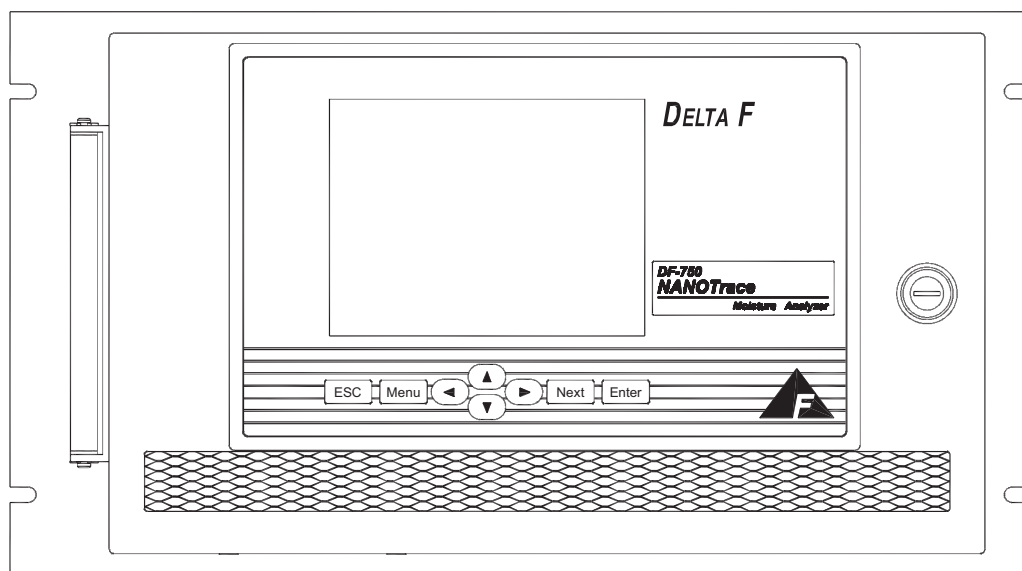


# NanoTrace Moisture Analyzer

## DF-750



## Instruction Manual

Firmware Version 5.2.5



**DELTA F CORPORATION**  
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P/N 99000033  
020911

## **The Delta F Difference**

Your NanoTrace Moisture Analyzer has been designed, manufactured and is supported under the tightest of controls, thus helping to insure the highest possible standards of quality.

Every analyzer that Delta F manufactures is tested and operated on a variety of gas concentrations to insure that it functions properly when you receive it.

The certificate of calibration assures your analyzer has been calibrated on gases that are traceable to NIST standards. With proper maintenance, your analyzer should remain calibrated for years.

For a fast and successful startup, please read this manual carefully. There are important cautions and a number of helpful hints to help you to optimize the operation of your analyzer.

If you have questions, please do not hesitate to call the Delta F Service Line at (781) 935-5808, use our Service FAX Line at (781) 932-0053 or e-mail us at [Service@Delta-F.com](mailto:Service@Delta-F.com).

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# Read Me First...

## Unpacking Procedure

Follow the procedure below to unpack your NanoTrace Moisture Analyzer

1. Examine the condition of the packaging and its contents. If any damage is apparent, immediately notify the carrier and Delta F. Do not proceed with the installation.
2. Check the contents against the packing slip to make sure the shipment is complete. Unattached equipment may be shipped with the analyzer in supplemental packaging. Shortages should be reported to Delta F immediately.
3. All NanoTrace Moisture Analyzers are shipped with the following:

Item	Delta F Part Number
Power cord with 115 VAC connector NOTE: No power cord is supplied with 220 VAC units	59017237
USB Memory Stick, Flash Drive (SONY USM512J)	49600512
VCR Filter Gasket	60300268
Aspirator	14241410
Instruction Manual	99000033

4. Open the analyzer door, remove any shipping materials and verify that nothing has come loose during transit.
5. The analyzer is set at the factory to operate on 120 VAC or 240 VAC. Examine the voltage indicator on the rear panel to verify that the voltage is set as ordered.
6. Save the original container in the event you may need to ship the analyzer to another location or back to the factory (see Shipping in the Service section).

## Installation and Maintenance

The NanoTrace Moisture Analyzer provides years of accurate and dependable service if it is set up, operated and maintained properly. It is essential to make a careful and complete installation as outlined in the *Installation and Start Up* section of this manual. It is assumed that NanoTrace Moisture Analyzer users are familiar with the techniques and precautions associated with Ultra-High Purity (UHP) gas, its plumbing, and devices such as UHP regulators and gas purifiers, and that the analyzer is used as designed and intended.

Unlike much UHP analytical equipment, NanoTrace Moisture Analyzer does not require constant maintenance. However the maintenance intervals for zero

and span calibrations, and purifier maintenance, must be determined and followed carefully.

### **Thank You**

Thank you for selecting the NanoTrace Moisture Analyzer. Delta F designs, manufactures, exhaustively tests, and supports every analyzer under the tightest quality controls. You should expect every Delta F analyzer to arrive in perfect working order and, with good maintenance, provide years of trouble-free service. Please call the Service Phone Line at (781) 935-5808 if you need assistance or if you have suggestions, or use our Service Fax Line at (781) 932-0053 or e-mail us at [Service@Delta-F.com](mailto:Service@Delta-F.com).

# 1 Table of Contents

<b>1</b>	<b>Table of Contents .....</b>	<b>1</b>
1.1	Table of Figures.....	4
<b>2</b>	<b>Cautions.....</b>	<b>7</b>
2.1	Symbols and Explanations.....	7
2.2	Important Warnings .....	7
<b>3</b>	<b>Specifications .....</b>	<b>9</b>
3.1	Moisture.....	9
3.2	General.....	9
<b>4</b>	<b>Installation, Start Up and Shut Down .....</b>	<b>13</b>
4.1	Analyzer Installation .....	14
4.1.1	Gas Connections.....	14
4.1.2	Pneumatic Pressure Line Connection .....	15
4.1.3	Sample Gas Connections .....	15
4.1.4	Electrical Connections .....	16
4.1.5	Hydrogen Service Safety System .....	16
4.2	Analyzer Start Up.....	19
4.2.1	Gas Delivery System.....	19
4.2.2	Gas Pressure and Flow Settings .....	20
4.2.3	Backflow Prevention System.....	21
4.2.4	System Data Download.....	21
4.3	Analyzer Shut Down .....	21
<b>5</b>	<b>Options .....</b>	<b>23</b>
5.1	Key Lock.....	23
5.2	Operating Voltage .....	23
5.3	Serial Communications.....	23
5.4	Analog Voltage Output.....	23
5.5	Hydrogen Service Safety System .....	23
5.6	Vacuum Pump .....	23
5.6.1	Installation of the Vacuum Pump.....	24
5.6.2	Moisture Sample Gas Outlet Connection to Vacuum Pump.....	26
5.6.3	Electrical Connections.....	26
<b>6</b>	<b>Connecting to External Devices .....</b>	<b>29</b>
6.1	Serial Communication Port – J5 .....	29
6.2	Analog Signal Outputs – J4 .....	30
6.3	4-20 mA Outputs – J4.....	30
6.4	Relay Ports – J8, J9.....	31
<b>7</b>	<b>User Interface .....</b>	<b>33</b>
7.1	Data Display Screen .....	33
7.2	Keypad.....	33
7.3	Menu Structure.....	34
7.4	Main Menu.....	34
7.4.1	Isolate Analyzer.....	35

7.4.2	Restore Sample Gas Flow .....	36
7.4.3	Controls Menu.....	36
7.4.4	Calibrate Menu.....	39
7.4.5	Data History Routine .....	45
7.4.6	Data Downloader Routine.....	47
7.4.7	View Logs Menu .....	50
7.4.8	Analyzer Setup .....	53
7.4.9	Analog Output Setup .....	60
7.4.10	Graph Setup.....	61
7.4.11	Diagnostics Menu .....	62
7.4.12	Adjust Contrast.....	69
7.4.13	Power Up Default.....	70
7.4.14	Date/Time.....	71
7.4.15	Communications.....	72
7.4.16	Download System Data.....	73
7.4.17	System Info.....	74
<b>8</b>	<b>Sample Gas Preparation and Delivery .....</b>	<b>77</b>
8.1	Introduction.....	77
8.2	Sample Flow Rate and Pressure .....	77
8.3	Flow Rate Effects on Sensor Performance.....	77
8.4	Sample Gas Scale Factor .....	77
8.4.1	Background Gas Effects on Indicated Flow Rate.....	77
8.5	Flammable Sample Gas .....	78
<b>9</b>	<b>Service .....</b>	<b>79</b>
9.1	Return Material Authorization number .....	79
9.2	Maintenance.....	79
9.2.1	Storage Conditions .....	79
9.2.2	Moisture Cell Maintenance.....	79
9.2.3	Vacuum Pump Maintenance.....	79
9.2.4	Gas Purifier Maintenance .....	80
9.2.5	Gas Purifier Removal/Installation Procedure.....	81
9.3	Replaceable Parts List.....	83
9.4	Troubleshooting the DF-750 NanoTrace Analyzer .....	85
<b>10</b>	<b>Theory of Operation .....</b>	<b>87</b>
10.1	The Moisture Measurement.....	87
10.1.1	Moisture and the IR Spectrum.....	87
10.1.2	Absorption Spectroscopy.....	88
<b>11</b>	<b>Safety.....</b>	<b>89</b>
11.1	General Warnings.....	89
11.2	Material Safety Data Sheet (MSDS) for Gas Purifier Packing.....	91
<b>12</b>	<b>Warranty .....</b>	<b>97</b>
<b>13</b>	<b>Index .....</b>	<b>99</b>
<b>14</b>	<b>Appendix A – User Menu Screens.....</b>	<b>101</b>
<b>15</b>	<b>Appendix B – Hydrogen Service Safety System.....</b>	<b>103</b>
15.1	Instrument .....	103
15.2	Vacuum Pump .....	103

15.3 Installation..... 103  
15.4 Operation..... 104

## 1.1 Table of Figures

Figure 1: Overall View.....	11
Figure 2: Major Internal Components.....	13
Figure 3: Aspirator Installation .....	14
Figure 4: Rear Panel Gas Connections and Controls.....	16
Figure 5: AC Power Connections .....	17
Figure 6: Data Display Screen.....	19
Figure 7: Block Diagram of Gas Flow Path .....	22
Figure 8: Vacuum Pump Assembly.....	24
Figure 9: Vacuum Pump Mount Dimensions.....	25
Figure 10: Vacuum Pump Dimensions .....	25
Figure 11: Vacuum Pump Power Connections and Controls .....	26
Figure 12: Block Diagram of Gas Flow Path with Optional Vacuum Pump .....	27
Figure 13: Rear Panel Electrical Connectors.....	29
Figure 14: Data Display Screen .....	33
Figure 15: Keypad.....	34
Figure 16: Main Menu .....	34
Figure 17: Isolate Analyzer .....	35
Figure 18: Isolate Warning.....	35
Figure 19: Restore Sample Gas Flow.....	36
Figure 20: Controls SubMenu .....	36
Figure 21: Gas Valves Control .....	37
Figure 22: Back Flow Prevention Warning.....	38
Figure 23: Re-established flow delay .....	38
Figure 24: Calibrate SubMenu.....	39
Figure 25: Check/Adjust Zero Menu .....	39
Figure 26: Check/Adjust Zero Screen .....	40
Figure 27: User Zero Offset.....	40
Figure 28: Set Zero Gas Valves .....	41
Figure 29: Manual Zero Screen .....	42
Figure 30: AutoZero Screen .....	43
Figure 31: AutoZero Setup Menu .....	44
Figure 32: AutoZero Setup Screen.....	44
Figure 33: Data History Menu.....	46
Figure 34: Data History Screen.....	46
Figure 35: Install Media.....	46
Figure 36: Example of Data Download.....	47
Figure 37: Data Downloader Menu .....	47
Figure 38: Data Downloader Screen .....	48
Figure 39: View Location Screen .....	48
Figure 40: Keyboard Display.....	49
Figure 41: Delete Selection .....	49
Figure 42: View Logs SubMenu .....	50
Figure 43: View Zero Log Menu .....	50
Figure 44: Zero Log Screen.....	51
Figure 45: View System Error Code Log Menu .....	51
Figure 46: System Error Log Screen.....	51
Figure 47: Pump Capacity Test Log Menu.....	52
Figure 48: Pump Capacity Test Log .....	53



Figure 49: Analyzer Setup Menu .....	53
Figure 50: Sample GSF Menu .....	54
Figure 51: Sample GSF Setup Screen .....	54
Figure 52: GSF Pressure Setting.....	55
Figure 53: Purifier Warning .....	55
Figure 54: Fan Failure Alarm.....	55
Figure 55: Alarm Setup Menu .....	56
Figure 56: Alarm Setup Screen.....	57
Figure 57: Temperature Alarm Setup .....	58
Figure 58: Pressure Range Alarm Setup .....	58
Figure 59: System Alarm Setup.....	59
Figure 60: Analog Output Setup Menu .....	60
Figure 61: Analog Output Setup Screen.....	60
Figure 62: Graph Setup Menu .....	61
Figure 63: Graph Setup Screen.....	61
Figure 64: Diagnostics SubMenu.....	62
Figure 65: Active Zero Menu .....	62
Figure 66: Active Zero Setup Screen .....	62
Figure 67: Test Relays Menu.....	64
Figure 68: Test Alarm Relays Screen.....	64
Figure 69: Test Analog Outputs Menu.....	64
Figure 70: Test Analog Voltage Output Screen.....	65
Figure 71: Signal Monitor Menu .....	65
Figure 72: Signal Monitor Screen.....	66
Figure 73: Purge Purifier Menu.....	66
Figure 74: Purge Start .....	67
Figure 75: Purifier Purge Time Line.....	67
Figure 76: Purge Cancel.....	67
Figure 77: Pump Capacity Test Menu.....	68
Figure 78: Pump Capacity Test.....	68
Figure 79: Pump Pressure Failure.....	68
Figure 80: Pump Capacity Test Log.....	69
Figure 81: Adjust Contrast Menu .....	69
Figure 82: Adjust Display Contrast Screen .....	69
Figure 83: Power Up Default Menu .....	70
Figure 84: Power Up Default Screen.....	70
Figure 85: Date/Time Menu .....	71
Figure 86: Date/Time Setup Screen .....	71
Figure 87: Communications Menu .....	72
Figure 88: Communications Setup Screen .....	72
Figure 89 Down Load System Data Menu .....	73
Figure 90: Insert Media.....	73
Figure 91: Media Warning .....	74
Figure 92: Down Load Time Line .....	74
Figure 93: System Info Menu .....	74
Figure 94: System Info Screen.....	75
Figure 95: Firmware Upgrade .....	75
Figure 96: Gas Purifier Installation .....	82
Figure 97: Schematic of Moisture Cell .....	87
Figure 98: Hydrogen Service Safety System.....	107
Figure 99: Pump Purge Option .....	108

## Table of Tables

Table 1: Recommended Sample Outlet Vacuum Pressure .....	21
Table 2: Pin-out of Serial Comm Connector J5.....	30
Table 3: Serial Communications Connections .....	30
Table 4: Pin-Out of Moisture Signal Output Connector J4.....	30
Table 5: Pin-Out of Relay Connectors J8 and J9 .....	31
Table 6: Alarm Codes .....	56
Table 7: Sample Outlet Pressure.....	77
Table 8: Replaceable Parts List.....	83

## 2 Cautions

There are a number of warnings and cautions that must be observed to avoid damage to the analyzer as well to insure the safety of its users. The analyzer must be operated in a manner specified in this manual. Delta F cannot be responsible for direct or consequential damages that result from installing or operating the analyzer in a manner not described in this manual. Importantly, the analyzer has been designed for use with inert, non-toxic, non-combustible sample gases only. Delta F cannot be responsible for direct or consequential damages that result from using the analyzer with these gases.

