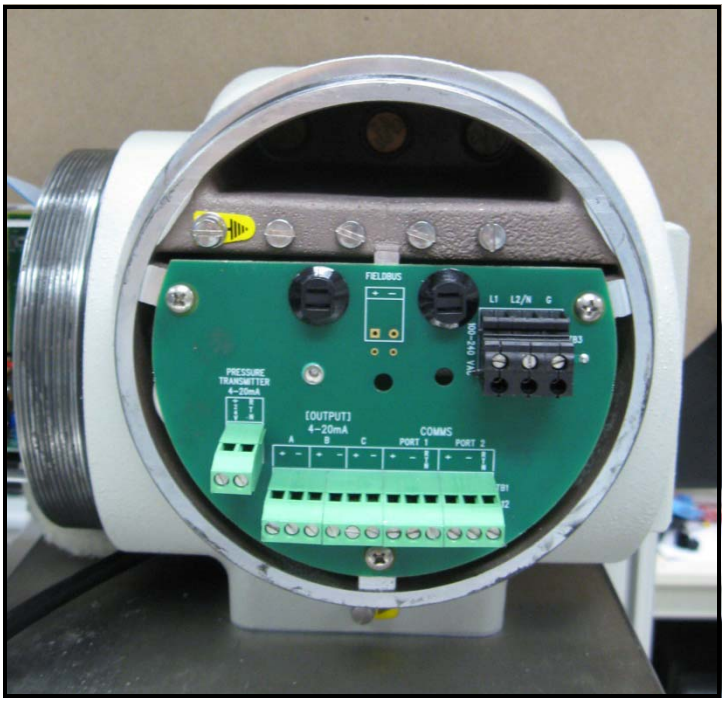


Figure 6: Wiring Terminal Blocks

Note: *Supply connection wiring shall be rated at least 10°C above the rate maximum service temperature of 85°C, be stripped back 5/16 in. (8 mm) and torqued to a minimum of 4.4 in. lb. (0.5 Nm).*

4. Run the AC power connections to the Power Terminal Block shown in Figure 7. It is recommended to use 12-18 AWG (3.3 - 0.82 mm^2) power wiring.

Figure 7: Power Terminal Block

2.8 Making Electrical Connections (cont.)

5. Use wiring conduit runs, separate from the **Aurora Trace** main power, for all I/O (Input/Output) leads. Wire up to three 4-20mA outputs to the terminals labeled A, B, and C. The three analog outputs A, B and C (0-20mA or 4-20mA) are internally powered by the **Aurora Trace**. Use shielded 18-22 AWG (0.82–0.33 mm^2) twisted pair wire, and ground the shield at one end only. Wire up digital communications to Port 1 and/or Port 2 as labeled.

6. Either digital port may be configured for RS-232 or RS-485. Port 1 is designated as "SCADA." Port 2 is designated as "SERVICE." Port 2 must be configured as RS485 if verification system option comes with the system.

- For operation on RS-485, 2-wire, half-duplex bus, attach the RS-485(+) to (+), and the RS-485(–) to (–). A third conductor must also interconnect all the devices of the bus: the common.

Note: *For an RS-485 Multidrop Network, a terminating resistor must be installed across the* ***Aurora Trace*** *RS-485 terminals, or an internal terminating resistor can be applied. See below.*

When using the **Aurora Trace** in RS-485 mode, and to prevent signal reflections on the high-speed RS-485 connections, it is recommended that the far end of the RS-485 lines be terminated properly. The termination can be accomplished in one of two ways:

a. Connect 120Ω ¼W leaded resistors across the + and – terminals of ports 1 and 2 (both ports or whichever one will be in use), or

b. Using long-nose pliers, move jumpers J15 and J16 from pins 2 and 3 (default setting from factory) to pins 1 and 2 (see Figure 8 on page 14). J16 is the termination for port 1 and J15 is the termination for port 2. It is also recommended that basic ESD precautions such as grounded wrist straps be used for this procedure.

Multi-drop RS-485:
For multiple **Aurora Trace** units connected in daisy-chain fashion to the RS485 interface, it is important that the farthest unit away from the transmitting device be the only unit incorporating any termination. All other units must have jumpers J15 and J16 in positions 2 & 3 (default setting from the factory). For more details on RS-485 wiring or operation, refer to TIA/EIA-485-A Specification.

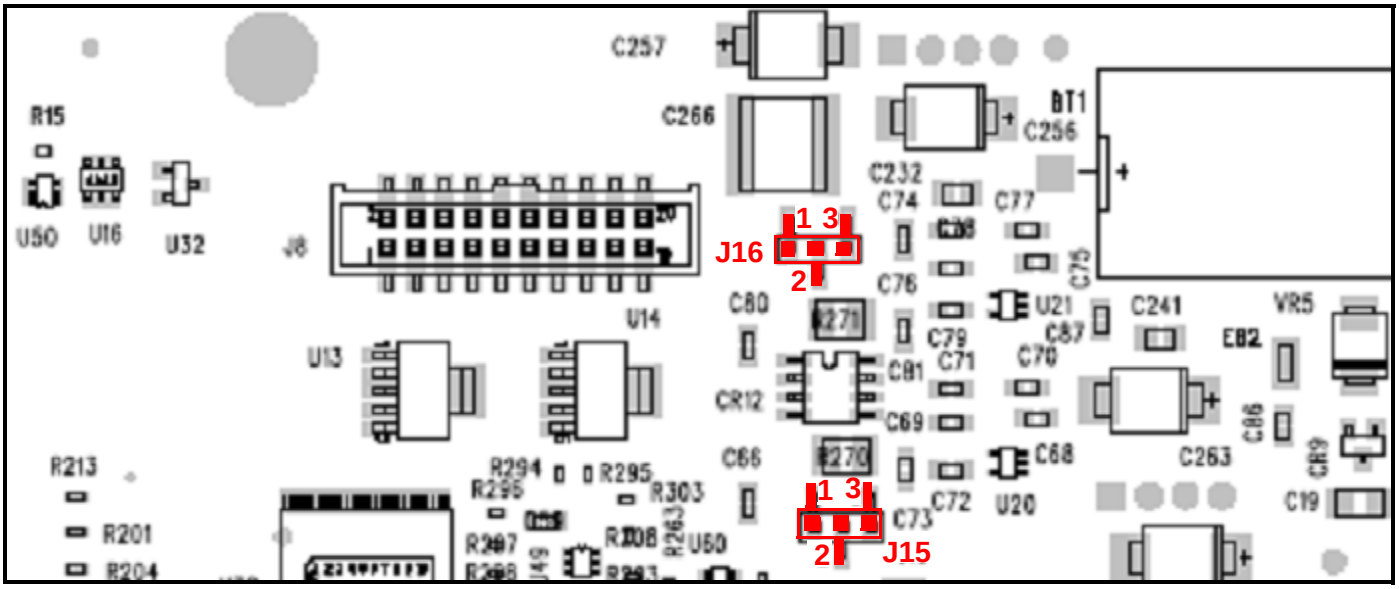


Figure 8: RS-485 Mode Termination - Install Jumpers at J15 and J16, Pins 1 and 2

2.8 Making Electrical Connections (cont.)

Note: *Terminations are NOT required when using ports in RS-232 mode.*

- For operation on RS-232, connect RS-232(TXD) to (+), RS-232(RXD) to (–), and RS-232(GND) to RTN.

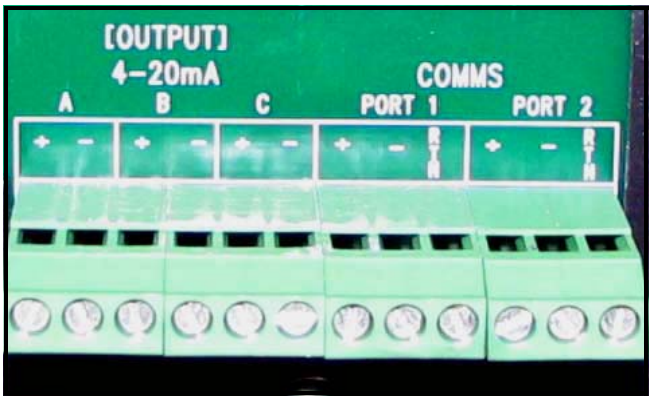


Figure 9: Input/Output Connections

7. For connection to a PC to interface with AuroraView Software, you may use the supplied 704-688 cable (RS-232 w/ SUB-D-9 connector to tinned leads). Wire the cable as follows:

Color Code		Aurora Trace Terminal
White	Tx	+
Red	Rx	–
Green	Ground	RTN

Note: *The default configuration is as shipped:*

BAUD Rate	115,200
Parity	Even
ID Note	1 for Port 1, 2 for Port 2

8. Use a separate wiring conduit run for any 4-20mA pressure transmitter input. This input is used when a live input pressure reading for the main process pressure is desired, to determine an equivalent dewpoint by the **Aurora Trace** analyzer. Wire the 4-20mA pressure transmitter to the Pressure Transmitter terminal block. The **Aurora Trace** supplies 24VDC for use with a loop-powered, 2-wire pressure transmitter.

2.8 Making Electrical Connections (cont.)

Figure 10: Pressure Transmitter Connections

Note: *Use of an external pressure transmitter is not covered by the* **Aurora Trace** *hazardous area certifications. The external pressure transmitter should be suitably rated for the area classification. Its associated wiring should be done in accordance with local codes and regulations, and suitably rated for the area classification.*

9. Lastly, the Aurora Trace analyzer requires a connection to ground from the electronics explosion-proof/flame-proof enclosure and/or the stainless steel enclosure. There are two external ground connections available for the user on the left and right sides of the explosion-proof/flame-proof enclosure. There is another external ground connection available for the user on the bottom of the stainless steel enclosure. Wire this connection to earth ground, local to the Aurora Trace analyzer installation site

Figure 11: Earth Ground Connection

2.9 Startup Procedure for Aurora Trace Sample System without Verification Option

To start your sample system, refer to Figure 12 below and complete the following steps:

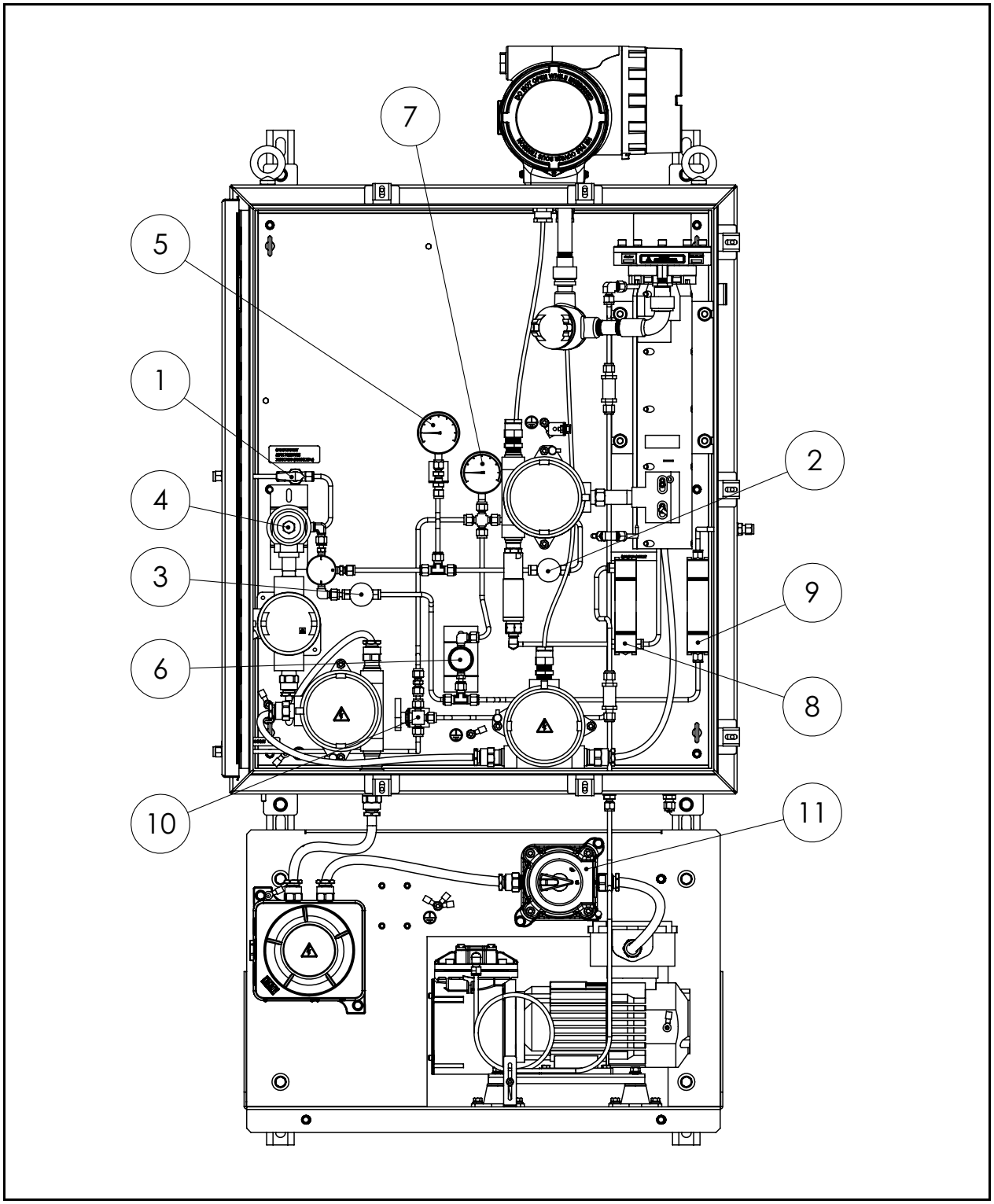


Figure 12: Aurora Trace Sample System (without H_2O Verifier Option)

2.9 Startup Procedure for Aurora Trace Sample System without Verification Option (cont.)

Table 1: Key to Figure 12

1	Sample Gas Isolation Ball Valve
2	Verifier Bypass Valve
3	Sample Gas Bypass Metering Valve
4	Sample Gas Pressure Regulator
5	Sample Gas Pressure Gauge
6	Back Pressure Regulator
7	Orifice Upstream Pressure Gauge
8	Multi-Pass Cell Flow Meter
9	Sample Bypass Flow Meter
10	Process/Test 3-Way Valve
11	Vacuum Pump Switch

1. Before connecting the unit to a gas supply at sample inlet port, ensure Sample Gas Isolation Ball Valve (Item #1) is closed.

2. Warm up Aurora Trace analyzer.

Make sure power supply lines for Aurora Trace and vacuum pump have been wired properly according to Section 2.7.

a. Turn on power supply for Aurora Trace analyzer. *(This will stabilize the Aurora Trace analyzer laser temperature.)*

b. Make sure Vacuum Pump Switch (Item #11) is at OFF position. Turn on power supply to the vacuum pump. *(This will warm up multi-pass cell.)*

3. Set up valve positions.

a. Fully open Item #2 (Verifier Bypass Valve).

b. Fully close Item #3 (Sample Gas Bypass Metering Valve).

c. Turn #6 clock-wise to the end (Back Pressure Regulator).

d. Make sure the Process/Test 3-way Valve (Item #10) handle points upward.

2.9 Startup Procedure for Aurora Trace Sample System without Verification Option (cont.)

4. Set upstream pressure to 16 psig.

If an electrically heated Sample Gas Pressure Regulator (Item #4) is installed in the Aurora Trace sample system, follow these steps:

a. Locate junction box for setting temperature of the heated Sample Gas Pressure Regulator (Item #4). It is right below the heated Sample Gas Pressure Regulator marked as #4.

b. Open junction box cover. Make sure temperature is set mid-scale. If not, use a flat head screw driver to set mid-scale. Allow 15 minutes to warm up.

c. Remove the cap covering the Sample Gas Pressure Regulator adjustment screw (Item # 4).

d. Using a 5/32” hex driver, turn the regulator adjustment screw fully counter-clockwise (minimum pressure output).

e. Open Item #1 (Sample Gas Isolation Ball Valve).

f. Turn the regulator adjustment screw slowly clockwise while observing Item #5 (Sample Gas Pressure Gauge) to 16±1psig.

g. If Sample Gas Pressure Gauge (#5) pressure reading oscillates, go back to step b and increase temperature set point to the next level. Allow 15 minutes to warm up. If Sample Gas Pressure Gauge (#5) becomes stable, raise temperature set point one more level, then close junction box. If not, repeat above process until Sample Gas Pressure Gauge (#5) is stable and then raise temperature set point one more level, then close junction box.

h. Try to avoid setting the heated Sample Gas Pressure Regulator (Item #4) to its maximal temperature, if possible. The Heated Sample Gas Pressure Regulator (Item #4) could be overheated if set at maximal temperature for an extended period of time when there is no gas flowing through it.

If a standard un-heated, Sample Gas Pressure Regulator (Item#4) is installed in Aurora Trace sample system, follow these steps:

a. Turn the Sample Gas Pressure Regulator (Item #4) fully counter-clockwise (minimum pressure output).

b. Open Item #1 (Sample Gas Isolation Ball Valve).

c. Turn the Sample Gas Pressure Regulator (Item #4) slowly clockwise while observing Item #5 (Sample Gas Pressure Gauge) to 16±1psig.

5. Turn ON Vacuum Pump Switch (Item #11). Ensure pump discharge is not restricted.

6. Adjust internal sample pressure to 2.5 psia.

a. Go to the Aurora Trace display to make sure sample pressure reading (psia) is configured on Aurora Trace display

b. Adjust Item #6 (Back Pressure Regulator) counter clock-wise so that Item #7 (Orifice Upstream Pressure Gauge) reads 12 psig.

c. Allow 15 minutes for system pump down.

d. Observe Item #8 (Multi-pass Cell Flow Meter) to be at full scale.

e. Adjust Item #6 (Back Pressure Regulator) while observing the sample pressure reading on the unit display. Set the pressure to read 2.5±0.1 on the display.

2.9 Startup Procedure for Aurora Trace Sample System without Verification Option (cont.)

f. Slowly open Item #3 (Sample Gas Bypass Metering Valve) until the desired flow is achieved at Item #9 (Sample Bypass Flow Meter).

g. Repeat step e and make sure the pressure reads 2.5+/-0.1 on the display.

h. Re-install the pressure regulator adjustment screw cap if an electrically heated Sample Gas Pressure Regulator (Item #4) is installed in Aurora Trace sample system.

Total sample gas flow rate from Aurora Trace outlets are flow rate from Sample Bypass Flow Meter (# 9) plus flow rate through vacuum pump. Flow rate through vacuum pump varies from unit to unit, but it is typically less than 1.86 slpm in normal operation.

2.10Startup Procedure for Aurora Trace Sample System with Verification System Option

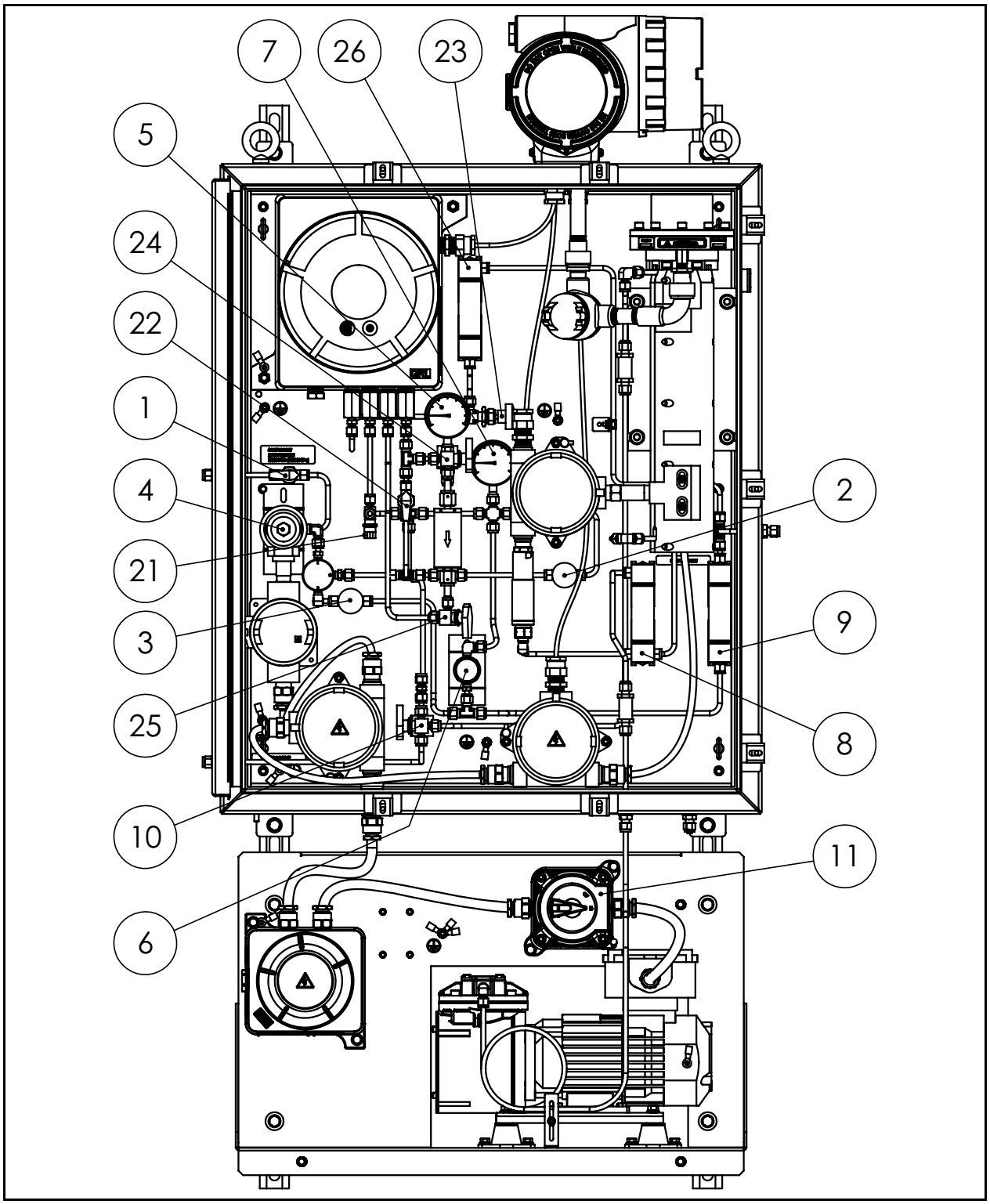


Figure 13: Aurora Trace Sample System with H_2O Verifier Option

2.10 Startup Procedure for Aurora Trace Sample System with Verification System Option (cont.)

Table 2: Key to Figure 13

1	Sample Gas Isolation Ball Valve	**21**	Verifier Isolation 3-Way Valve
2	Verifier Bypass Valve	**22**	Verifier Isolation Ball Valve
3	Sample Gas Bypass Metering Valve	**23**	Verifier Bypass Metering Valve
4	Sample Gas Pressure Regulator	**24**	Purifier Isolation Ball Valve
5	Sample Gas Pressure Gauge	**25**	Purifier Isolation Ball Valve
6	Back Pressure Regulator	**26**	Verifier Bypass Flow Meter
7	Orifice Upstream Pressure Gauge		
8	Multi-Pass Cell Flow Meter		
9	Sample Bypass Flow Meter		
10	Process/Test 3-Way Valve		
11	Vacuum Pump Switch		

To start your sample system, refer to Figure 13 on page 21 and complete the following steps:

1. Before connecting the unit to a gas supply at sample inlet port, ensure Sample Gas Isolation Ball Valve (Item #1) is closed

2. Warm-up Aurora Trace analyzer and verifier.

a. Make sure power supply lines for Aurora Trace and vacuum pump have been wired properly according to Section 2.7.

b. Turn on power supply for Aurora Trace analyzer. (This will warm up verification system and stabilize Aurora Trace analyzer laser temperature.)

c. Make sure Vacuum Pump Switch (Item #11) at OFF position. Turn on power supply to the vacuum pump. (This will warm up multi-pass cell.)

3. Set up valves positions.

a. Open Items #21 and #22 (Verifier Isolation 3-way Valve, handle pointing inward, Verifier Isolation Ball Valve).

b. Fully close Item #2 (Verifier Bypass Valve).

c. Fully close Item #3 (Sample Gas Bypass Metering Valve).

d. Close Item #23 (Verifier Bypass Metering Valve).

e. Open Items #24 and #25 (Purifier Isolation Ball Valves).

f. Make sure Process/Test 3-way Valve (Item #10) handle points upward.

4. Set upstream pressure to 50 psig.

2.10 Startup Procedure for Aurora Trace Sample System with Verification System Option (cont.)

If an electrically heated Sample Gas Pressure Regulator (Item #4) is installed in Aurora Trace sample system, follow these steps:

a. Locate junction box for setting temperature of the heated Sample Gas Pressure Regulator (Item #4). It is right below the heated Sample Gas Pressure Regulator marked as #4.

b. Open junction box cover. Make sure temperature is set mid-scale. If not, use a flat head screw driver to set mid-scale. Allow 15 minutes to warm up.

c. Remove the cap covering the Sample Gas Pressure Regulator adjustment screw (Item # 4).

d. Using a 5/32" hex driver, turn the regulator adjustment screw fully counter-clockwise (minimum pressure output).

e. Open Item #1 (Sample Gas Isolation Ball Valve).

f. Turn the regulator adjustment screw slowly clockwise while observing Item #5 (Sample Gas Pressure Gauge) to 50±5 psig.

g. Slowly open Item #3 (Sample Gas Bypass Metering Valve) until the desired flow is achieved at Item #9 (Sample Bypass Flow Meter).

h. If Sample Gas Pressure Gauge (#5) pressure reading oscillates, go back to step b and increase temperature set point to the next level. Allow 15 minutes to warm up. If Sample Gas Pressure Gauge (#5) becomes stable, raise temperature set point one more level, then close junction box. If not, repeat above process until Sample Gas Pressure Gauge (#5) is stable and then raise temperature set point one more level, then close junction box.

i. Try to avoid setting the **heated Sample Gas Pressure Regulator** (Item #4) to its maximal temperature, if possible. The Heated Sample Gas Pressure Regulator (Item #4) could be overheated if set at maximal temperature for an extended period of time when there is no gas flowing through it.

If a standard un-heated, Sample Gas Pressure Regulator (Item#4) is installed in Aurora Trace sample system, follow these steps:

a. Turn the Sample Gas Pressure Regulator (Item #4) fully counter-clockwise (minimum pressure output).

b. Open Item #1 (Sample Gas Isolation Ball Valve)

c. Turn the Sample Gas Pressure Regulator (Item #4) slowly clockwise while observing Item #5 (Sample Gas Pressure Gauge) to 50 ±5psig.

d. Slowly open Item #3 (Sample Gas Bypass Metering Valve) until the desired flow is achieved at Item #9 (Sample Bypass Flow Meter).

5. Turn ON Vacuum Pump Switch (Item #11). Ensure pump discharge is not restricted.

6. Set up verification system's orifice flow and bypass flow.

a. Go to Aurora Trace display **Main Menu/Settings/Verifier/Diags**.

b. Display following readings

- Perm tube temperature (Prf): warming up to 50°C

2.10 Startup Procedure for Aurora Trace Sample System with Verification System Option (cont.)

- Preheat temperature (Mnf): warming up to 50°C
- Orifice Flow (Orf): controlled at 1860 sccm

c. Slowly adjust Verifier Bypass Metering Valve (Item #23) so that Verifier Bypass Flow Meter (Item #26) reads 48 LPH (1.7 SCFH).

d. Wait until Orifice Flow (Orf) stable at 1860 sccm on display

e. Adjust Item #23 slightly so that Item 26 reads 60 LPH (2.1 SCFH).

f. Repeat d and e so that Item #26 reads 60 LPH (2.1 SCFH) and Orifice Flow (Orf) stable at 1860 sccm on display.

7. Adjust internal sample pressure to 2.5 psia.

Make sure sample pressure reading (psia) is configured on Aurora Trace display.

a. Adjust Item #6 (Back Pressure Regulator) so that Item #7 (Orifice Upstream Pressure Gauge) reads 12 psig.

b. Allow 15 minutes for system pump down.

c. Observe Item #8 (Multi-pass Cell Flow Meter) to be at full scale.

d. Adjust Item #6 (Back Pressure Regulator) while observing the sample pressure reading on the unit display. Set the pressure to read 2.5±0.1 on the display.

8. Re-install the pressure regulator adjustment screw cap if an electrically heated Sample Gas Pressure Regulator (Item #4) is installed in Aurora Trace sample system.

Total sample gas flow rate from Aurora Trace outlets are flow rate from Sample Bypass Flow Meter (# 9) plus flow rate through vacuum pump. Flow rate through vacuum pump varies from unit to unit, but it cannot exceed 1.86 slpm when a verification system is installed.

Sample systems for trace moisture applications will require some time to “dry-down” for reaching the actual process moisture level. Typically 12-24 hours operation with process gas flowing at normal flow rates will “dry” the system, but this will vary depending on process conditions, length of tubing runs and storage conditions for the Aurora Trace prior to installation. Once the analyzer has reached process moisture levels, it is recommended to run the verification cycle 6-8 times to ensure all components within are adequately dry to provide accurate verification cycle values.

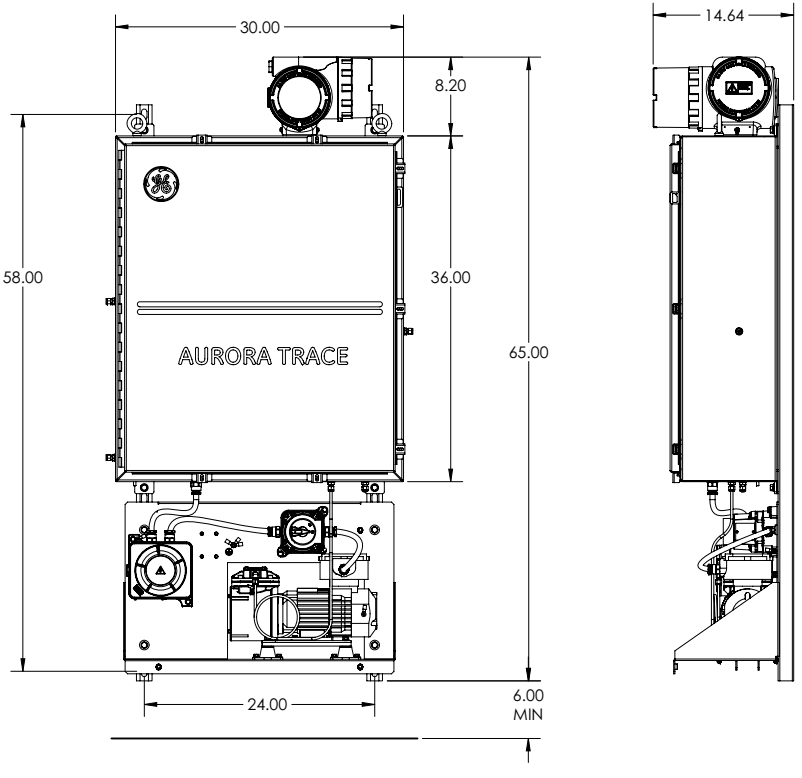


Figure 14: Aurora Trace Outline and Mounting (ref. dwg #712-1456)

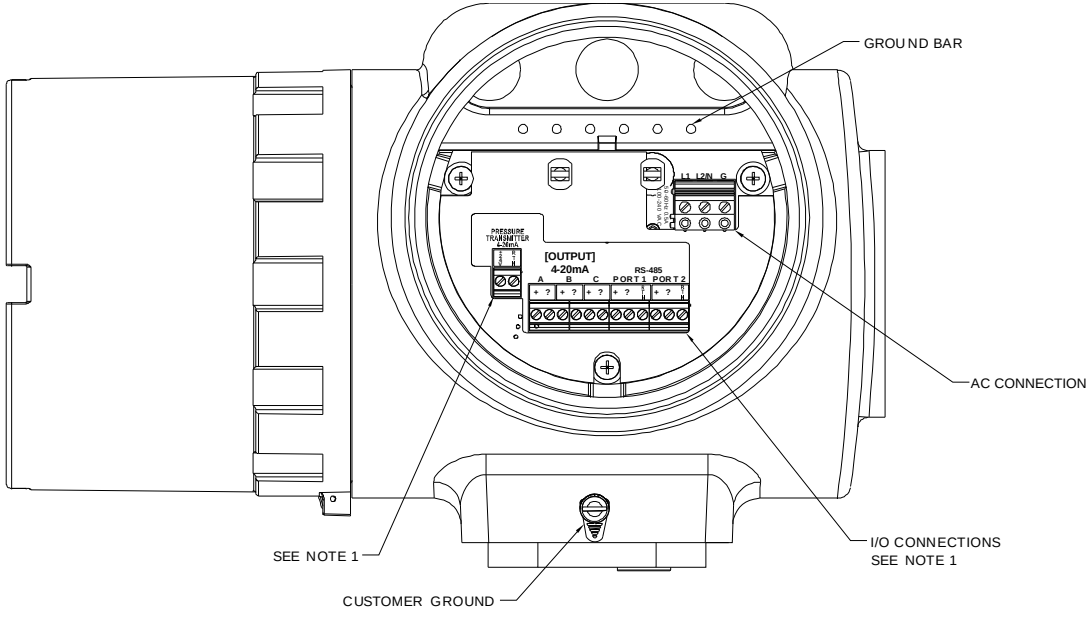


Figure 15: Aurora Trace Electronic Assembly Wiring Diagram (ref. dwg #702-8976)

NOTE:

1. I/O CONNECTIONS AND PRESSURE TRANSMITTER WIRE GAUGE RANGE 12-24 AWG.

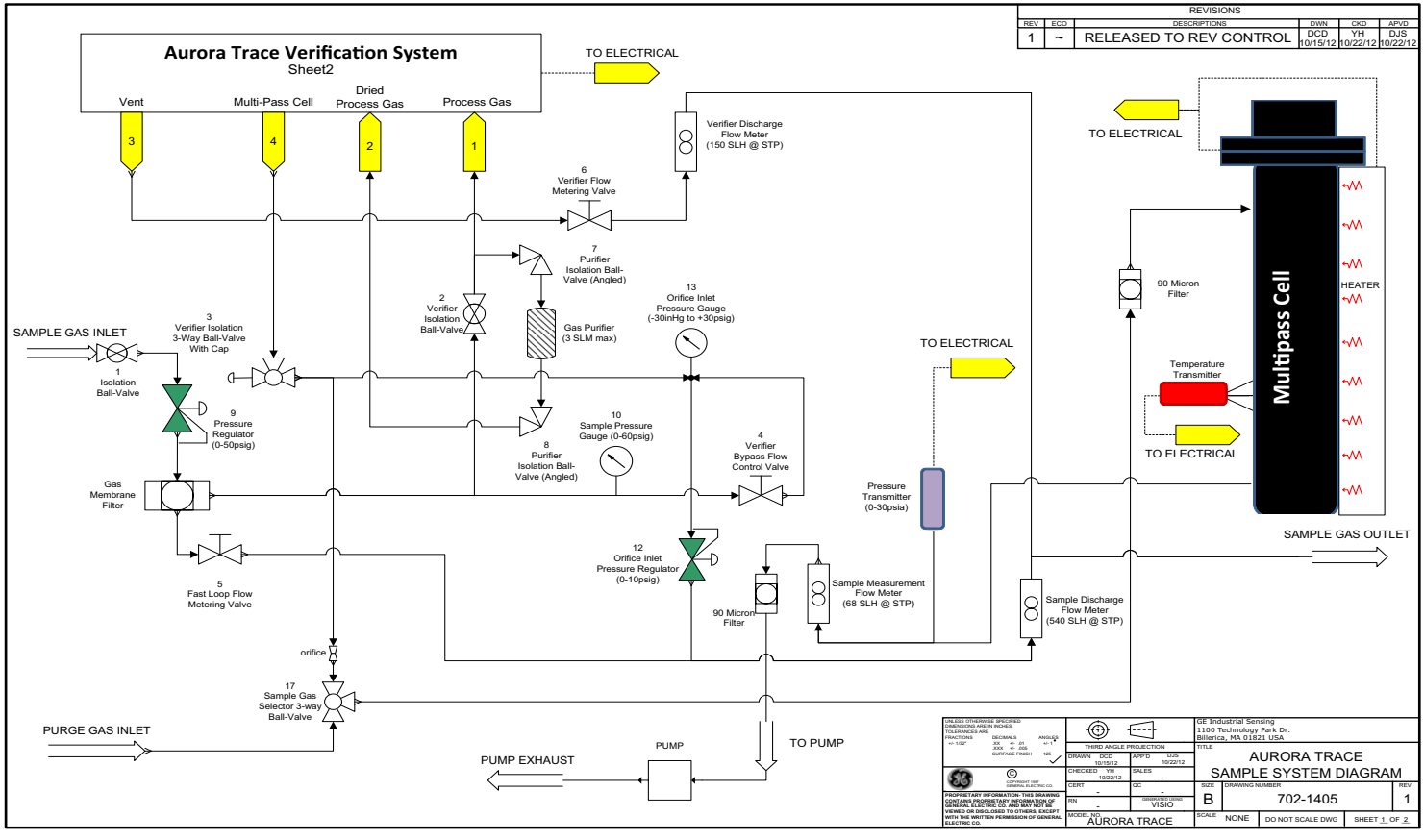


Figure 16: Sample System Diagram (rev. dwg. 702-1405, sh. 1)

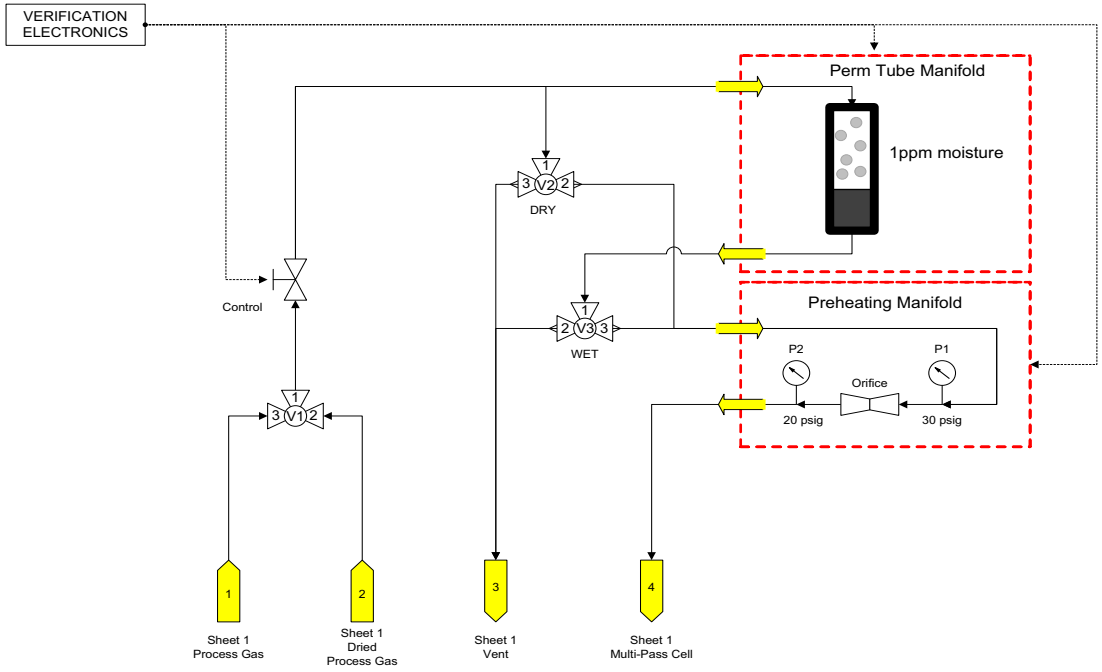


Figure 17: Sample System Diagram (rev. dwg. 702-1405, sh. 2)

Chapter 3. Operation and General Programming

3.1 Using the Aurora Trace

Follow the information in this chapter to operate the **Aurora Trace** system.