### 2.1 Symbols and Explanations

Following is a list of the various symbols used throughout this manual and their definitions.

#### CAUTION



*This symbol alerts the user to the presence of physically hazardous conditions that may be dangerous to individuals or equipment.*

#### NOTE



*This symbol alerts the user to the presence of important operations and/or maintenance information.*

### 2.2 Important Warnings

#### CAUTION



*Potentially hazardous AC voltages are present within this instrument. Leave all servicing to qualified personnel. Disconnect the AC power source when installing or removing: external connections, the sensor, or the electronics.*

## CAUTION



*Do not setup or operate this analyzer without a complete understanding of the instructions in this manual. Do not connect this Analyzer to a power source until all signal and plumbing connections are made.*

## CAUTION



*This analyzer must be operated in a manner consistent with its intended use and as specified in this manual.*

## EMI DISCLAIMER



*This Analyzer generates and uses small amounts of radio frequency energy. There is no guarantee that interference to radio or television signals will not occur in a particular installation. If interference is experienced, turn-off the analyzer. If the interference disappears, try one or more of the following methods to correct the problem:*

- Reorient the receiving antenna.
- Move the instrument with respect to the receiver.
- Place the analyzer and receiver on different AC circuits.

# 3 Specifications

## 3.1 Moisture

**Lowest Detection Level (LDL):** 200 ppt @ Constant Conditions

**Resolution:** Analytical (Smallest Detectable Change): 100 ppt

Display: 10 ppt

**Accuracy:** Greater of  $\pm 3\%$  of reading or  $\pm 0.2$  ppb @ Constant Conditions

**Speed of Response:** Typically 10 minutes to reach 90 percent of an upward step change

**Upset Recovery Time:** Typically less than 5 minutes from a high ppb upset to within 10 ppb of the previously stable reading.

**Range:** 0-20 ppm

**Background Gas Compatibility:** All inert and passive gases including N<sub>2</sub>, H<sub>2</sub>, He, Ar and O<sub>2</sub>

**Return Pressure:** Variable from 200 – 760 Torr based on background gas

## 3.2 General

**Warranty:** One year from ship date on the entire instrument. See *Warranty* section.

**Power Requirements:** 100 to 120 VAC, 50/60 Hz, standard, 5 Amps

200 to 240 VAC, 50/60 Hz (optional), 2.5 Amps

**Display:** 7.4 inch VGA Color (640X480)

**Ambient Operating Temperature:** 10° C to 40° C (50° F to 105° F)

**Output Signals:**

Analog Output: User Scalable: 0-2 ppb to 0-20 ppm Moisture

0-1, 0-2, 0-5, or 0-10 VDC (minimum load resistance 1K)

Isolated 4-20 mA DC, 1K ohm loop resistance max (28V Compliance voltage provided)

**Digital Communications:** Two-way RS-232 or RS-485 set at the time of order

**Operating Inlet Pressure:** 30 to 150 psig (2 to 10 bar)

**Flow Rate:** 1.0 – 4.0 slpm N<sub>2</sub>

**Sample Temperature:** 10° C to 80° C (50° F to 176° F)

**EMI Sensitivity:** Tested to standards EN61000-3-3 and EN61326-1

**Audible/Visual Alarm Status Indicators:** Four Moisture levels, Temperature, Moisture cell Diagnostic, Zero Verification or Calibration in Process, Moisture Analyzer off-line, Analog output freeze during calibration.

**Alarm Relays:** Four non-latching, independently assignable to moisture alarms or to moisture calibration-in-process indicator. SPDT contacts rated at 1 Amp @ 30 VDC. Fail safe action upon loss of power to alarm condition. Not designed to switch AC power.

**Storage Temperature:** Not to exceed 50° C (122° F)

**Construction:** NEMA 1, 19 inch rack mount

**Dimensions:** 19 inch (48.3cm) wide x 10.5 inch (26.7 cm) high x 22.5 inch (57.2 cm) deep

**Weight:** 72 pounds (32.6 kg)

**Gas Path Construction Materials:**

300 series stainless steel electro-polished

1/4-inch VCR-type compatible sample inlet fitting

1/8-inch compression sample outlet fitting

1/4-inch compression vacuum fitting

Kel-f valve seats

polyethylene vacuum tubing

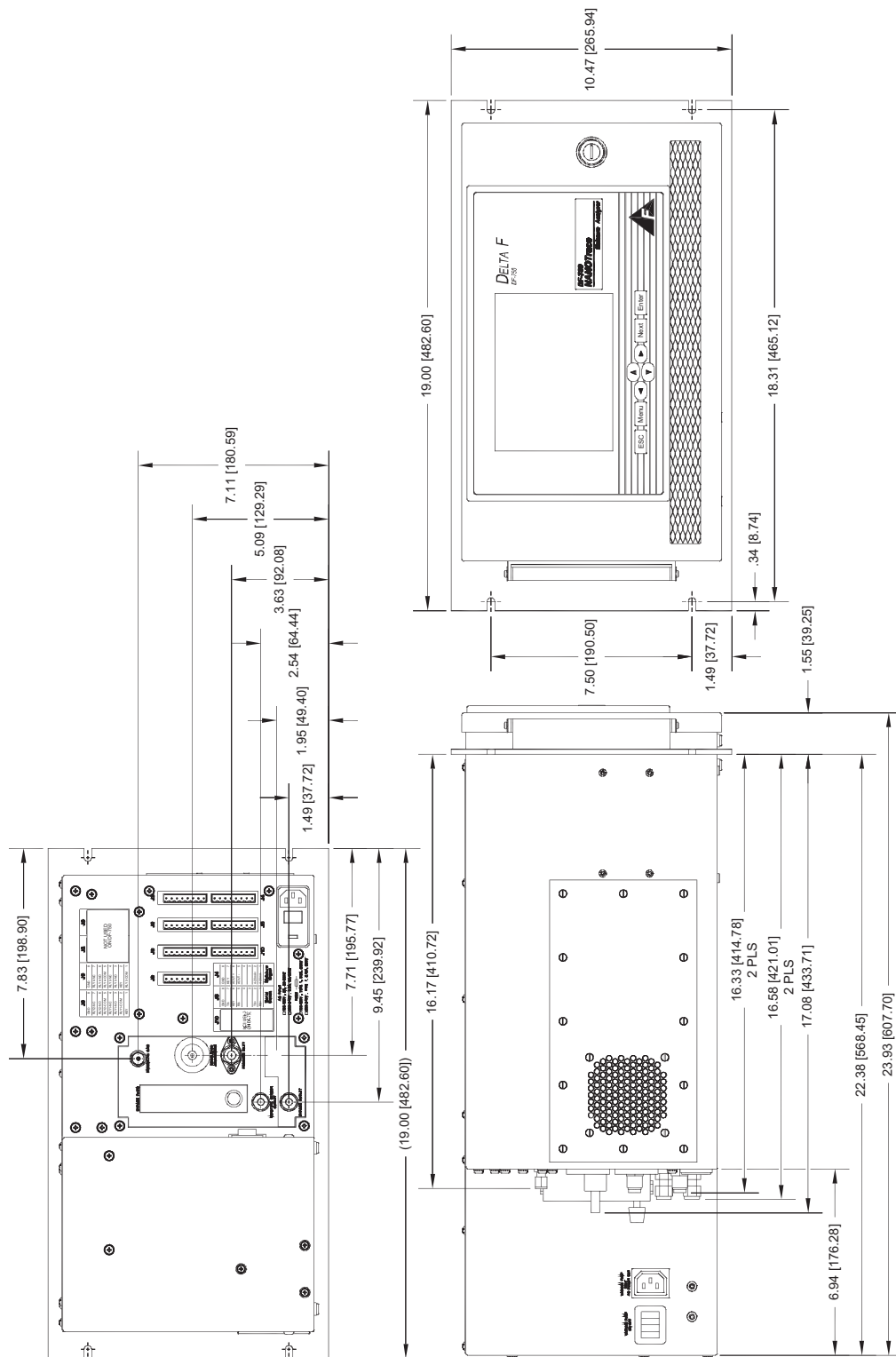


Figure 1: Overall View





# 4 Installation, Start Up and Shut Down

Installation of the analyzer requires the following steps be followed:

- Connecting the N<sub>2</sub>/Air supply to the aspirator
- Connecting an exhaust tube to the aspirator outlet, if needed
- Connecting the pneumatic pressure service to the pneumatic inlet fitting
- Connecting the sample gas line to the analyzer inlet fitting
- Making the power connection to the analyzer
- Installation of the zero gas purifier

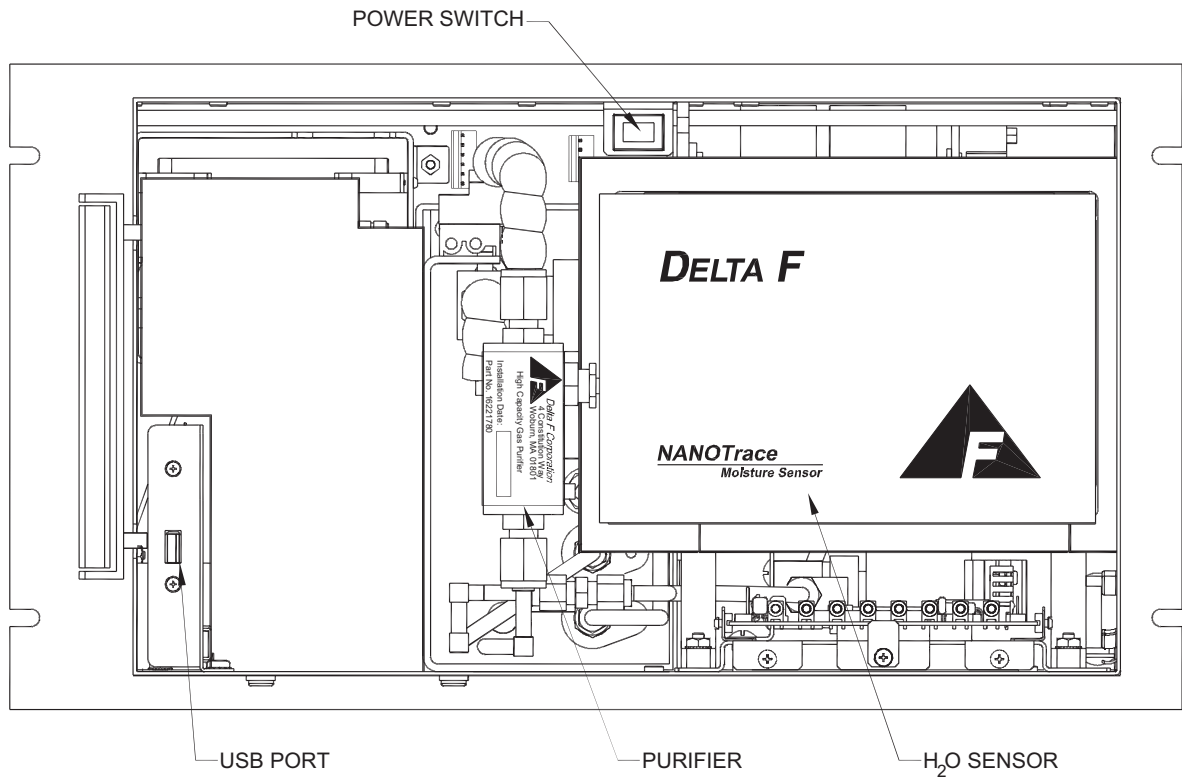


Figure 2: Major Internal Components

## 4.1 Analyzer Installation

### 4.1.1 Gas Connections

#### 4.1.1.1 Aspirator

The standard vacuum source provided with the DF-750 analyzer is a factory installed aspirator as shown in Figure 3. Aspirator installation with the optional gas panel is identical.

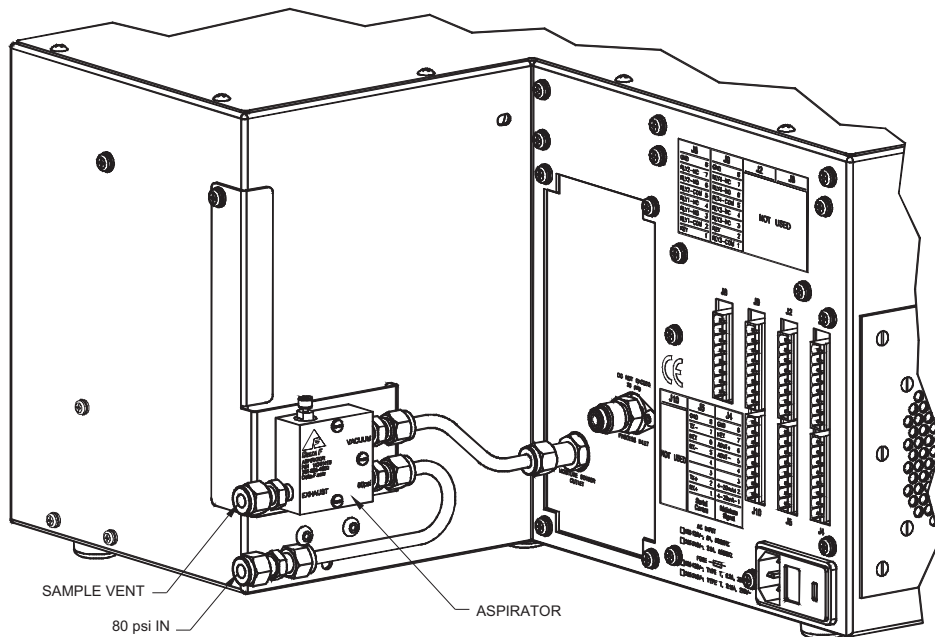


Figure 3: Aspirator Installation

A regulated source of dry compressed gas (either N<sub>2</sub> or air) is required at 80psi and a flow rate of approximately 15 slpm.



The use of N<sub>2</sub> is required when the analyzer is used in an H<sub>2</sub> application.

Connection is made to the aspirator by way of a ¼ inch compression fitting labeled “80 psi IN”. It is very important to note that the diameter of the gas supply line must be a minimum of ¼ inch to provide sufficient flow. If operation in Helium background is anticipated, a shut off valve should be installed at the inlet to the aspirator.

For ease of installation, the aspirator source can also supply the pneumatic gas inlet by way of a 1/8 inch adapter.

The gas at the sample vent port is comprised of the analyzer sample gas and the compressed gas, and any noise can be mitigated by simply installing a ¼ inch tube of approximately 3 ft in length. Backpressure should be minimized at this port (max 2.0 psi) and if the exhaust must be vented for safety reasons it must be done to a header of greater diameter.

The aspirator needle valve should be opened (CCW) completely.



Be sure to use a backup wrench when making all connections to the aspirator.

#### 4.1.1.2 Vacuum Pump

An optional vacuum pump can be purchased for those cases where there is insufficient gas pressure or flow to operate the aspirator, or when the analyzer is installed in a portable cart and connection to a continuous gas supply is inconvenient. See page 23 for information on the installation of the optional vacuum pump.

### 4.1.2 Pneumatic Pressure Line Connection

The pneumatic gas connection is a 1/8 inch compression fitting as shown in Figure 4 and requires 70 – 125 psig air or N<sub>2</sub> pressure. For ease of installation, the pneumatic feed line can be connected directly to the 1/4 inch aspirator source by way of a 1/8 inch adapter.

### 4.1.3 Sample Gas Connections

#### 4.1.3.1 Sample Gas Inlet Connection

Sample gas is connected to the analyzer via a 1/4 inch male swivel VCR fitting labeled Process Inlet at the rear of the instrument as shown in Figure 4. Sample pressure of 30 – 150 psig is required and is regulated internally.

Pre-purge the line by connecting to the analyzer (with a new VCR *filter* gasket) only finger tight and flowing gas for 15 minutes. Then tighten the inlet fitting.

NOTE: A VCR *filter* gasket (supplied) should always be used to protect the gas delivery system from any particulate matter that may have collected in the line.

When power is applied to the analyzer, the internal gas control valves will automatically go to a state as determined by the user. See the section on Power Up Defaults on page 70 for additional information.

NOTE: When received from the factory, the moisture cell will be isolated with pressure in the system. See the sections on Moisture Gas Valves Control on pages 37 for instructions on starting the gas flow through either sensor.

See Figure 7 for an overview of the gas flow through the analyzer.

See the section on Gas Pressure and Flow Settings on page 20 for important information on plumbing and powering up the analyzer.

#### 4.1.3.2 Sample Gas Outlet Connection

The sample gas outlet connection is a 1/4 inch compression fitting labeled Moisture Sensor Outlet as shown in Figure 4. A 1/4 inch stainless tube is connected from the analyzer sample outlet to the Aspirator assembly. See Figure 3.

**Open the needle control valve (CCW) on the top of the aspirator assembly completely.**

NOTE: If the Hydrogen Service Safety System is included, the sample outlet line must be made of steel. See page 103 for additional information.

See page 23 for information on the installation of the optional vacuum pump.

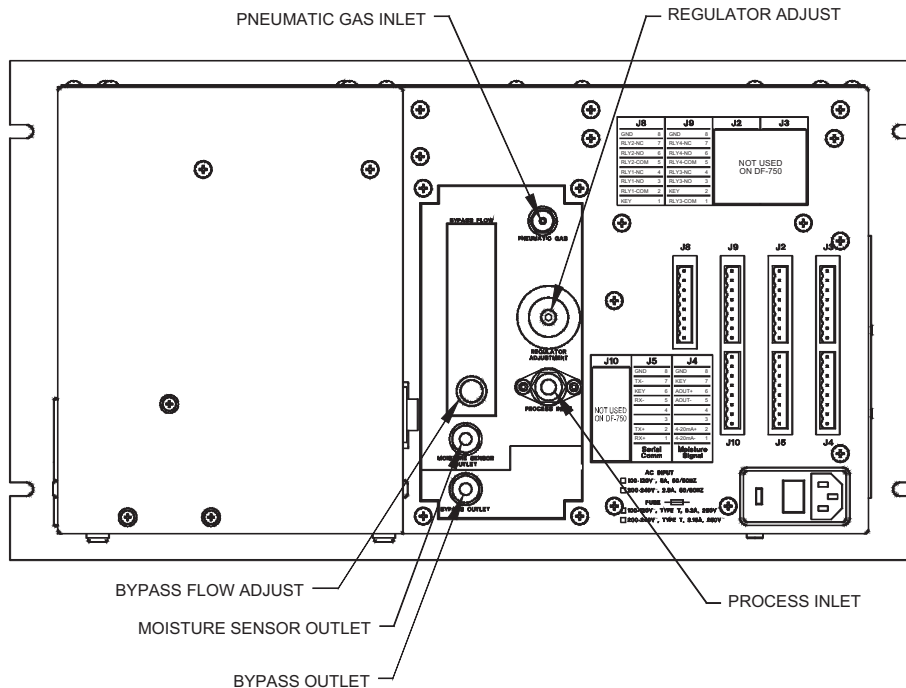


Figure 4: Rear Panel Gas Connections and Controls

#### 4.1.4 Electrical Connections

Open the door and locate the power switch in the center of the upper rail. Be sure it is in the OFF position. Plug the line cord (supplied with 110VAC units only) into the receptacle at the back of the analyzer. Verify the operating voltage is proper according to the label on the rear and connect the line cord to the power source. See Figure 5.

#### 4.1.5 Hydrogen Service Safety System

This optional system is designed to safeguard the DF-760 from explosion hazards when operating on hydrogen sample gas under normal pressure and flow conditions as detailed in the Operating Instruction Manual. The instrument chassis and the remote pump, if equipped, are both protected by maintaining a safe condition within their respective enclosures. If installed, this option impacts the electrical wiring, gas plumbing and operation of the analyzer. See page 103 for additional installation and operation information.

NOTE, if equipped with the Hydrogen Safety Service System, when shipped from the factory the analyzer will be configured through the GSF screen to measure hydrogen. As a result, the Hydrogen Safety Service System will be enabled out of the box.

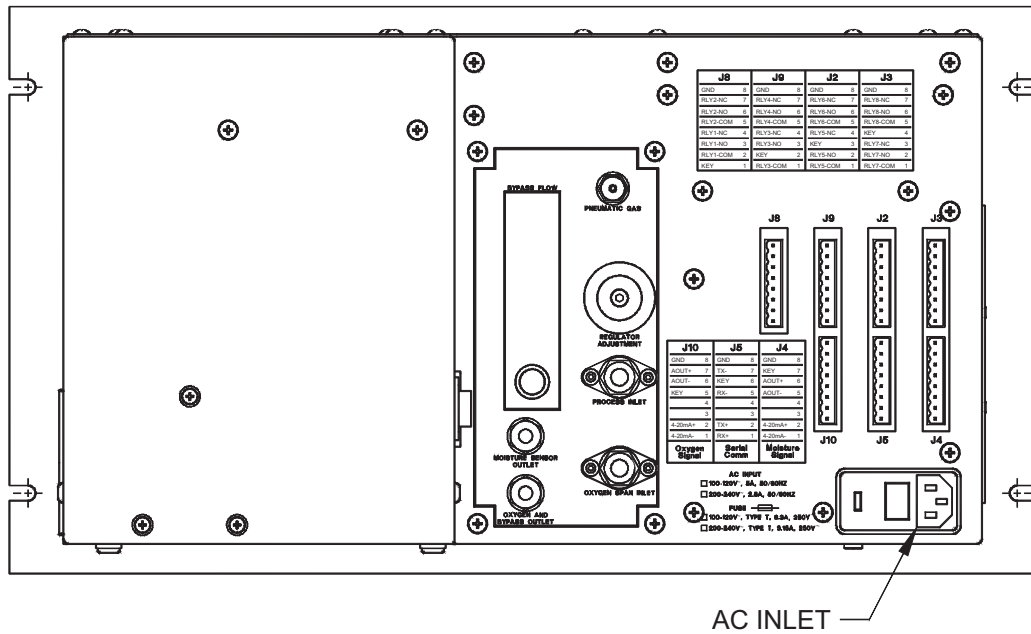


Figure 5: AC Power Connections



## 4.2 Analyzer Start Up

It is important to note that the moisture cell is isolated from gas flow while the analyzer is off power.

Open the door and turn on the power using the main power switch inside the analyzer. See Figure 2. The pump, if equipped, should turn on and the analyzer will undergo a series of Diagnostic Procedures while the various startup screens are displayed. Next, the Delta F Corporation logo is briefly displayed and then the data display appears with the “Warming Up” screen flashing. The warm up process takes approximately six to ninety minutes after which the display will look similar to Figure 6 (values shown are only representative).

Note – During the warm up period, all analog and digital outputs are held to an artificial 0.011ppb reading to avoid the reporting of false readings.

See the section on PowerUp Defaults on page 70 for setting user selectable preferences at the time of power up.

During the Warm Up process the gas valves can be opened and gas flow started. See the section on Gas Pressure and Flow Settings on page 20 for important information on the gas delivery system and setting proper pressures and flow rates.

### NOTE



During the warm up period all analog and digital outputs are held to an artificial 0.011ppb reading to avoid the reporting of false readings.

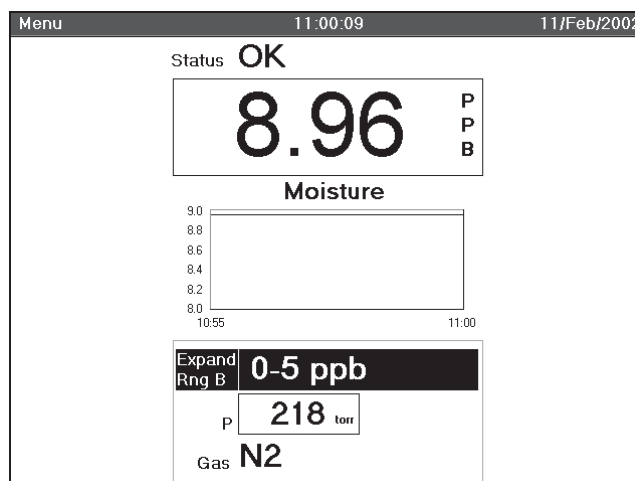


Figure 6: Data Display Screen

### 4.2.1 Gas Delivery System

The gas delivery system as shown in Figure 7 is designed to deliver a gas flow rate of 1 liter per minute to the moisture cell while maintaining the highest standards of gas purity and delivery for ultra-trace analysis. Features include a single inlet line for the gas sample, a

bypass loop to maintain constant purging, and essentially dead-leg free delivery. The gas delivery system also allows the user to perform zero calibration adjustments for the moisture cell.

The connections at the rear of the gas delivery system include a pneumatic gas connection (1/8" compression), a 1/4" VCR swivel connection for the process inlet, a 1/4" compression outlet for the moisture cell, and a 1/4" compression outlet for the bypass loop. Also on the rear of the gas delivery system are a sample gas regulator to adjust the internal sample pressure and a bypass flow meter.

The moisture sensor outlet will be connected to the aspirator or if equipped, to the vacuum pump.

The process inlet to the moisture analyzer, as well as the zero gas inlet, are heated to 60 C. This is done to mitigate any effects of adsorption-desorption of trace moisture on the walls of the tubing.

## 4.2.2 Gas Pressure and Flow Settings

Attention to the setting of gas pressure and flow is critical to proper operation of the analyzer. If all steps are followed carefully at the time of start up, subsequent changes to flow or background gas will be made easier. The following procedure assumes all electrical and plumbing connections have been made according to instructions in this manual. In addition, this procedure assumes a Nitrogen gas background unless otherwise noted.

1. Power up the unit. See page 19. If the unit is equipped with a Hydrogen Safety System, no flow will enter the system until the unit is on power.
2. Ensure that the needle valve on the aspirator is fully open.
3. Completely open (turn fully clockwise) the inlet regulator on the rear of the analyzer. For operation in Nitrogen, Argon and Oxygen the regulator is closed (turned counter clockwise) to the approximate middle, or 50% of its range. For operation in Helium and Hydrogen it should be closed to 80-90% of its range.
4. Open the flowmeter bypass valve on the rear of the analyzer and flow in the bypass loop will be indicated on the flowmeter. Adjust the flowmeter bypass valve to 0.5 slpm. See Figure 4.
5. Purge for 15 minutes before opening gas valves.
6. The state of the gas control valves is indicated on the main display. The default state of a factory-shipped instrument is isolation. This can be adjusted in the Power Up Default section. If the moisture cell is isolated, establish process flow via the Main menu. See page 36.
7. Once flow has been established through the moisture cell, observe the pressure indicator on the main display. For all gases, with the exception of helium, the pressure in the moisture cell is only controlled by adjusting the needle control valve at the aspirator. See Table 1 for appropriate pressure settings. In the case of helium, the vacuum source must be off, and the needle control valve wide open.



8. It is important to ensure that a minimum of 0.2 slpm flows through the bypass loop at all times to prevent backflow. See page 21 for additional information on back pressure prevention.
9. The proper pressure ranges listed in Table 1 will automatically appear on the display when the background GSF is selected.

Background Gas	Pressure	Vacuum Source
N2	150 - 250 Torr	ON
Ar	280 - 380 Torr	ON
He	740 - 780 Torr	OFF*
H2	300 - 400 Torr	ON
O2	300 - 400 Torr	ON

\*A shut off valve must be installed at the inlet to the aspirator to disable the vacuum.

Table 1: Recommended Sample Outlet Vacuum Pressure

### 4.2.3 Backflow Prevention System

It is imperative that flow be maintained through the analyzer. For this reason a flow detection system is installed in the bypass loop to monitor the flow rate. In the event of loss of sufficient flow the analyzer is automatically isolated to prevent ambient air from contaminating the plumbing system. For additional information see page 37.

### 4.2.4 System Data Download

The final step of the installation, after a couple days of dry down, should be to download the system data (see page 73), and send them by e-mail to [service@delta-f.com](mailto:service@delta-f.com) for review. This will allow the factory to confirm that the analyzer is working properly by comparison with data stored at the time of shipment, and in addition will set a baseline for comparison with future downloads, if any.

## 4.3 Analyzer Shut Down

In order to minimize the time required for the analyzer to re-achieve a zero baseline on start up, the following steps should be followed when shutting the analyzer down.

**Short Term Shut Down** - A short-term shut down, for example to move and restart the analyzer, can be accomplished by simply shutting off the power switch behind the front door. This action initiates the standard isolation process and computer shut down which takes approximately 40 seconds.

**Long Term Shut Down** - From the Main Menu go to System, and select Isolate Analyzer. A routine automatically starts that closes the downstream valve and allows pressure to build in the moisture cell after which an upstream valve closes as well. Throughout this process a message appears over the display instructing the user to wait 40 seconds. Once complete, the message disappears and the user may shut the power off with

the switch behind the front door that initiates the computer shut down sequence that takes an additional 40 seconds.

Additional long-term isolation security can be achieved by closing the valve on the rotameter on the rear of the instrument as well as completely closing the sample inlet regulator.

If the analyzer is being disconnected from gas, be sure to tightly cap all gas connections.

NOTE: See the section on Power up Default on page 70 for setting user selectable preferences at the time of power up.

Loss of power will result in automatic valve closure and the following restoration of power will result in the “Scan Disk” function occurring before system start-up.