CLASS 1 LASER PRODUCT

WARNING! Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous laser exposure.

3.2 Sample System

See the instruction below and Figures 12 and 13 in Chapter 2 to operate the **Aurora Trace** sample system.

3.2.1 Startup

Refer to sections 2.8 and 2.9 for startup procedure.

3.2.2 Shut Down

1. Turn Vacuum Pump Switch (item #11) OFF.
2. Close the Sample Gas Isolation Ball Valve (item #1) to depressurize the system. Monitor the Sample Gas Pressure Gauge (item #5) to drop to zero.
3. Turn the Sample Gas Pressure Gauge (item #4) fully counter-clockwise.
4. Turn the Back Pressure Regulator (item #6) fully counter-clockwise.
5. Close the following valve(s):
   Item #3 Sample Gas Bypass Metering Valve

   If Aurora Trace unit has the verification system installed:
   Item #21 Verifier Isolation 3-Way Valve
   Item #22 Verifier Isolation Ball Valve
   Item #23 Verifier Bypass Metering Valve
   Item #24 Purifier Isolation Ball Valve
   Item #25 Purifier Isolation Ball Valve

3.2.3 Purge

1. Follow shut down procedure according to section 3.2.2.
2. Disconnect vacuum pump inlet from sample system (see Figure 18).
3. Hook up the purge gas through Purge Inlet.
4. Regulate the pressure externally to 3-5 psig.
5. Turn the Process/Test 3-Way Valve (item #10) toward the purge inlet (downward).
6. Adjust external pressure to set Multi-Pass Cell Flow Meter (item #8) to 30 SLPH (1 SCFH).
7. When purge is complete, reconnect the vacuum pump inlet to the sample system.

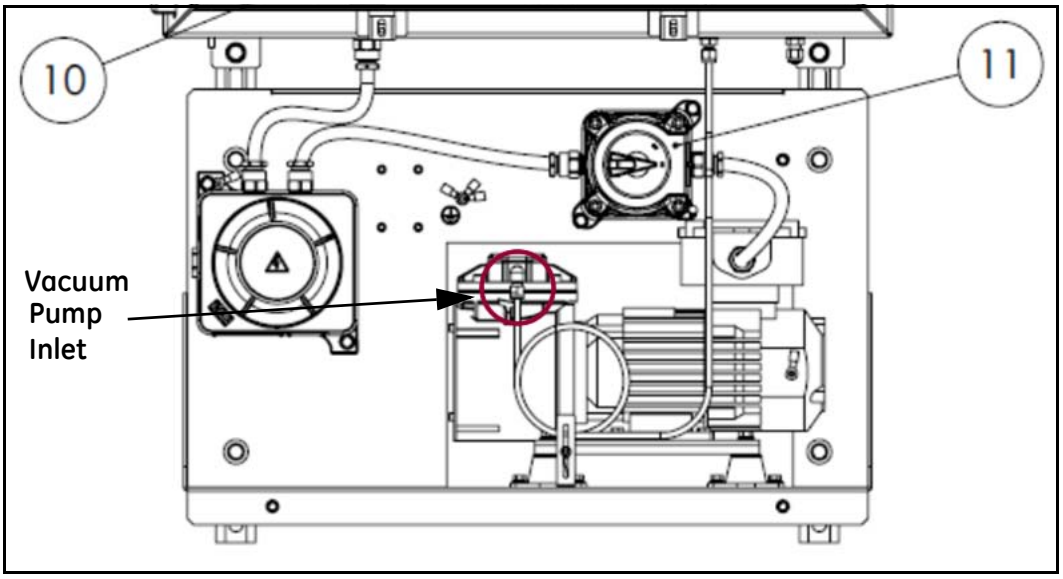


Figure 18: Vacuum Pump Inlet

3.3 Keypad Features

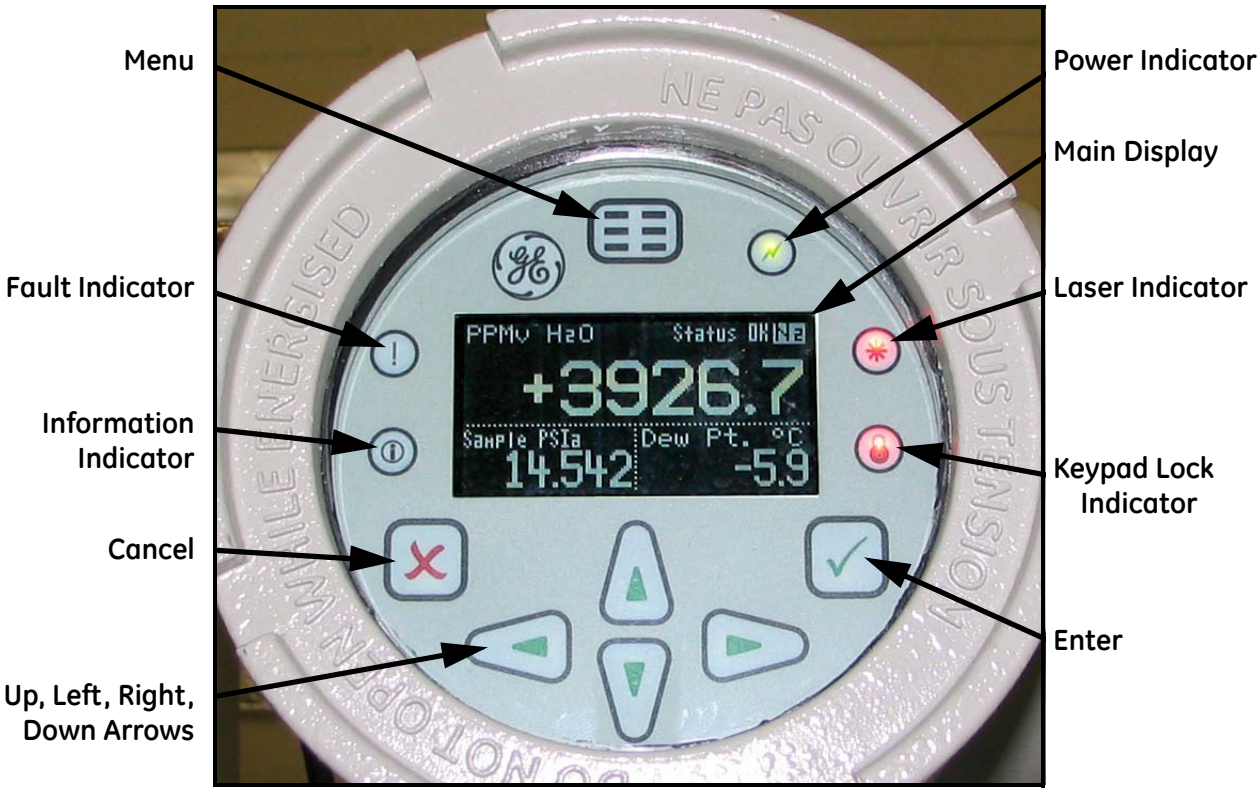


Figure 19: Aurora Trace Keypad

The **Aurora Trace** has seven keys: a **Menu** key, four arrow keys, a **Cancel** ✘ key, and an **Enter** ✓ key.

- Use the **Menu** key to open the main menu on the display.
- Use the arrow keys to navigate among menu choices and to increment/decrement numeric entries.
- Use the **Cancel** ✘ key to cancel a numeric entry change, or exit a menu.
- Use the **Enter** ✓ key to accept a numeric entry or select a menu option.

3.3.1 Indicator Lights

If the **Fault Indicator** is lit, an instrument fault is detected. A message will be displayed in the Main Display, top/right.

If the **Information Indicator** is lit, the instrument is still operating, but a message will appear in the Main Display top/right, with information about the instrument.

The **Keypad Lock Indicator** will be lit if either: A) the Keypad Lock-Out Switch, internal to the instrument, has been engaged, or B) the instrument keypad has not been used for a period of several minutes, engaging a software feature to lock-out inadvertent key usage. Type (B) keypad lock-out is overcome by pressing **Cancel**, **Enter**, **Cancel** in sequence.

If the **Laser Indicator** is lit, the laser is powered and operating normally. This indicator will be off if there is a laser-specific fault. This indicator will also be off for a brief period when the instrument is first powered. After initial power-up, this indicator may blink several times as the laser temperature is stabilized. The laser indicator will be lit constantly in normal operation.

The **Power Indicator** is normally lit when the instrument is powered.

3.3.2 The Magnetic Stylus

Each of the keys can be selected using a hand-held magnet called a *Magnetic Stylus*, which is included with the meter. By touching the clear window at a key location, that key will be selected and will flash a red light to verify the contact.

Figure 20: Magnetic Stylus

3.3.3 The Default Display

Figure 21 shows the default display of the **Aurora Trace** window.

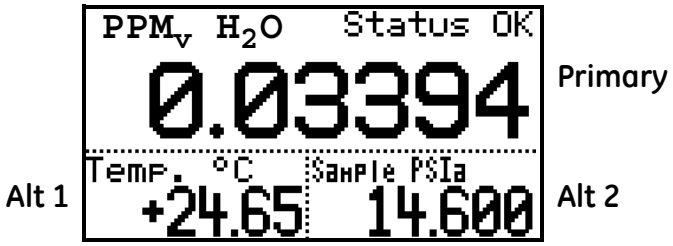


Figure 21: Default Display

3.3.4 Unlocking the Keypad

After power-on, the **Aurora Trace** keypad is locked as indicated by the symbol , lit up with a red backlight. It is necessary to enter the keypad unlock sequence to make any changes to the **Aurora Trace**.

Similar to a mobile phone, the **Aurora Trace** will prompt the operator to unlock if any key is pressed. A passcode is required to use certain factory service features only.

To unlock the keypad, press **Cancel** ✘, **Enter** ✓, **Cancel** ✘ in sequence.

3.3.5 Keypad Lock-Out Switch

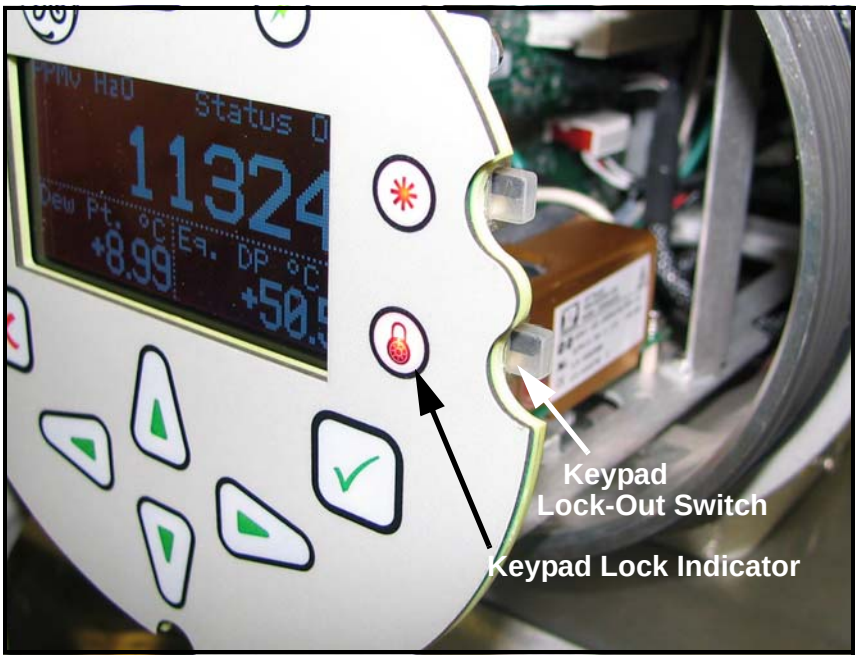


Figure 22: Keypad Lock-Out Switch Location

Note: *If the* Keypad Lock-Out Switch *is in the "down" position (towards the* ***Aurora Trace*** *sample system), the keypad is locked out and the* RED LED *on the* Keypad Lock Indicator *is on all the time.*

WARNING! **Do not open or remove the cover with the power on, unless the area is non-hazardous.**

3.3.6 Accessing the Menus

After successfully unlocking the keypad, press the ☰ Menu key. The **Aurora Trace** will display the Main Menu (see Figure 23). Use the arrow keys to highlight the menu item desired. Refer to *Menu Map*, Figure 26 on page 75.

Press **Enter** ✓ to select the highlighted item. Many menu items will display another menu. Use **Cancel** ✗ to return to the previous menu page. Pressing **Cancel** ✗ from the Main Menu will return the screen to the Measurement Display.

Note: *Menu items displayed with an ellipsis (shown as a series of three dots after the menu item) will bring up more choices, while those without take immediate action.*

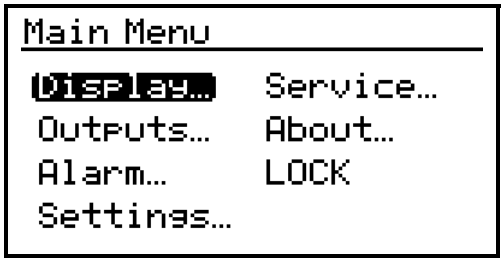


Figure 23: Main Menu

3.3.7 Entering Numeric Values

Since the **Aurora Trace** has no numeric keypad, numeric values are entered using a "combination lock" style of entry:

Use the **left** ◀ and **right** ▶ arrow keys to select the digit to change. The digit selected will be indicated with a ▲.

Use the **up** ▲ and **down** ▼ arrow keys to increment or decrement the digit.

Note: *If incrementing or decrementing a digit would cause the numeric value to exceed its allowable range (maximum/minimum value), the digit will not change.*

Press **Enter** ✓ to save the new value and return, or **Cancel** ✗ to return, leaving the original value intact.

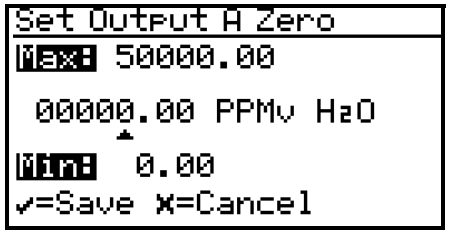
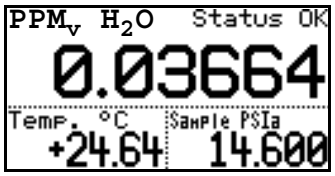


Figure 24: Numeric Entry

3.3.8 Starting Up

After proper installation, the **Aurora Trace** Transmitter can be set up to accommodate the user's requirements. Typically, the user may need to configure the analog outputs, trim the analog outputs, and program the digital outputs. Refer to the Menu Map, Figure 26 on page 75, and complete the following steps. Upon startup, the **Aurora Trace** proceeds through several displays until a screen similar to the following appears:



After startup, the screen will need to be unlocked. To unlock the screen, select

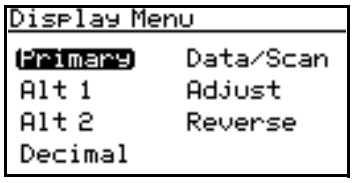
✘ ✓ ✘
Cancel, **Enter**, **Cancel**.

Note: *In most instances; use the* **Enter** *key to save an entry and/or move ahead to the following screen; use the* **Cancel** *key to reject an entry and/or return to the previous screen.*

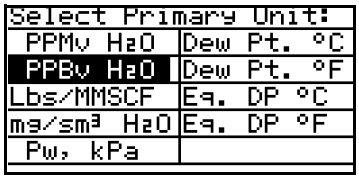
3.4 Setting Up the Display

When the screen is unlocked, touch the **Menu** key and the Main Menu appears with several options. To set up the display, select Display... and press **Enter**. The following screen appears:

3.4.1 Selecting Primary Units

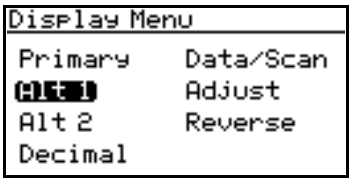


To select units for the primary display, select Primary and press **Enter**. The following screen appears:

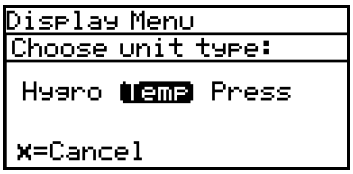


Use the arrow keys to highlight the desired units and press **Enter**. The screen returns to the Display Menu.

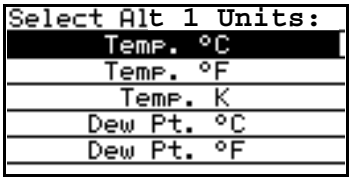
3.4.2 Selecting Alt 1 and Alt 2 Units



To set the units for Alt 1 and/or Alt 2, use the arrow keys to highlight the one to be set, and press **Enter**. The following screen appears:

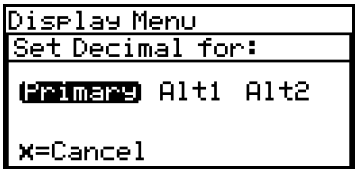


Use the arrow keys to highlight the desired unit type (Hygro, Temperature or Pressure) and press **Enter**. If Temp is selected, the following screen appears.



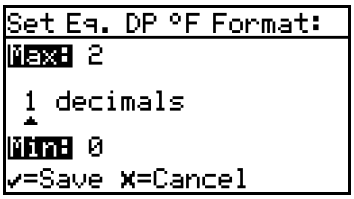
Use the arrow keys to highlight the desired unit and press **Enter**. The screen returns to the Display Menu. Use the same procedure to change other units.

3.4.3 Setting Decimal Places



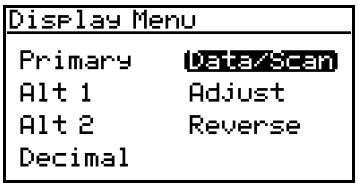
To set the decimal places for unit values, from the Display Menu use the arrow keys to highlight Decimal and press **Enter**. Then select the type of display and press **Enter**.

The decimal places setting determines the number of digits displayed for the value to the right of the decimal symbol ("**.**"), if possible.

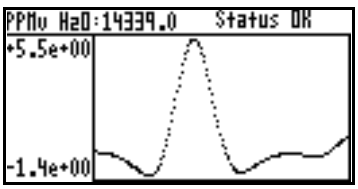


Use the arrow keys to change the number of decimal places and press **Enter**, or press **Cancel** if no changes are necessary. The screen returns to the Display Menu.

3.4.4 Data/Scan

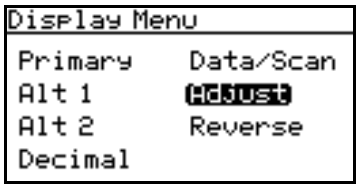


To toggle the display between showing the numeric values (data), and a graphic plot of the 2f waveform (scan), from the Display Menu use the arrow keys to highlight Data/Scan and press **Enter**. A screen similar to the following appears.

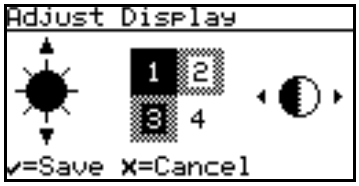


Note:*The scan can be used for diagnostic purposes when a PC with* ***AuroraView*** *is not readily available.*

3.4.5 Adjust

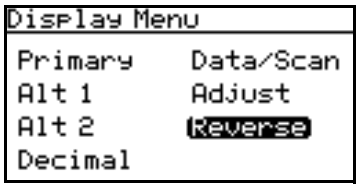


To modify the display contrast and brightness, from the Display Menu use the arrow keys to highlight Adjust and press **Enter**. The following screen appears.

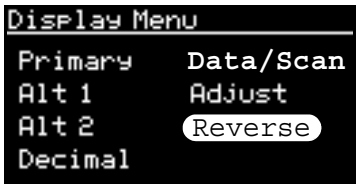


Use the Right/Left arrow keys to increase/decrease display contrast. Press **Enter** to save the changes, or press **Cancel** to return to the previous setup. The screen returns to the Display Menu.

3.4.6Reverse



To reverse the text and background shades, from the Display Menu use the arrow keys to highlight Reverse and press **Enter**. The following screen appears.

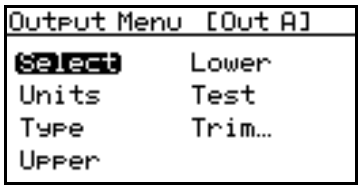


To return to the previous shade setup, select Reverse and press **Enter**. The previous screen appears.

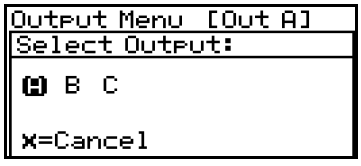
3.5 Setting Up Outputs

3.5.1 Selecting an Output for Setup

To set up outputs, from the Main Menu choose Outputs... and press **Enter**. The following screen appears.

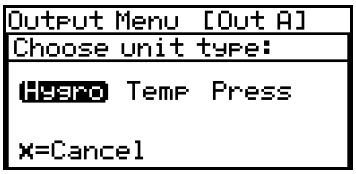


From the Output Menu choose Select and press **Enter**. The following screen appears.

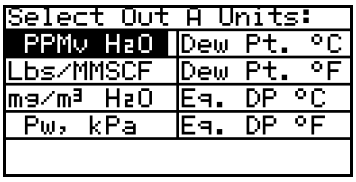


Use the arrow keys to select the output (A, B or C) to be set up, and press **Enter**.

3.5.2 Selecting Output Units

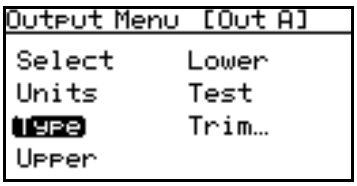


From the Output Menu, select Units and press **Enter**. Use the arrow keys to select the unit type and press **Enter**. A screen similar to the following appears:

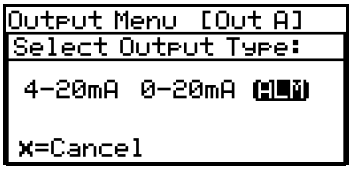


Use the arrow keys to select a new unit. Press **Enter** to save (or **Cancel** to keep the previous value), and return to the Output Menu.

3.5.3 Selecting an Output Type

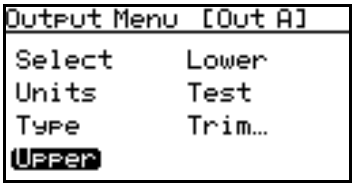


To change the output type, from the Output Menu select Type and press **Enter**. A screen similar to the following appears:

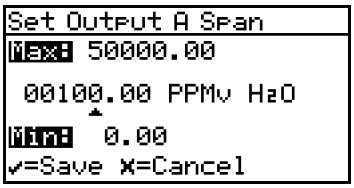


Use the arrow keys to select a new output type. Press **Enter** to save (or **Cancel** to keep the previous value), and return to the Output Menu.
When ALM is selected, the output will track the state of the corresponding ALARM (Output A tracks Alarm A, Output B tracks Alarm B, etc.). When the ALARM is in the TRIPPED state, the corresponding OUTPUT will source maximum current (24 mA). When the Alarm is in the RESET state, the Output will source minimum current (0 mA). This signal can be used to operate a low-power relay or discrete input. The UPPER, LOWER, TEST, and TRIM menu options for the output are disabled when the ALM function is selected

3.5.4 Changing the Upper Output Span

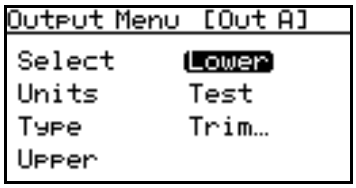


To adjust the upper output span, from the Output Menu select Upper and press **Enter**. A screen similar to the following appears.

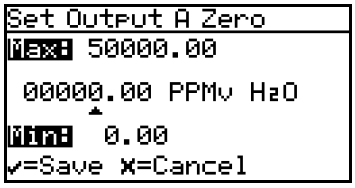


Use the left and right arrow keys to select each digit to be changed and the up and down arrow keys to increase or decrease its value. Press **Enter** to save (or **Cancel** to keep the previous value), and return to Output Menu.

3.5.5 Changing the Lower Output Span

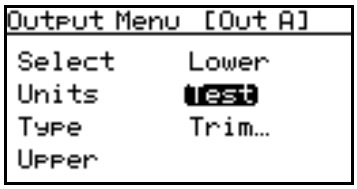


To adjust the lower output span, from the Output Menu select Lower and press **Enter**. A screen similar to the following appears.



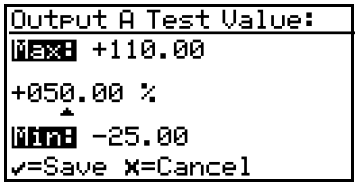
Use the left and right arrow keys to select each digit to be changed and the up and down arrow keys to increase or decrease its value. Press **Enter** to save (or **Cancel** to keep the previous value), and return to Output Menu.

3.5.6 Testing the Output



The Test Menu causes the **Aurora Trace** to generate a 0- or 4-20mA output at the percent of scale selected. For example, in 4-20 operation, 0% = 4mA, 50% = 12mA, 100% = 20mA. This allows the proper function of recording or SCADA equipment to be verified. In 0-20 operation, 0% = 0mA, 50% = 10mA, 100% = 20mA.

Note: *The TEST feature is not available when the Output is configured to ALM mode.*



To test system output, from the Output Menu select Test and press **Enter**. The **Aurora Trace** will proceed to check the settings, and a screen similar to this display will appear.

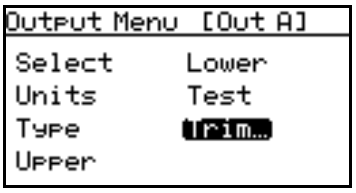
Use the left and right arrow keys to select each digit to be changed, and the up and down arrow keys to increase or decrease its value. Press **Enter** to save (or **Cancel** to keep) the previous value, and return to the Output Menu.

Check your output wiring. If the reading on your SCADA or DCS is off slightly, then you may use the Trim feature to trim the output zero or span.

3.5.7 Trimming the Outputs

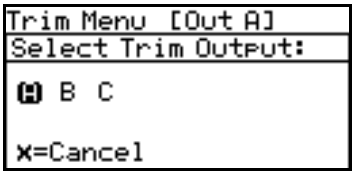
Note: *The TRIM feature is not available when the Output is configured to ALM mode.*

The Trim Menu enables the operator to compensate for differences in measurement of the 0/4-20 mA outputs by connected recorders or SCADA equipment. To trim the output:



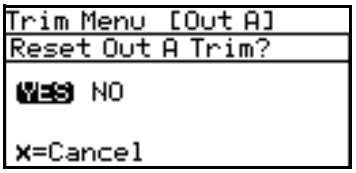
Select Trim from the Output Menu and press **Enter**. The following screen appears.

To select an output to be trimmed, highlight Select Trim Output and press **Enter**. The following screen appears

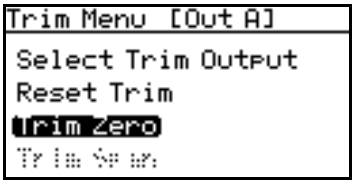


Use the left and right arrow keys to select an output (A, B or C) and press **Enter**. The screen returns to the previous display.

When performing a Trim operation, the **Aurora Trace** unit requires you to first reset the trim. To reset the trim output, highlight Reset Trim and press **Enter**. The following screen appears.



Use the left or right arrow keys to highlight YES and press **Enter**. This cancels any previous trim values, and returns the **Aurora Trace** to its factory adjustment. The display returns to the previous screen with Trim Zero highlighted.

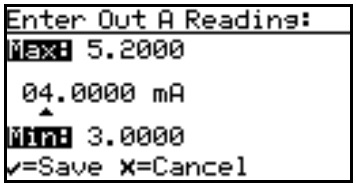


To trim the zero value, press **Enter**. A screen similar to the following appears.

This will cause the **Aurora Trace** to output 4.000 mA on the output being trimmed. The output value should then be read using the connected recorder, SCADA equipment, or DVM. Enter the value read from the connected equipment as the Zero Trim value, as follows:

3.5.7 Trimming the Outputs (cont.)

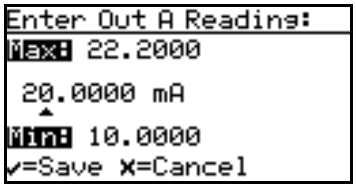
Note: *Since you cannot trim 0 mA for negative offsets, trim for the lower end of the scale is at the 4 mA output level.*



Use the left and right arrow keys to select each digit to be changed, and the up and down arrow keys to increase or decrease its value. Press **Enter** to save (or **Cancel** to keep the previous value).

The Trim Menu returns with Trim Span highlighted. To change the span value, press **Enter**. A screen similar to the following appears.

This will cause the **Aurora Trace** to output 20.000 mA on the output being trimmed. The output value should then be read using the connected recorder, SCADA equipment, or DVM. Enter the value read from the connected equipment as the Span Trim value.



Use the left and right arrow keys to select each digit to be changed, and the up and down arrow keys to increase or decrease its value. Press **Enter** to save (or **Cancel** to keep the previous value).

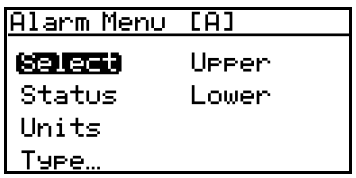
Trimming is complete. Accuracy can be verified using the Test Menu, above.

Example: Trim is reset, then Trim Zero is selected. The SCADA input reports 3.977 mA.
The operator enters "3.977" as the Zero Trim value.
Trim Span is selected. The SCADA input reports 19.985 mA.
The operator enters "19.985" as the Span Trim value.
Aurora Trace will adjust the output accordingly to true the output as read by the customer recorder, SCADA or DVM. Using the Test Menu, the operator verifies that a test value of 0% now reads 4.000 mA at the SCADA equipment, and a test value of 100% now reads 20.000 mA.

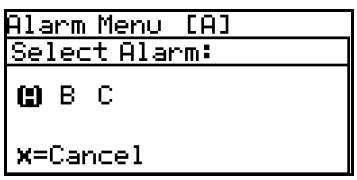
3.6 Setting Up Alarms

Note: *The* **Aurora Trace** *is not equipped with alarm relays. The Alarms' state can be queried via Modbus, or an Analog Output can be configured as a discrete level output, as described in "Selecting an Output Type" on page 38.*

3.6.1 Selecting an Alarm Output

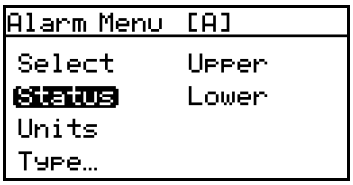


To set up alarm outputs, on the Main Menu choose Alarm and press **Enter**. From the Alarm Menu choose Select and press **Enter**. A screen similar to the following appears.

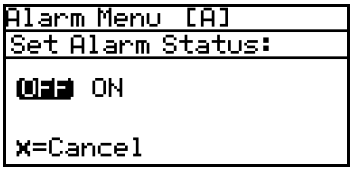


Use the arrow keys to select the output (A, B or C) to be set up and press **Enter**. The display returns to the Alarm Menu.

3.6.2 Selecting Alarm Status

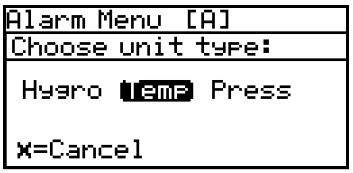


To select the alarm status, from the Alarm Menu select Status and press **Enter**. The following screen appears:

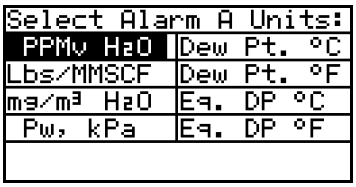


Use the arrow keys to select OFF or ON and press **Enter**. The display returns to the Alarm Menu.

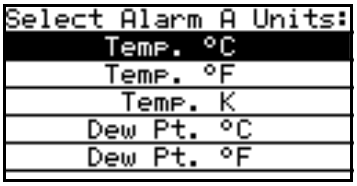
3.6.3 Selecting Alarm Units



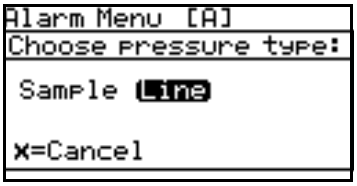
To select alarm units, from the Alarm Menu select Units and press **Enter**. Use the arrow keys to select the unit type and press **Enter**.



If Hygro was selected, this display appears. Use the arrow keys to select a unit. Press **Enter** to save (or **Cancel** to keep the previous value), and return to the Alarm Menu.

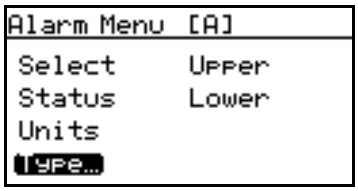


If Temperature was selected, this display appears. Use the arrow keys to select a unit. Press **Enter** to save (or **Cancel** to keep the previous value), and return to the Alarm Menu.



If Pressure was selected, this display appears. Use the arrow keys to select a unit. Press **Enter** to save (or **Cancel** to keep the previous value), and return to the Alarm Menu.

3.6.4 Selecting an Alarm Type



To change the alarm type, from the Alarm Menu select Type and press **Enter**. A screen similar to the following appears:

Use the arrow keys to select an alarm type. Press **Enter** to save (or **Cancel** to keep the previous value), and return to the Alarm Menu.

- SetPoint: Alarm activates when parameter exceeds upper limit, and deactivates when parameter is less than lower limit.
- Inner Band: Alarm activates when parameter is between upper and lower limits.
- Outer Band: Alarm activates when parameter is outside upper and lower limits.
- Fault: When Fault is selected, the alarm will **trip** when a fault is detected that would prevent the Aurora Trace from measuring accurately. When the fault condition is removed, the alarm will **reset**.

  The UPPER, LOWER, and UNITS menu options for the alarm are disabled when the FAULT function is selected. Monitored conditions and faults are listed below.