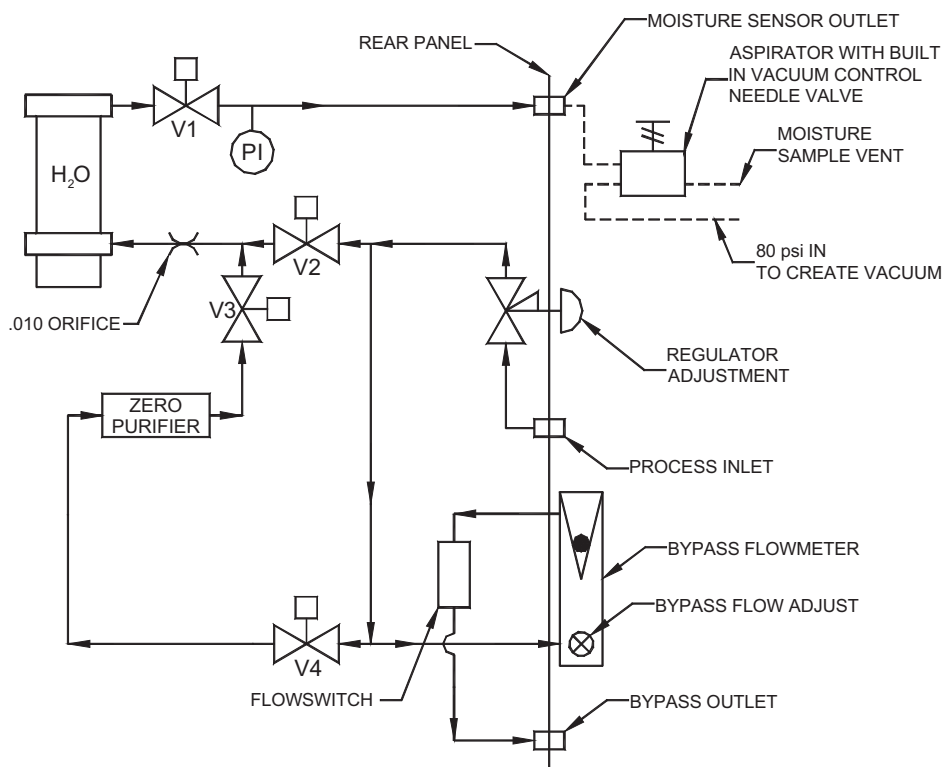


Figure 7: Block Diagram of Gas Flow Path

# 5 Options

The following options to the DF-750 are available at the time of order.

## 5.1 Key Lock

An optional key lock can be installed in the door of the analyzer to prevent access to the power switch and other internal components. The lock is supplied with two keys.

If the analyzer is operating, the key lock does not prevent adjustments from the front panel.

## 5.2 Operating Voltage

The analyzer can be wired for operation at either 100-120 Volts AC or 200-240 Volts AC.

The operating voltage is not adjustable in the field.

## 5.3 Serial Communications

The analyzer can be set for communications by RS-232 or RS-485.

The serial communications option is not adjustable in the field.

See page 29, 71 and 73 for additional information.

## 5.4 Analog Voltage Output

The maximum analog voltage output can be set at the factory for 0-1, 0-2, 0-5 or 0-10 Volts DC.

The maximum analog voltage output is not adjustable in the field.

See page 30 and 60 for additional information.

## 5.5 Hydrogen Service Safety System

This option enables the analyzer to be safely used in a hydrogen background application.

See page 103 for additional information.

## 5.6 Vacuum Pump

An optional pump can be purchased to replace the aspirator in cases where there is insufficient gas flow for the aspirator or when the analyzer is installed in a portable cart and connection to an air supply is inconvenient.

NOTE: If a pump is being retrofitted to an analyzer configured with an aspirator, then the aspirator assembly must be removed completely to uncover the pump power connector and

breaker switch. The pump connection should be made directly to the Moisture Sample Outlet as described below.

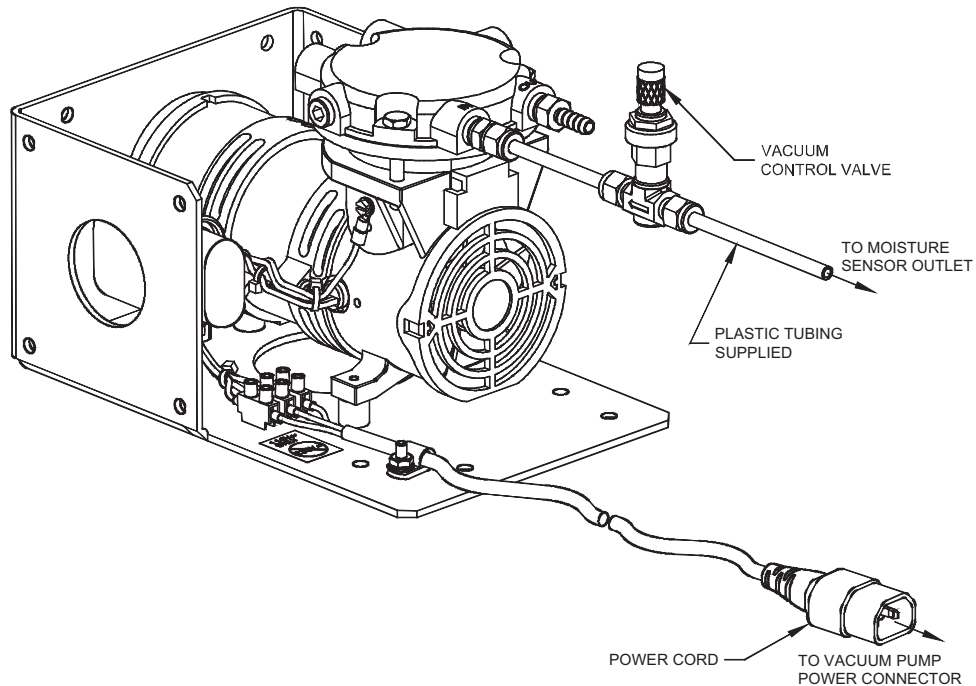


Figure 8: Vacuum Pump Assembly

### 5.6.1 Installation of the Vacuum Pump

- Mount the vacuum pump to the bracket
- Connect the line from the moisture sample outlet to the needle control valve and vacuum pump
- Make the electrical power connection to the vacuum pump

#### 5.6.1.1 Vacuum Pump Mounting

Mount the vacuum pump within 8 feet of the analyzer. Refer to Figure 9 and Figure 10 for mounting hole and pump dimensions.

#### CAUTION



Be sure the pump outlet is at atmospheric pressure before starting. The pump is not designed to start against any backpressure.

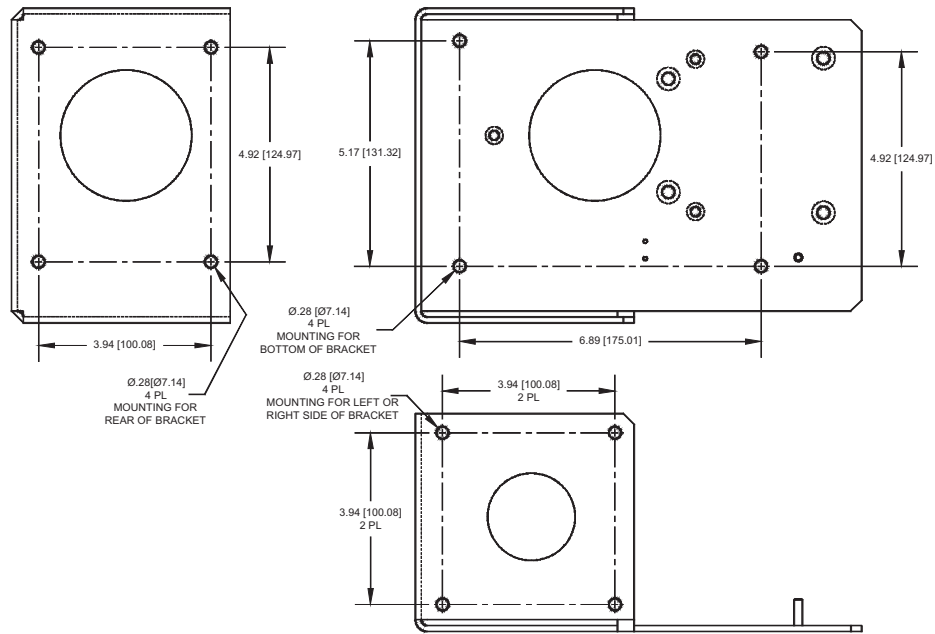


Figure 9: Vacuum Pump Mount Dimensions

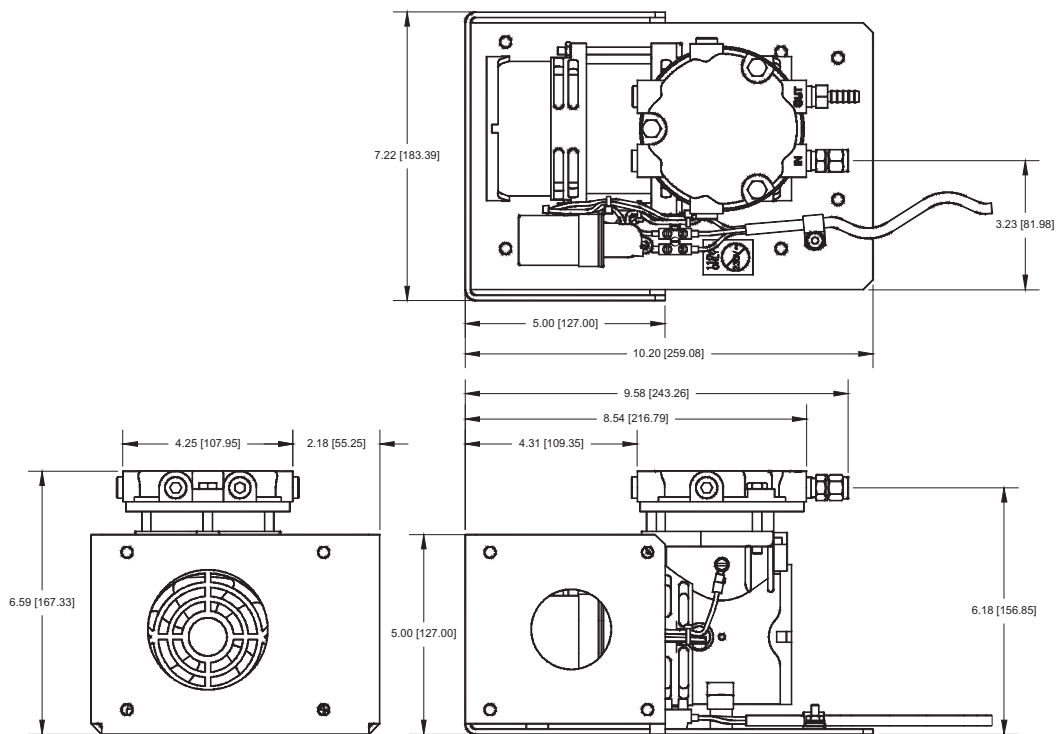


Figure 10: Vacuum Pump Dimensions

## 5.6.2 Moisture Sample Gas Outlet Connection to Vacuum Pump

The sample gas outlet connection is a ¼ inch compression fitting labeled Moisture Sensor Outlet as shown in Figure 4. Use the polyethylene tubing provided with the analyzer to connect between the outlet fitting and the ¼ inch fittings on the needle control valve and vacuum pump (included separately). See Figure 8. **Open the needle control valve completely.**

NOTE: If the Hydrogen Service Safety System is included, the sample outlet line must be made of steel. See page 103 for additional information.

## 5.6.3 Electrical Connections

Plug the vacuum pump power cord into the vacuum pump power receptacle on the rear of the analyzer. Turn on the vacuum pump power breaker that is adjacent to the receptacle. The pump will not turn on until the main analyzer power switch is turned on. See Figure 11.

NOTE: The voltage supplied at the vacuum pump power connector is the same as the input voltage to the analyzer. For example, if 110VAC is supplied to the analyzer then 110VAC is supplied to the pump.

### CAUTION



Be sure the pump outlet is at atmospheric pressure before starting.  
The pump is not designed to start against any backpressure.

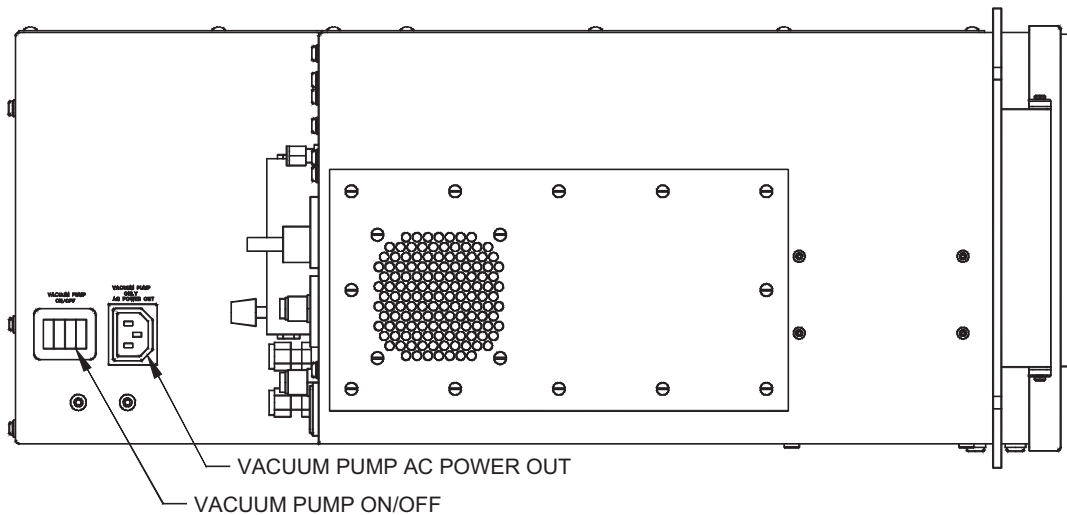


Figure 11: Vacuum Pump Power Connections and Controls

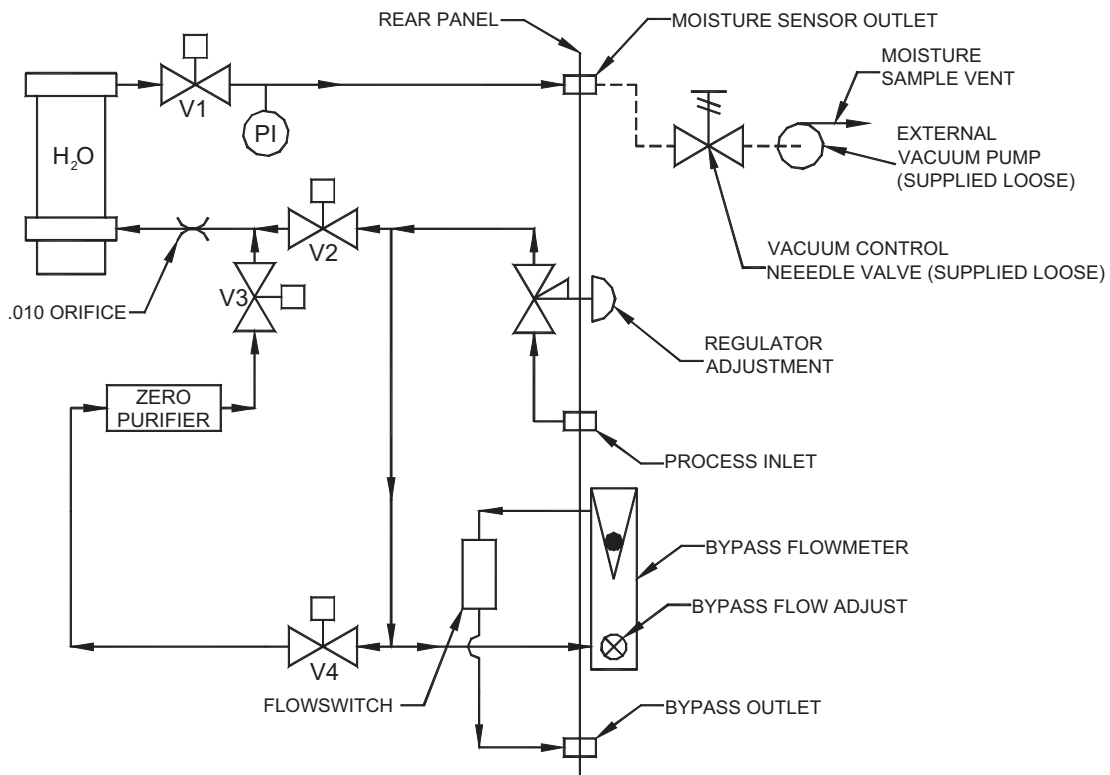


Figure 12: Block Diagram of Gas Flow Path with Optional Vacuum Pump





# 6 Connecting to External Devices

The analyzer can be interfaced to a variety of external devices via the ports on the rear panel. Alarm contacts, voltage, and current outputs, and serial communications are supported. All outputs, analog or digital, are fully isolated from earth ground.

### NOTE



During the six minute warm up period at startup, all analog and digital outputs are held to an artificial 0.01 lppb reading to avoid the reporting of false readings.

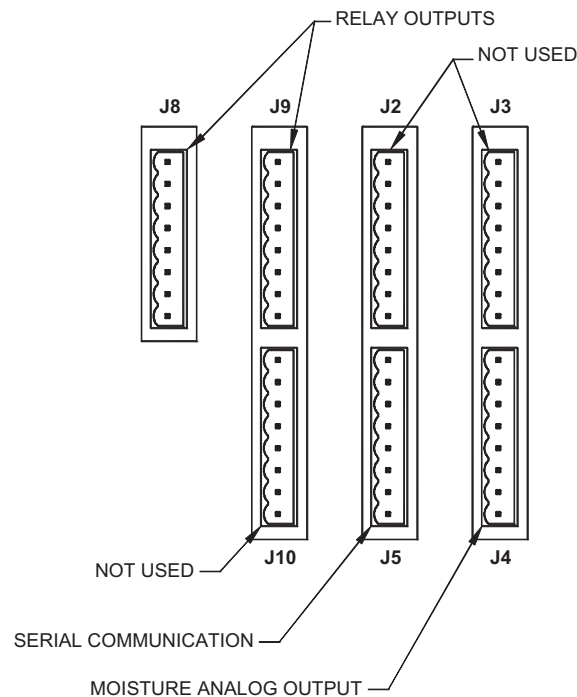


Figure 13: Rear Panel Electrical Connectors

## 6.1 Serial Communication Port – J5

Either of two serial communication ports are available at the time of order: RS232C or RS485 which enable interface between the analyzer and other operating systems.

Up to 32 units may be accessed via RS-485. Operating parameters are 8 bits, no parity, and one stop bit. Baud rate may be selected from the menu on the display.

See Table 2 on page 30 for wiring information.

See the chapter on Communications on page 71 for additional information on setting unit ID's and baud rates. A program to facilitate serial communications is available from Delta F.

Pin #	Signal	Description
J5-8	GND	Ground
J5-7	TX-	4 wired 485 paired with TX+
J5-6	Key	Unused
J5-5	RX-	4 wire 485 paired with RX+
J5-4		Unused
J5-3		Unused
J5-2	TX+	Data transmitted by the analyzer via RS-232 or RS-485
J5-1	RX+	Data received by the analyzer via RS-232 or RS-485

Table 2: Pin-out of Serial Comm Connector J5

Pin assignments			
DF-750 Connector J5	PC-DB9/RS-232	PC-DB25/RS-232	PC/RS-485 converter
1: RX+	3: TD	2: TD	TX+
2: TX+	2: RD	3: RD	RX+
8: Gnd	5: Gnd	7: Gnd	
5: RX-			TX-
7: TX-			RX-

Table 3: Serial Communications Connections

## 6.2 Analog Signal Outputs – J4

The analog voltage output correlating to the front panel display reading is provided on the rear of the analyzer through connector J4. The full scale voltage is set at the factory at the time of order to: 0 to 1 VDC, 0 to 2 VDC, 0 to 5 VDC, or 0 to 10 VDC. The output is electrically isolated from all other analyzer outputs, and from chassis (Earth) ground. See page 60 for additional information on setting the Analog Output. The output may be tested with the use of the analog voltage test routine found on page 64.

## 6.3 4-20 mA Outputs – J4

J4 Pin #	Moisture Signal	Description
J4-8	GND	Ground
J4-7	Key	
J4-6	A Out +	Analog Voltage Output (+)
J4-5	A Out -	Analog Voltage Output (-)
J4-4		Unused
J4-3		Unused
J4-2	4-20 mA +	4-20 mA Output (+)
J4-1	4-20 mA -	4-20 mA Output (-)

Table 4: Pin-Out of Moisture Signal Output Connector J4

The 4-20 mA analog output correlating to the front panel display reading is provided on the rear of the analyzer through connector J4. This output is electrically isolated from all other analyzer outputs, and from chassis (Earth) ground.

The maximum load resistance for each is 1K Ohms and the analyzer provides a compliance voltage of approximately 28 VDC.

## 6.4 Relay Ports – J8, J9

Four form C (SPDT) relays (contact closures) are provided to assign to the various alarms. The contacts are rated at 30 VDC, 1A. They are not designed to switch AC power.

The relay contacts can be programmed through the user interface for up to four moisture levels, temperature, moisture cell diagnostics, zero calibration in progress, analyzer off line, freeze of analog outputs during calibration.

The relays are wired for Fail Safe operation such that a Normally Open (No alarm) contact connects to common when an alarm occurs or when power to the instrument is lost.

The relay wiring can be tested with the Relay test routine found on page 63.

Pin #	Moisture Relay	Description
J8-8	GND	Ground
J8-7	RLY2-NC	Relay 2 Normally Closed
J8-6	RLY2-NO	Relay 2 Normally Open
J8-5	RLY2-COM	Relay 2 Common
J8-4	RLY1-NC	Relay 1 Normally Closed
J8-3	RLY1-NO	Relay 1 Normally Open
J8-2	RLY1-COM	Relay 1 Common
J8-1	KEY	Unused
J9-8	GND	Ground
J9-7	RLY4-NC	Relay 4 Normally Closed
J9-6	RLY4-NO	Relay 4 Normally Open
J9-5	RLY4- COM	Relay 4 Common
J9-4	RLY3-NC	Relay 3 Normally Closed
J9-3	RLY3-NO	Relay 3 Normally Open
J9-2	Key	Unused
J9-1	RLY3-COM	Relay 3 Common

Table 5: Pin-Out of Relay Connectors J8 and J9



# 7 User Interface

## 7.1 Data Display Screen

The front panel display consists of the Graphical User Interface (GUI), as displayed on the view screen in Figure 14 below.

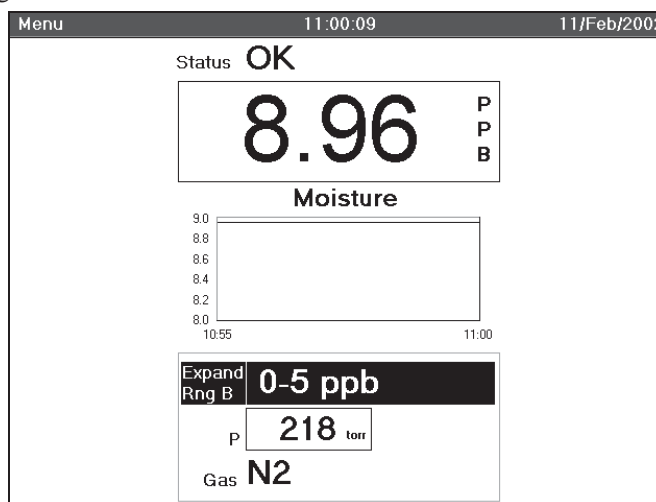


Figure 14: Data Display Screen

The various elements of the main data display screen are as follows:

- Alarm status indicator – ‘1, etc.’ denotes an alarm condition (if enabled), ‘OK’ denotes no alarm conditions (if enabled).
- The Data Line, providing the most recent concentration measurement in the large number display. This box will also provide indication of abnormal operating conditions for each sensor.
- A strip chart history of concentration measurements.
- A ppb output range, for the analog outputs, as designated by the user.
- Gas pressure within the moisture cell.
- Background gas as set by the user.

The digital readout of moisture concentration will be over written with a warning if any of the four moisture level or system alarms are tripped.

## 7.2 Keypad

The keypad allows the user to control all of the features of the analyzer. The layout of the keypad on the front panel is represented in Figure 15.

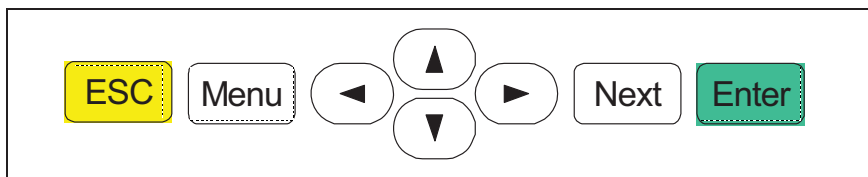


Figure 15: Keypad

The 'Menu' key activates the menu structure along the top of the GUI interface on the view screen.

Once in the menu, the arrow keys (▲ and ▼) highlight the various menu features. When the desired selection is highlighted, the right arrow will access the submenu if available (denoted by a right arrow next to the menu text). The 'Next' key and the 'Enter' key will do this as well. The arrows also enable the entry of numerical parameters as will be described below.

The 'Enter' key will call up dialogue boxes from the menu (denoted by the sequence ... next to the menu text). It will also enter numerical values within dialogue boxes.

The 'Next' key allows the user to change between active inputs within a dialogue box. The down arrow key will also accomplish this activity.

The 'ESC' key allows the user to exit numerical entry boxes within dialogue boxes without any user changes, dialogue boxes without any user changes, and the menu bar.

## 7.3 Menu Structure

The NanoTrace Moisture Analyzer menu tree consists of main menus, sub-menus and screens and is depicted below. See Appendix A on 101 for a summary of the available menus.

## 7.4 Main Menu

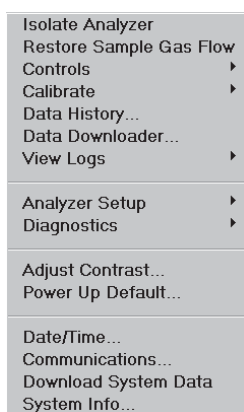


Figure 16: Main Menu

The Main Menu is accessed by pressing the Menu key on the front panel. Use the arrow keys (▲ and ▼) to navigate up and down through the list. Select the highlighted item with the Enter key on the front panel.

### 7.4.1 Isolate Analyzer

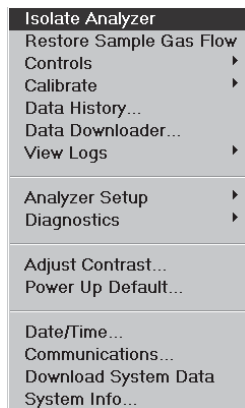


Figure 17: Isolate Analyzer

Isolate Analyzer allows the internal gas lines and the moisture sensing cell volume to be isolated in the case of an impending break in the external delivery lines. It is also considered the first step in the shut down procedure. Highlight this item and hit the Enter key to initiate the isolation process. The Isolate Warning shown in Figure 18 will appear for 40 seconds.

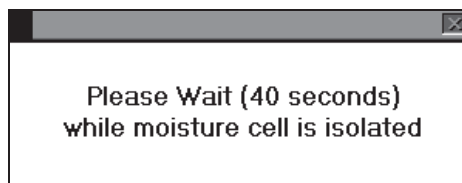


Figure 18: Isolate Warning

While the moisture cell is isolated from gas flow, a warning will appear at the bottom of the main display indicating "Isolated". Under this condition, the pressure alarm is disabled.

#### CAUTION



*When in isolation mode the moisture cell's pressure transducer will yield an incorrect reading of the actual cell pressure. Because the displayed moisture reading is dependant upon a proper pressure reading, moisture readings should be ignored while the cell is under isolation.*

*NOTE: Under these conditions the pressure alarm is disabled.*

## 7.4.2 Restore Sample Gas Flow

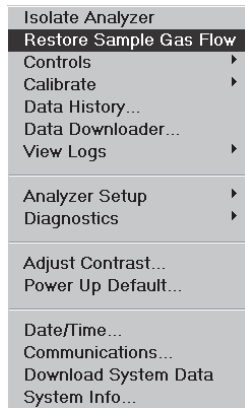


Figure 19: Restore Sample Gas Flow

This command allows the user to return the analyzer gas flow to normal after isolation.

### CAUTION



*Before restoring flow to an isolated moisture cell, be sure the pressure at the outlet is at or below the cell pressure at the time of isolation to avoid back diffusion of ambient air from the outlet into the cell.*

## 7.4.3 Controls Menu

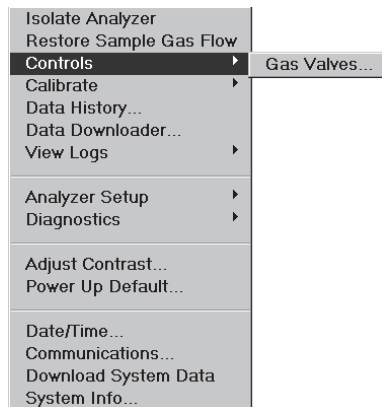


Figure 20: Controls SubMenu

The Moisture Controls menu provides access to the control of items related to the gas flowing through the moisture cell.



### 7.4.3.1 Gas Valves Control

The moisture gas valves control screen as shown in Figure 21 is used to control the flow of gas through the moisture cell.

Three options exist for gas valve control. Use the arrow keys (▲ and ▼) to move between the selections. After highlighting your choice use the **Enter** key to move to the **Apply** button, and hit **Enter** again to apply your choice. The gas valves screen will stay visible, allowing other changes until the **Next** key is used to highlight the **Done** button, and the **Enter** key is hit to return to the main display.

- **Isolate Sensor** closes the upstream and downstream valves for the moisture cell. This is done to prevent contamination of the cell when in transport or for changing process lines.
- **Restore Process Gas flow** opens the upstream and downstream valves of the moisture cell to allow for gas flow from the sample inlet for normal operation.
- **Restore Zero Gas flow** diverts the sample inlet flow through the gas purifier and then through the moisture cell. Flowing the sample through the purifier is necessary for performing zero calibrations or for assessing the purity level of the incoming gas.