Fault or Error	Fault Condition
Over Temperature	Sample temperature exceeds 68 °C, or PCB temperature exceeds 85 °C
Laser Reference Error	Low / no signal from laser reference photodetector
Temperature Fault	The temperature sensor signal indicates an open or short circuit
Sample/Line Pressure Fault	Pressure transmitter signal is less than 3.6 mA or greater than 21.0 mA
TEC Failure	The thermoelectric temperature control failed to stabilize in the time allowed
TEC Range Error	The TEC controller was commanded to an invalid temperature
Pressure Range Error	The Multipath Cell pressure is outside the allowed range of 2.0 – 2.8 PSIa (13.8 – 19.3 kPa)

3.6.5 How the Alarm Types Work

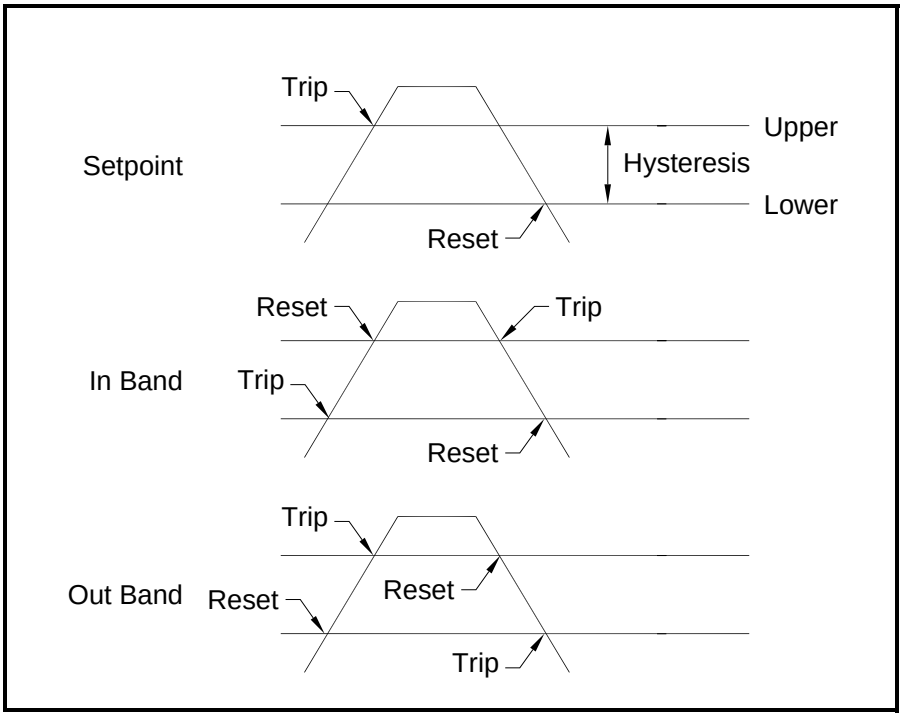
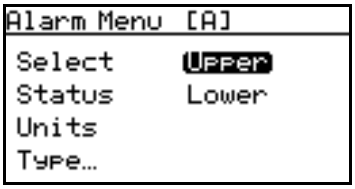
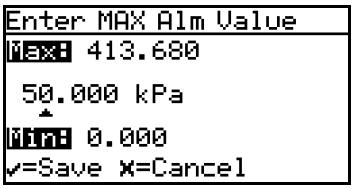


Figure 25: Example of Alarm Types

3.6.6 Changing the Upper Alarm Span

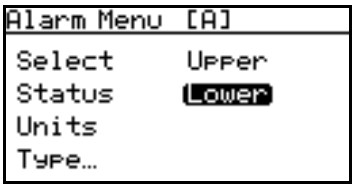


To adjust the upper alarm span, from the Alarm Menu select Upper and press **Enter**. A screen similar to the following appears.

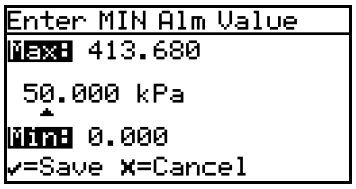


Use the left and right arrow keys to select each digit to be changed and the up and down arrow keys to increase or decrease its value. Press **Enter** to save (or **Cancel** to keep the previous value), and return to Output Menu.

3.6.7 Changing the Lower Alarm Span



To adjust the lower alarm span, from the Alarm Menu select Lower and press **Enter**. A screen similar to the following appears.



Use the left and right arrow keys to select each digit to be changed and the up and down arrow keys to increase or decrease its value. Press **Enter** to save (or **Cancel** to keep the previous value), and return to Output Menu.

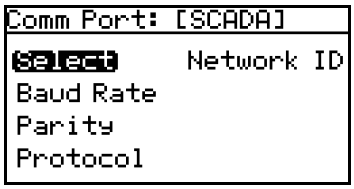
Chapter 4. Programming Advanced Features

4.1 Comm Port Settings

To access the communication port settings, from the Main Menu select Settings.and press **Enter**. The following screen appears:

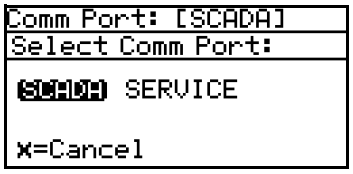
To access the communications port settings, select Comms… and press **Enter**. The following screen appears:

4.1.1 Selecting a Comm Port



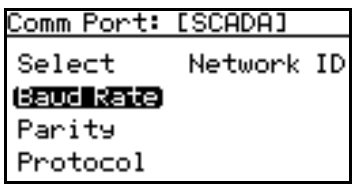
There are two physical comm ports in the **Aurora Trace**. Comm Port 1 is aligned to *SCADA* in the instrument program and Comm Port 2 is aligned to *SERVICE*. This setup enables the user to have Comm Port 1 set up for the primary digital output (for example, RS-485 to the customer SCADA system), and Comm Port 2 to be used for service (for example, to enable a service engineer to interface with the **Aurora Trace** using an RS-232 cable connected to a lap top in the field, running **AuroraView** software). If the Aurora Trace is equipped with an optional Moisture Verifier, the *SERVICE* port is not available when the Verifier is in the CONNECTED state

To select a communication port, use the arrow keys to highlight Select and press **Enter**. The following screen appears.

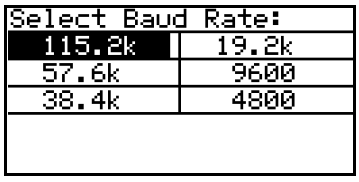


Select SCADA or SERVICE and press **Enter**. The screen returns to the Comm Port Menu.

4.1.2 Setting the Baud Rate

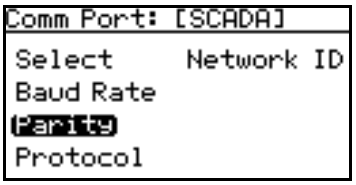


To set the baud rate, from the Comm Port Menu select Baud Rate and press **Enter**. The following screen appears.

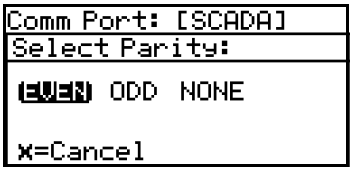


Use the arrow keys to highlight the desired baud rate and press **Enter**. The screen returns to the Comm Port Menu.

4.1.3 Setting Parity

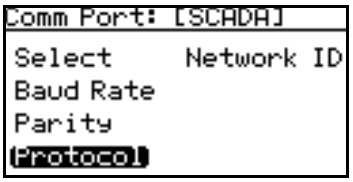


To set parity, from the Comm Port Menu select Parity and press **Enter**. The following screen appears.

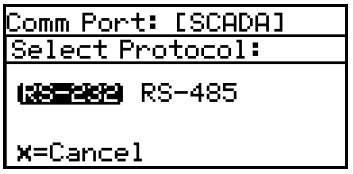


Use the arrow keys to highlight the desired parity and press **Enter**. The screen returns to the Comm Port Menu.

4.1.4 Selecting Protocol

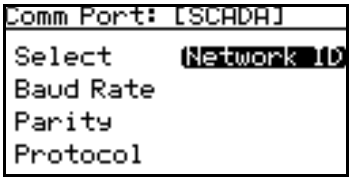


To select protocol, from the Comm Port Menu select Protocol and press **Enter**. The following screen appears.

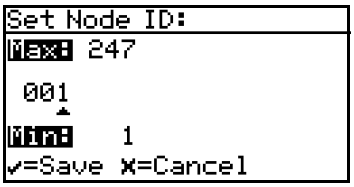


Use the arrow keys to highlight the desired protocol and press **Enter**. The screen returns to the Comm Port Menu.

4.1.5 Setting the Network ID



To set the network ID, from the Comm Port Menu select Network ID and press **Enter**. The following screen appears.

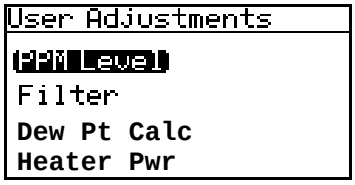


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the Comm Port Menu.

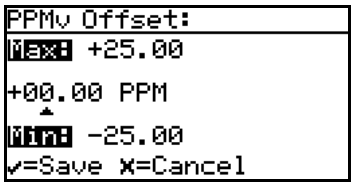
4.2 User Adjustments

To adjust offset values, from the Settings Menu select Adjust… and press **Enter**. The following screen appears.

4.2.1 Adjusting the PPMv Offset

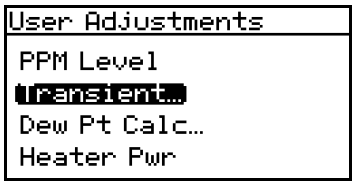


To adjust the PPMv offset, select PPM Level and press **Enter**. The following screen appears.



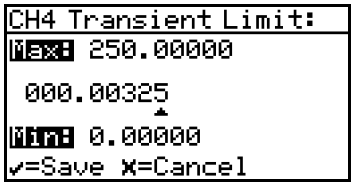
Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the User Adjustments Menu.

4.2.2 Adjusting the Transient Response

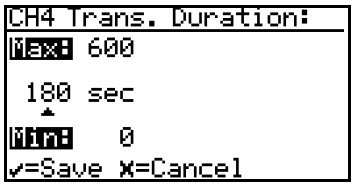


The Transient Response settings are used to change the Aurora Trace response to transient moisture events and step changes. The Aurora Trace normally smooths the moisture reading with a moving average filter. When a transient or step change occurs that is greater than a programmed threshold, the Aurora Trace will bypass the moving average to report the instantaneous moisture level. This permits extremely fast response to moisture "breakthrough" or other anomalies in the process. Once the threshold is exceeded, the Aurora Trace will continue to report the instantaneous value for a programmed time duration after the transient has passed, then return to reporting the normal smoothed value. There is a separate threshold value for each background gas (N2, CH4, optional Mixtures 1 and 2).

The threshold values are determined during factory calibration, but may be modified if required. A smaller value increases the sensitivity to a process upset; a larger value decreases the sensitivity. Using a threshold value that is too low will produce noisier results; too high will make the Aurora Trace respond slowly to a process upset.



To adjust the Transient Response, select Transient and press **Enter**. The Transient Limit appears.Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**.



The Transient Duration screen appears.

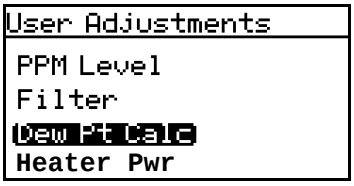
Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the User Adjustments Menu.

4.2.3 Setting the Dew Point Calculation Method

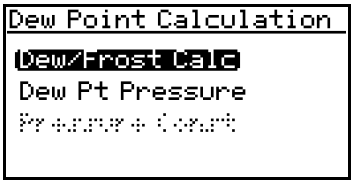
- The **dew point** is the temperature at which the air is saturated with respect to water vapor over a **liquid** surface.
- The **frost point** is the temperature at which the air is saturated with respect to water vapor over an **ice** surface.

There can be a difference of several degrees C between the dew and frost point.

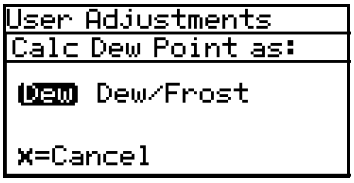
- When set for Dew/Frost, the Aurora Trace will report the Dew Point if the reading is above freezing, and report the Frost Point if the reading is below freezing.
- When set for Dew Point, the Aurora Trace will calculate the Dew Point temperature, even if that temperature is below freezing.



To set the dew point calculation method, from the User Adjustments Menu select Dew Pt Calc and press **Enter**. The following screen appears.



From the Dew Point Calculation menu, select Dew/Frost Calc and press **Enter**.



Use the arrow keys to highlight the desired dew point setting and press **Enter**. The screen returns to the User Adjustments Menu.

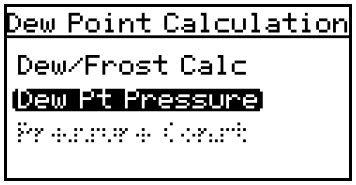
- The Dew calculation should be used for compatibility with ASTM-1142/IGT-8. The tables and calculations in those reports require measurements and provide results in dew point, regardless of the actual phase (dew or frost).
- The Dew/Frost calculation should be used for compatibility with ISO-18453:2004, or when using a chilled mirror apparatus as a check standard.

4.2.3 Setting the Dew Point Calculation Method (cont.)

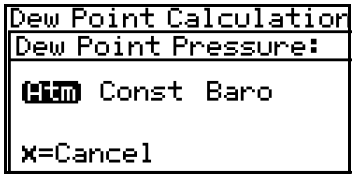
The dew point calculation is dependent on pressure. The Aurora Trace makes its measurements at ~2.5 PSIa (17.2 kPa), but a downstream analyzer or conversion table will generally operate at or near atmospheric pressure. The Aurora Trace can be configured to calculate the dew point at 1 Standard Atmosphere (14.696 PSIa / 101.325 kPa), or a user-specified constant pressure. If the Aurora Trace is equipped with the optional Moisture Verifier, a live barometric pressure reading may be used. This is recommended if the Aurora Trace is installed at high altitude, where the typical atmospheric pressure is significantly lower than sea-level pressure.

Note: *The standard dew point calculation is premised on the sample behaving as an ideal gas, which is generally true for methane and natural gas at pressures below 100 PSIa (7 bar). For pressures above 100 PSIa, the Equivalent Dew Point calculation should be used, as this calculation accounts for the significant non-ideal behavior of methane and natural gas at high pressure.*

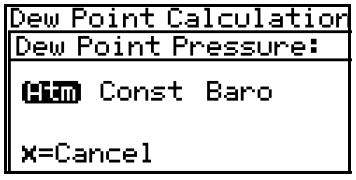
Use the Dew Pt Pressure menu item to select the pressure value to use:



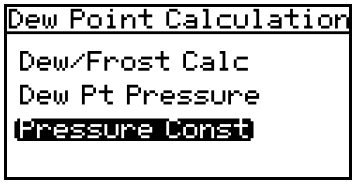
From the Dew Point Calculation menu, select Dew Pt Pressure and press **Enter**.

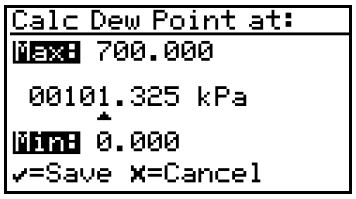


Select Atm to use the Standard Atmosphere for the dew point calculation. This is the Aurora Trace default.



Select Const to specify the pressure for the dew point calculation. If Const is selected, the Dew Point Calculation menu will enable the Pressure Const item to permit entry of the desired constant value.



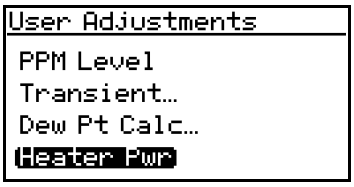


Use the arrow keys to enter the desired pressure settings and press **Enter**. The screen returns to the User Adjustments Menu.

Select Baro to use the Barometric pressure reading provided by the optional Moisture Verifier. The Barometric Pressure value can be displayed using the Verifier Diags display.

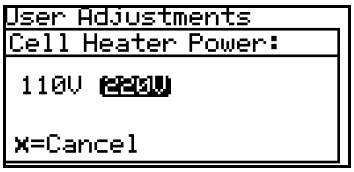
Note: *If* Baro *is selected, but the Aurora Trace is not equipped with a Moisture Verifier, or the Verifier is disconnected, the Aurora Trace will use the Standard Atmosphere value for the calculation.*

4.2.4 Adjusting the Heater Power



The Aurora Trace Multipath Cell is equipped with a heater to maintain a constant temperature and to prevent condensation of liquids. The heater accepts a universal input from 100-240 VAC. The heater controller must be configured with the line voltage applied. The voltage does not have to be exact; select the setting that is closest to the line voltage in use.

Note: *The Heater Power setting is configured at the factory according to the vacuum pump supplied, and should match the pump's voltage configuration.*



To adjust the heater power select Heater Pwr and press **Enter**. The following screen appears. Use the left and right arrow keys to select either 110 or 220 V. When finished, press **Enter**. The screen returns to the User Adjustments Menu.

4.3 Set Up the Background Gas

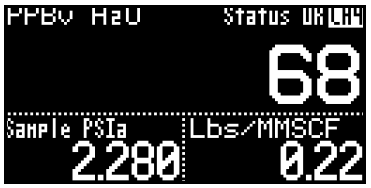
4.3.1 Selecting the Type of Gas

The Background Gas is selectable from the Settings, Gas Menu. For normal operation in natural gas service, Methane (CH4) should be selected as the background gas. For verification testing, it may be desirable to use Nitrogen with a known moisture concentration. In this application, Nitrogen (N2) should be selected as the background gas.

Note: *The N2 setting may also be used with Dry Air, if pure nitrogen is not available.*

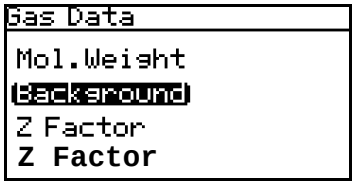
The Aurora Trace displays a Background Gas indication in the upper right corner of the LCD, adjacent to the status message.

Indicator	Background Gas
N2	Nitrogen / Air
CH4	Methane, typical Natural Gas
Mx1	Custom Gas Mixture / Calibration 1
Mx2	Custom Gas Mixture / Calibration 2

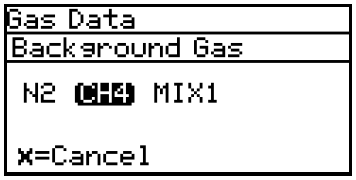


Note: *Custom Gas Mixtures are for unusual gas compositions, and are only provided as a special order. Your GE Applications Specialist can help determine if a special calibration is required for your gas composition.*

To change the type of background gas, from the Settings Menu select Gas and press **Enter**. The following screen appears.



From the Gas Data menu, select Background and press **Enter**. The following screen appears.

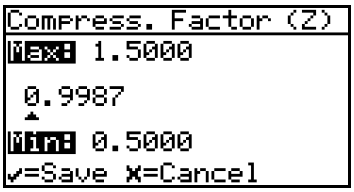


Use the arrow keys to select the desired background gas, and press **Enter**. The background gas selection is now complete. Press **Cancel** to return to the display page.

4.3.2 Setting the Z Factor

The Z factor is a number that accounts for the non-ideal compressibility of natural gas, and is vital for accurate calculation of mass/volume (lbs/MMSCF, mg/m^3).

To set the Z factor, from the Gas Data Menu, select Z Factor and press enter. The following screen appears.



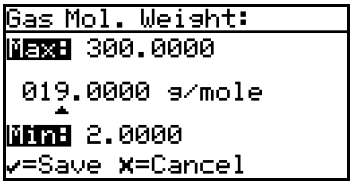
Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the Settings Menu.

4.3.3 Adjusting the Gas Molecular Weight

The input information for gas molecular weight is not currently used for any moisture calculations and is reserved for future use.

- lbs/MMSCF is calculated using IGT Research Bulletin #8 and ASTM D-1142-95 referenced at 60°F, 1 ATM.
- mg/cm^3 is based on ideal gas law derivation referenced at 15°C, 1.01325 kPa.

To adjust the gas molecular weight offset, from the Settings Menu select Gas and press **Enter**. From the Gas Data menu select Mol. Weight and press **Enter**. The following screen appears.



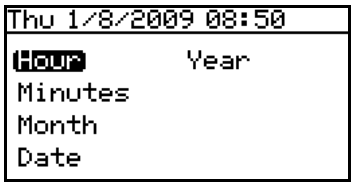
Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the Settings Menu.

4.4 Clock Settings

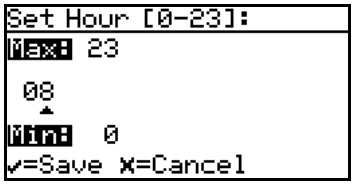
The clock settings are for informational purposes. They are used to keep track of the test analyzer start time and the laser operational time.

To reset the clock, from the Settings Menu select Clock and press **Enter**. The following screen appears.

4.4.1 Resetting the Hour

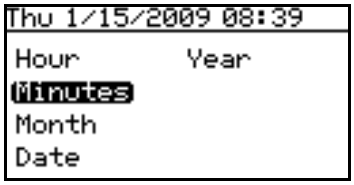


To reset the hour, from the Clock Menu select Hour and press **Enter**. The following screen appears.

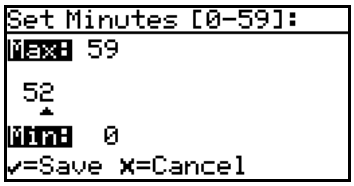


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the Clock Menu.

4.4.2 Resetting the Minutes

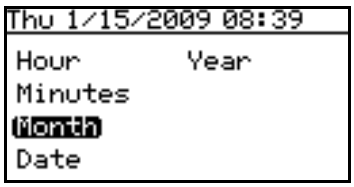


To reset the minutes, from the Clock Menu select Minutes and press **Enter**. The following screen appears.

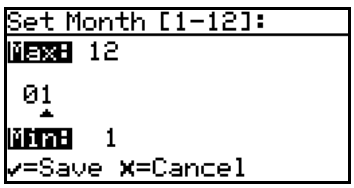


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the Clock Menu.

4.4.3 Resetting the Month

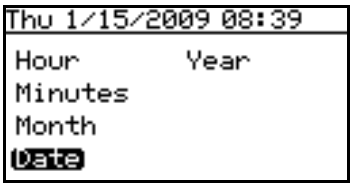


To reset the month, from the Clock Menu select Month and press **Enter**. The following screen appears.

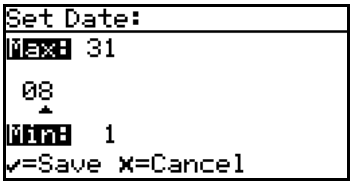


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the Clock Menu.

4.4.4 Resetting the Date

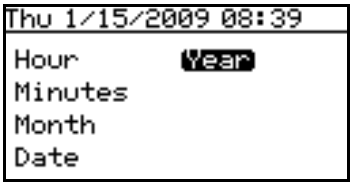


To reset the date, from the Clock Menu select Date and press **Enter**. The following screen appears.

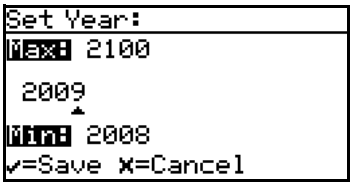


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the Clock Menu.

4.4.5 Resetting the Year



To reset the year, from the Clock Menu select Year and press **Enter**. The following screen appears.

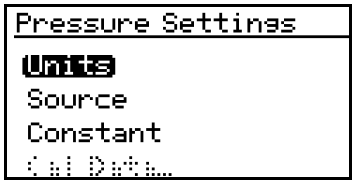


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the Clock Menu.

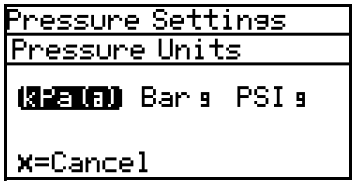
4.5 Pressure Settings

To reset the pressure settings, from the Settings Menu, select Pressure... and press **Enter**. The following screen appears.

4.5.1 Setting the Pressure Units



Press **Enter** to select the units for the Line Pressure input. The pressure value may be entered in kPa absolute, Bars gauge (Barg), or Pounds per Square Inch gauge (PSIg). The following screen appears.



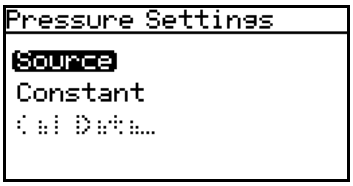
Use the left and right arrow keys to select the desired value. When finished, press **Enter**. The screen returns to the Pressure Menu.

4.5.2 Setting the Source

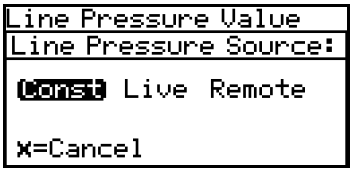
When calculating Equivalent Dew Point, the process, or Line pressure must be provided. This value can be:

- A constant (for conditions where the line pressure is very stable)
- Supplied from a 4-20 mA pressure transmitter installed in the process
- Sent to the Aurora Trace via Modbus from a DCS or SCADA system

Use the Pressure Source menu to select the source desired.



To reset the source, from the Pressure Menu, select Source and press **Enter**. The following screen appears.

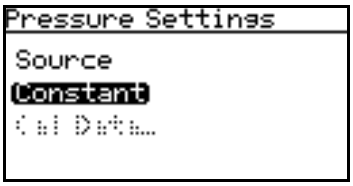


Use the left and right arrow keys to select the line pressure source. To change the constant, select Constant. Press **Enter**. The screen returns to the Pressure Menu.

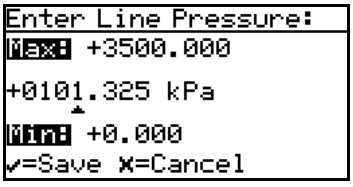
4.5.3 Changing the Constant

The Aurora Trace supports connections for a two-wire 4-20 mA pressure transmitter to determine the process (Line) pressure. The transmitter should be connected as described in Section 2.7, Step 7.

The Zero and Span calibration values for the transmitter can be entered by selecting Cal Data from the Line Pressure Value menu. The calibration can be entered in kPa absolute (kPa), Bars gauge (Barg), or Pounds per Square Inch gauge (PSIg). If the transmitter is calibrated in other units, a suitable conversion to kPa should be performed.

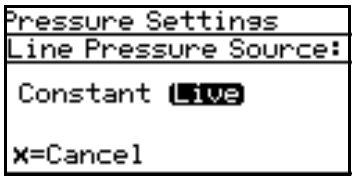


If the pressure source selected is Constant, to reset its value, select Constant from the Pressure Menu and press **Enter**. The following screen appears.

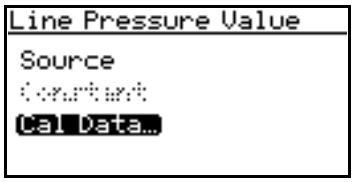


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the Pressure Menu.

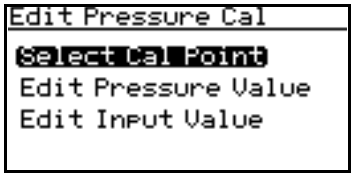
4.5.4 Editing Pressure Calibration



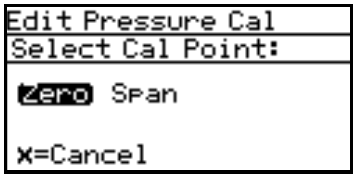
Pressure input in this section is used only for equivalent dewpoint calculations. Equivalent dewpoint is the dewpoint of the process gas at the process pressure. Input a "constant" value if the line pressure is at a normal pressure, or use an external pressure transmitter to input a "live" pressure input into the **Aurora Trace** analyzer.
To edit the pressure calibration, from the Line Pressure Source Menu, select Live and press **Enter**. The following screen appears.



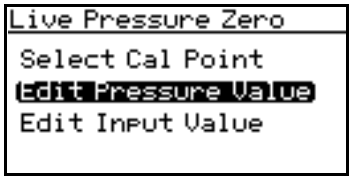
To edit the Calibration Data, use the arrow keys to select Cal Data and press **Enter**. The following screen appears.



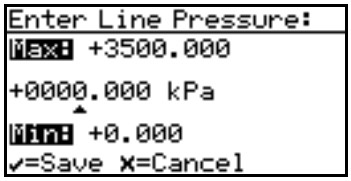
To select the Calibration Point, use the up and down arrow keys to highlight Select Cal Point and press **Enter**. The following screen appears.



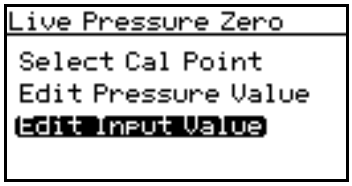
Use the left and right arrow keys to select Zero or Span and press **Enter**. The screen returns to the previous menu.



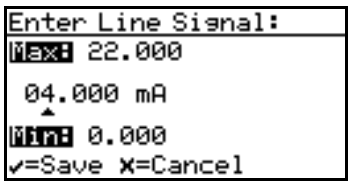
To edit the Pressure Value, use the up and down arrow keys to select Edit Pressure Value and press **Enter**. The following screen appears.



Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the previous menu.



To edit the Input Value, use the up and down arrow keys to select Edit Input Value and press **Enter**. The following screen appears.



Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the previous menu.

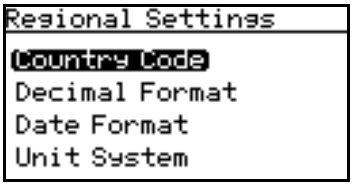
4.6 Regional Settings

This section enables the setting of regional information, depending on the location of the **Aurora Trace**.

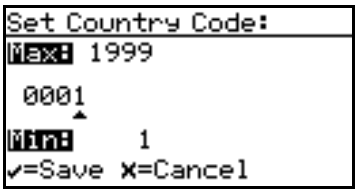
To reset the regional settings, from the Settings Menu, select Locale... and press **Enter**. The following screen appears.

Note: *Locale settings for your order have been set at the factory and are access code protected. If you determine a need to access* Regional Settings*, contact the factory for assistance.*

4.6.1 Setting the Country Code



To edit the country code, from the Regional Settings Menu select Country Code and press **Enter**. The following screen appears. A passcode is required to make changes.

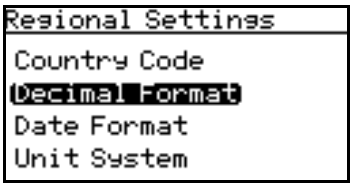


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter**. The screen returns to the Regional Settings Menu.

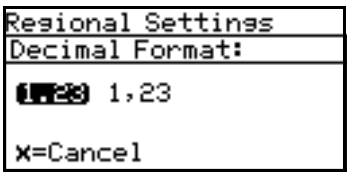
- Country Codes = international phone country codes.
- Default = 1 for U.S.
- Option = 81 for Japan is available to conform to METI requirements.

Note: *When Country Code 81 (Japan) is selected, the Unit System menu is disabled, and only SI units will be available for selection. This is to ensure compliance with requirements issued by the Japan Ministry of Economy, Trade and Industry (METI).”*

4.6.2 Setting the Decimal Format

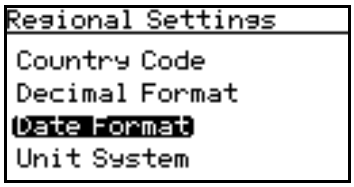


The Decimal Format option determines whether a decimal [**.**] or a comma [**,**] is used as the decimal separator. To edit the decimal format, from the Regional Settings Menu select Decimal Format and press **Enter**. The following screen appears.

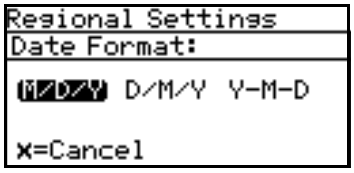


Use the left and right arrow keys to select a decimal [**.**] or a comma [**,**] as the decimal separator and press **Enter**. The screen returns to the Display Menu.

4.6.3 Setting the Date Format

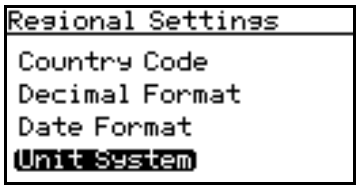


To edit the date format, from the Regional Settings Menu select Date Format and press **Enter**. The following screen appears.

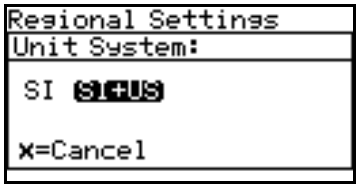


Use the left and right arrow keys to select the desired date format and press **Enter**. The screen returns to the previous display.

4.6.4 Setting the Unit System



To select the unit system to be used for measurements, select Unit System and press **Enter**. The following screen appears.



Use the left and right arrow keys to select the Unit System desired [SI = metric (only unit types), SI + US = metric + English (unit types such as °F, psig, etc.)] and press **Enter**. The screen returns to the Regional Settings Menu.

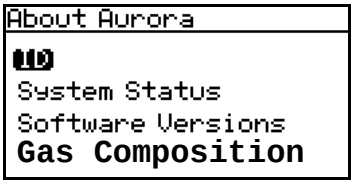
4.7 Service Settings

The Service Settings Menu should be used by factory-trained personnel only.

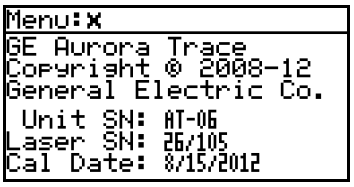
4.8 Aurora Trace Information

To check **Aurora Trace** information, from the Main Menu select About and press **Enter**. The following screen appears.

4.8.1 Checking the ID

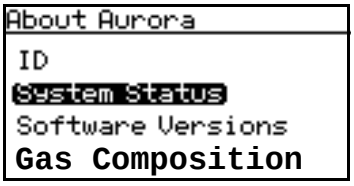


To check identification information, select ID and press **Enter**. A screen similar to the following appears.

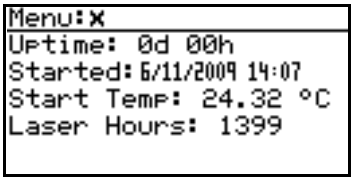


To return to the About Menu, press **Enter**.

4.8.2 Checking the System Status



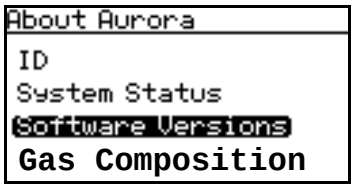
To view the status of the **Aurora Trace** system, from the About Menu select System Status and press **Enter**. A screen similar to the following appears.



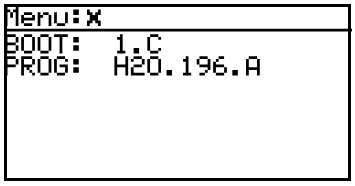
Uptime: is the elapsed time since the **Aurora Trace** was powered on or reset.
Started: is the date and time that the **Aurora Trace** was last powered on/reset.
Start Temp: is the laser housing temperature as measured at the last startup/reset.
Laser Hours: indicates the total lifetime that the laser has been energized.

To return to the About Menu, press **Enter**.

4.8.3 Checking the Software

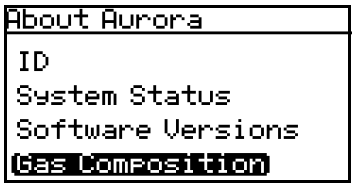


To view the software versions being used, from the About Menu select Software Versions and press **Enter**. A screen similar to the following appears.

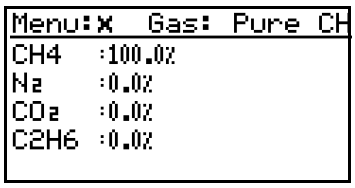


To return to the About Menu, press **Enter**.

4.8.4 Checking the Gas Composition



To view the gas content, from the About Menu select Gas Composition and press **Enter**. A screen similar to the following appears.



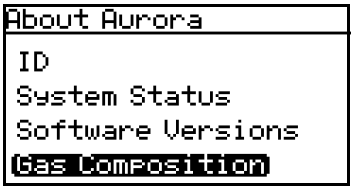
To return to the About Menu, press **Enter**.

4.8.5 Checking the Alternate Gas Composition

The Aurora Trace TDLAS is calibrated with pure Methane (CH4) gas, as that is the typical composition of most liquefied natural gas.

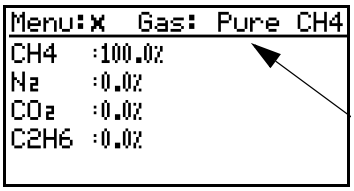
For special applications, where the composition of the gas to be measured differs significantly from pure methane, GE can provide an alternate calibration. If this service has been ordered, the Aurora Trace will be shipped from the factory with both the standard and custom calibration installed.

The calibration in use can be verified at any time using the **Aurora Trace** About… menu. From the Main Menu, select About and press **Enter**. The following screen appears.



From the About Aurora menu, select Gas Composition and press **Enter**. The following screen appears.

An identifier label for the gas composition will be displayed above the components:

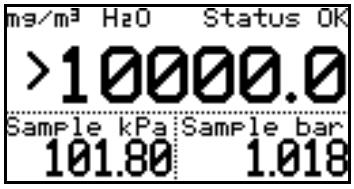


Gas Composition Identifier

4.9 Locking/Unlocking the Display

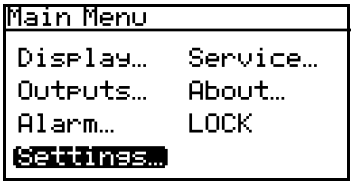
To lock the **Aurora Trace** against any future changes, from the Main Menu select Lock and press **Enter**. The screen returns to the standard display.

Note: *This menu option is the same as exiting the programming menu and waiting for a keypad time-out to lock the keypad.*



To unlock the **Aurora Trace** for changes, press **Cancel**, **Enter**, **Cancel** as instructed in *Unlocking the Keypad* on page 33.

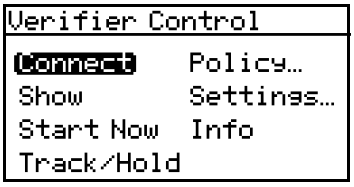
4.10 Verifier Settings



To access the verifier settings, from the Main Menu select Settings and press **Enter.** The following screen appears:

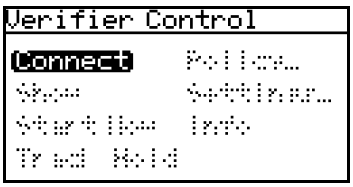
To access the verifier settings, select Verifier… and press **Enter.**

4.10.1 Connecting Verifier

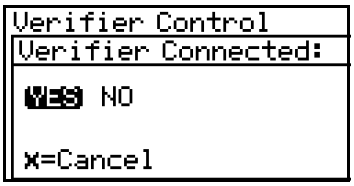


If a verifier was installed, then the menu should be all active (i.e., no grayed out items).

Note:*In addition to having a physical verifier installed, software must be configured to connect to the verifier in order to use the verification system. The only valid configurations are installed and connected or not installed and not connected. If a physical verifier is installed, then SERVICE port is not accessible as a Modbus Slave.*



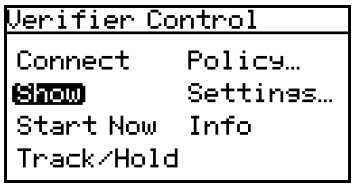
If no verifier was installed, then the menu should be mostly grayed out.



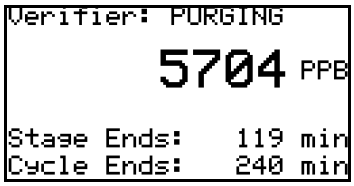
Use the left and right arrow keys to select the verifier configuration. In case where the software configuration does not match with installation of physical verifier, select Connect and select **YES** if installed, **NO** if not installed.

Note: *Without this step properly configured to match the hardware configuration, verifier and Modbus on SERVICE port will not run properly.*

4.10.2 Showing Verifier Status



To show the current verification run status, select Show.



A new screen will populate with Verifier state, live PPB level, how much time is left in current stage and when the run is expected to end.

This display can be exited with **ESC** key and always reentered with selecting Show from Settings -> Verifier.

The very top is Verifier Status. It can have:

PURGING: Working on verifying Zero point — based on Policy -> Threshold.

SPANNING: Working on verifying Span point.

IDLE: Verifier is idle.

COMMFAIL: Communication error. Check connection.

PT Htr FAIL: Permtube heater is having difficulty controlling temperature.

PreHtr FAIL: Pre-heat heater is having difficulty controlling temperature.

Orifc FAIL: Orifice valve is having difficulty controlling flow.

Pres FAIL: Pressure sensor is failing.

UNSTABLE: Passed but signal is too noisy.

OUT AT ZERO: Failed Zero, but passed Span.

OUTRANGE: Passed Zero, but failed Span.

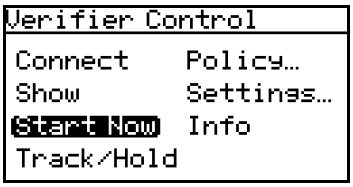
IN RANGE: Passed Zero and Span.

Purging and Spanning are verification in-progress; in the other statuses, the verifier either has never started a verification run or has already completed a run.

If the verifier is in Purging or Spanning, current PPB level is displayed and updated.

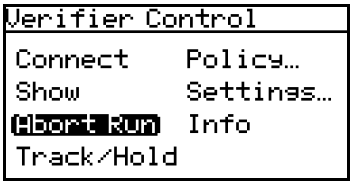
Once a verification run is completed, Zero point and Span point readings for the run are displayed.

4.10.3 Start Now/Abort Run



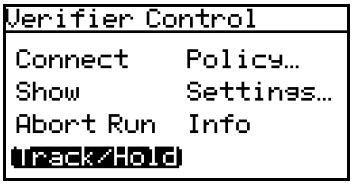
Select this menu item to toggle verification run on/off.

If there is no ongoing verification run, item will read Start Now. Selecting it starts a new verification run and the Show screen pops up.

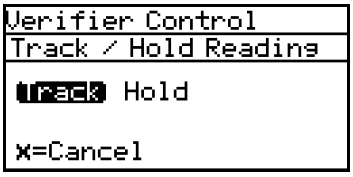


If there is an ongoing verification run, item will read Abort Run. Selecting it stops the verification run prematurely.

4.10.4 Track/Hold



Select this menu item to have Aurora Trace's moisture reading to track verification run moisture or to hold last good reading before the beginning of a new run.

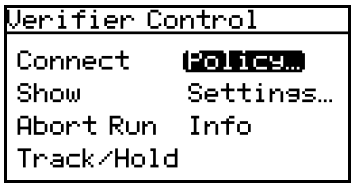


Use the left and right arrow keys to select the Track/Hold configuration. Select **Track** to have the reported moisture reading track verification run.

Select **Hold** to have reported moisture reading be last known reading from the process gas until the run completes.

Note: *The PPB reading displayed on Show screen is always live regardless of what gets reported to DCS.*

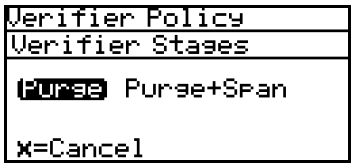
4.10.5 Policy



The Policy menu item allows for editing numerous adjustments to a verification run.

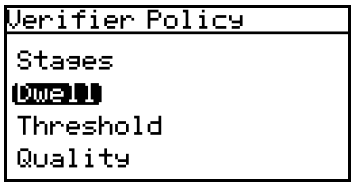
4.10.5a Stages

Select which stages to run for the verification cycle.



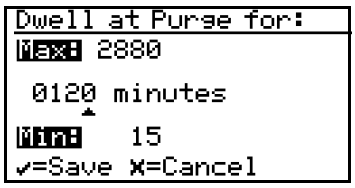
Use the left and right arrow keys to select between running only **Purge** or **Purge and Span** for stages to run.

4.10.5b Dwell



This item allows for editing duration of each dwell of a verification run.

Use the left and right arrow keys to choose between **Purge** or **Span** for editing dwell time.

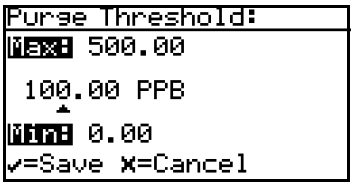


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter.** The screen returns to the Policy Menu. To cancel, press **ESC** instead.

Note:*The span dwell duration is similarly adjusted.*

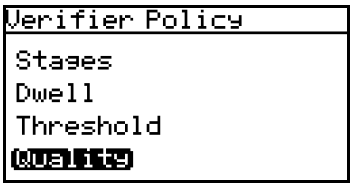
4.10.5c Threshold

This item allows for editing passing level of PPB for **Purge** stage.

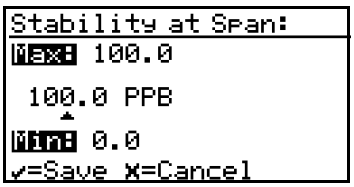


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter.** The screen returns to the Policy Menu. To cancel, press **ESC** instead.

4.10.5d Quality

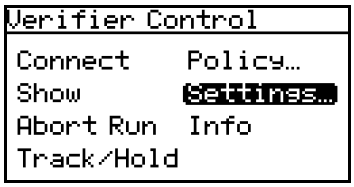


The Quality item allows for editing passing level of **Standard Deviation** for span. If moisture reading at **Span** has higher **Standard Deviation** than this setting, it is reported as an issue.



Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter.** The screen returns to the Policy Menu. To cancel, press **ESC** instead.

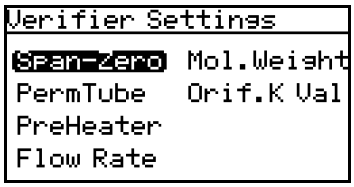
4.10.6 Settings



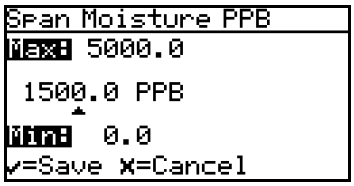
Select this menu item to have the Verifier's configuration changed.

Note:*This menu modifies configuration stored in Verifier changed, not Aurora Trace. GE strongly advises not changing values under this menu without an understanding of the verification mechanism.*

4.10.6a Span-Zero



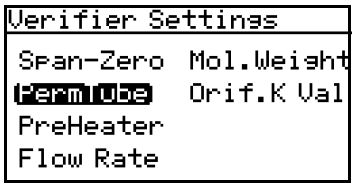
This item allows for editing how much difference is expected between Purge and Span. It directly determines pass/fail of verification run.



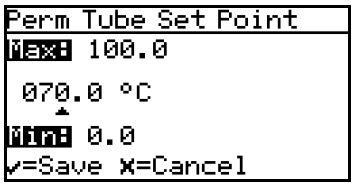
Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter.** The screen returns to the Settings Menu. To cancel, press **ESC** instead.

Note:*It is advised to leave this value as the original value.*

4.10.6b PermTube

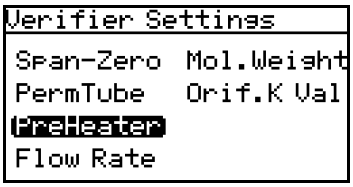


This item allows for editing to what temperature to control Perm Tube in the verification run.

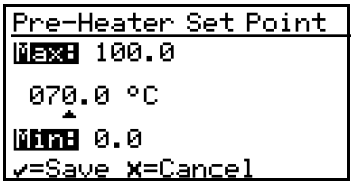


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter.** The screen returns to the Settings Menu. To cancel, press **ESC** instead.

4.10.6c PreHeater

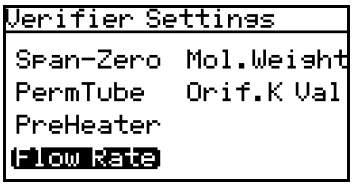


The PreHeater item allows for editing to what temperature to control Pre-Heater in verification run.

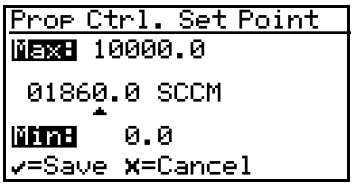


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter.** The screen returns to the Settings Menu. To cancel, press **ESC** instead.

4.10.6d Flow Rate

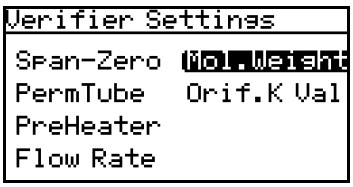


This item allows editing the set flow rate for the verification runs.

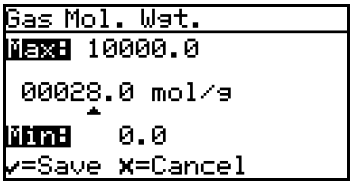


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter.** The screen returns to the Settings Menu. To cancel, press **ESC** instead.

4.10.6e Mol. Weight

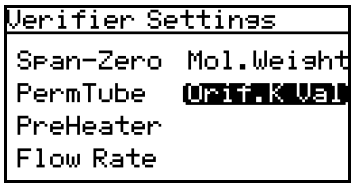


The Mol. Weight item allows editing gas molecular weight (g/mol. 28.0 for nitrogen; 16 for methane, 29 for air and 19 for natural gas).

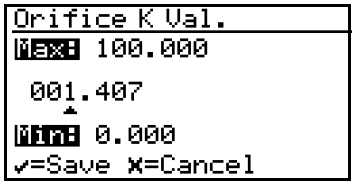


Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter.** The screen returns to the Settings Menu. To cancel, press **ESC** instead.

4.10.6f Orifice K Value

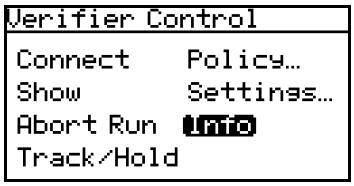


This item allows editing specific heat ratio (gas constant) for flow calculation. It is specific per gas (i.e., 1.3068 for methane, 1.407 for nitrogen and 1.4 for air).



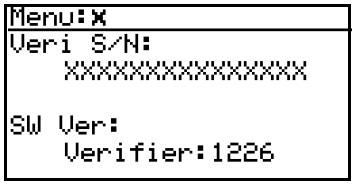
Use the left and right arrow keys to select each digit to be changed. Use the up and down arrow keys to change the value. When finished, press **Enter.** The screen returns to the Settings Menu. To cancel, press **ESC** instead.

4.10.7 Info



Select this menu item to have the Verifier's information displayed.

Note:*This menu modifies the configuration stored in Verifier changed, not Aurora Trace.*



- **Veri S/N**: Serial number of the verifier.
- **SW Ver**: Verifier's firmware version.

Press **ESC** to exit.

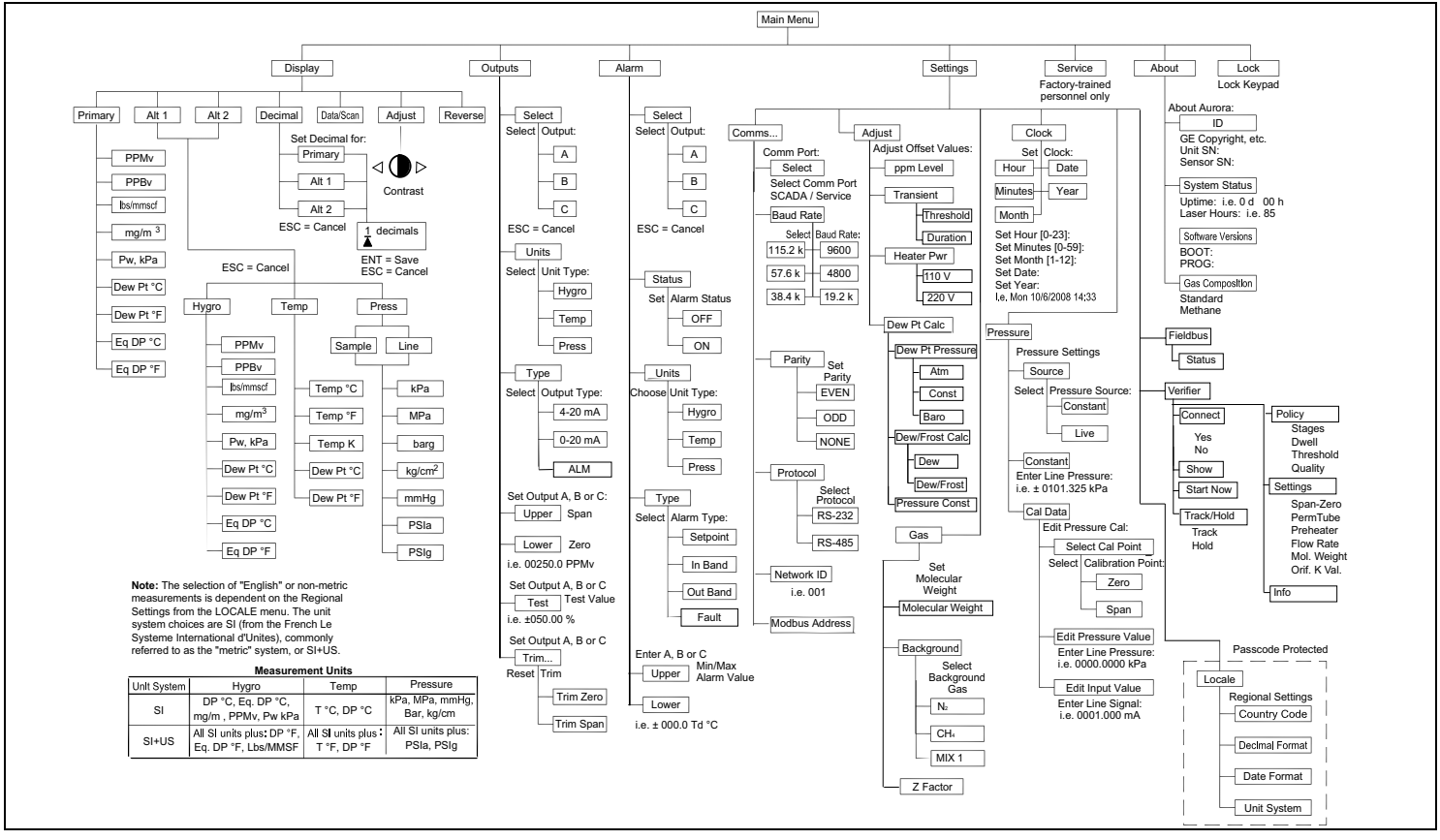


Figure 26: Programming Menu Map

Chapter 5. AuroraView Interface Software

5.1 Capabilities

Your **Aurora Trace** Analyzer is shipped with a CD which includes a PC-Software Application called ***AuroraView***. With ***AuroraView***, you can:

- View **Aurora Trace** Configuration Items Like Alarms & Outputs.
- DataLog data to a comma delimited .txt file, that can be opened by spreadsheet applications like MicroSoft Excel.
- Plot real-time data for one or more **Aurora Trace** parameters
- Manipulate plotted data in a variety of ways: color, line type, zoom in/out, etc.
- Trend tabular data in real-time.
- Show Scan Plots of the moisture absorption spectra.
- Copy plots from ***AuroraView*** to other Window applications like Microsoft Powerpoint or Word.
- Start, stop, monitor, and log verification cycles.

AuroraView does not provide functionality for the following:

- **Aurora Trace** Software Updates.
- Save the **Aurora Trace** Configuration. The **Aurora Trace** is designed in a robust manner where the meter should recover from fault conditions without the need to upload the configuration of the meter using external software.

5.2 Requirements

AuroraView leverages a National Instruments Run-Time environment: specifically, NI LabVIEW Run-Time Engine 2011 SP1 and NI-VISA Runtime 5.2.0. This environment is supported on the following operating systems with the necessary requirement minimum installation requirements:

- 340MB of available hard disk space
- 256 MB Ram or more
- 866 MHz Pentium CPU
- Windows 7/Vista/XP SP2, Windows Server 2003 R2 (32-bit), Windows Server 2008 R2 (64-bit)
- Internet Explorer v5.0 or higher

A user cannot access LabVIEW using a Guest account on Windows.

AuroraView supports the following interfaces:

- RS232
- RS485 Modbus

5.3 Installing AuroraView

1. Install the Installation CD in your PC.
2. The Installation program should auto-run. If it does not, select Start → Run → Browse.

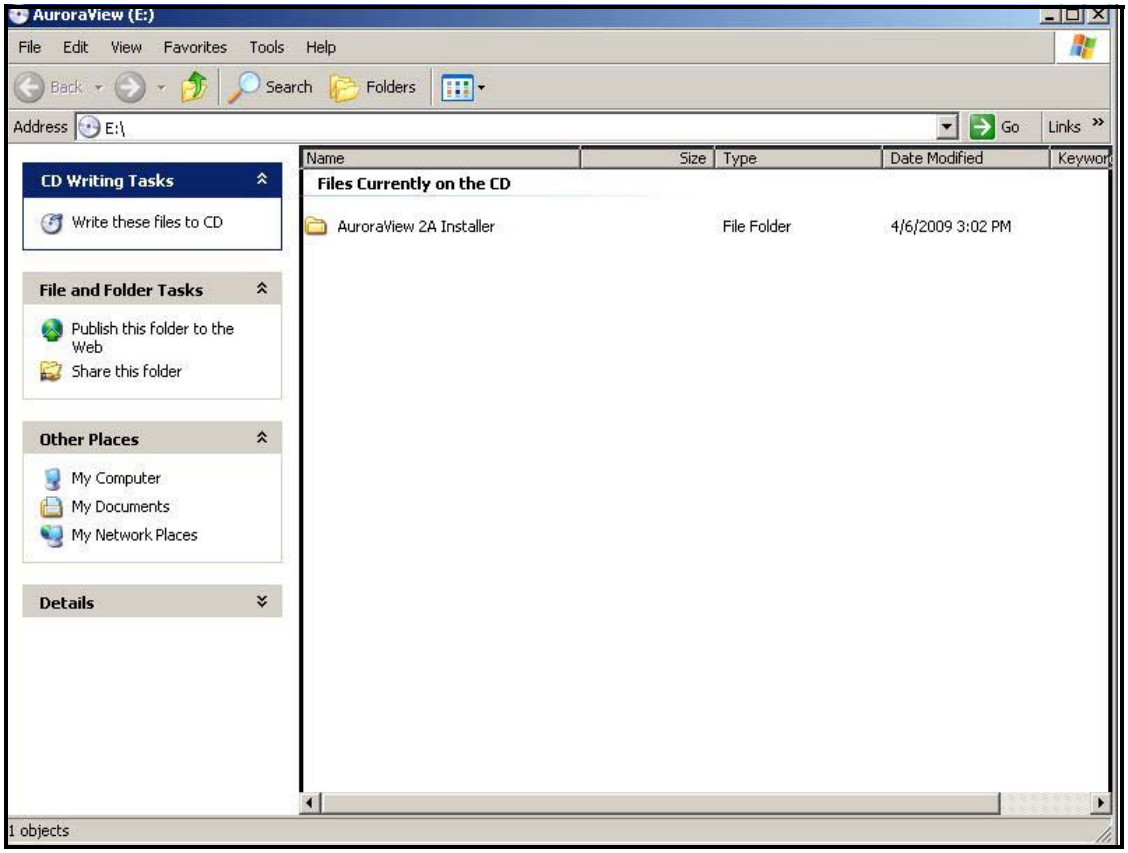


Figure 27: Initial Screen

5.3 Installing AuroraView (cont.)

3. Browse to the file named "setup.exe" in the root directory. Click Open and then OK to start the setup file.

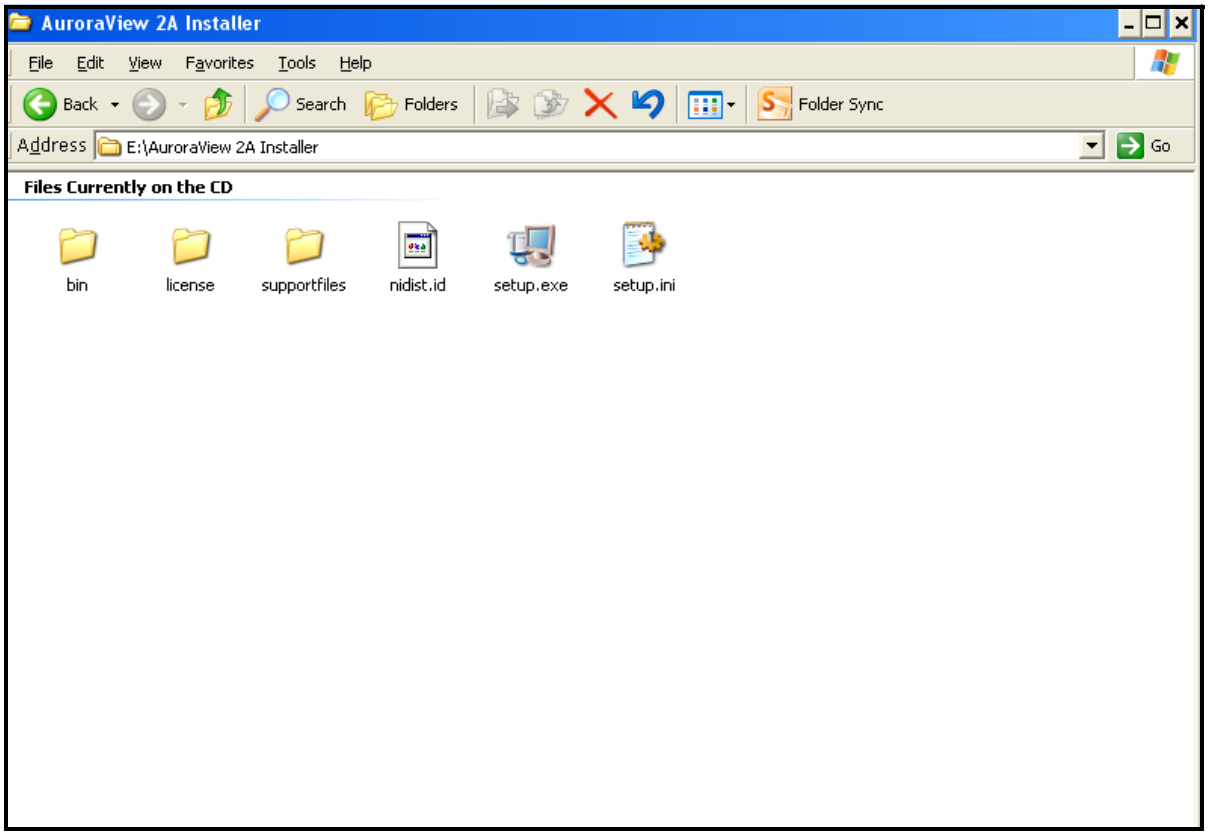


Figure 28: AuroraView Installer

5.3 Installing AuroraView (cont.)

4. Exit all other programs before running the installer.

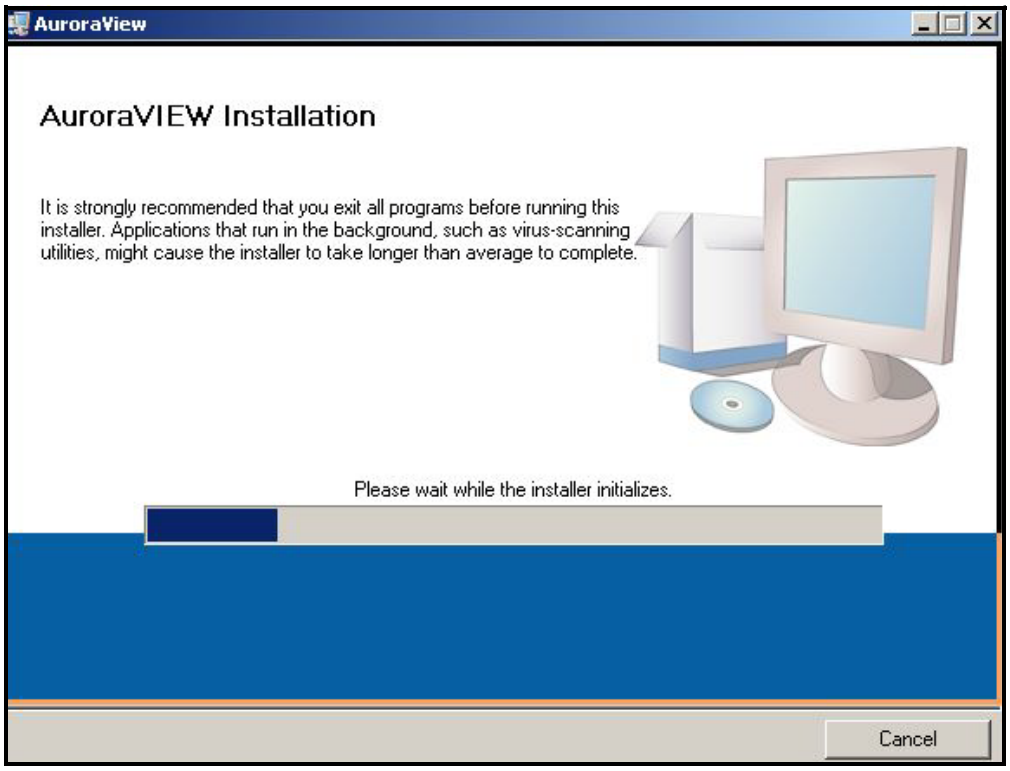


Figure 29: Installation Recommendation

5.3 Installing AuroraView (cont.)

5. The next screen provides the opportunity to change installation locations if necessary. When complete, click Next.

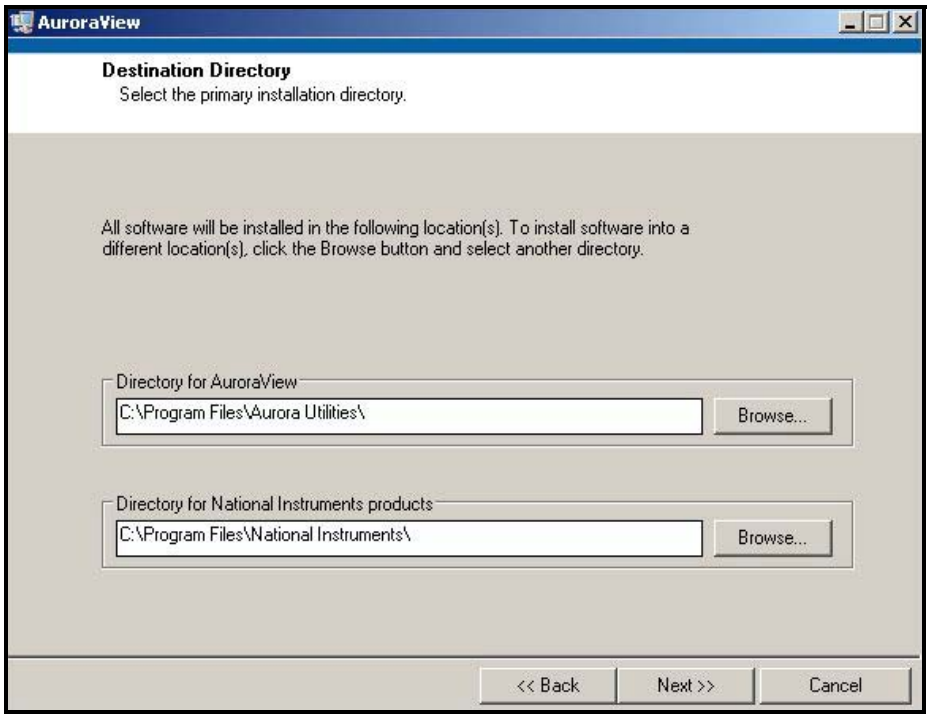


Figure 30: Destination Directory

6. The next screen shows the Software License Agreement. Select "I accept the License Agreement" and click Next.

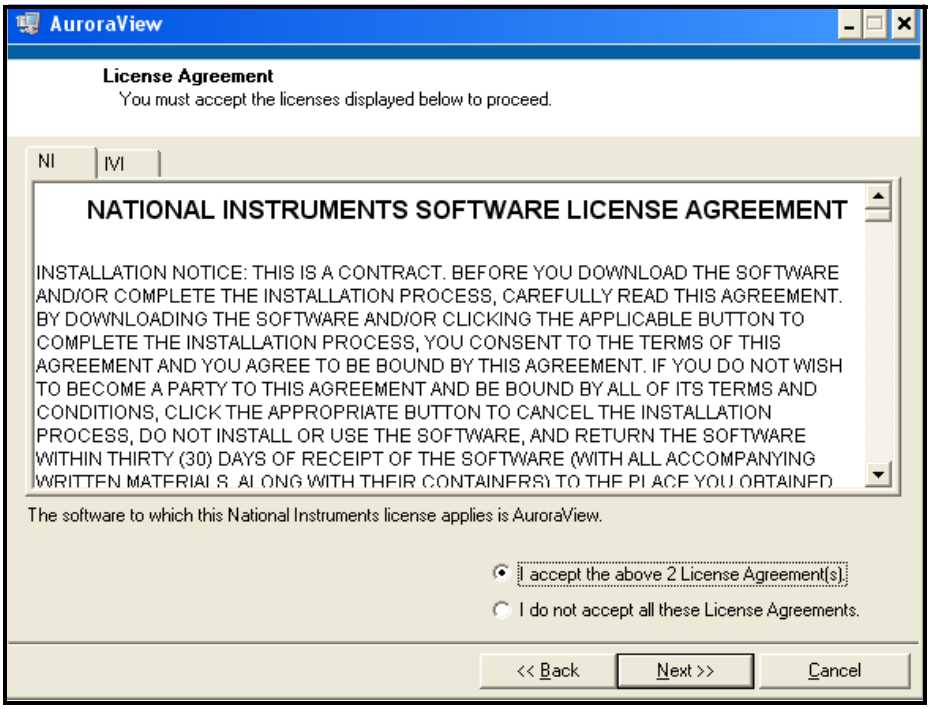


Figure 31: Software License Agreement

5.3 Installing AuroraView (cont.)

7. The next screen gives instructions to initiate the installation. When complete, click Next. The installation begins.

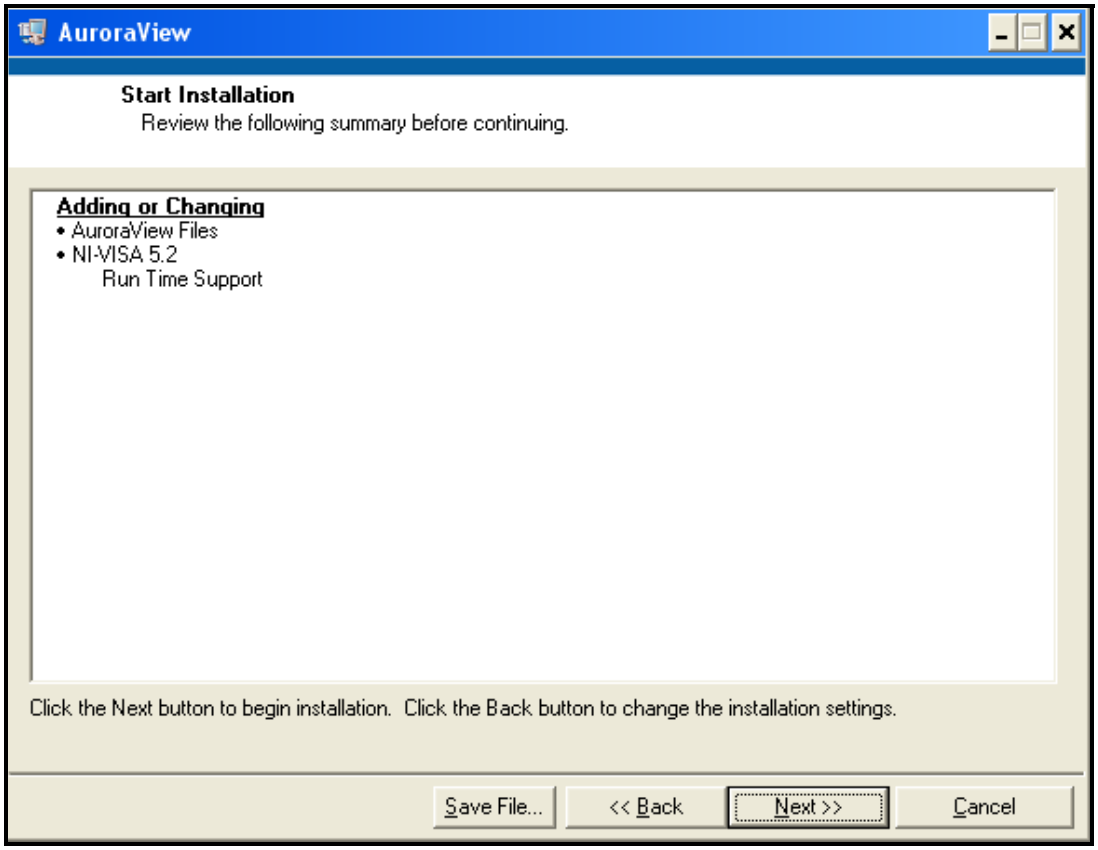


Figure 32: Starting Installation (Note that this list may vary, depending on which components are already installed.)