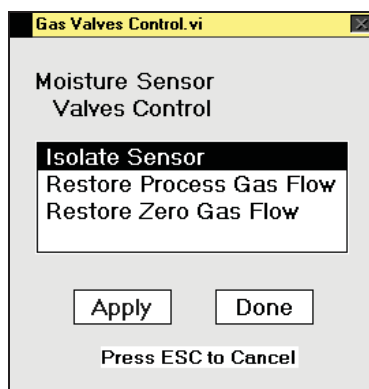


Figure 21: Gas Valves Control

### 7.4.3.2 Back Flow Prevention System

The Back Flow Prevention System provides a means of eliminating the possibility of contamination of the plumbing system when gas flow is lost or accidentally shut off. Under this condition ambient air may be drawn in to the system through the bypass exhaust by means of the aspirator or vacuum pump.

During normal operation the gas flow is constantly monitored by a flowswitch mounted in the bypass loop that is set to trip when the flow drops below .1 lpm. In the event that flow is reduced, the switch will automatically isolate the gas panel valves. In addition the pressure reading will be forced to zero. When the system detects a zero pressure reading a message will be displayed which states that backflow prevention is engaged and to check

sample and bypass flow. See Figure 22. The analyzer will remain in isolation and the user will not have control of any valves at this point.

### CAUTION



While the Back Flow Prevention System is engaged the moisture reading is *not* valid.

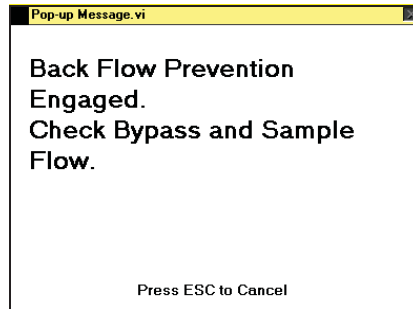


Figure 22: Back Flow Prevention Warning

The user must determine the cause of the loss of gas flow and remedy the situation.

When flow has been restored to the analyzer the pressure reading will go to a non-zero value and a message will then appear stating that sample flow has been restored and to wait five minutes to restore internal sample flow to the sensors. See Figure 23.

A five minute timeline is displayed and the user will still not have valve control until the five minutes are up. During this time, the ESC key may be hit to cancel the five minute delay and return control to the user. Once the Esc key is hit, or the five minute waiting period has expired, all remaining messages are cleared from the screen and the system will remain in isolation until the user restores flow. See page 37 for additional information on restoring gas flow.

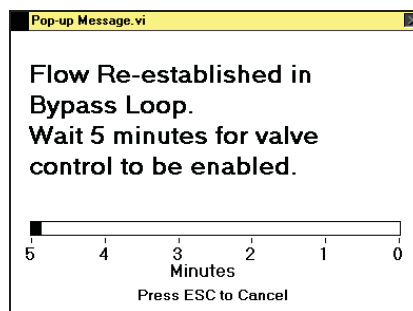


Figure 23: Re-established flow delay

This event will trigger a system alarm (192) for the moisture cell. See page 51 for additional information on system alarms.

## 7.4.4 Calibrate Menu

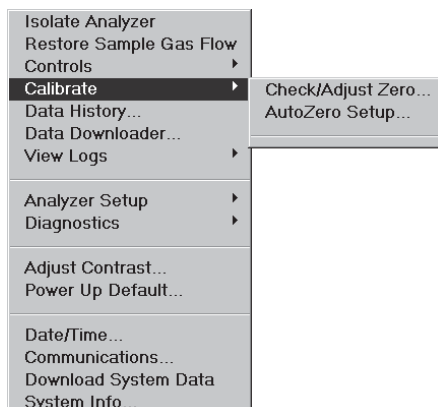


Figure 24: Calibrate SubMenu

“Calibration” of the moisture analyzer is somewhat of a misnomer. Because of the nature of absorption measurements, instrumental drift has minimal effect on the quantitative moisture content result. Once operating parameters are in place from the factory, no other *SPAN* “calibration” is necessary.

However, sample line contributions to moisture offsets in ppb measurements, especially at the sub-ppb level, are difficult to remove even with a correctly operating system. The dry down process of the analyzer and/or gas supply system can literally take many months. The moisture analyzer has an array of zeroing features that enable the user to establish *temporary* performance near 0.0 ppb during the dry down process. Monitoring the zero reference number during that time, or repeated restoration of the factory zero, will give the user a sense of the offset being induced by the user zero actions.

Any zero action whether completed or aborted is recorded in the Zero Cal Log as shown in Figure 44.

### 7.4.4.1 Check/Adjust Zero

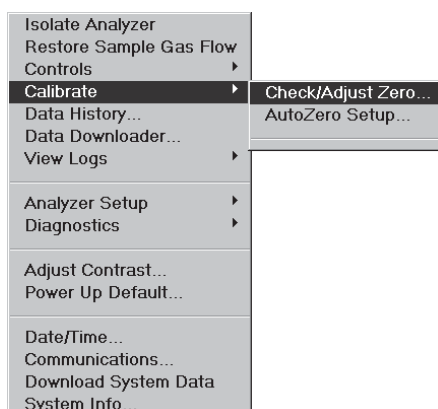


Figure 25: Check/Adjust Zero Menu

The moisture Check/Adjust Zero screen displays many pieces of information including a live reading of moisture in ppb (or ppm) and the state of the zero gas control valves. Also depicted are Zero Reference and Zero Offset values.

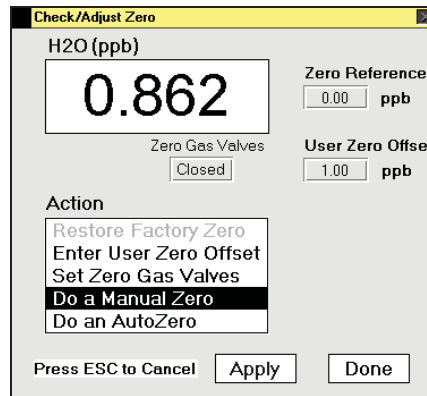


Figure 26: Check/Adjust Zero Screen

The Zero Reference value is a reflection of the deviation of the instrument's baseline from what was set at the factory. The zero reference of an instrument from the factory will be 0.00. After a manual or auto zero is performed, this value may change slightly.

If the moisture cell has been previously calibrated by the user, Restore Factory Zero will be enabled on this screen. Enacting this will erase any user zero and restore the factory set point.

The Active Zero Offset is another offset feature. When this feature is turned on, the User Zero Offset display is inactive and Active Zero Offset will be displayed instead. See page 62 for additional information on the Active Zero feature.

A relay is available on the Analog Output Setup Screen (see page 60) to signal that a zero calibration is taking place, and the analog output signal can also be frozen or allowed to update during the calibration process.

#### 7.4.4.1.1 User Zero Offset

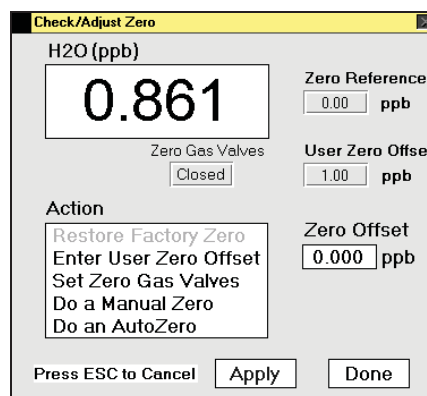


Figure 27: User Zero Offset

The User Zero Offset function enables the user to add a given moisture ppb value to the displayed concentration. This can be useful in preventing negative readings to be displayed should the baseline drift below the calibrated zero point. The value does not affect zero calibration, it is simply added to the calibrated zero. For example, an offset of 1.0 ppb could be put into a system reading 0.0 ppb to allow a chart recorder attached to the output to read slightly above zero. Under this condition, the moisture reading would be 1.0 ppb.

Use the arrow keys (▲ and ▼) to highlight Enter User Zero Offset in the Check/Adjust Zero screen, Figure 26, hit the Enter key on the front panel, and the zero offset box will appear on the screen as shown in Figure 27. With the left and right arrow keys move the cursor to the right of the digit you want to change. With the up and down arrow keys set the number to the desired value. When done hit the Enter key which will move the highlighted area to the Apply button and hit Enter to set the value. Use the Next key to go back and change the value or move to the Done button, followed by hitting the Enter key to leave the screen. Using the ESC key at any time will exit the screen making no changes and return to the main display.

#### 7.4.4.1.2 Set Zero Gas Valves

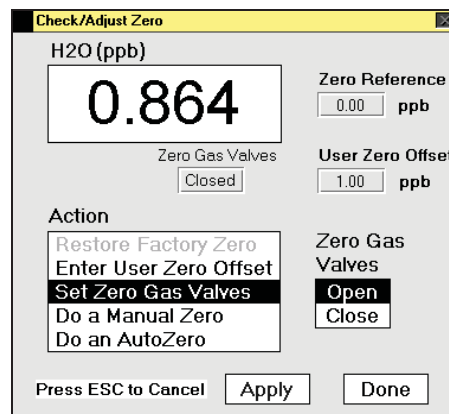


Figure 28: Set Zero Gas Valves

The state of the Zero Gas Control Valves can be toggled on or off from this screen. Use the arrow keys (▲ and ▼) to highlight Set Zero Gas Valves on the Check/Adjust Zero screen, Figure 26, hit the Enter key on the front panel, and the Zero Gas Valves box will appear on the screen as shown in Figure 28. Use the arrow keys (▲ and ▼) to highlight Open or Close and hit Enter which will move the highlighted area to the Apply button. Hit Enter again to change the valve state. Use the Next key to move back to the control box or to the Done button followed by hitting Enter to leave the screen. Using the ESC key at any time will exit the screen making no changes and return to the main display.

#### 7.4.4.1.3 Do A Manual Zero

The manual zero command enables the user to zero the moisture cell in an interactive manner.

For this purpose, it is necessary to ensure that moisture free gas is entering the sensor. This can be accomplished by opening the zero gas valves for the moisture cell. See Figure 28. When switching to a gas that is moisture free, it is important to wait a period necessary to allow the reading to re-stabilize.

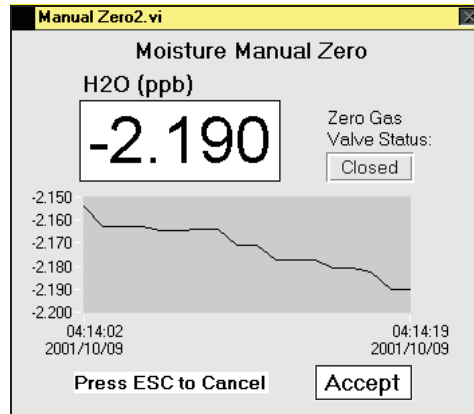


Figure 29: Manual Zero Screen

After opening the zero gas valve and selecting **Do a Manual Zero**, a screen will appear which displays a trace of the recent moisture reading. See Figure 29. Observe the trace until the reading is stable and then press **Enter**. This action will accept the present value as the new zero setting for the moisture cell and the **Zero Reference** field will be updated. After this action, the user will be brought back to the **Check/Adjust Zero** screen.

Pressing **ESC** during the calibration process will abort the action and return the user to the main display. Pressing **Accept** will complete the zero process, update the zero log and return the user to the main display.

Once complete the gas valves must be returned to the original state with process gas going directly through the sensor. See Figure 28.

A relay is available on the **Analog Output Setup Screen** (see page 60) to signal that a zero calibration is taking place, and the analog output signal can also be frozen or allowed to update during the calibration process.

#### 7.4.4.1.4 Do an AutoZero

The **AutoZero** command enables the user to zero the moisture cell in an automated manner. In addition, the **AutoZero** procedure can be scheduled to run automatically by using the **AutoZero Setup** procedure described on page 44.

The process measurement mode can be restored at anytime during the calibration process by pressing **ESC** or it will be automatically restored at the end of the **AutoZero** process.

Before the **AutoZero** process can be started various criteria must be set using the **AutoZero Setup** screen Figure 32. See page 44 for additional information.

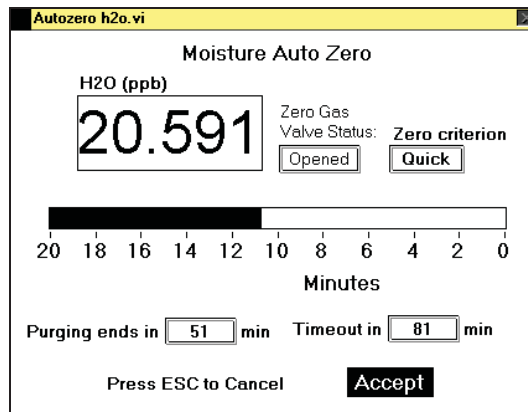


Figure 30: AutoZero Screen

After selecting “Do an AutoZero” from Figure 28 a screen similar to Figure 30 will appear. Throughout the zero process the screen displays the current moisture reading as well as the valve status and selected zero criteria. If a Pre-Zero purge time has been set in the AutoZero Setup screen, then the zero purifier will be valved in and the gas will flow through the purifier to purge the plumbing for that amount of time. Once the pre-purge is complete, the twenty minute autozero cycle begins. During this twenty minute cycle, the analyzer applies stability criteria. If after twenty minutes the moisture reading has acceptable stability the analyzer automatically accepts the reading, updates the **Zero Reference**, and returns to the Data Display Screen. If the reading is not stable, the analyzer continues the stability monitoring until the criteria has been met or until the cycle timer expires. In the latter case, the analyzer returns to operation on sample gas with no adjustment to the zero calibration and reports a failed zero calibration. See the section on AutoZero Setup below for a description of the **Cycle Timeout** function. The Zero Ref in the Check/Adjust Zero screen may change as a result of this process. Pressing ESC during the calibration process will abort the action. The user may also restore the factory calibration from the Check/Adjust Zero screen.

A relay is available on the Analog Output Setup Screen (see page 60) to signal that a zero calibration is taking place. Also the analog output signal can either be frozen or allowed to update during the calibration process.

### 7.4.4.2 AutoZero Setup

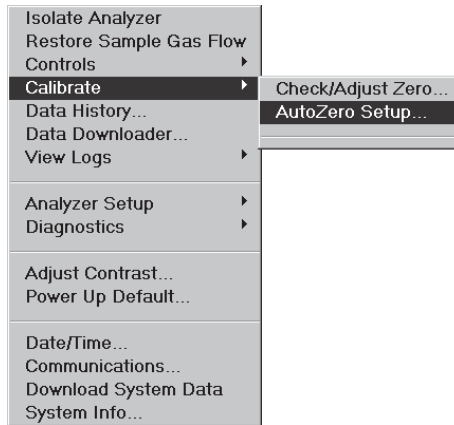


Figure 31: AutoZero Setup Menu

Use the **Next** key to move from between fields and use the arrow keys (**▲** and **▼**) to change the highlighted selections and to enter numerical values. When done, use the **Next** key to move to the **Accept** button and hit the **Enter** key to return to the main display. Using the **ESC** key at anytime will exit the screen making no changes and return to the main display.

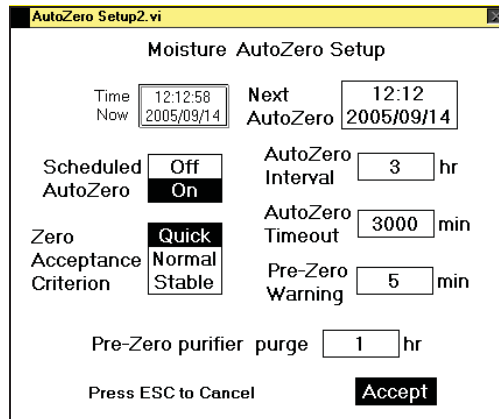


Figure 32: AutoZero Setup Screen

Moisture AutoZero Setup allows for unattended, automatic zeroing of the moisture analyzer at preset times.