5.3 Installing AuroraView (cont.)

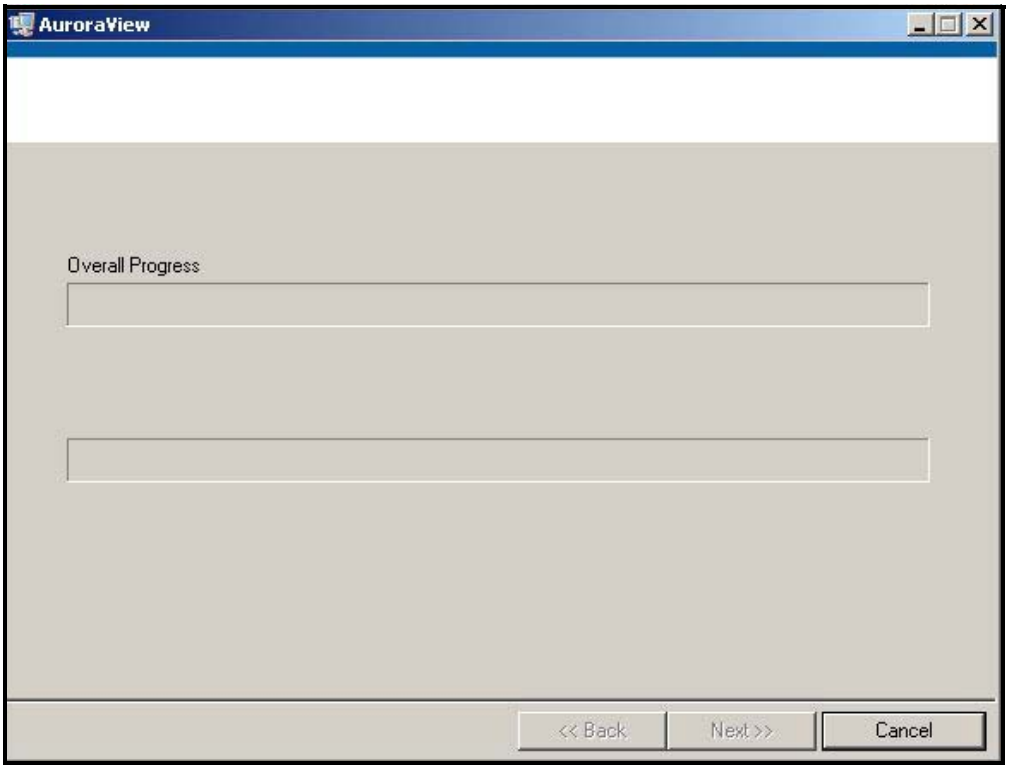


Figure 33: Overall Progress

5.3 Installing AuroraView (cont.)

8. The following screens appear when the installation is complete.

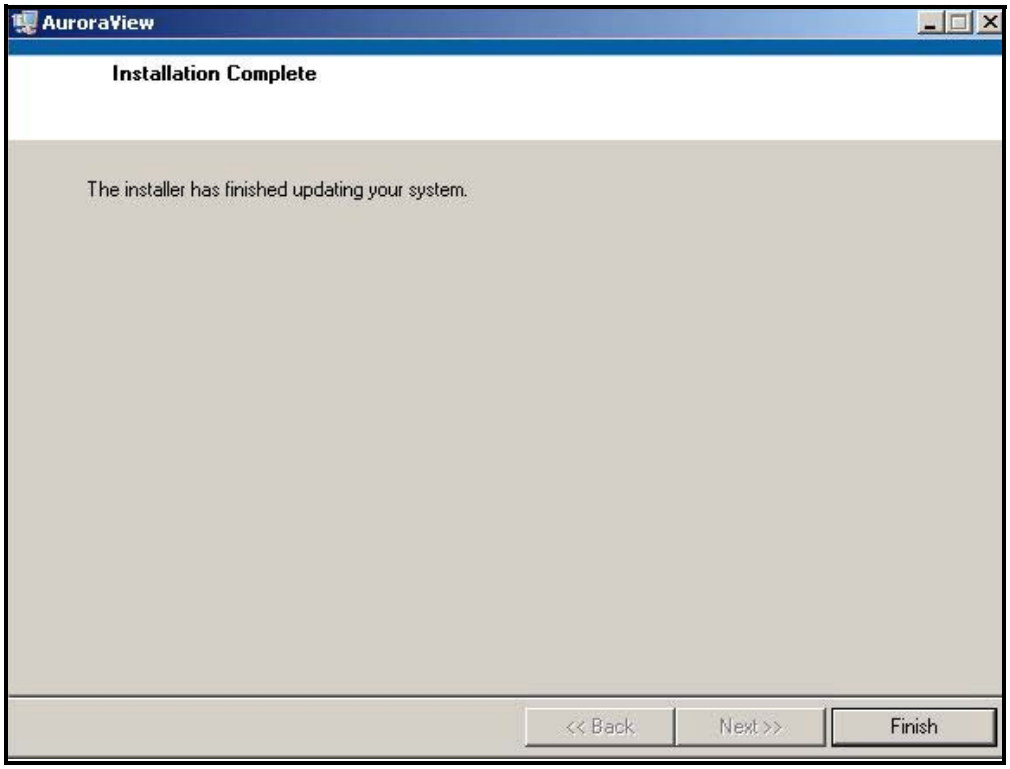


Figure 34: Installation Complete

9. You may be prompted to restart the computer. If so, please restart.

Figure 35: Restart Request

5.4 Starting AuroraView

1. From the Start menu, click Programs → AuroraView → AuroraView.

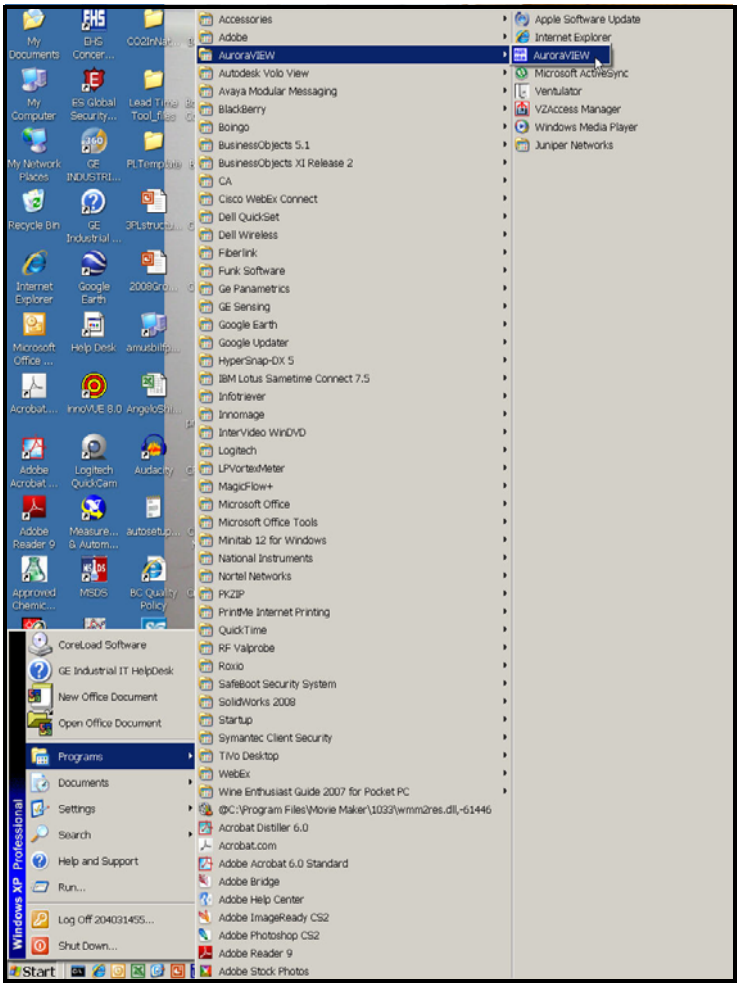


Figure 36: *AuroraView* in Programs Menu

5.4 Starting AuroraView (cont.)

2. **AuroraView** will boot up and display a screen similar to Figure 37.

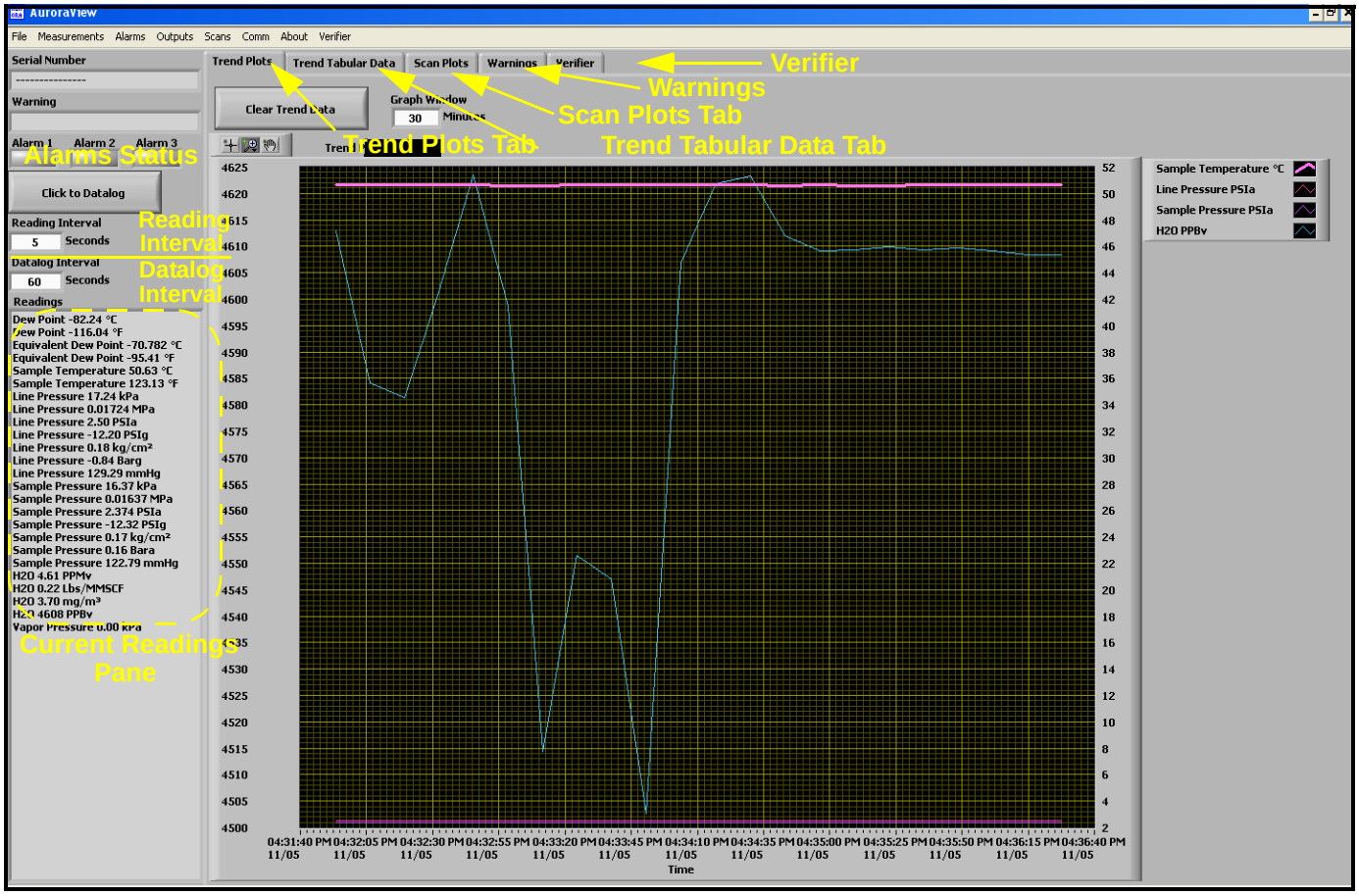


Figure 37: *AuroraView* Main Screen

5.5 Using the Main Menus

1. Click Measurements → Config

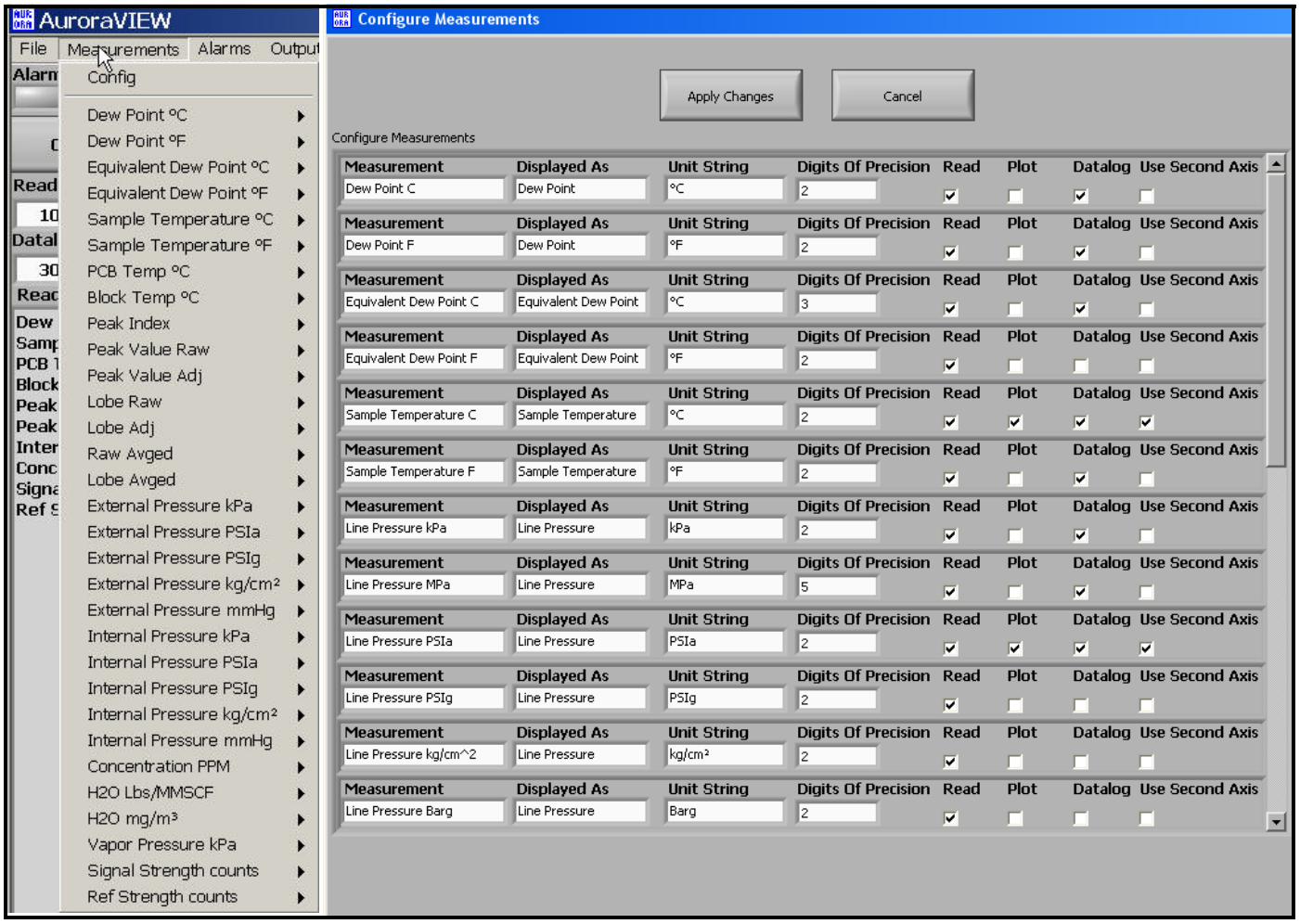


Figure 38: Configuration Measurements

- Unit String: Set this value to the value you want to read, plot or datalog.
- Digits of Precision: Set a numerical value (typically 0, 1, 2). This sets the resolution of the displayed measurement units to the right of the decimal place (i.e. “20.78” would be a setting of 2).
- Read: Check this box if you want to show the value in the current Readings pane.
- Plot: Check this box if you want to show the value in the Trend Plots graph AND the Trend Tabular Data tab.
- * Datalog: Check this box if you want to log the measurement into a log file.
- * Second Axis: Check this box to make “plotted” measurement scale onto the right side Y-axis.

5.5 Using the Main Menus (cont.)

2. Click Alarms → Config

This window enables the user to configure the alarm status within the **AuroraView** application. This feature allows you to remotely configure **Aurora Trace**'s alarms, which are used only with Modbus RTU digital output. The **AuroraView** Alarms are shown below.

Figure 39: Alarms Configuration

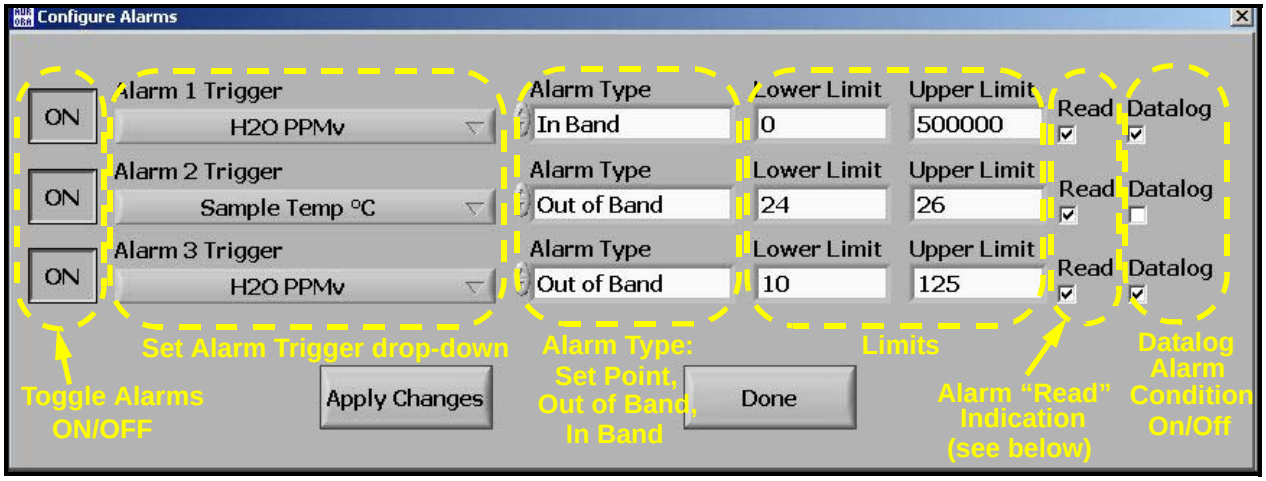


Figure 40: Other Measurement Options

Figure 41: Alarm Status Indicators

3. Click Outputs → Config

Figure 42: Outputs Configuration

5.5 Using the Main Menus (cont.)

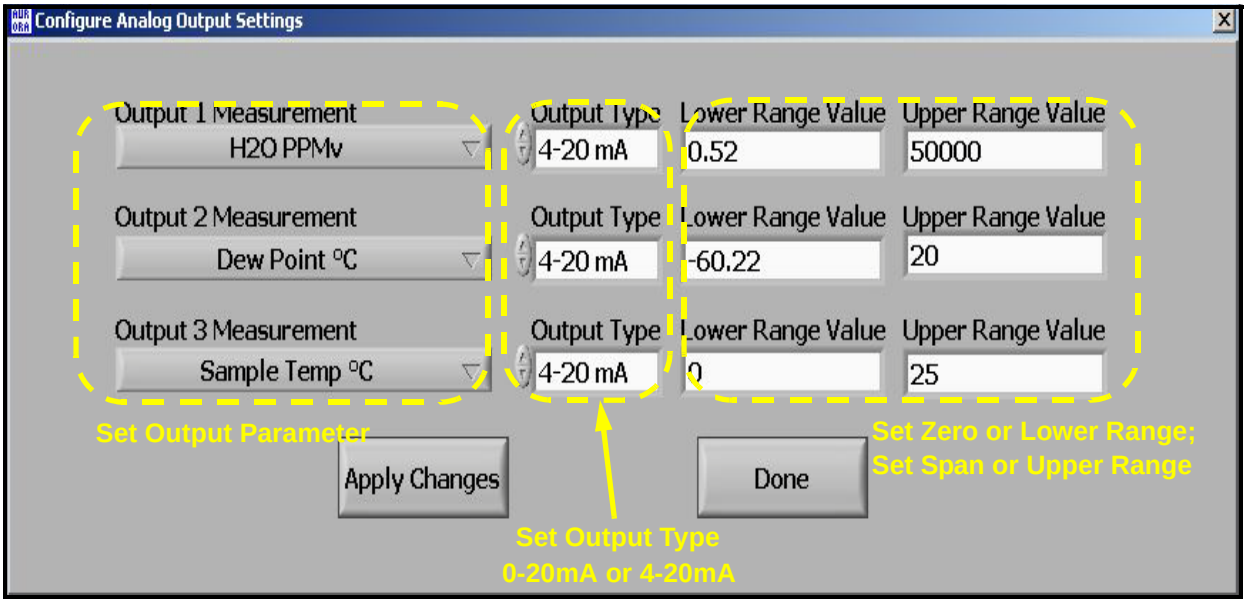


Figure 43: Other Output Options

5.5 Using the Main Menus (cont.)

4. Click Scan

This section will enable you to pick the type of scan you want to see. The default scan is the SPECTRA scan, which shows the 2f spectral scan. This is the processed signal waveform that the **Aurora Trace Analyzer** uses to determine the moisture concentration. Viewing this scan may be helpful in certain troubleshooting situations. A typical 2f spectra scan is shown in Figure 45 on page 91. You may select the scan interval in minutes. This will be the refresh rate at which **AuroraView** updates the scan plot. To enter a scan interval, click on the Click to Save Scans Periodically button, and the following screen appears. Enter the interval and click on Continue to save or Cancel to reject the change.

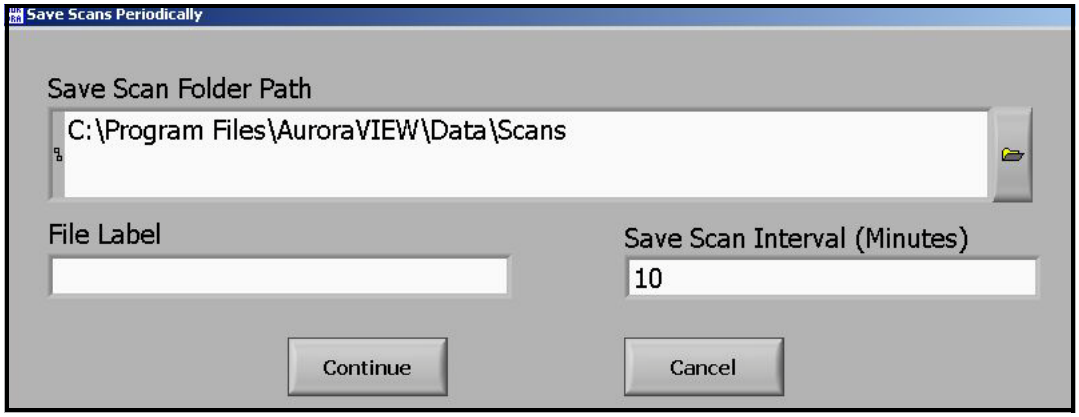


Figure 44: Save Scans Periodically

5.5 Using the Main Menus (cont.)

Figure 45: Scan Plot Tab

5.5 Using the Main Menus (cont.)

5. Click Comms

This window enables you to configure communication options. If you have more than one **Aurora Trace** on your network, you will have to establish different NETWORK ID's for each analyzer using the main keypad on the **Aurora Trace**. For your PC system, you will have to select which comm port to use. This is typically COM1. The default baud rate is 115200 baud.

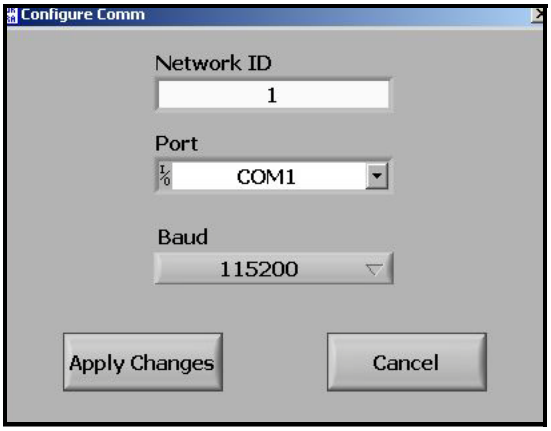


Figure 46: Configure Communication Options

6. Click Help

This screen indicates the revision level of **AuroraView**.

Figure 47: Software Information

5.5 Using the Main Menus (cont.)

7. Click Verifier → Config.

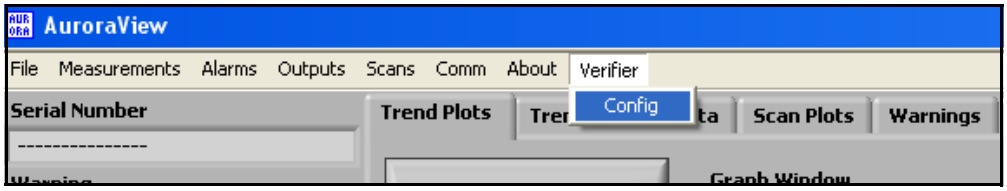


Figure 48: Verifier Configuration

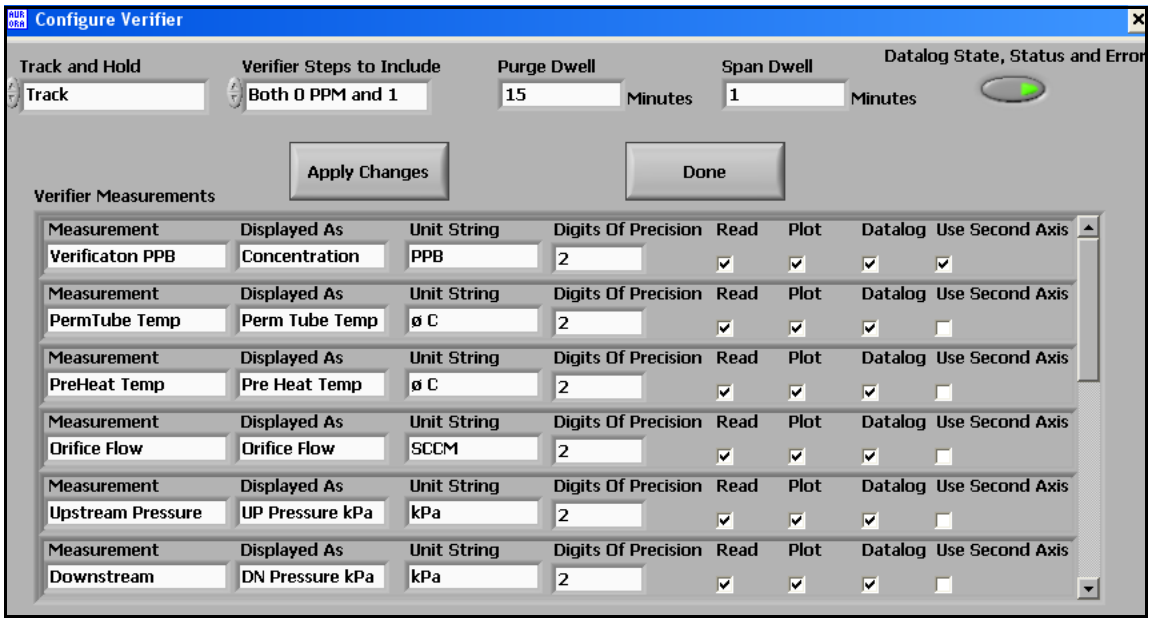


Figure 49: Verifier Options

- Track and Hold: Track makes normal moisture measurements to track the verifier-caused moisture level. Hold displays last known measurement before the verification run begin.
- Verifier Steps to Include: Only Purge or both Purge and Span.
- Purge Dwell: Duration of Purge in minutes.
- Span Dwell: Duration of Span in minutes.
- Datalog State, Status and Error: Toggles state, status, and error log.
- Verifier Measurements: Which verifier measurements to Read, Plot, and Datalog in Verifier Tab and log.

* Verifier measurements are updated onto Trend Tabular Data tab as well as Aurora Trace measurements.

5.5 Using the Main Menus (cont.)

Verifier information can be seen by selecting the Verifier tab.

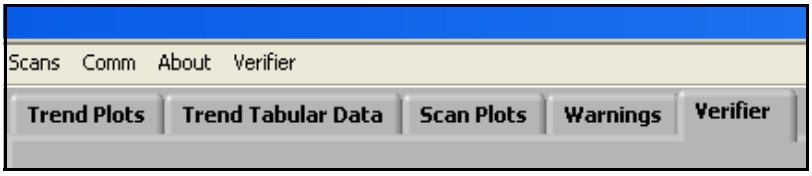


Figure 50: Verifier Tab

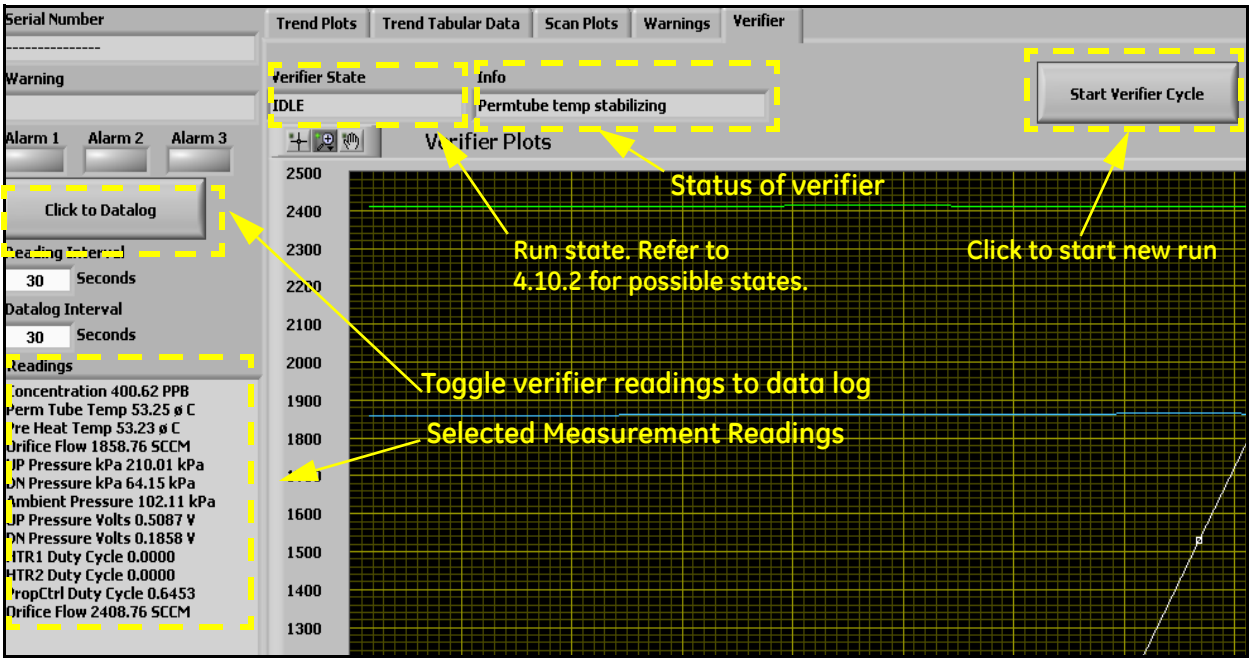


Figure 51: Verifier Plot

Figure 52 on the next page shows a screen before you start the verifier run. Note that the verifier state is IDLE and the button displays Start Verifier Cycle. There is no present verification running and the plot simply reports the verifier readings.

5.5 Using the Main Menus (cont.)

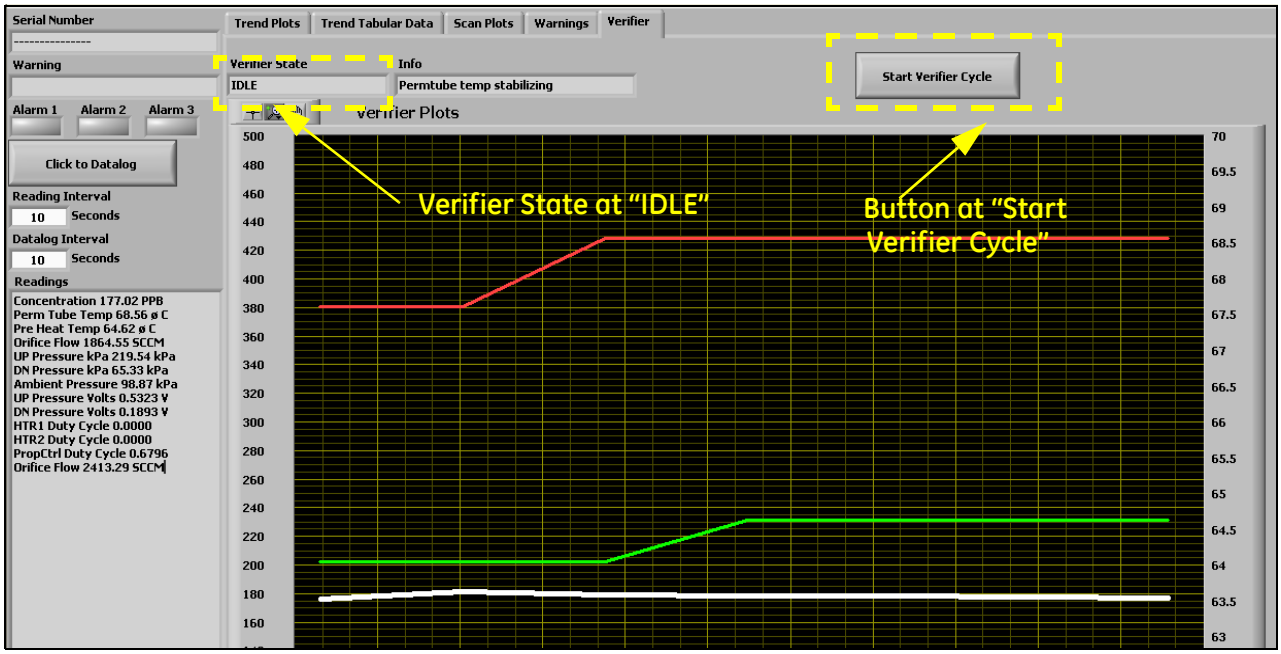


Figure 52: Before Verifier Run

Once you click Start Verifier Cycle, the Verifier State changes to PURGING, the remaining times are displayed and the Start Verifier Cycle icon is now changed to Abort Verifier Cycle.

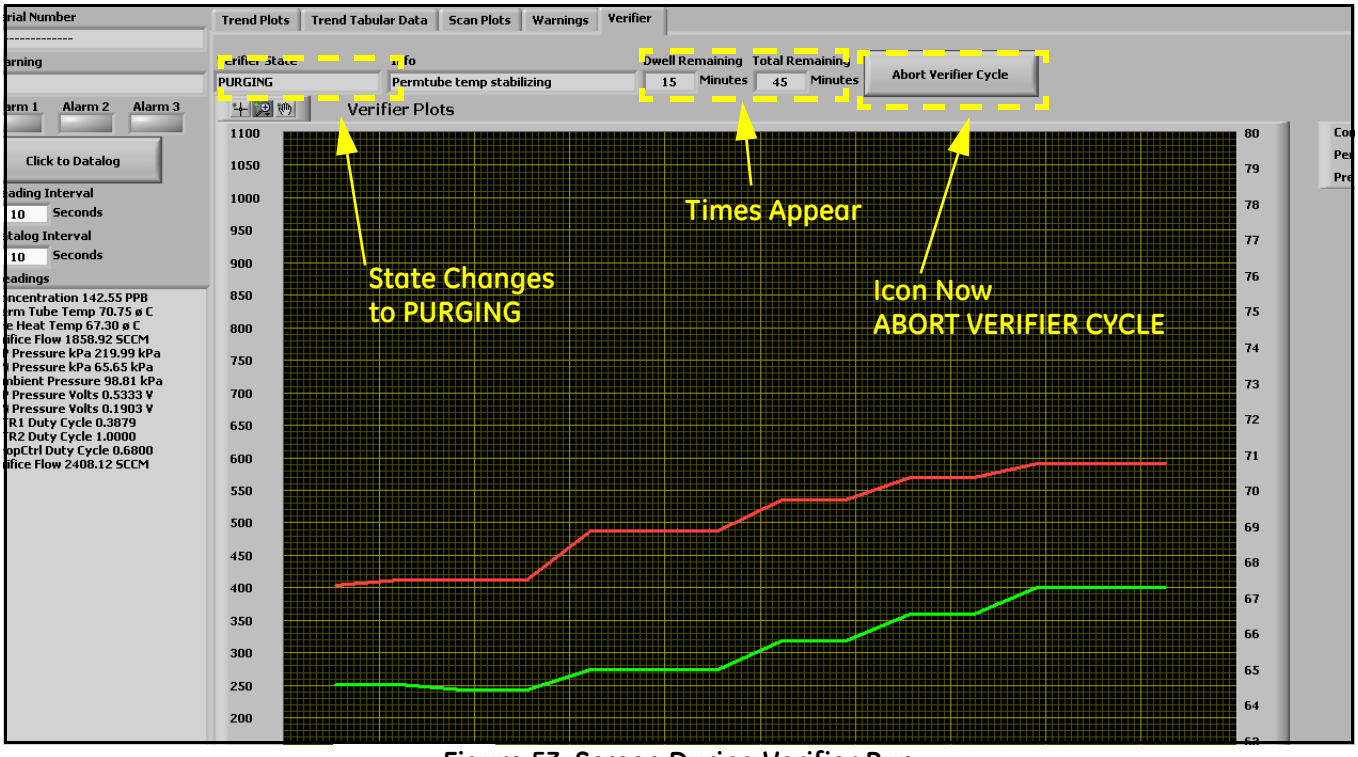


Figure 53: Screen During Verifier Run

5.5 Using the Main Menus (cont.)

Figure 54 below shows a typical verification cycle plot with Concentration PPB (in white) declining during PURGE, taking a jump up to and stabilizing at SPAN level.

Verifier State is now IN RANGE, indicating that the PURGE and SPAN of the verification run have successfully completed. Also, the Abort Verifier Cycle icon once again shows Start Verifier Cycle.

Refer to “Showing Verifier Status” on page 67 for all possible Verifier States for successful and unsuccessful verification runs.

Refer to page 93 for details on customizing the verification run characteristics, such as changing dwell times and pass/fail criteria.

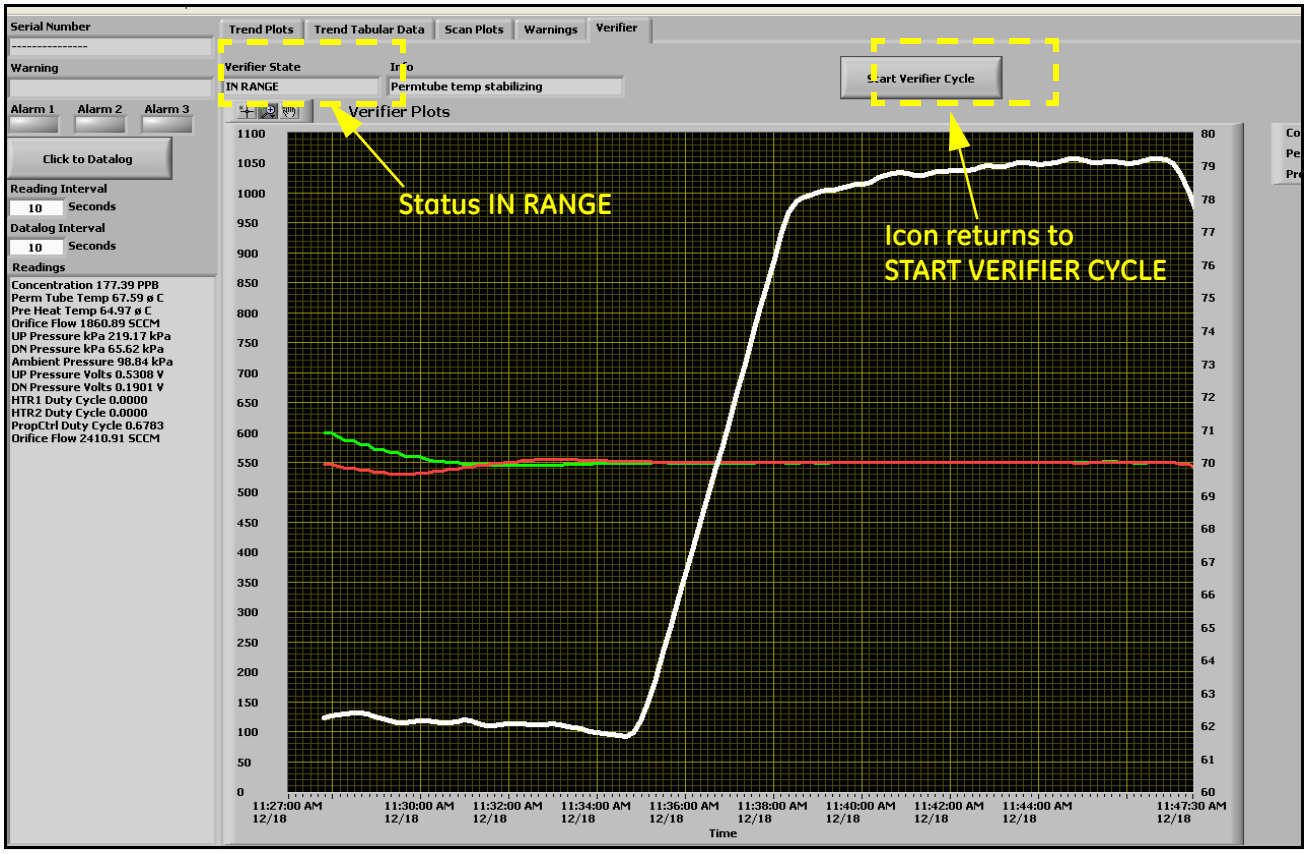


Figure 54: Verifier Run Completed

5.6 Datalogging with AuroraView

1. In the main view, click on the button Click to Datalog.

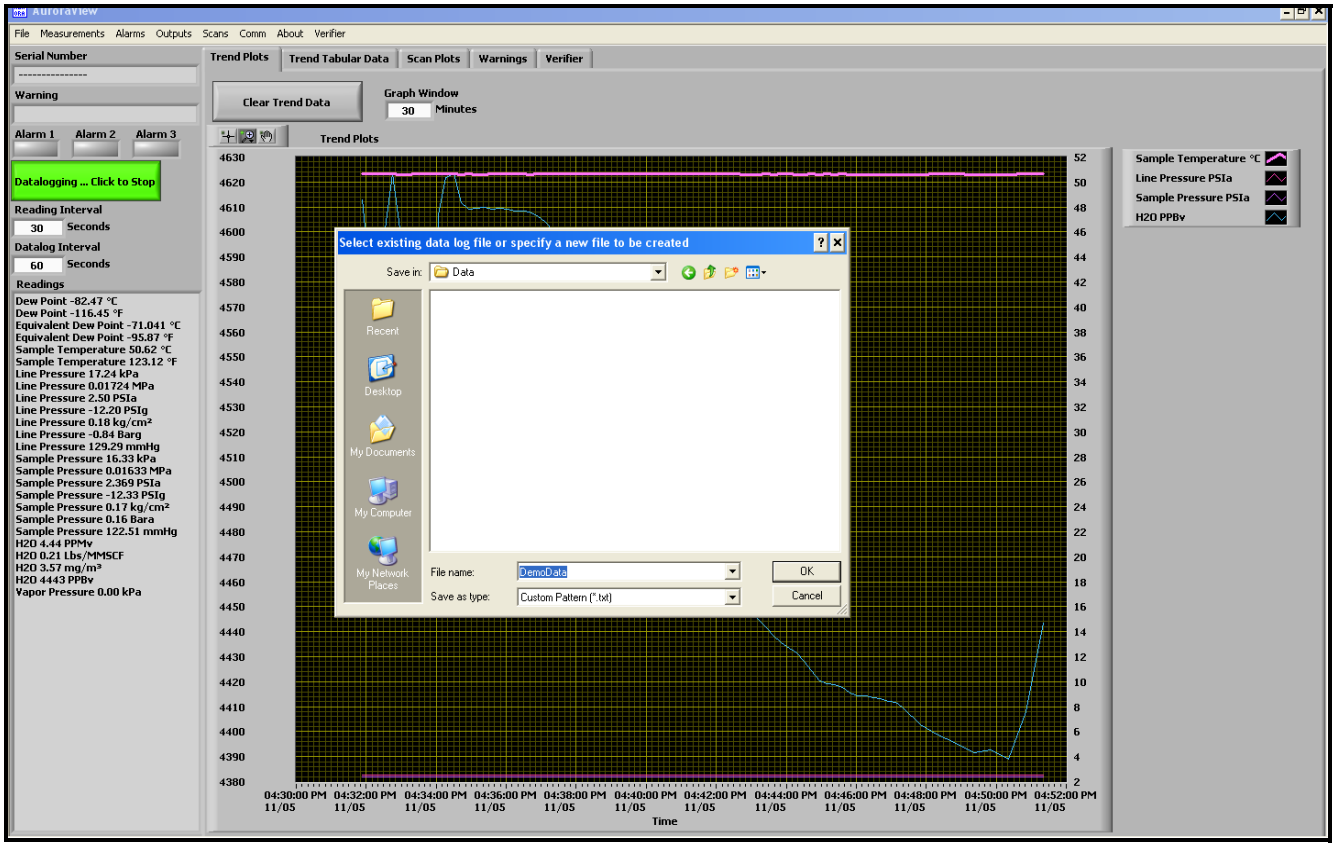


Figure 55: Dataloging with AuroraView

2. **AuroraView** will request a file location. Pick a file location and a file name to save your data log file. All data log files are comma delimited .txt files by default.
3. Once you pick a file location, **AuroraView** will write any parameter that has a check box with Datalog checked in the main Config window at the time interval set in the Datalog Interval box, and the button in the main window will change to Datalogging...Click to Stop.
4. When you are done datalogging, click the button to stop logging. You may now open your .txt datalog file in any application, such as Microsoft Excel, so that you can analyze that data.

Note: *When datalogging multiple parameters at intervals of five seconds or less, it is recommended to use baud rates of 57.6K or 115.2K.*

5.7 Working with Trend Plots, Trend Tabular Data & Scan Plots

1. Trend Plots is a powerful graphing feature in **AuroraView**. You can graph many parameters at the same time.

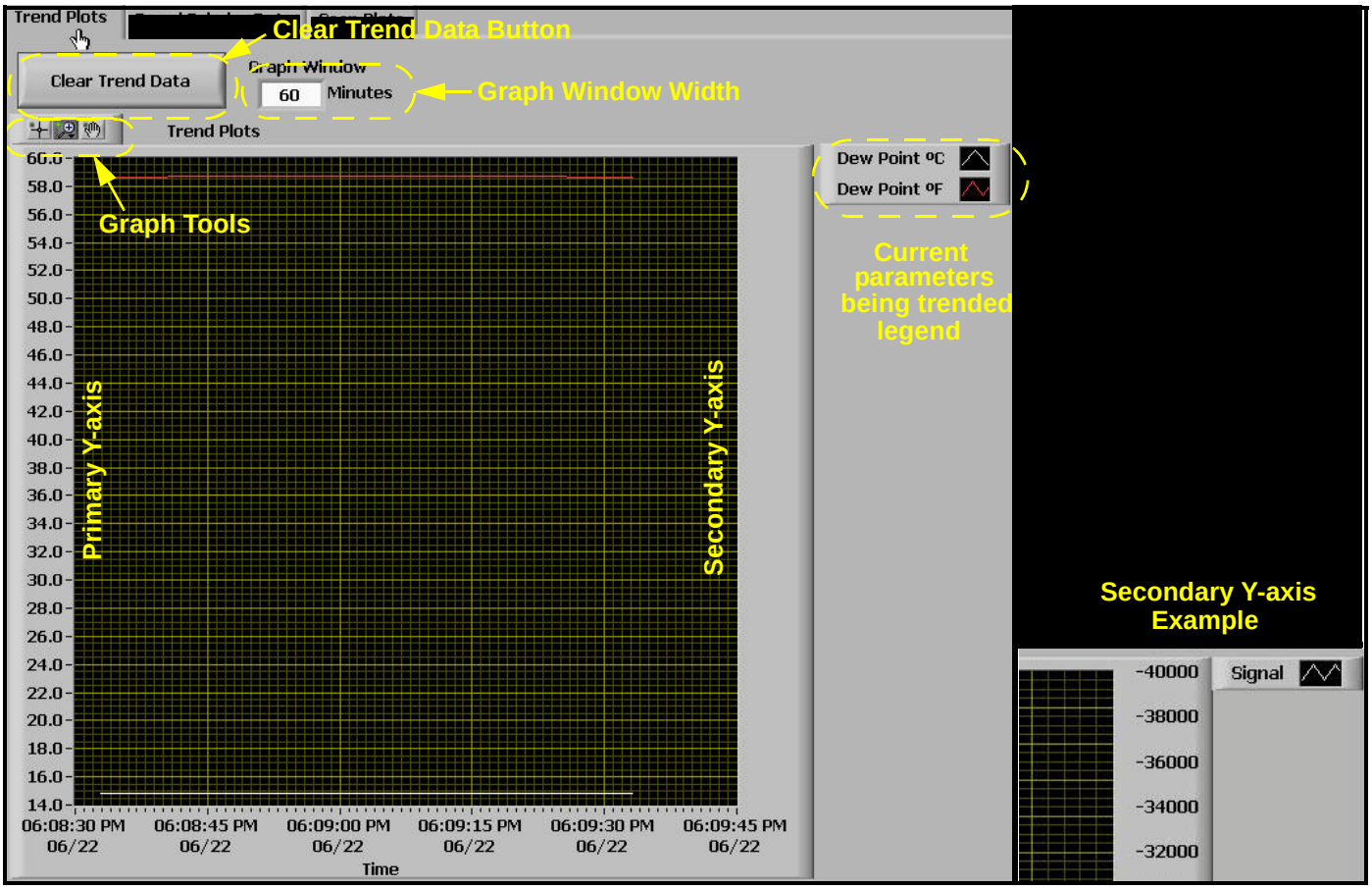


Figure 56: Using Trend Plots

Note: *If you use the secondary y-axis, you may see "–" tick marks preceding the value. These are tick marks from the graphical applet and not an indication of negative values.*

5.7 Working with Trend Plots, Trend Tabular Data & Scan Plots (cont.)

2. If you right-click on any series of data within the graph, or you click on the current parameter being-trended item in the legend, you will see a variety of options for graphing data. You can change to a variety of common plots and adjust color, line style, and line width. For some data sets with lots of finite points, you may want to click Anti-Aliased which will smooth the plot line. You can also change bar plots, fill base line, interpolation and point style. X-Scale adjusts the x-scale. Y-Scale adjusts the y-scale and enables the secondary y-axis.

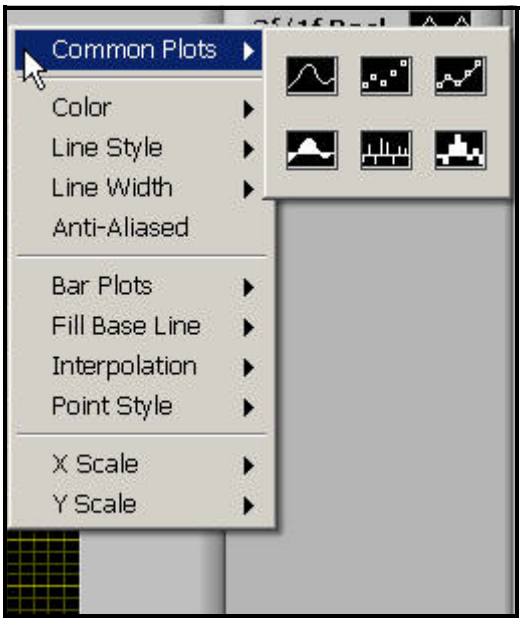


Figure 57: Options for Graphing Data

3. There is a series of Graph Tools available at the top left of the trend plot area.

Figure 58: Graph Tools

- Pointer
- Zoom Tool - gives you six options as shown in Figure 59.

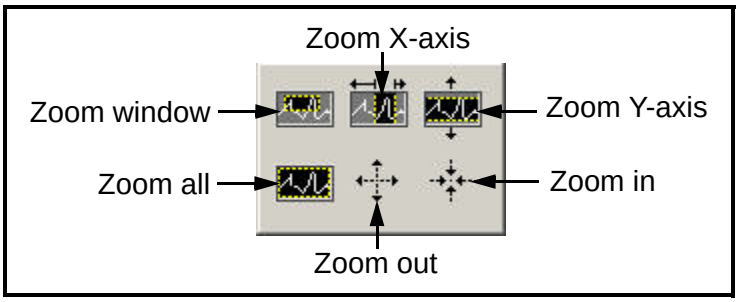


Figure 59: Zoom Tool

- Hand Tool - Enables you to graph the trend plot area and move it around without rescaling.

5.7 Working with Trend Plots, Trend Tabular Data & Scan Plots (cont.)

4. Copying and Pasting a Trend Plot can be done from **AuroraView**. One way to do this quickly is to simply right click over the data area and choose Copy. In another application, like Microsoft Word, simply paste.

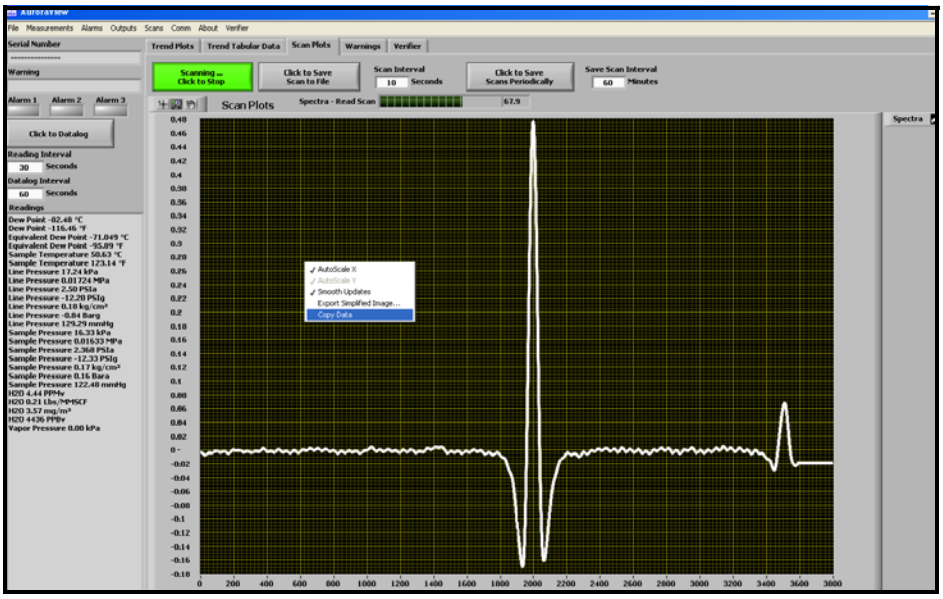


Figure 60: Copying a Trend Plot

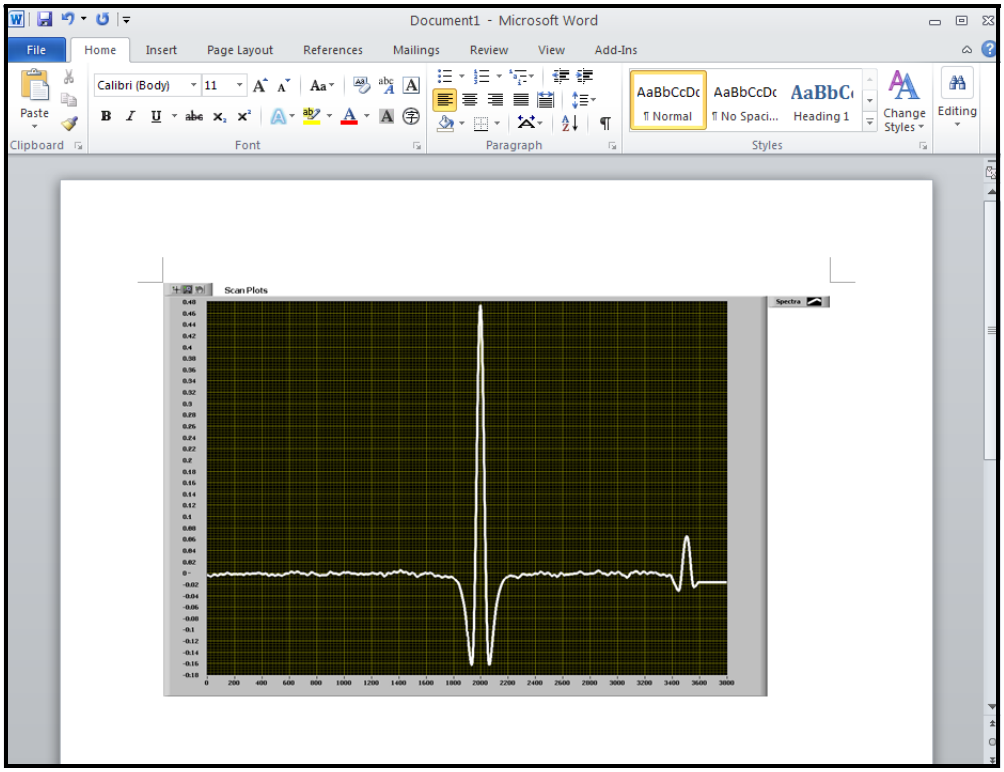


Figure 61: Pasting a Trend Plot

5.7 Working with Trend Plots, Trend Tabular Data & Scan Plots (cont.)

Another option is to right-click and chose the option Export Simplified Image. When you do this, a variety of image file formats will appear. A good universal option is Enhanced Metafile. Pasting an enhanced metafile will give you the ability to paste an image with an inverted color scheme as shown in the second example posted into Word (see Figure 64 on page 102).

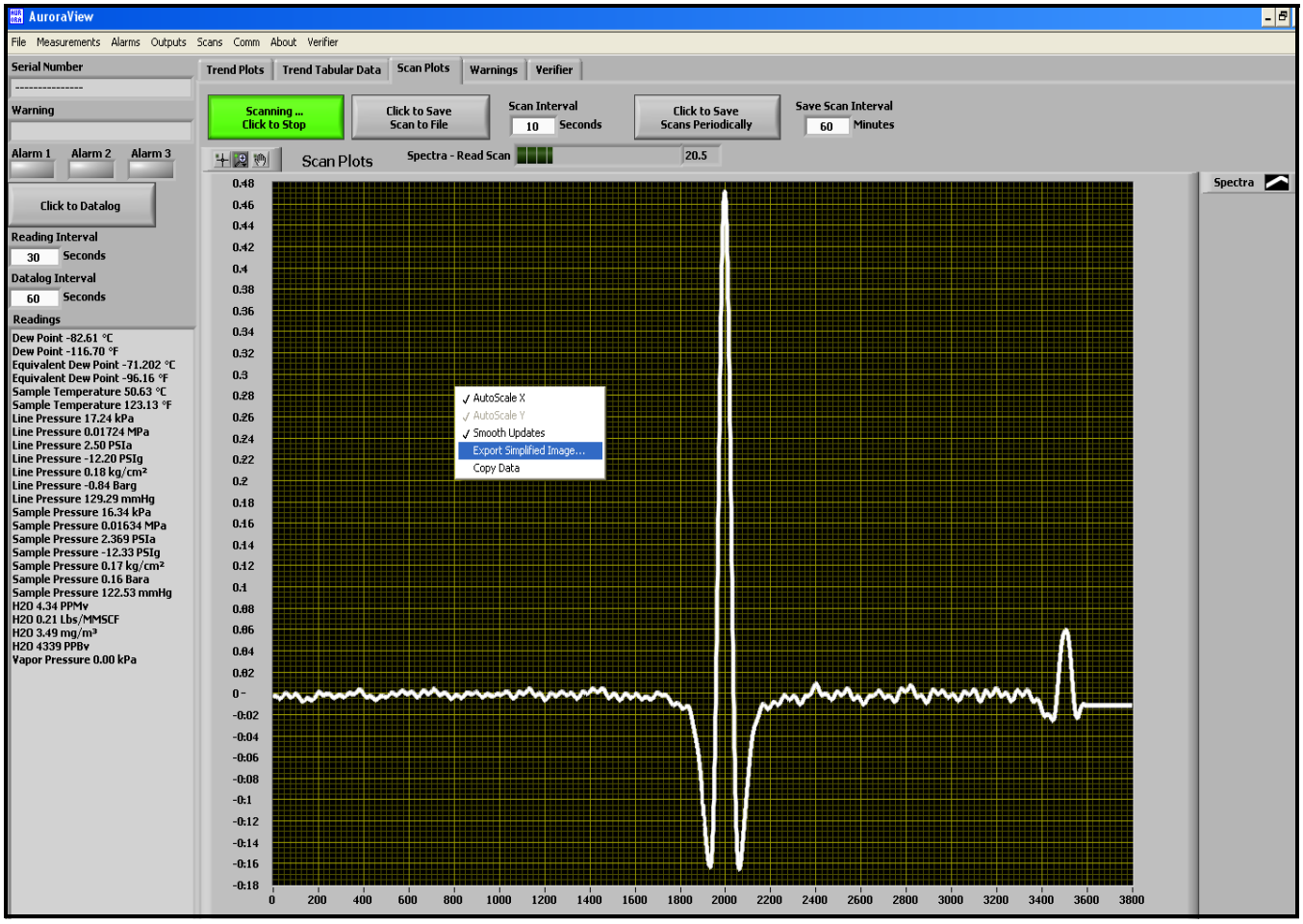


Figure 62: Exporting a Simplified Image

5.7 Working with Trend Plots, Trend Tabular Data & Scan Plots (cont.)

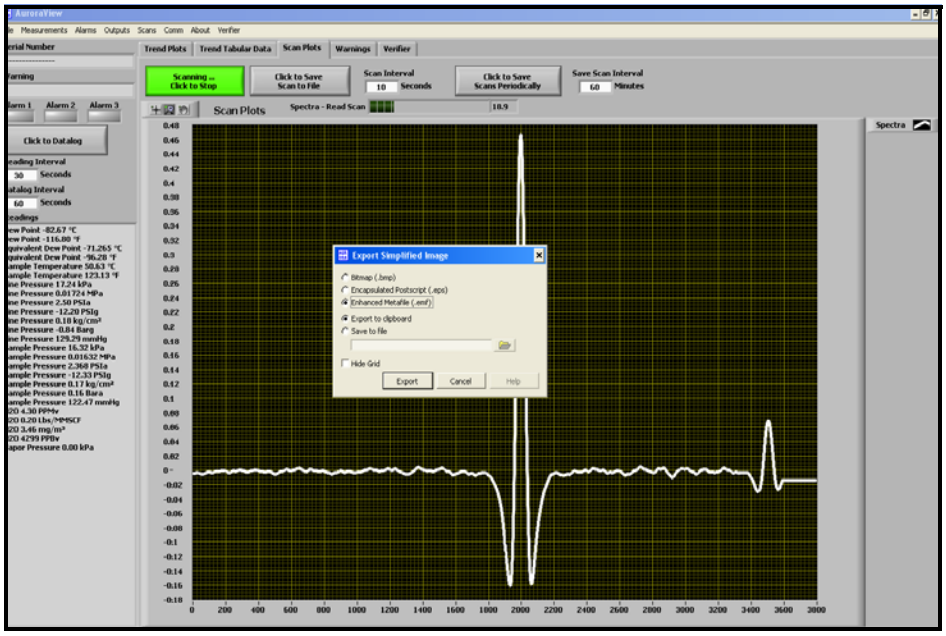


Figure 63: Selecting Enhanced Metafile

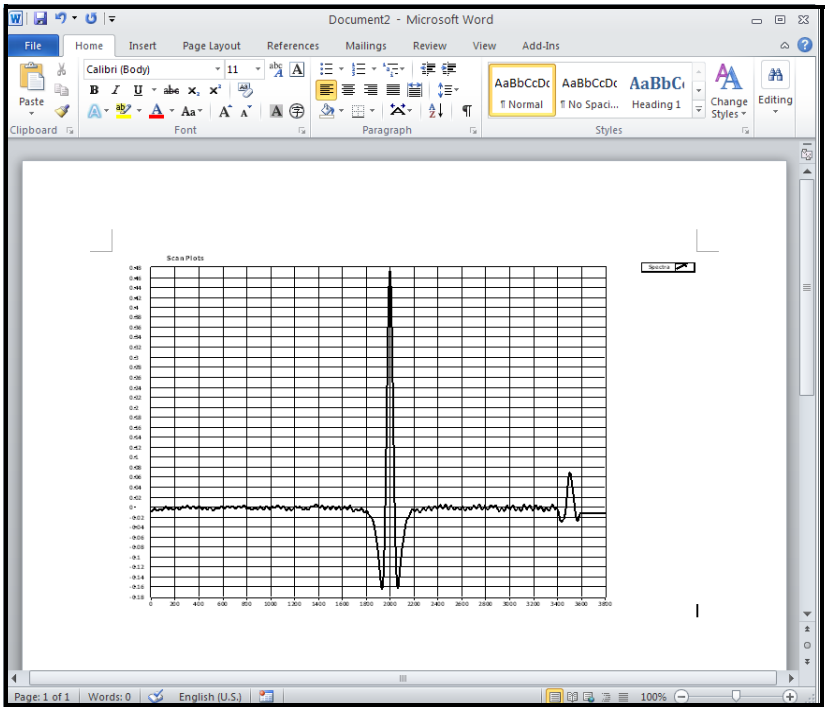


Figure 64: Pasting an Enhanced Metafile

5.7 Working with Trend Plots, Trend Tabular Data & Scan Plots (cont.)

Working with Trend Tabular Data, you will be able to see data in tabular format as shown in Figure 65. You can adjust column widths to see data more easily with full titles in the header row.

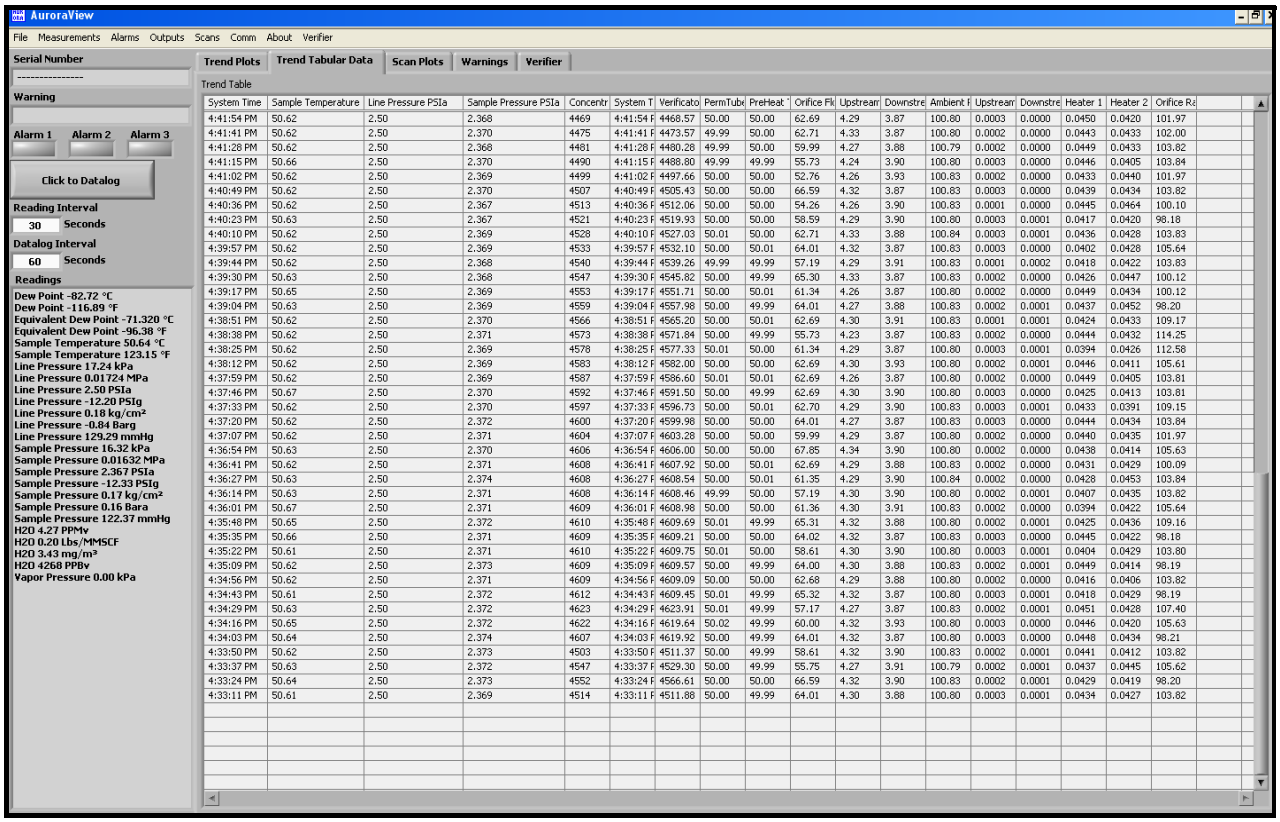


Figure 65: Trend Data in Tabular Format

[no content intended for this page]

Chapter 6. Maintenance

6.1 Spare Parts

Table 2: Aurora Trace Spare Parts List

Part No.	Description	Qty.
704-668-12	RS-232 Cable; SUB-9-F to Tinned Leads; 12 ft.	1
421-3230	Magnetic Stylus	1
705-1522-00	**Vacuum Pump Diaphragm Kit**	
461-102	Pump Diaphragm & Gasket Kit	4
240-314	Allen Wrench for pump head (Hex L-key, 1/4" size, 3-5/16" long)	1
240-315	Allen Wrench for pump cover (Hex L-key, 5/32" size, 2-5/8" long)	1
240-316	Allen Wrench for pump valve (Hex L-key, 1/16" size, 1-13/16" long)	1
400-999	Loctite Removable 242 10ml bottle (with MSDS)	1
403-173	Nylon mesh abrasive hand pads, general purpose, maroon color	1
705-1523-00	**Aurora Trace Filter Kit**	
463-111	Package of Five Membrane Filter Elements	1
255-1217	Stainless Steel In-Line Particulate Filter, 1/4 in. Swagelok Tube Fitting, 90 Micron	2
255-1100	Stainless Steel Orifice Restrictor	1
705-1521-00	**Verification System Perm Tube and Purifier Replacement Kit**	
790-222	Verification Permeation Tube	2
421-3432	Insulation for Permeation Tubes	1
240-317	Allen wrench for verification system (9/64", ball-point Hex L-Keys, 4" long)	1
463-089	Verification Gas Purifier	1
255-220-02	Gasket 1/4VCR SS	2

CAUTION! CLASS 1M INVISIBLE LASER RADIATION WHEN OPEN. DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS.

WARNING! Use of controls or adjustments or performance of procedures other than those specified herein may result in radiation exposure that is more hazardous than specified.

6.2 Recommended Factory Verification Period

Aurora Trace technology is designed for long life without calibration. There are no wetted sensing surfaces, which might degrade over time due to direct sample gas contamination. The optical components are designed to be stable over the span of many years. GE recommends that **Aurora Trace** analyzers may be returned to the factory for verification on a five (5) year periodic basis. GE will inspect, clean, replace filter elements and calibrate the unit to traceable standards as part of the factory service for **Aurora Trace** analyzers.

6.3 Replacing the Membrane Filter

The Aurora Trace uses a membrane filter as the secondary filter. This filter is intended to prevent liquid or particulate contamination from entering the absorption cell. The Aurora Trace should not be operated without a filter train upstream of the unit. The membrane filter is equipped with “Flow Block” which shuts off the flow if the filter element is heavily loaded with contamination. A spring loaded check valve closes the outlet flow of the sample if the differential pressure across the filter element exceeds a threshold limit. At any given time the flow through the Aurora Trace can be checked by observing the rotameter. If the “flow block” feature shuts off the flow, do not increase the pressure. Replace the filter element and clean the filter.

If the flow is being shut off too frequently, additional sample condition schemes, or the combination of the following, will have to be employed.

- Bypass flow - needed to sweep liquids or contamination off the filter. A 10:1 bypass flow rate should be maintained.
- Additional upstream filtration
- Heat – Heat tracing of the sample line and sample system components, sufficiently above both the water and hydrocarbon dewpoint, will keep the sample in gas phase.

1. Follow gas shut down procedure as shown in section 3.2.2, “Shut Down” on page 29, to depressurize the system. Monitor the sample system's pressure gauge's readings to drop to zero.
2. Turn the filter cap counter-clockwise. You might need to use a channel-lock wrench to assist in loosening the cap.