If, when this screen is entered, and the **Scheduled AutoZero** is turned off, the box in the upper right corner will not be displayed. When the **Scheduled AutoZero** is switched from off to on, the box will appear and the time of the **Next** scheduled **AutoZero** will be set to the current time and date. If no other changes are made, when this screen is accepted the autozero process will start immediately. Use the **ESC** key to escape from the screen without starting an autozero process.



Setting a time and date for the **Next AutoZero** is accomplished by accepting the current time and date or using the **Next** key to move to the **Next AutoZero** box. With the left and right arrow keys, move the cursor to the right of the digit you want to change and use the up and down arrow keys set it to the desired value. When done, use the **Enter** key to move to the next box.

**NOTE:** If the **Scheduled AutoZero** is then turned off, the autozero process is stopped and returning to this screen will not show the **Next AutoZero** box in the upper right hand corner.

The **AutoZero Interval** can be used to set the frequency of zeroing the moisture cell starting with the setting in the box labeled **Next AutoZero**. The date and time of the next scheduled **AutoZero** is automatically calculated based on the current **AutoZero Interval** setting.

With the **AutoZero Timeout** setting the user can adjust the allowed time for stabilization. If the required stable period is not achieved during this time, the **AutoZero** is automatically aborted and the **Fail Zero** flag is set.

The system provides warning of a scheduled **AutoZero** before the calibration takes place, per the time set in the **Pre-Zero Warning**.

The **Pre-Zero purifier purge** enables the user to set an amount of time during which the system will be purged with zero gas before the **AutoZero** process begins.

The **Zero Acceptance Criterion** allows the user to select the stability criteria required before the zero value is accepted. The **Stable** selection (recommended) ensures the most accurate zero calibration but takes the longest time to execute (68 minute delay before the zero process begins). The **Quick** selection takes the least time (17 minute delay) and as a result is the least precise. The **Normal** selection applies an average of the two (34 minute delay).

A relay is available on the **Analog Output Setup Screen** (see page 60) to signal that a zero calibration is taking place, and the analog output signal can also be frozen or allowed to update during the calibration process.

### **7.4.5 Data History Routine**

The **Data History Screen** (Figure 34) enables the user to see the data history displayed in strip chart form on the front display. By default, the data history screen displays data for the most recent 24 hour period sampled at 1 point per minute (fixed) and the y-axis is auto-scaling.

The **Next** button can be used to toggle the X axis from 1 day (default), to 1 hour, to 1 week and then to 3 weeks.

The **Next** button can also toggle the cursor to the max and min values on the Y axis and the arrow keys can then be used to adjust the values, and the display will actively update.

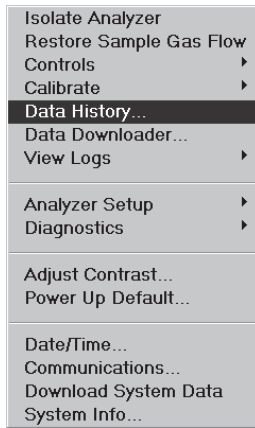


Figure 33: Data History Menu

The data history may be downloaded to a USB memory stick, by using the Next key to move to the Download box and hitting ENTER. A screen will appear, requesting that a memory stick can be placed in the external USB socket. The socket is located behind the front door on the left side of the chassis.

The downloaded file will be in tab delimited form and will be all moisture data in the system up to 3 weeks old if available. The download process will take up to 15 seconds and the display will indicate downloading is in progress. Once the download is complete, control of the analyzer is returned to the operator. See Figure 36 for an example of a portion of a download taken between the dates of May 1 and May 22. The complete file covers three full weeks.

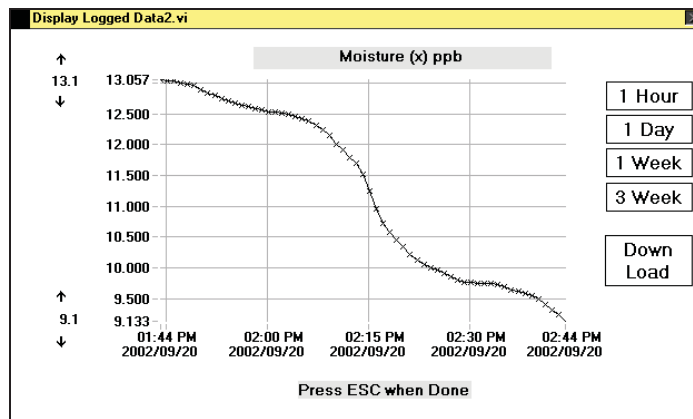


Figure 34: Data History Screen

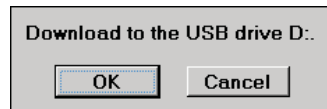


Figure 35: Install Media

Firmware version	0.6.1	
Serial #	ND-10016	
Model #	DF-750	
Start time	05-01-2003	03:07 PM
End time	05-22-2003	03:07 PM
Date	Time	H2O
5/16/03	1:24 PM	5.423
5/16/03	1:25 PM	5.423
5/16/03	1:26 PM	5.421
5/16/03	1:27 PM	5.416
5/16/03	1:28 PM	5.411
5/16/03	1:29 PM	5.406

Figure 36: Example of Data Download

### 7.4.6 Data Downloader Routine

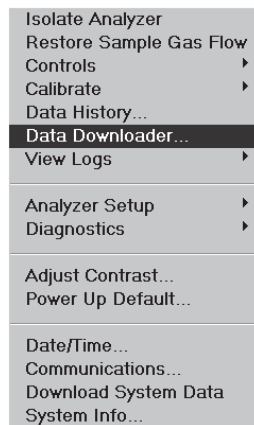


Figure 37: Data Downloader Menu

The Moisture Data Downloader screen, Figure 38, enables the user to label data with unique location names as well as to view and download specified data.

The **Next** key is used to toggle through the various options on the screen and the arrow keys (▲ and ▼) move up and down through the location list.

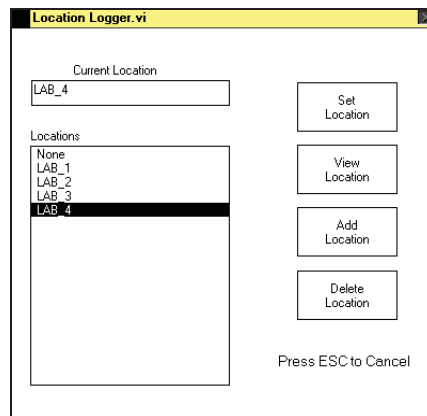


Figure 38: Data Downloader Screen

#### 7.4.6.1 Set Location

The set location function is used to choose a location from a list of existing locations previously entered into the system (see Add Location on page 49). On the Moisture Data Downloader screen Figure 38, use the **Next** key to move to the list of existing names and then use the arrow keys (▲ and ▼) to select the location desired. Then use the **Next** key to move to **Set Location** and press **Enter** to accept the new location.

The action of setting a location starts the logging process and creates a new file. Changing to a new location will, in turn, end the previous file and start a new one.

#### 7.4.6.2 View Location

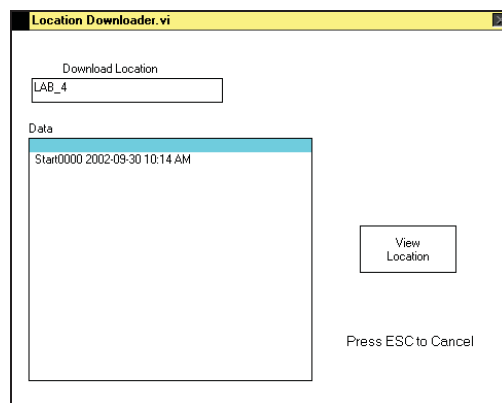


Figure 39: View Location Screen

The view location function is used to view data previously stored in the system sorted by location. On the Moisture Data Downloader screen Figure 38, use the **Next** key to move to the list of existing names and then use the arrow keys (▲ and ▼) to select the location desired. Then use the **Next** key to move to **View Location** and press **Enter**. The View Location screen will appear as in Figure 39.

Use the arrow keys (▲ and ▼) to select the data block desired and use the **Next** key to move to **View Location** and press **Enter**. The data history screen will appear as shown in Figure 34. From the data history screen, the data may also be downloaded to a USB Memory Stick.

### 7.4.6.3 Add Location

The user can create a new location stamp by moving the cursor to the **Add Location** button and hitting enter. This brings up the keyboard shown in Figure 40 that is used to enter the name of the new location.

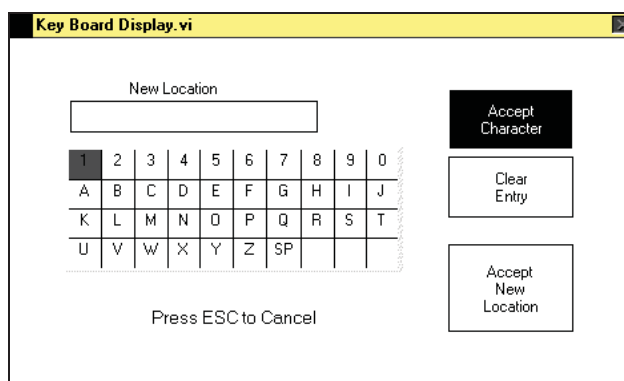


Figure 40: Keyboard Display

Use the arrow keys (▲ and ▼) to navigate the keyboard and use the **Enter** key to accept each character. If an error is made use the **Next** key to move to the **Clear Entry** key and hit enter. When the location name is complete use the **Next** key to move the highlight to **Accept New Location** and hit **Enter**. The display will return to the Downloader Screen and the name will appear in the list of available locations.

### 7.4.6.4 Delete Location

The delete location function is used to remove a location from the list of available names. On the Moisture Data Downloader screen Figure 38, use the **Next** key to move to the list of existing names and then use the arrow keys (▲ and ▼) to select the location desired. Then use the **Next** key to move to **Delete Location** and press **Enter**. A confirmation box will then appear (see Figure 41) and the user can either accept the deleted selection with the **Enter** key or can hit **ESC** to cancel the action. If accepted, the name will be removed from the list of available locations.

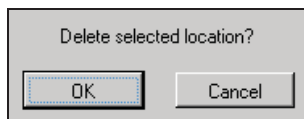


Figure 41: Delete Selection

## 7.4.7 View Logs Menu

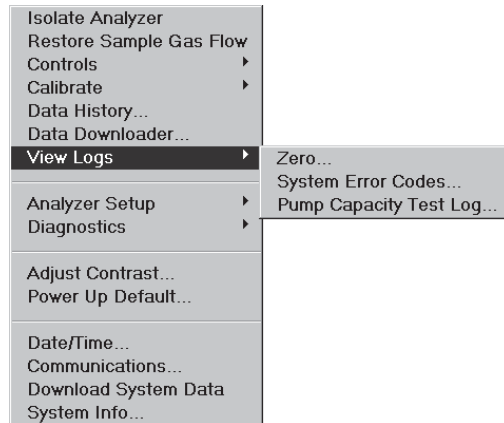


Figure 42: View Logs SubMenu

View Logs allows the user to easily access past events that may be connected with past operational changes (e.g., zero) or instrument upsets. Use the arrow keys (▲ and ▼) to scroll up and down through the list. Pressing ESC will return to the main display.

### 7.4.7.1 Zero Log

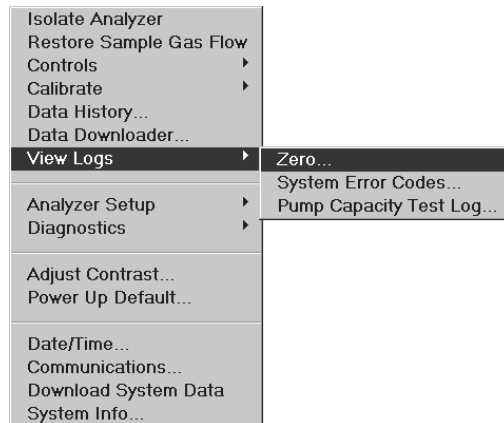


Figure 43: View Zero Log Menu

The Moisture Zero Log reports on adjustments made to the moisture cell zero setting. The date and time of the zero calibration is noted. The zero is listed in the notes section as either Manual or Automatic. The letters Q, N and S in the notes section indicate the type of acceptance criteria selected (Quick/Normal/Stable). The notes section also indicate if the zero was aborted, failed due to timeout, or in the event of an Automatic Zero, if it were scheduled. The time to perform the zero and the resulting zero reference also appear.

Display Logged Events.vi

**Moisture Zero Cal Log**

↑more

Date & Time	Notes	Min	ZRef
05/16/2005 11:12	Manual Nzero Aborted	0.1	NaN
05/16/2005 10:40	Automatic Szero Aborted	0.4	-21.72
05/16/2005 10:34	Automatic Szero Aborted	0.1	-44.14
05/16/2005 10:33	Manual Nzero Aborted	0.1	0.00
05/13/2005 07:52	Manual Nzero	0.1	7.78
05/13/2005 07:51	Manual Nzero	0.1	7.94
05/13/2005 07:44	Manual Nzero	0.1	9.81
05/13/2005 07:31	Manual Nzero	0.0	2.40
05/13/2005 07:30	Manual Nzero	0.0	-14.45

↓more

Press ESC when Done

Figure 44: Zero Log Screen

### 7.4.7.2 System Error Codes

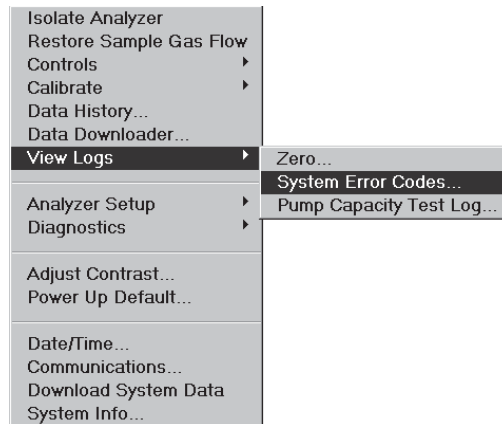


Figure 45: View System Error Code Log Menu

**System Error Log**

\* : Send System Data to Customer Support.  
 Refer to User Manual for code.

Date & Time	Notes
12/31/2009 12:10	Error 101 peak not found*

Press ESC when Done

Figure 46: System Error Log Screen

The System Error Log reports functional errors in the moisture system. If the error persists for more than 30 minutes, the code is displayed, if warranted. In addition, a system alarm will trip if configured to do so. See page 65 for additional information on setting System Alarms. NOTE: The 30 minute clock is delayed for 60 minutes on a “cold” system start up.

Following is a list of System Error/Event Codes and their descriptions:

- 101 = peak unstable or not found
- 133 = data acquisition system event
- 141 = sample gas pressure outside of pressure matrix range.
- 191 = fan condition voltage out of range – “Fan Failure”

Contact Delta F for assistance in interpreting the various codes if one should appear on the screen.