Figure 66: Removing the Filter Cap

6.3 Replacing the Membrane Filter (cont.)

3. Place the filter cap on a horizontal flat surface, filter side up.

4. Carefully remove the large O-ring.

Note: *The O-rings are reused. Replacement O-rings are not included in the maintenance kit.*

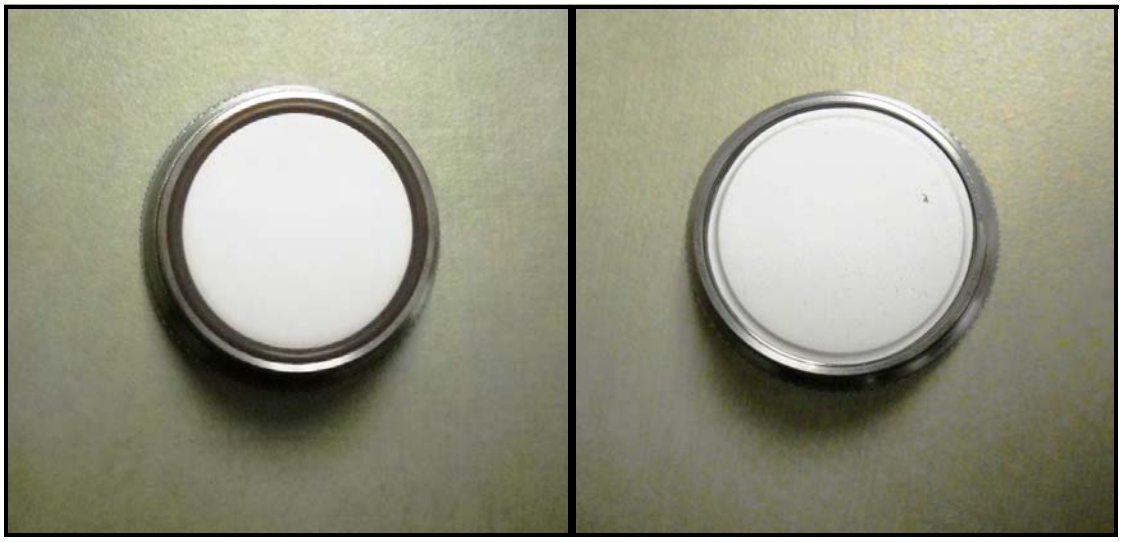


Figure 67: Orient the Filter Cap and Remove the Large O-Ring

5. Remove the white membrane filter element and the membrane backing plate.

Figure 68: Remove the White Filter Element and the Membrane

6.3 Replacing the Membrane Filter (cont.)

6. Remove the small O-ring.

Figure 69: Remove the Small O-ring

7. Using a tissue, clean the filter components.

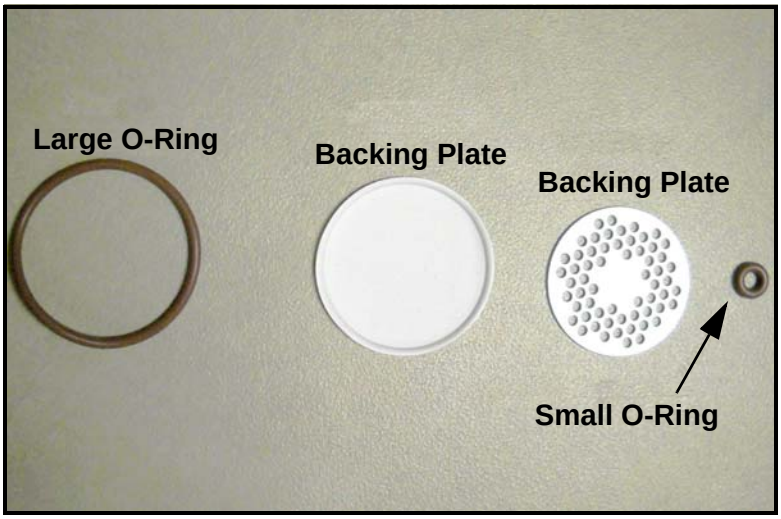


Figure 70: O-Rings and Backing Plates Removed

8. If optional Aurora Trace Maintenance Kit is available, replace the used membrane with a new one (463-111). Re-assemble the filter. Make sure the smooth side of membrane faces outside. Reinstall the cap hand-tight.

6.4 Vacuum Pump Maintenance

A six-month inspection and replacement cycle for the vacuum pump's diaphragm is recommended to ensure successful operation. During inspection, in some cases, if the valve flapper shows any sign of material degradation or deformation (see 6.4.3, step 3.b) or the pump head gasket is suspected to be leaky, (which usually do not happen frequently), it is suggested that steps 4 through 8 be followed to replace valve flappers (qty=2), valve stop and the head gasket. Otherwise, if only diaphragms have to be changed, (which is the case most of the time), skip steps 4 through 8.

6.4.1 Items Required (you need Vacuum Pump Diaphragm Kit)

- Personal protective equipment
- Allen wrenches (1/4", 5/32" and 1/16"), from **Vacuum Pump Diaphragm Kit (705-1522-00)**
- Pump Diaphragm & Gasket Kit (461-102), from **Vacuum Pump Diaphragm Kit (705-1522-00)**
- Loctite Removable 242 (or equivalent), from **Vacuum Pump Diaphragm Kit (705-1522-00)**
- Nylon Mesh Abrasive Hand Pad (403-173), from **Vacuum Pump Diaphragm Kit (705-1522-00)**

6.4.2 Optional Items:

- Torque wrench(es) (70 in-lbs and 150 in-lbs)
- Flat-bladed screwdriver

6.4.3 Maintenance and Inspection Procedure

Note: *Estimated time of completion = 15 min.*

Note: *During maintenance and inspection, protect the vacuum pump from the ingress of dirt, sand, water, or any other contaminating particles.*

1. Turn the power switch to the OFF position to de-energize the vacuum pump and turn off power supply to the pump.
   a. Follow any necessary lockout/tagout procedures.
2. Follow gas shut down procedure (section 3.2.2 on page 29) to depressurize the system. Monitor the sample system's pressure gauge's readings to drop to zero. Disconnect the vacuum pump's exhaust line.
3. Remove the head section by unscrewing the four 1/4" socket head cap screws using a 1/4" Allen wrench (see Figure 71, labeled A)
   a. A flat-bladed screwdriver may be needed to gently pry the head free of the diaphragm.

6.4 Vacuum Pump Maintenance (cont.)

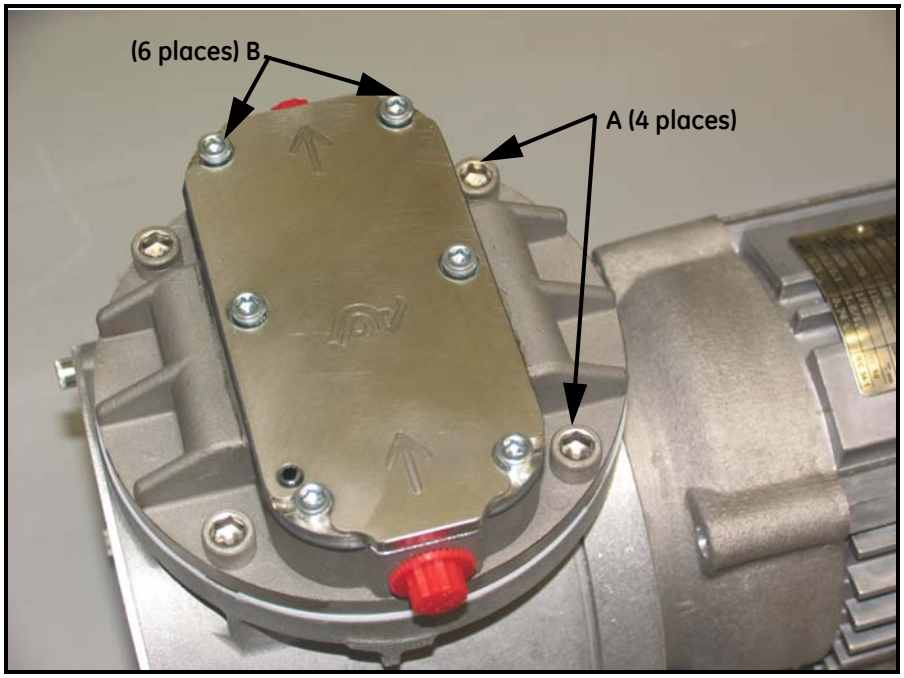


Figure 71: Locating the Head Section Screws and Socket Head Screws

b. Flip over the head section. If the surface area that is in contact with diaphragm has residue left from pump operation, use the Nylon Mesh Abrasive Hand Pad (403-173) to completely remove the residue on the surface.

If the valve flapper shows any sign of material degradation or deformation, or the pump head gasket is suspected to be leaky (which usually do not happen frequently), continue to step 4 to replace valve flappers (qty=2), valve stop and head gasket. If not, skip steps 4 through 8 and continue with step 9.

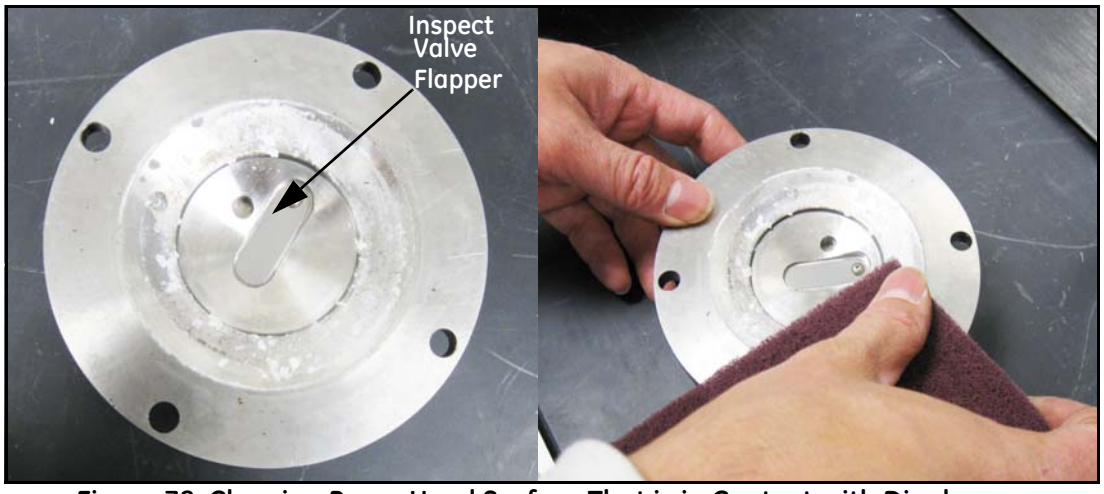


Figure 72: Cleaning Pump Head Surface That is in Contact with Diaphragm

Use clean compressed air to blow away all dust from the cleaning process.

6.4 Vacuum Pump Maintenance (cont.)

4. Remove the valve cover from the head by unscrewing the six 5/32” socket head cap screws using a 5/32” Allen wrench (see Figure 71, labeled B)

a. For further explanation, reference Figure 73.

Figure 73: Removing the Head Section and Socket Head

5. Remove the gasket from the valve cover and discard (see Figure 74).

Figure 74: Removing the Valve Cover Gasket

6.4 Vacuum Pump Maintenance (cont.)

6. The valve flappers (see Figure 75, labeled C) and valve stop (see Figure 75, labeled D) can then be removed by unscrewing the two 1/16” Allen screws using a 1/16” Allen wrench (see Figure 75, labeled E).

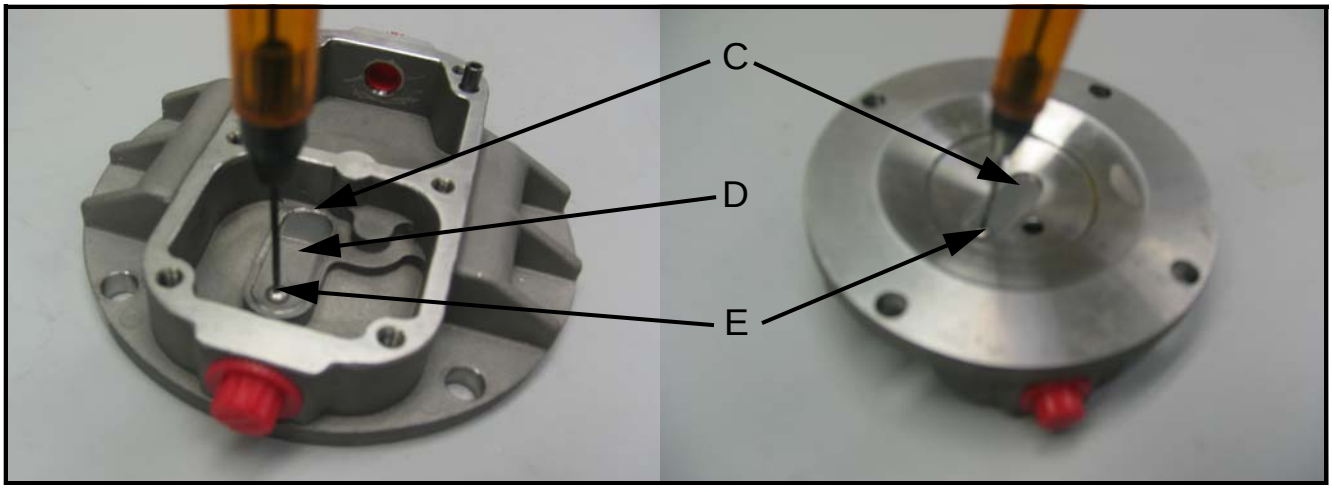


Figure 75: Removing the Flapper Valves and Valve Stop

7. Once the flapper valves (and valve stop) have been removed from the head, clean all internal surfaces from any accumulation of dirt. Install the two new valve flappers and valve stop, and tighten the two 1/16” Allen screws using a 1/16” Allen wrench.

a. Apply one drop of Loctite® Removable 242® on the threads before tightening.

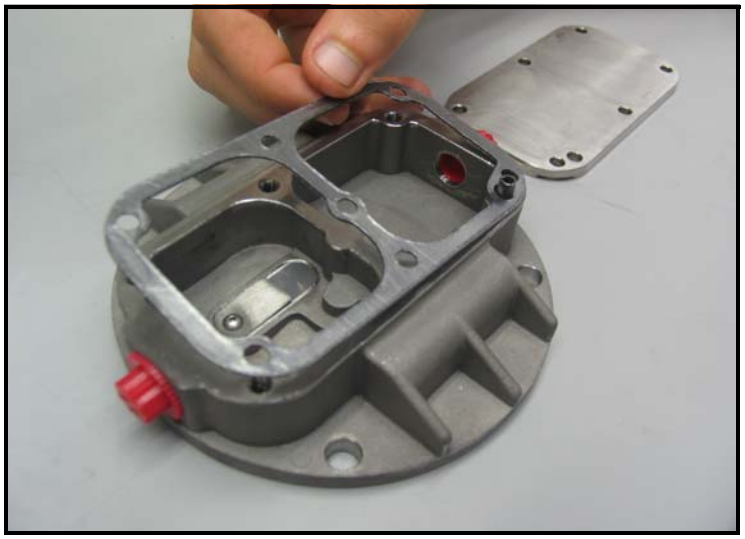


Figure 76: Installing the New Valve Cover Gasket

8. Install the new gasket on the head, mount the valve cover, and tighten the six 5/32” socket head cap screws to approximately 70 in-lbs using a 5/32” Allen wrench.

a. Apply one drop of Loctite® Removable 242® on the threads before tightening.

b. Tighten the socket head cap screws evenly, in an alternating pattern.

6.4 Vacuum Pump Maintenance (cont.)

9. The diaphragm is secured by the single screw in its center. Remove the 5/32” screw with a 5/32” Allen wrench (see Figure 77). The diaphragm and its clamping plate should be easily lifted off.

a. Some light adherence to the metal may occur if the diaphragm has been in use for a long period.

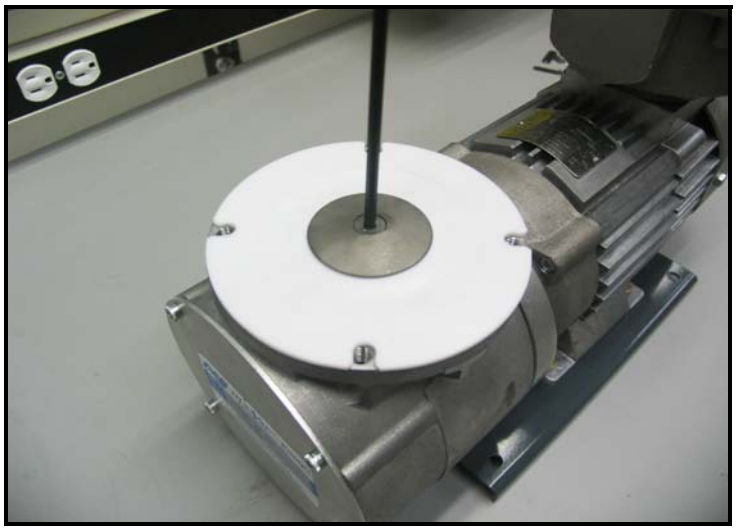


Figure 77: Removing the Diaphragm and Clamping Plate

10. Install the new diaphragm and mount the clamping plate. Before inserting the diaphragm cap screw, apply a PTFE washer seal (see Figure 78, labeled G) (do not use PTFE tape), then tighten the 5/32” screw to approximately 70 in-lbs using a 5/32” Allen wrench.

a. Apply one drop of Loctite® Removable 242® on the threads before tightening.

b. When replacing the diaphragm, be sure the four 1/4” socket head cap screw holes on the housing are aligned with the diaphragm holes before the part is clamped in place. Be sure the diaphragm plate is firmly replaced with its center screw.

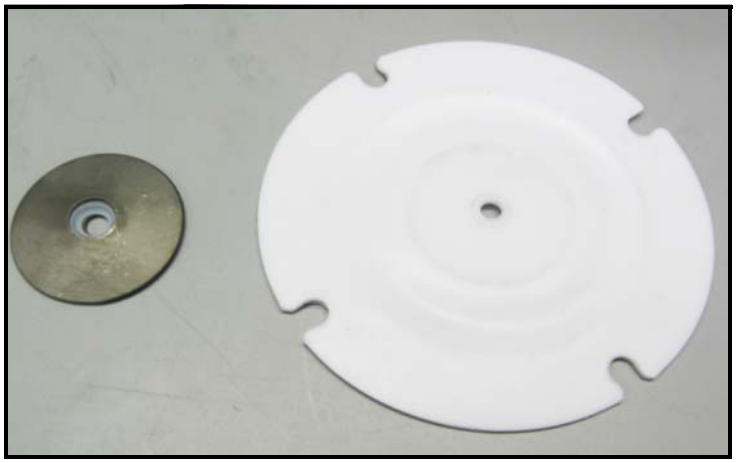


Figure 78: Installing the New Diaphragm and Clamping Plate

6.4 Vacuum Pump Maintenance (cont.)

11. Mount the head section and tighten the four 1/4” socket screws to approximately 150 in-lbs using a 1/4” Allen wrench.

a. Apply one drop of Loctite® Removable 242® on threads before tightening.

b. Tighten the socket head cap screws evenly, in an alternating pattern.

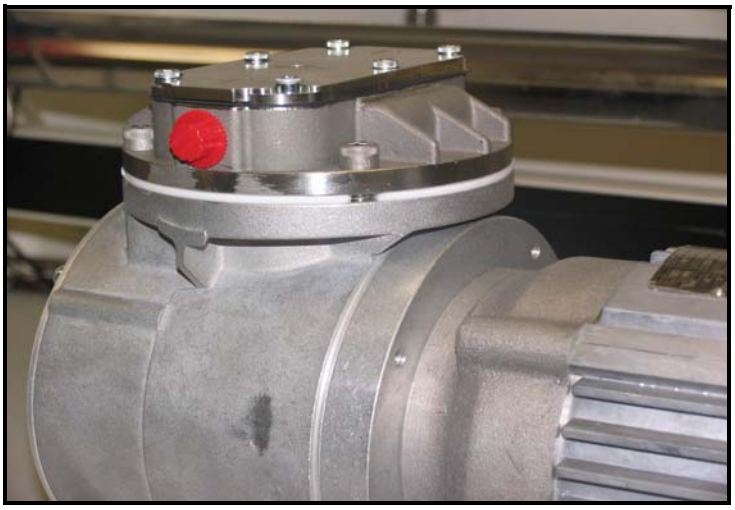


Figure 79: Remounting the Head Section

12. Reconnect the vacuum pump's exhaust line.

13. Follow any necessary lockout/tagout procedures.

14. Follow any gas start-up procedures and make sure the pump is operable after the maintenance and inspection.

6.5 Verification System Permeation Tube Replacement

6.5.1 Maintenance and Inspection Interval

For normal usage, an inspection and replacement cycle every two years for the verification system's permeation tubes is recommended to ensure successful operation.

6.5.2 Maintenance and Inspection Equipment

Required:

- Personal protective equipment
- Allen wrench (qty=1, 240-317, 9/64”, Ball-Point Hex L-Keys, 4" long), from **Verification System Perm Tube and Purifier Replacement Kit (705-1521-00)**
- Permeation tubes (qty = 2, 790-222, with calibration factor in PPM from factory), from **Verification System Perm Tube and Purifier Replacement Kit (705-1521-00)**
- Insulation for Permeation Tubes (qty=1, 421-3432), from **Verification System Perm Tube and Purifier Replacement Kit (705-1521-00)**

6.5.3 Maintenance and Inspection Procedure

Estimated time of completion = 45 min

Note: *During maintenance and inspection, protect the verification system from the ingress of dirt, sand, water or any other contaminating particles.*

1. Turn the power switch to the vacuum pump, located under the SS enclosure, to OFF position.
2. Follow the gas shut down procedure in section 3.2.2 on page 29 to depressurize the system.
3. Turn the power supply to the vacuum pump and the analyzer OFF.
   a. Follow any necessary lockout/tagout procedures
4. Open the front cover of the verifier's enclosure and wait 20 minutes for verifier to cool down (Figure 80).

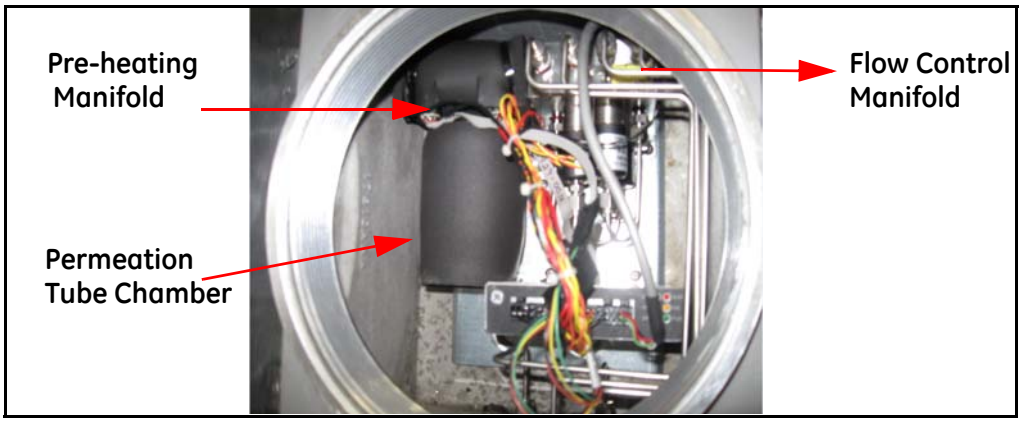


Figure 80: Verifier Interior

6.5 Verification System Permeation Tube Replacement (cont.)

5. Use one hand to hold the pre-heating manifold and use the other hand to gently remove the insulation around the permeation tube chamber (Figure 81).

WARNING! **The permeation tube chamber and pre-heating manifold are attached to the flow control manifold by seven plastic bolts and two steel bolts. Applying too much force on the permeation tube chamber when removing the insulation may break the plastic bolts and damage the verifier.**

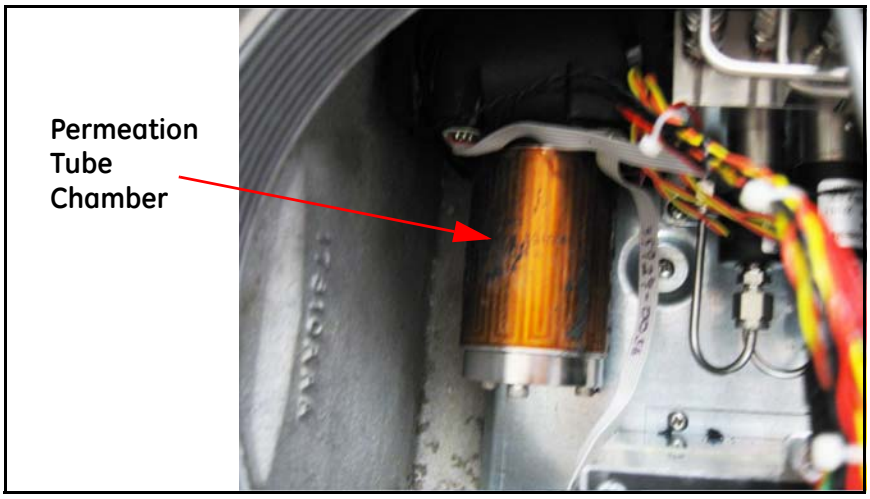


Figure 81: Removing Insulation

6. Use the 9/64” Allen wrench to loosen the three bolts slightly at the bottom of the permeation tube chamber.

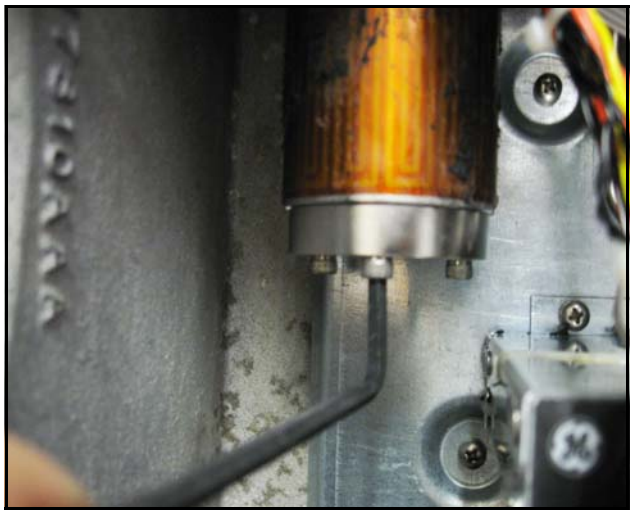


Figure 82: Using the Allen Wrench

7. Once slightly loosened by Allen wrench, the three bolts can be easily loosened further by hand. Keep the three bolts engaged with the chamber cover.

6.5 Verification System Permeation Tube Replacement (cont.)

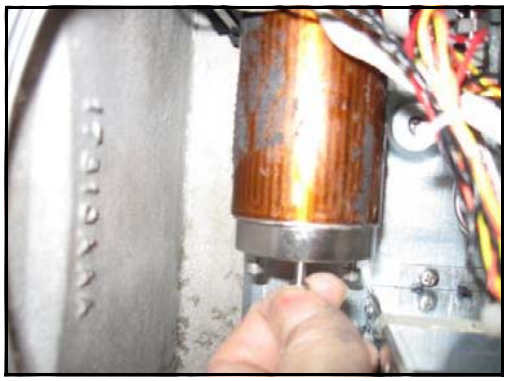


Figure 83: Hand-loosening Bolts

8. Carefully lower the cover with two permeation tubes in it from the chamber.

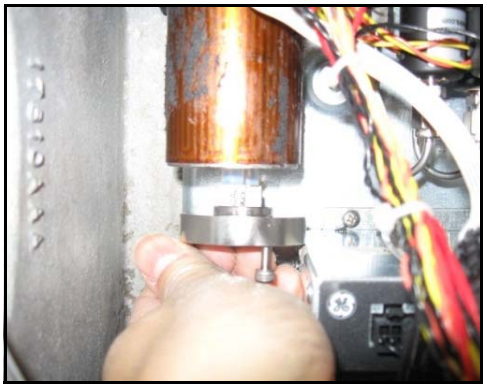


Figure 84: Lowering the Cover and Tubes

9. Check water level inside the permeation tubes. If both tubes have at least 50% of water, there is no need to replace them; if at least one of the tubes has less than 25% of water, they both need to be replaced.

Figure 85: Water in Permeation Tubes

6.5 Verification System Permeation Tube Replacement (cont.)

10. The new permeation tubes are packaged in a clean container with a label on it. Remove the permeation tubes from container by grabbing both ends of the tubes at the same time.

WARNING! **Do not touch or contaminate the PTFE membrane - the middle section of the tube.**

Figure 86: New Permeation Tubes

11. Carefully replace the old permeation tubes with the new ones. Re-install the cover back to the permeation tube chamber.

Figure 87: Reinstalling Cover

6.5 Verification System Permeation Tube Replacement (cont.)

12. Finger tight the three bolts first.

Figure 88: Tightening the Bolts

13. Use the 9/64” Allen wrench to tighten the three bolts. Make sure you have metal to metal contact between cover and chamber.

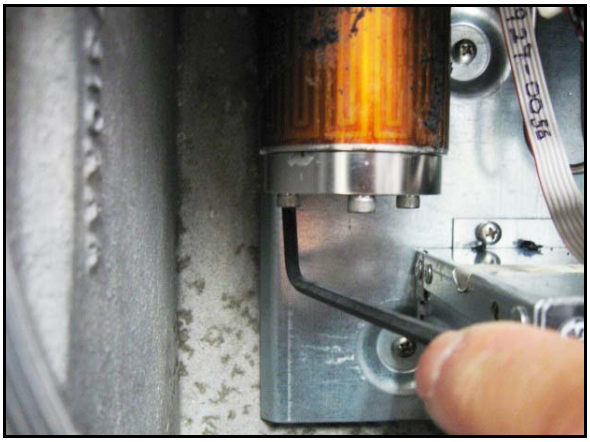


Figure 89: Using the Allen Wrench

6.5 Verification System Permeation Tube Replacement (cont.)

14. Discard the old insulation. Install the new insulation gently.

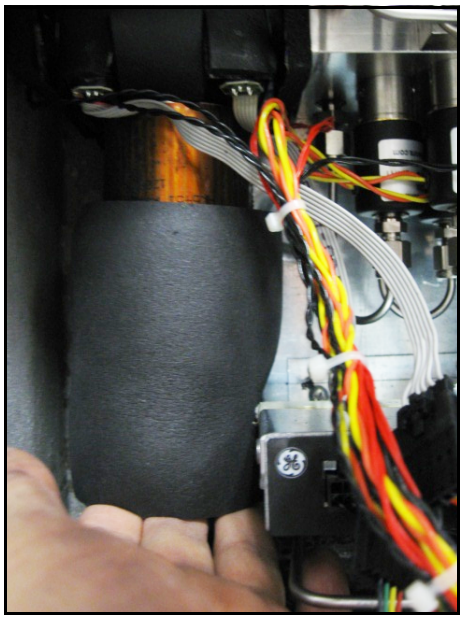


Figure 90: Installing Insulation

15. The permeation tube chamber should resemble Figure 91 below after insulation is re-installed.

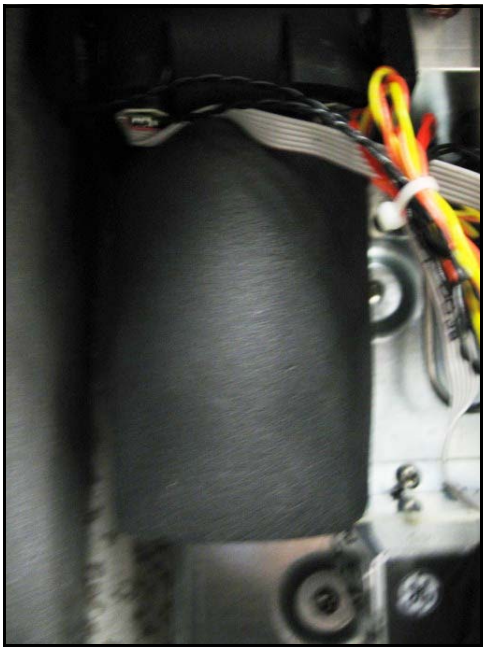


Figure 91: Complete Installation

16. Follow any necessary lockout/tagout procedures.

17. Follow the procedures in section 2.8 on page 17 and section 2.9 on page 21 in Chapter 2 to start up the analyzer.

6.5 Verification System Permeation Tube Replacement (cont.)

18. Go to **Main Menu/Setting/Verifier/Settings/Span-Zero** on the analyzer display and program the new permeation tubes' factory calibrated moisture emission rate in PPM. The replacement of permeation tubes is complete.

19. The verification process must be repeated at least four times to remove any atmospheric contaminants in the new permeation tubes before you can expect a valid verification process.

6.6 Verification System Gas Purifier Maintenance

6.6.1 Maintenance and Replacement Interval

For normal usage, a replacement cycle every two years for the verification system's gas purifier is recommended to ensure successful operation.

6.6.2 Maintenance and Replacement Equipment Required

- Personal protective equipment
- 3/4” and 1-3/8” Wrenches
- Gas Purifier (qty = 1, 463-089), from **Verification System Perm Tube and Purifier Replacement Kit (705-1521-00)**
- Gasket 1/4VCR SS (qty=2, 255-220-02), from **Verification System Perm Tube and Purifier Replacement Kit (705-1521-00)**

Figure 92: Gas Purifier

WARNING! **The gas purifier is sealed with a VCR end cap on each end. Minimize exposure to atmosphere when loosening or removing the VCR fittings. Do not remove the VCR fittings until indicated in these instructions.**

6.6.3 Replacement Procedure

Estimated time of completion = 10 min

Note: *During maintenance and replacement, protect the disconnected sample lines and gas purifier's inlet and outlet from the ingress of dirt, sand, water or any other contaminating particles.*

1. Turn the power switch to the vacuum pump, located under the SS enclosure, to OFF position.

2. Follow the gas shut down procedure in section 3.2.2 on page 29 to depressurize the system.

6.6 Verification System Gas Purifier Maintenance (cont.)

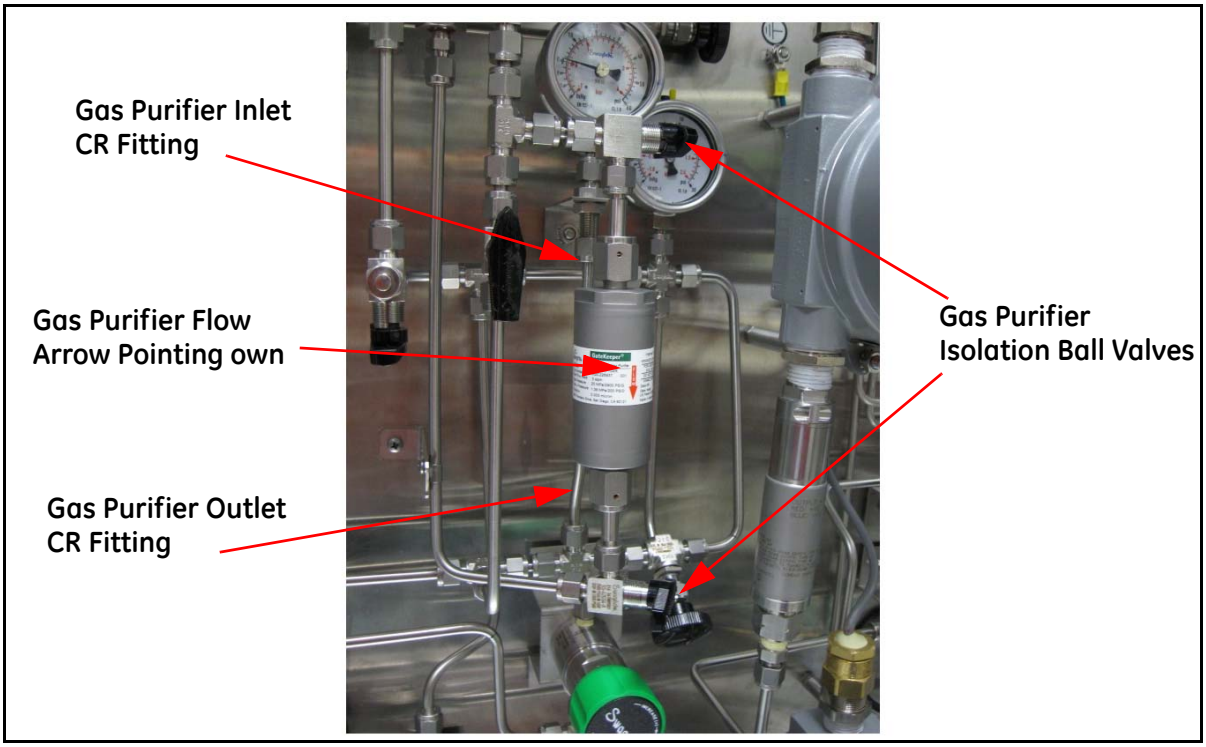


Figure 93: Gas Purifier Components

3. Completely shut off the gas purifier's isolation ball valves.
4. Use a 1-3/8” wrench to hold gas purifier stationary and use a 3/4” wrench to disconnect the two VCR fittings on both ends of the purifier. Remove the purifier and the two metal gaskets.
5. Remove the new purifier from the sealing bag. Orient the new purifier in the gas line so that the flow arrow pointing down.
6. Remove the purifier inlet cap. Insert a new metal gasket (255-220-02) for the inlet and hand tighten the connection. **Never reuse the metal gasket.**
7. Remove the purifier outlet cap. Insert a new metal gasket (255-220-02) for the outlet and hand tighten the connection. **Never reuse the metal gasket.**
8. Use a 1-3/8” wrench to hold the purifier stationary. Using a 3/4” wrench, tighten the inlet and outlet connections an additional 1/8 of a turn pass finger tight to complete each face seal fitting. Do not over tighten as this may cause damage to the fittings. **DO NOT TURN/ROTATE THE PURIFIER.** The purifier installation is complete.
9. Turn on both isolation valves for the purifier. Turn on the inlet sample isolation valve. Turn the power switch to the vacuum pump, located under the SS enclosure, to the ON position and follow proper start-up procedure.
10. The verification process must be repeated at least four times to remove any atmospheric contaminants in purifier before you can expect a valid verification process.

6.7 Replacement of In-line Particulate 90-micron Filters (255-1217) for Multi-pass Cell

Replacement Interval: varies

The two 90-micron in-line filters are installed to prevent any contamination to the multi-pass cell from sample gas. Their replacements are necessary only when there is indication that they may be clogged due to contamination. Consult factory when this happens.

6.7.1 Maintenance and Replacement Equipment Required

- Personal protective equipment
- 9/16” and 3/4” Hex Wrenches
- 90-micron Stainless Steel In-Line Particulate Filters (qty = 2, 255-1217), from **Aurora Trace Filter Kit (705-1523-00)**
- Minimize the exposure to atmosphere when loosening or removing the 90-micron filters. Do not remove the 90-micron filters until indicated in these instructions.

6.7.2 Replacement Procedure

Estimated time of completion = 10 min

Note: *During maintenance and replacement, protect the disconnected sample lines and 90-micron filter's inlet and outlet from the ingress of dirt, sand, water or any other contaminating particles.*

1. Turn the power switch to the vacuum pump, located under the SS enclosure, to OFF position.
2. Follow the gas shut down procedure in section 3.2.2 on page 29 to depressurize the system.
3. Use a 3/4” wrench to hold filter stationary and use a 9/16” wrench to disconnect the two Swagelok fittings on both ends of the filter. Remove the filter.

6.7 Replacement of In-line Particulate 90-micron Filters (255-1217) for Multi-pass Cell (cont.)

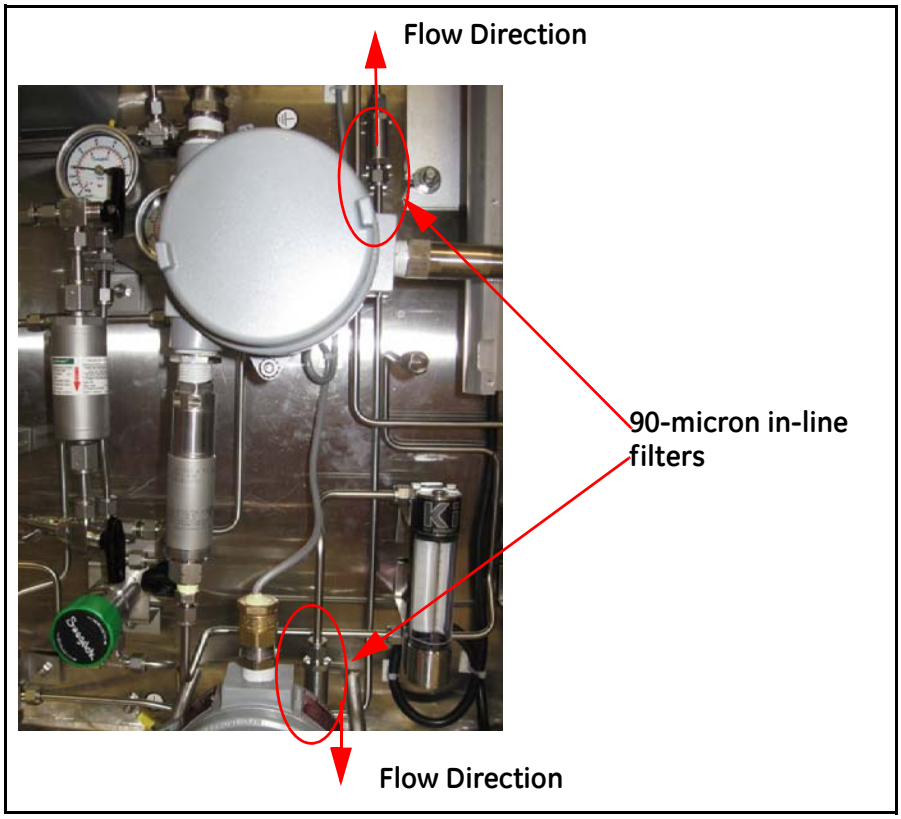


Figure 94: In-line Filters

4. Orient the new filter in the gas line so that the flow arrow matches the flow direction in Figure 12.
5. Use a 3/4” wrench to hold the filter stationary. Using a 9/16” wrench, rotate the nuts for the filter's inlet and outlet to the previously pull-up positions. Tighten the connections slightly. Do not over tighten as this may cause damage to the fittings. **DO NOT TURN/ROTATE THE FILTER.**
6. Repeat steps 3 - 5 for the other filter. The 90-micron filters replacement is complete.
7. Turn on the inlet sample isolation valve. Turn the power switch to the vacuum pump, located under the SS enclosure, to the ON position and follow proper start-up procedure.
8. The 90-micron filters must be purged to remove any atmospheric contaminants in the filters before a valid moisture measurement is expected.

6.8 Replacement of Orifice Restrictor (255-1100) for Multi-pass Cell

Replacement Interval: varies

The orifice restrictor is installed to generate a vacuum pressure of 2.5psia for the sample gas in the multi-pass cell. Its replacement is necessary only when there is indication that it may be clogged due to contamination. Consult the factory when this happens.

6.8.1 Maintenance and Replacement Equipment Required

- Personal protective equipment
- 9/16” and 1/2” Hex Wrenches
- Stainless Steel Orifice Restrictor (255-1100), from **Aurora Trace Filter Kit (705-1523-00)**
- Minimize the exposure to atmosphere when loosening or removing the orifice restrictor. Do not remove the orifice restrictor until indicated in these instructions.

6.8.2 Replacement Procedure

Estimated time of completion = 10 min

Note: *During maintenance and replacement, protect the disconnected sample lines and the orifice restrictor's inlet and outlet from the ingress of dirt, sand, water or any other contaminating particles.*

1. Turn the power switch to the vacuum pump, located under the SS enclosure, to OFF position.
2. Follow the gas shut down procedure in section 3.2.2 on page 29 to depressurize the system.
3. Use 1/2” wrench to hold the orifice restrictor and use a 9/16” wrench to disconnect the two Swagelok fittings on both ends of the orifice restrictor. Remove the orifice restrictor.
4. Identify the new orifice restrictor inlet side by Figure 14 and orient the orifice restrictor in the gas line so that it is consistent with the flow direction (Figure 13).
5. Use the 1/2” wrench to hold the orifice restrictor stationary. Using 9/16” wrench, rotate the nuts for the orifice's inlet and outlet to the previously pull-up positions. Tighten the connections slightly. Do not over tighten as this may cause damage to the orifice. **DO NOT TURN/ROTATE THE ORIFICE RESTRICTOR**. The orifice restrictor replacement is complete.

6.8 Replacement of Orifice Restrictor (255-1100) for Multi-pass Cell (cont.)

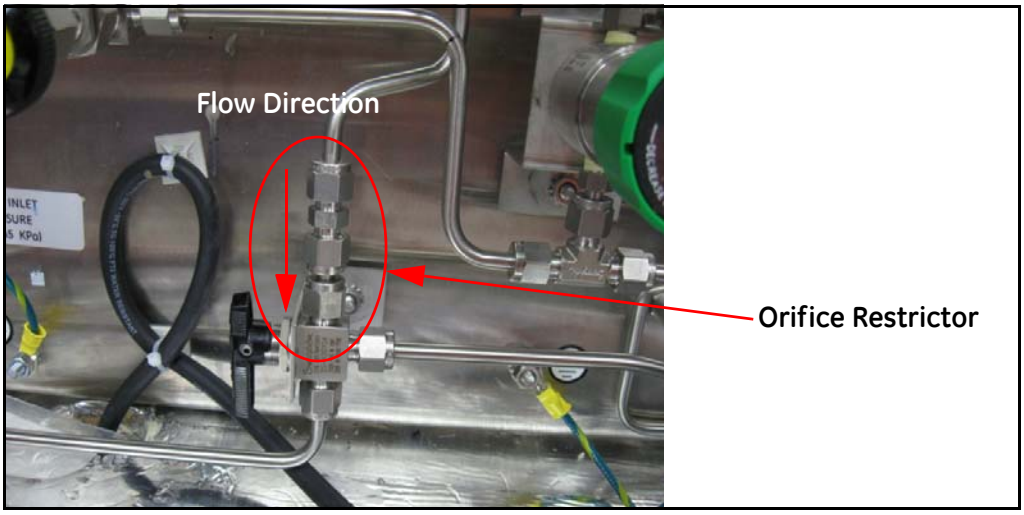


Figure 95: Orifice Restrictor

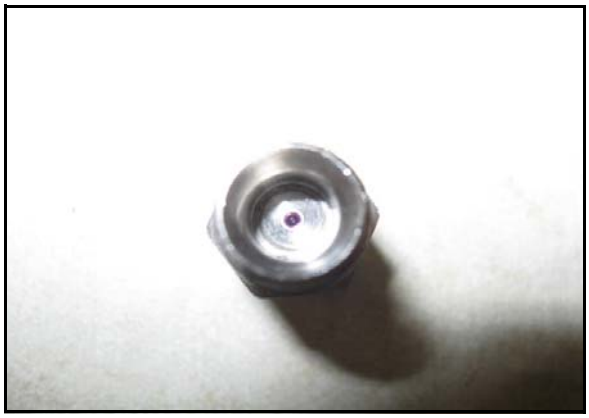


Figure 96: Restrictor View from Inlet (Flat Side of Orifice Insert)

6. Turn on inlet sample isolation valve. Turn the power switch to the vacuum pump, located under the SS enclosure, to ON position and follow proper start-up procedure.
7. The orifice restrictor must be purged to remove any atmospheric contaminants in the restrictor before a valid moisture measurement is expected.

Chapter 7. Troubleshooting

7.1 Introduction

The following are possible **Aurora Trace** analyzer conditions with details on how to deal with them.

7.2 Blank Display

1. Is the green POWER LED lit?

a. Yes - proceed to **2**.

b. No - Check wiring and fuse

2. Are the four arrow keys illuminated?

a. Yes - If the keys remain illuminated for more than 12 seconds, the Boot Loader cannot find a valid Instrument Program to run.

b. No - contact the factory for service.

7.3 Display Dim or Hard to Read

Adjust the LCD brightness and contrast using the Display/Adjust menu.

7.4 Status Messages and Indicators

1. The **Aurora Trace** categorizes status messages as either Faults, Warnings, or Information. Status messages are displayed in the upper right corner of the display. Messages that are longer than the message area continuously scroll from right to left.
2. A fault is a non-recoverable condition that can affect the quality of measurement by the **Aurora Trace**. Fault messages are accompanied by a rapid flashing (!) indicator.
3. A warning is a recoverable condition that can affect the quality of measurement by the **Aurora Trace**. Warning messages are accompanied by a slow flashing (!) indicator.
4. Information messages alert the operator to a condition that is abnormal, but does not affect the quality of measurements. Info messages are accompanied by a slow flashing (**i**) indicator.
5. **Aurora Trace** fault and status messages are prioritized; in case of more than one fault/status condition, the condition with the highest priority will be displayed. When that condition is resolved, the next highest priority condition will display.

Table 3: Status Messages and Indicators

Message	Condition	Description
Status OK	**Info**	**Aurora Trace** is operating normally, no faults or other indications.
No CH4 detected	**Info**	**Aurora Trace** is reading moisture, but cannot detect the presence of methane.
H2O Under Range	**Info**	The moisture level is below the system detection limits.
No Calibration	**Info**	The **Aurora Trace** has not completed factory calibration, or the calibration data has been erased.
Weak Signal Return	**Info**	**Aurora Trace** could not detect a signal returned from the Multipath Cell, or the signal is below allowed limits.
Signal Saturated	**Info**	The signal returned from the Multipath Cell is at saturation. Verify that the system is not sampling atmospheric moisture.
TEC Adjust at Limits	**Info**	The Signal Temperature Compensation has reached its limits. Verify that the Multipath Cell Heater is functioning properly.
ATTN - Cell Temp Unstable	**Info**	The Multipath Cell temperature is outside its setpoint by more than 10 percent. This message will appear for thirty minutes to one hour from cold start, as the Multipath Cell heater brings the cell to the operating temperature. If the enclosure is left open, extreme temperature fluctuations may trigger this message.
ATTN - Cell Pressure out of Range	**Info**	The pressure in the Multipath Cell is outside the ideal range of 13.8 – 19.3 kPa (2.0 – 2.8 PSIa). The **Aurora Trace** remains capable of making accurate measurements, but this is an indication of insufficient or excess vacuum. Refer to the Startup Procedure or Troubleshooting section for corrective actions.

Table 3: Status Messages and Indicators (cont.)

Laser Temp Unstable...	**Warning**	The temperature of the laser is not stable. This warning occurs briefly at power on, as the **Aurora Trace** sets the correct operating temperature. The laser is powered off until the temperature has stabilized.
WARNING - Sample Pressure TOO HIGH	**Warning**	The pressure in the Multipath Cell exceeds 212 kPa (30.75 PSIa). Verify regulator and flow settings; check for blocked vent line or excessive back pressure.
WARNING - Cell Pressure Limits Accuracy	**Warning**	The pressure in the Multipath Cell exceeds 27.6 kPa (4.0 PSIa). Pressure broadening will affect the accuracy of the moisture reading. This is an indication of insufficient vacuum. Refer to the Startup Procedure or Troubleshooting section below for corrective actions.
FAULT: System Overheating	**Fault**	The temperature inside the electronics module exceeds 85°C (185°F) or the air temperature inside the sample system enclosure exceeds 68°C (154°F). The laser is powered off until the electronics module temperature is below 80°C, and the sample system enclosure temperature is below 65°C.
FAULT: Laser Reference	**Fault**	**Aurora Trace** could not detect any signal from the laser. Contact the factory for assistance.
FAULT: Temperature	**Fault**	The temperature transducer is operating out of limits, is disconnected, or has failed.
FAULT: Sample Pressure	**Fault**	The internal (sample) pressure transducer is operating out of limits, is disconnected, or has failed.
FAULT: Line Pressure	**Fault**	The external (line) pressure transmitter is operating out of limits, is disconnected, or has failed. Occurs if source of the line pressure measurement is set to “Live”, and no pressure transmitter is attached.
Service Req: ###	**Fault**	**Aurora Trace** has detected a fault condition that has no associated status message. Contact the factory for assistance.

7.5 No Flow Measurement Indicated on Aurora Trace Measurement Cell Outlet

Check to make sure that the outlet of the **Aurora Trace** is venting to atmospheric pressure. Ensure that the sample system valves are configured correctly and that the **Aurora Trace** internal pressure regulator is capable of a barely positive pressure setting. Check/Replace the filter element in the coalescer/filter as detailed in Chapter 5, *Maintenance*.

7.6 Background Selection Lockout

To prevent accidental selection or tampering, the Background selection can be disabled using a mechanical switch located behind the **Aurora Trace** display. Access to the switch requires removal of the cover, and should be performed only in the absence of hazardous conditions.

Note: *Unless otherwise requested, the Aurora Trace is shipped from the factory with the Background Selection* ***unlocked****.*

The Lockout switch is positioned to the right of the Laser Indicator (see Figure 97).

When the switch is in the UP position, the Background Selection menu is **unlocked**. When the switch is in the DOWN position, the Background Selection menu is **locked**.

Figure 97: Background Selection Lockout Switch Location

Attempting to access the Background Gas Selection menu with the switch in the Locked Out (down) position will result in the following message displayed:

```
Menu:x
Gas select is locked.
Use Gas Lockout
switch to unlock.
```

Appendix A. MODBUS RTU / RS485 Communications

The **Aurora Trace** supports digital communications using the Modbus/RTU protocol, with 2-wire RS-485 or 3-wire RS-232C as the physical layer. Data rate can be specified from 1200 to 115200 bits per second (bps), with selectable parity.

Aurora Trace has two physically separate communications ports. Both ports can be selected for either RS-232 or RS-485 operation. **Aurora Trace** can communicate with both ports simultaneously.

Aurora Trace supports the Modbus/RTU protocol as defined in:

MODBUS Application Protocol Specification, V1.1b
&
MODBUS over Serial Line Specification and Implementation Guide V1.02.

These specifications are available from the Modbus Organization at http://modbus-ida.org/

The functions supported by **Aurora Trace** are:

(0x03) Read Holding Registers
(0x04) Read Input Registers
(0x08) Diagnostics (Serial Line only) - only supports Echo subcommand
(0x10) Write Multiple registers
(0x11) Report Slave ID (Serial Line only)
(0x2B/0x0E) Read Device Identification - only supports Basic Device Identification tags, which are:

- VendorName
- Product code
- Revision number

Aurora Trace supports data types of Short, Integer and Double/Float. Shorts are always two (2) bytes and should be read with request for one register. Integers are always four (4) bytes and should be read with request for two registers (two bytes per each register, two registers total) at the address. Double/Float type will provide eight (8) byte double precision data or four (4) byte single precision data. This depends on how many registers are requested; four registers for double, two registers for single precision reading.

All registers denoted with a bullet (•) in the Read-Only column are read-only registers and should be read with function "Read Input Registers." All other registers can be read and written with "Read Holding Registers" or "Write Multiple Registers."

Table 4 on page 134 is the Modbus Register Address map supported by **Aurora Trace.**

Table 4: Modbus Register Map

WARNING! **Changing the values in service registers can negatively impact the accuracy and performance of Aurora.**

Function	Parameter		Range/State	Addr	Data Type	Read Only
System Status[1]	Status Register			0	Integer	•
	Status Register, Latched	Write 0 to clear		1000	Integer	
Foundation Fieldbus	PV	Primary Variable Value	Moisture Measurement 1	500	Float	
	SV	Secondary Variable Value	Moisture Measurement 2		Float	
	TV	Tertiary Variable Value	Temperature		Float	
	QV	Quatinary	Pressure		Float	
	PV Unit	Primary Variable Unit Code	Moisture 1		Short	
	SV Unit	Secondary Variable Unit Code	Moisture 2		Short	
	TV Unit	Tertiary Variable Unit Code	Temperature		Short	
	QV Unit	Quatinary	Pressure		Short	
	Primary Dew Point Select	Primary Dew Point Select	Dew Point - Equivalent Dew Point		Short	
	Secondary Dew Point Select	Secondary Dew Point Select	Dew Point - Equivalent Dew Point		Short	
	Temperature Select	Temperature Select	Internal/External		Short	
	Pressure Select	Pressure Select	Internal/External		Short	
Verifier Status	Verifier error register. Highest bit is most significant error.				Integer	
Analog Output	Output 1	Trim Sequence Start/Resume Live Output[2]		2100	Integer	
		Units	Reg. address of Meas.	2110	Integer	
		Type	0 = 4-20mA, 1 = 0-20mA	2120	Integer	
		Trim Reading Zero	3.0 ~ 5.2	2140	Double/Float	
		Trim Reading Span	10.0 ~ 22.2	2150	Double/Float	
		Upper of Value	–10000 ~ 10000	2160	Double/Float	
		Lower of Value	–10000 ~ 10000	2170	Double/Float	
		Test	% value of output, 0~100	2180	Double/Float	
	Output 2	Trim Sequence Start/Resume Live Output[2]		2200	Integer	
		Units	Reg. address of Meas.	2210	Integer	
		Type	0 = 4-20mA, 1 = 0-20mA	2220	Integer	
		Trim Reading Zero	3.0 ~ 5.2	2240	Double/Float	
		Trim Reading Span	10.0 ~ 22.2	2250	Double/Float	
		Upper of Value	–10000 ~ 10000	2260	Double/Float	
		Lower of Value	–10000 ~ 10000	2270	Double/Float	
		Test	% value of output, 0~100	2280	Double/Float	

Table 4: Modbus Register Map

WARNING! **Changing the values in service registers can negatively impact the accuracy and performance of Aurora.**

Function	Parameter		Range/State	Addr	Data Type	Read Only
	Output 3	Trim Sequence Start/Resume Live Output[2]		2300	Integer	
		Units	Reg. address of Meas.	2310	Integer	
		Type	0 = 4-20mA, 1 = 0-20mA	2320	Integer	
		Trim Reading Zero	3.0 ~ 5.2	2340	Double/Float	
		Trim Reading Span	10.0 ~ 22.2	2350	Double/Float	
		Upper of Value	–10000 ~ 10000	2360	Double/Float	
		Lower of Value	–10000 ~ 10000	2370	Double/Float	
		Test	% value of output, 0~100	2380	Double/Float	
Alarm	All Alarm Status		0 ~ 7 (Bitfield)	3000	Integer	•
	Alarm 1	Status	0 = Not tripped, 1 = Tripped	3100	Integer	•
		Switch	0 = OFF, 1 = ON	3110	Integer	
		Units	Reg. address of Meas.	3120	Integer	
		Type	Set Point = 0, In Band = 1, Out Band = 2	3130	Integer	
		Upper	Depends on unit type	3140	Double/Float	
		Lower	Depends on unit type	3150	Double/Float	
	Alarm 2	Status	0 = Not tripped, 1 = Tripped	3200	Integer	•
		Switch	0 = OFF, 1 = ON	3210	Integer	
		Units	Reg. address of Meas.	3220	Integer	
		Type	Set Point = 0, In Band = 1, Out Band = 2	3230	Integer	
		Upper	Depends on unit type	3240	Double/Float	
		Lower	Depends on unit type	3250	Double/Float	
	Alarm 3	Status	0 = Not tripped, 1 = Tripped	3300	Integer	•
		Switch	0 = OFF, 1 = ON	3310	Integer	
		Units	Reg. address of Meas.	3320	Integer	
		Type	Set Point = 0, In Band = 1, Out Band = 2	3330	Integer	
		Upper	Depends on unit type	3340	Double/Float	
		Lower	Depends on unit type	3350	Double/Float	

Table 4: Modbus Register Map

WARNING! **Changing the values in service registers can negatively impact the accuracy and performance of Aurora.**

Function	Parameter		Range/State	Addr	Data Type	Read Only
Settings	Adjust	PPM Level	–25.00 ~ +25.00	5210	Double/Float	
		Equivalent Dew Point Type	0 = dew point only. 1 = dew point + frost point		Integer	
		Post Average Filter	1 ~ 1024 samples		Integer	
		Scan Average Filter	1 ~ 512 samples		Integer	
	Gas	Molecular Weight	0 ~ 500.00 g/mole		Double/Float	
		Background Gas	0=nitrogen, 1=methane, 2= MIX1, 3=MIX2, 4=MIX3		Int	
		Z Factor	0.5 ~ 1.5		Double/Float	
	Clock	Hour	0~23	5410	Integer	
		Minutes	0~59	5420	Integer	
		Month	1~12	5430	Integer	
		Date	1~28/29/30/31	5440	Integer	
		Year	2000~2099	5450	Integer	
	External Pressure	Constant	0 ~ 3500.00 kPa	5510	Double/Float	
		Pressure Zero Calibration, mA	0~22 mA	5520	Double/Float	
		Pressure Span Calibration, mA	0~22 mA	5525	Double/Float	
		Pressure Zero Calibration, kPa	0~3500 kPa	5530	Double/Float	
		Pressure Span Calibration, kPa	0~3500 kPa	5535	Double/Float	
		Pressure Source	Constant Value = 0, Live Sensor = 1	5540	Integer	
	Verifier Settings	Dwell Times	Purge 15 ~ 2880 minutes 1 PPM 1 ~ 240 minutes		Integer	
		Track/Hold	0: Track, 1: Hold		Integer	
		Stages	0: Purge Only, 1: Purge & Span		Integer	
		Time Remaining	Minutes Left of Run Minutes Left of Stage		Integer	
		Verifier Is Attached	0: Not attached, 1: Is Attached		Integer	
Device ID	Aurora Trace Serial Number	------	------	8100	8 Character Bytes	•
	Laser Serial Number	------	------	8200	8 Character Bytes	•
	Calibration Date	Month	1~12	8310	Integer	•
		Date	Depends on month	8320	Integer	•
		Year	2000~2100	8330	Integer	•
	System Up Time	MSDate	Uptime, in days	8400	Double/Float	•

Table 4: Modbus Register Map

WARNING! **Changing the values in service registers can negatively impact the accuracy and performance of Aurora.**

Function	Parameter		Range/State	Addr	Data Type	Read Only
Measure-ments	Dew Point	Dew Point °C	------	9110	Double/Float	•
		Dew Point °F	------	9120	Double/Float	•
		Equivalent Dew Point °C	------	9130	Double/Float	•
		Equivalent Dew Point °F	------	9140	Double/Float	•
	Temp	Sample Temperature °C	------	9210	Double/Float	•
		Sample Temperature °F	------	9220	Double/Float	•
	External Pressure	kPa	------	9510	Double/Float	•
		MPa	------	9512	Double/Float	•
		PSIa	------	9520	Double/Float	•
		PSIg	------	9530	Double/Float	•
		kg/cm^2	------	9540	Double/Float	•
		Bars	------	9550	Double/Float	•
		mmHg	------	9560	Double/Float	•
	Internal Pressure	kPa	------	9610	Double/Float	•
		MPa	------	9612	Double/Float	•
		PSIa	------	9620	Double/Float	•
		PSIg	------	9630	Double/Float	•
		kg/cm^2	------	9640	Double/Float	•
		Bars	------	9650	Double/Float	•
		mmHg	------	9660	Double/Float	•
	H_2O Concentration	PPM	------	9710	Double/Float	•
		Lbs MMSCF	------	9720	Double/Float	•
		mg/sm^3	------	9730	Double/Float	•
	Vapor Pressure	kPa	------	9800	Double/Float	•

[1]Address 0 is System Status register, and 1000 is latching version of System Status register. That is, both registers will show the error bit if the error is currently present, but only the latching register will show it if the condition is no longer present. Writing 0 to latching register will clear the error code it contains.

[2]The "Trim Sequence Start/Resume Live Output" registers for the three outputs, (address 2100, 2200, 2300) accept certain values through Write Multiple Register to trim the output current:

1. Write 0 to 2x00 to select the normal mA output (proportional to measurement).
2. Write 1 to 2x00 to reset the mA output trim to factory defaults.

3. Write 2 to 2x00 to output the "zero" current (~4.000 mA) and accept a calibration value written to 2x40.

4. Write 3 to 2x00 to output the "span" current (~20.000 mA) and accept a calibration value written to 2x50.

Note: *Attempting to write to Trim registers 2x40/2x50 without first writing to Trim State register 2x00 will fail with Modbus exception 4.*

At the end of calibration, write 0 to 2x00 to make **Aurora Trace** exit trim mode.

Table 5 lists the System Status codes with corresponding descriptions. It is possible for multiple status codes to be present; the hexadecimal values represent the bit set for a given condition.

Table 5: System Status Codes

Status	Description
0x00000000	**Aurora Trace** is operating normally, no faults or other indications.
0x00000008	**Aurora Trace** is reading moisture, but cannot detect the presence of methane.
0x00000010	The moisture level is below the system detection limits.
0x00000020	The temperature inside the electronics module exceeds 85°C. The laser is powered off until the temperature drops below 80°C.
0x00000040	The temperature transducer is operating out of limits, is disconnected, or has failed.
0x00000080	The internal (sample) pressure transducer is operating out of limits, is disconnected, or has failed.
0x00000100	The external (line) pressure transmitter is operating out of limits, is disconnected, or has failed. Occurs if source of the line pressure measurement is set to "Live", and no pressure transmitter is attached.
0x00000200	Power supply under voltage
0x00000400	System ground fault
0x00000800	The temperature of the laser is not stable. This warning occurs briefly at power on, as the **Aurora Trace** sets the correct operating temperature. The laser is powered off until the temperature has stabilized.
0x00001000	**Aurora Trace** has reached the limit for adjusting the signal gain. Contact the factory for assistance.
0x00002000	**Aurora Trace** has reached the limit for adjusting the TEC temperature. Contact the factory for assistance.
0x00004000	**Aurora Trace** could not detect any signal from the laser reference. Contact the factory for assistance.
0x00008000	**Aurora Trace** could not detect any signal from the laser signal. Contact the factory for assistance.
0x00010000	**Aurora Trace** could not stabilize TEC temperature. Contact the factory for assistance.
0x00020000	**Aurora Trace internal pressure is over 30 psi.**
0x00040000	The TEC temperature is at its allowable limit. Contact the factory for assistance.
0x00080000	Laser DC bias is too high. Contact the factory for assistance.
0x00200000	Gas pressure is below 2.0 psi or above 2.8 psi but less than 4.0 psi.

Table 5: System Status Codes

Status	Description
0x00400000	Gas pressure is above 4.0 psi.
0x1yyyzzzz	Extended Error Code

Appendix B.Using Aurora TRACE with Foundation Fieldbus

B.1 Introduction

Foundation Fieldbus (FF) connectivity is available as an option for the Aurora TRACE. This option permits monitoring Moisture, Temperature, and Pressure readings made by the Aurora TRACE, as well as essential diagnostic values via a two-wire, intrinsically safe, Foundation H1 connection.

B.2 Capabilities

The Aurora TRACE provides four (4) Analog In (AI) function blocks. Two AI blocks are reserved for moisture measurements. One AI is reserved for temperature measurements, and one AI is reserved for pressure measurements.

Standard Transducer (TB) and Resource (RB) function blocks are also included.

Aurora TRACE can publish moisture, temperature, and pressure in any measurement unit already provided.

Complete fault/warning status is provided, simplifying troubleshooting. The Aurora TRACE alarm status is available, expanding on the alarm capabilities included with Foundation Fieldbus.

For systems so equipped, control and status of the Aurora Verifier is available.

The Aurora TRACE provides a terminal block in the increased safety compartment for the H1 Fieldbus connection.

The Aurora TRACE automatically detects when the Fieldbus option is installed, and can verify the presence of an active fieldbus.

B.3 Compatibility

The Aurora TRACE Fieldbus implementation was developed in cooperation with Softing AG, widely recognized as an industry leader in Foundation Fieldbus. Interoperability is assured by compliance with the Foundation Interoperability Test Kit (ITK) 5.0.

A standard set of Device Description / Capabilities files is available from GE or from the Fieldbus Foundation web site at http://www.fieldbus.org .

B.4 Wiring

Suitable twisted-pair cable should be used to connect the Aurora TRACE to the fieldbus. GE recommends that the cable comply with Foundation specification FF-844. At a minimum, the cable must meet the following specifications:

- Shielded twisted pair (18 AWG minimum)
- Maximum resistance of 23.5Ω/km @ 20°C
- Characteristic Impedance of 100Ω +/- 20Ω @ 31.25 kHz
- Signal Attenuation < 3 dB/km @ 39 kHz

B.4 Wiring (cont.)

The Aurora TRACE FF option is bus powered, and therefore **polarity sensitive.** The FF option is protected against damage from reverse polarity, but correct bus polarity must be maintained when making the FF (+) and (-) connections for successful operation.

B.5 Configuration

The Aurora TRACE requires configuration via an appropriate FF tool, which may be Configurator software, a FF-capable DCS or SCADA system, or a Field Communicator.

The Transducer Block (TB) publishes four values. By default, the values published are in Table 6 below.

Table 6: Transducer Block Published Values

Value	Measurement	Units
Primary Value (PV)	Moisture	PPMv
Secondary Value (SV)	Moisture	Dew Point, °C
Tertiary Value (TV)	Temperature	Sample Temperature, °C
Quaternary Value (QV)	Pressure	Sample Pressure, PSIa

Any value (PV/SV/TV/QV) can be assigned to any of the four AI blocks.

Foundation Fieldbus has no concept of measurement type (e.g., moisture vs. temperature). All assignments are made by selecting the units to publish. For example, selecting **°F** for the PV (moisture) will result in the **dew point** in °F being published. Alternately, selecting **°F** for the TV (temperature) will result in the **temperature** in °F being published.

B.5 Configuration (cont.)

For each value, the units selected and the resulting measurement are shown in Table 7 below:

Table 7: Foundation Fieldbus Values

Unit	FF Unit Code	PV	SV	TV	QV
°C	1001	Dew Point, °C	Dew Point, °C	Temperature, °C	---
°F	1002	Dew Point, °F	Dew Point, °F	Temperature, °F	---
Bar[1]	1137	---	---	---	Pressure, Bar (abs)
Bara	1597	---	---	---	Pressure, Bar (abs)
Barg	1590	---	---	---	Pressure, Bar (gauge)[2]
K (Kelvin)	1000	---	---	Temperature, K	---
kg/cm^2	1145	---	---	---	Pressure, kg/cm^2 (abs)
kg/cm^2 a	1557	---	---	---	Pressure, kg/cm^2 (abs)
kPa	1133	Vapor Pressure (P_w), kPa	Vapor Pressure (P_w), kPa	---	Pressure, kPa (abs)
kPaa	1547	---	---	---	Pressure, kPa (abs)
Lbs/MMSCF	1718[3]	Lbs H_2O/MMSCF	Lbs H_2O/MMSCF	---	---
mg/m^3	1672	mg/m^3 H_2O	mg/m^3 H_2O	---	---
mmHg	1157	---	---	---	Pressure, mmHg (abs)
mmHga	1581	---	---	---	Pressure, mmHg (abs)
MPa	1132	---	---	---	Pressure, MPa (abs)
MPaa	1545	---	---	---	Pressure, MPa (abs)
PPB (parts per billion)	1424	PPBv H_2O	PPBv H_2O	---	---
PPM (parts per million)	1423	PPMv H_2O	PPMv H_2O	---	---
PSIa	1142	---	---	---	Pressure, PSI (abs)
PSIg	1143	---	---	---	Pressure, PSI (gauge)

Notes: *1. Unless otherwise indicated, pressure units are assumed to be absolute.*
2. Barg is only available for Line (external) pressure measurement.
3. Approved by the FF working group, ACT and TSC teams 3-Aug-2012.

B.6 Alternate Measurements

For moisture, temperature, and pressure, the Aurora TRACE can publish alternate values. Selector fields are provided in Table 8 below to choose which value is published.

Table 8: Selector Fields

Selector	0	1	2	Notes
Primary Dew Point Select	Dew Point at atmospheric pressure	Equivalent Dew Point (DP at line pressure)	---	Selects atmospheric or equivalent dew point when PV is assigned to °C or °F
Secondary Dew Point Select	Dew Point at atmospheric pressure	Equivalent Dew Point (DP at line pressure)	---	Selects atmospheric or equivalent dew point when SV is assigned to °C or °F
Temperature Select	Sample Temperature	Electronics Temperature	Laser Temperature	Selects Temperature value published as TV
Pressure Select	Sample Pressure	Line Pressure	---	Selects Pressure value published as QV

T

U

V

W

Warranty

Each instrument manufactured by GE Sensing is warranted to be free from defects in material and workmanship. Liability under this warranty is limited to restoring the instrument to normal operation or replacing the instrument, at the sole discretion of GE Sensing. Fuses and batteries are specifically excluded from any liability. This warranty is effective from the date of delivery to the original purchaser. If GE Sensing determines that the equipment was defective, the warranty period is:

- one year from delivery for electronic or mechanical failures
- one year from delivery for sensor shelf life

If GE Sensing determines that the equipment was damaged by misuse, improper installation, the use of unauthorized replacement parts, or operating conditions outside the guidelines specified by GE Sensing, the repairs are not covered under this warranty.

The warranties set forth herein are exclusive and are in lieu of all other warranties whether statutory, express or implied (including warranties or merchantability and fitness for a particular purpose, and warranties arising from course of dealing or usage or trade).

Return Policy

If a GE Sensing instrument malfunctions within the warranty period, the following procedure must be completed:

1. Notify GE Sensing, giving full details of the problem, and provide the model number and serial number of the instrument. If the nature of the problem indicates the need for factory service, GE Sensing will issue a RETURN AUTHORIZATION NUMBER (RAN), and shipping instructions for the return of the instrument to a service center will be provided.
2. If GE Sensing instructs you to send your instrument to a service center, it must be shipped prepaid to the authorized repair station indicated in the shipping instructions.
3. Upon receipt, GE Sensing will evaluate the instrument to determine the cause of the malfunction.

Then, one of the following courses of action will then be taken:

- If the damage is covered under the terms of the warranty, the instrument will be repaired at no cost to the owner and returned.
- If GE Sensing determines that the damage is not covered under the terms of the warranty, or if the warranty has expired, an estimate for the cost of the repairs at standard rates will be provided. Upon receipt of the owner's approval to proceed, the instrument will be repaired and returned.

[no content intended for this page]

GE
Sensing

DECLARATION OF CONFORMITY

DOC-0042, Rev. B

We,

GE Sensing
1100 Technology Park Drive
Billerica, MA 01821
USA

declare under our sole responsibility that the

Aurora Trace Moisture Analyzer

to which this declaration relates, is in conformity with the following standards:

- EN 60079-0: 2009
- EN 60079-1: 2007
- EN 60079-7: 2007
- EN 60529: 1991 +A1: 2000
- II 2 G Ex de IIB T6 Gb, T_a = -20°C to +50°C, IP66; FM11ATEX0052X (FM Global, UK)
- EN 61326-1: 2006, Class A, Table 2, Industrial Locations
- EN 61326-2-3: 2006
- EN 61010-1: 2001, Overvoltage Category II, Pollution Degree 2
- IEC 60825-1

following the provisions of the 2004/108/EC EMC, 2006/95/EC Low Voltage and 94/9/EC ATEX Directives.

The unit listed above and any ancillary equipment supplied with it do not bear CE marking for the Pressure Equipment Directive, as they are supplied in accordance with Article 3, Section 3 (sound engineering practices and codes of good workmanship) of the Pressure Equipment Directive 97/23/EC for DN<25.

May 2013
Issued

Mr. Gary Kozinski
Certification & Standards, Lead Engineer

CE

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