### 7.4.7.3 Pump Capacity Test Log

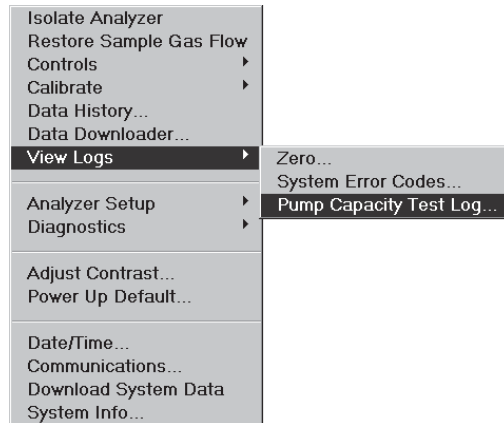


Figure 47: Pump Capacity Test Log Menu

The pump capacity test is used to determine the condition of the aspirator or the vacuum pump, which in turn will have a direct impact the flow of gas through the analyzer. A reduction in capacity can result in a reduction in gas flow and as a result on the stability of the analyzer reading. See page 68 for additional information on the pump test. As the last step of the test, the system automatically puts an entry in the pump capacity test log for future reference. See Figure 48. Review of this information can be useful in detecting a trend in the condition of the aspirator or the pump which can result in a need to rebuild the pump.



Display Logged Events.vi

Pump Capacity Test Log

Date & Time	Notes	h2o	torr
12/23/2009 16:05	pump capacity test	13.3	198.00
12/23/2009 16:05	pump capacity test	13.3	113.00
12/23/2009 16:04	pump capacity test	13.3	119.00
10/22/2009 14:26	pump capacity test	6.3	111.00
10/22/2009 14:26	pump capacity test	6.3	111.00
10/22/2009 14:26	pump capacity test	6.3	111.00
10/22/2009 14:24	pump capacity test	5.8	111.00
10/22/2009 14:23	pump capacity test	5.7	111.00
10/06/2009 15:02	pump capacity test	3.9	92.00

↓more      Press ESC when Done

Figure 48: Pump Capacity Test Log

### 7.4.8 Analyzer Setup

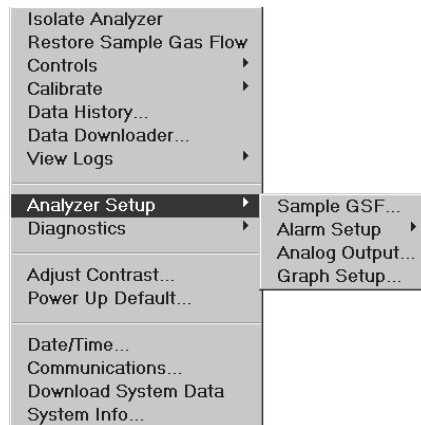


Figure 49: Analyzer Setup Menu

### 7.4.8.1 Sample GSF

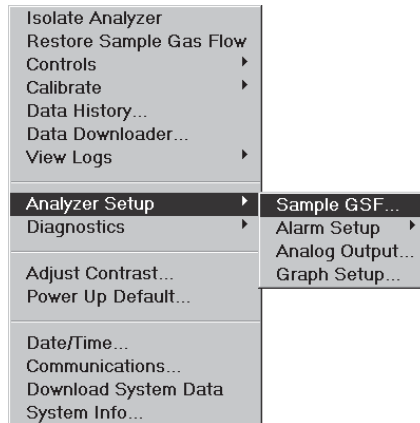


Figure 50: Sample GSF Menu

The GSF setup (Gas Scale Factor) is critical for obtaining quantitatively correct results. It accounts for the fact that moisture molecules have different absorption features in different buffer gases.

The GSF should be applied when the user has any knowledge of a change in the buffer gas or change in the percentages of a mixed background gas. The default setting from the factory is 100% N<sub>2</sub>, yielding a GSF of 1.00.

Use the **Next** key to move from between fields and use the arrow keys (▲ and ▼) to change the highlighted selections and to enter numerical values. When done, use the **Next** key to move to the **Accept** button and hit the **Enter** key to return to the main display. Using the **ESC** at anytime will exit the screen making no changes and return to the main display.

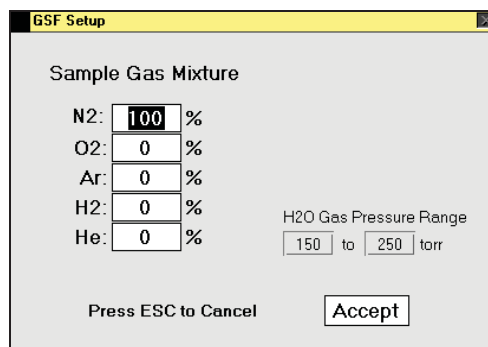


Figure 51: Sample GSF Setup Screen

After the percentages of all background gas are entered, the **Accept** button is hit and the system confirms that the total is 100%. Next if appropriate, the system indicates the proper pressure setting as in Figure 52 and the limits are set on the Pressure Alarm Screen. See page 58 for additional information on setting the Pressure Alarm.

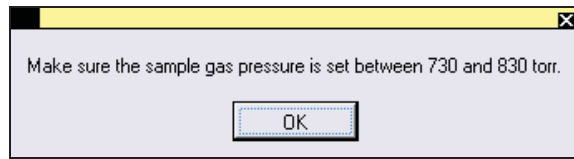


Figure 52: GSF Pressure Setting

NOTE: If a non-zero number is entered in the Oxygen field in the GSF setup screen, the Purifier Warning screen automatically appears and requires the user to indicate which type of purifier is installed in the analyzer before proceeding. See Figure 53.

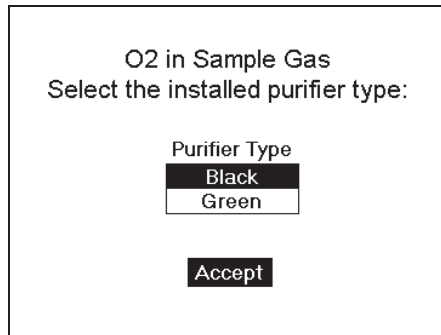


Figure 53: Purifier Warning

If a black purifier is installed in the analyzer, then no Zero adjustments will be possible using the internal purifier until the Oxygen value in the GSF screen is set to zero.

NOTE: An entry of any percentage of Hydrogen in the GSF calculation will automatically engage the Hydrogen Safety Service System option if equipped. See page 103 for additional information.

#### 7.4.8.2 Fan Failure

The analyzer constantly monitors the condition of the cabinet exhaust fans and if hydrogen is entered as a gas in the GSF Setup, and the system detects a failure in the exhaust fan circuitry the entire analyzer will automatically isolate.

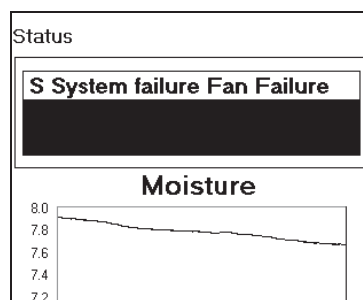


Figure 54: Fan Failure Alarm

A message of “Fan Failure” as shown in Figure 54 will flash over the moisture reading on the main display and the user will be unable to restore any flow until the fan problem has been fixed.

### 7.4.8.3 Alarm Setup

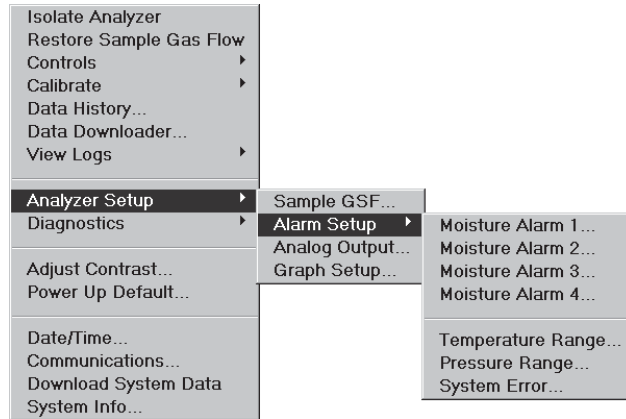


Figure 55: Alarm Setup Menu

The moisture analyzer includes a total of seven alarms. The four moisture concentration alarms can be user controlled to activate up to four optional relays. High and low setpoints as well as deadbands are user-set.

Alarm Number	Function
1	Moisture Level 1
2	Moisture Level 2
3	Moisture Level 3
4	Moisture Level 4
T	Temperature
P	Pressure
S	System

Table 6: Alarm Codes

The temperature alarm indicates an out of specification ambient temperature condition in the analyzer cabinet.

The pressure range alarm is related to the pressure in the gas path.

Finally, system errors are monitored, and under certain conditions will trip alarms if enabled.

NOTE: When any hydrogen is included in the background gas matrix (see discussion regarding GSF on page 54 for additional information), an additional alarm is enabled to monitor the cabinet exhaust fan status. If the system detects a failure in the operation of the cabinet exhaust fans while operating in a hydrogen background, the system immediately

isolates the moisture cell until the fan is repaired. A warning describing this condition will appear over the main display and the user will be unable to restore gas flow until the fan is repaired. See Fan Failure on page 55.

An alarm warning will overwrite the moisture level readout if an alarm condition exists. To acknowledge the alarm simply hit the Enter button and its number or letter will appear in the Alarm Status line above the display. See Figure 14. This action will not clear the alarm. Only restoration of the condition that existed prior to the alarm will clear the alarm.

Following is a list of alarm code abbreviations that can appear in the Status Line:

#### 7.4.8.4 Moisture Alarm Setup

Alarm	Trip
Off	Below Setpoint
On	Above Setpoint

Setpoint	Relay	N/U
0.000 ppm	Assigned	1
		2
		3
		4

Deadband: 0.000 ppm

Press ESC to Cancel      Accept

Figure 56: Alarm Setup Screen

The Setpoint value refers to the limit above or below which the alarm is triggered. The Trip command sets the above/below parameter. The deadband refers to the value from the nominal setpoint that the output value must exceed before an alarm is reset. The Relay Assignment indicates to which relay the alarm is assigned.

Use the Next key to move from between fields and use the arrow keys (▲ and ▼) to change the highlighted selections and to enter numerical values. When done, use the Next key to move to the Accept button and hit the Enter key to return to the main display. Using the ESC key at anytime will exit the screen making no changes and return to the main display.

### 7.4.8.5 Temperature Range Alarm Setup

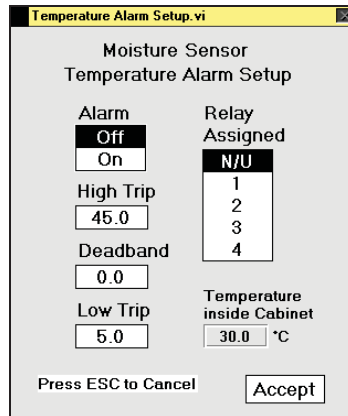


Figure 57: Temperature Alarm Setup

The system is constantly monitoring the ambient temperature in the analyzer cabinet. If enabled on the Temperature Alarm Setup screen, an alarm can be assigned to trip if the ambient temperature exceeds preset limits. The user may assign the temperature alarm to one of four relays.

Use the **Next** key to move from between fields and use the arrow keys (▲ and ▼) to change the highlighted selections and to enter numerical values. When done, use the **Next** key to move to the **Accept** button and hit the **Enter** key to return to the main display. Using the **ESC** key at anytime will exit the screen making no changes and return to the main display.

### 7.4.8.6 Pressure Range Alarm Setup

The system is constantly monitoring the pressure in the gas path and the result is displayed on the front panel. If enabled on the Pressure Alarm Setup screen, an alarm can be assigned to trip if the pressure exceeds preset limits. The user may assign the pressure alarm to one of four relays.

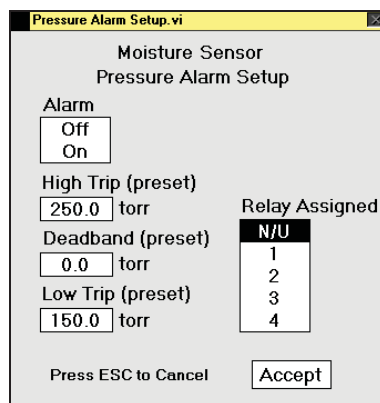


Figure 58: Pressure Range Alarm Setup

The limits are not user adjustable but are set automatically on the basis of the background gases entered in the GSF screen. See page 54 for additional information on setting the background gases.

Use the **Next** key to move from between fields and use the arrow keys (▲ and ▼) to change the highlighted selections and to enter numerical values. When done, use the **Next** key to move to the **Accept** button and hit the **Enter** key to return to the main display. Using the **ESC** key at anytime will exit the screen making no changes and return to the main display.

#### 7.4.8.7 System Alarm Setup

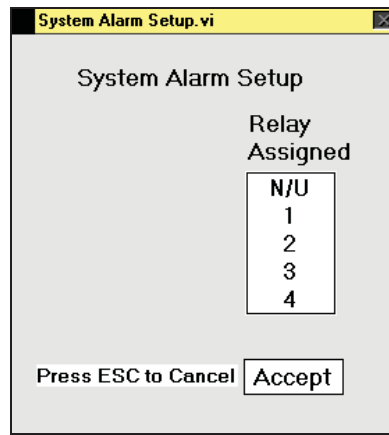


Figure 59: System Alarm Setup

If left for more than 30 minutes, a System Error Code will trip a System Alarm if configured to do so. See page 51 for additional information on System Error Codes.

NOTE: The 30 minute clock is delayed for 60 minutes on a “cold” system start up.

Use the **Next** key to move from between fields and use the arrow keys (▲ and ▼) to change the highlighted selections and to enter numerical values. When done, use the **Next** key to move to the **Accept** button and hit the **Enter** key to return to the main display. Using the **ESC** key at anytime will exit the screen making no changes and return to the main display.

## 7.4.9 Analog Output Setup

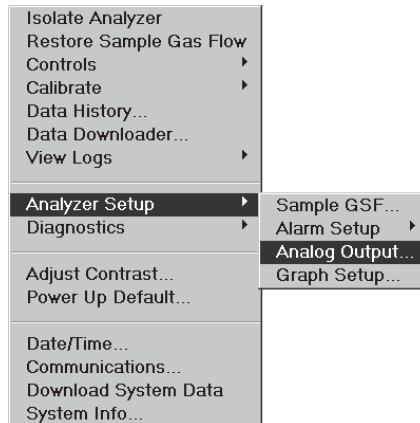


Figure 60: Analog Output Setup Menu

The Zero Point corresponds to the lowest voltage or current output (0 VDC, 4 mA) that is sent to a recorder, while the Full Scale corresponds to the maximum voltage or current output (1/5/10 VDC or 20mA) that is sent. The Full Scale set point (FS) is set from 0.002 ppm to 20.00 ppm.

Three ranges can be entered in this screen. The range of the primary Full Scale (FS) must be less than that of the Expanded Full Scale “A” (FS A) which must be less than that of the Expanded Full Scale “B” (FS B). The analyzer auto-ranges between the three outputs depending on the current analyzer reading. Relay contacts can then be assigned to signal a change in range. If only one expanded range is required, rather than two, then the value of FS B should be set to equal the FS A value.

A window as narrow as 10% of the analyzer’s decades can be set for the full-scale analog output.

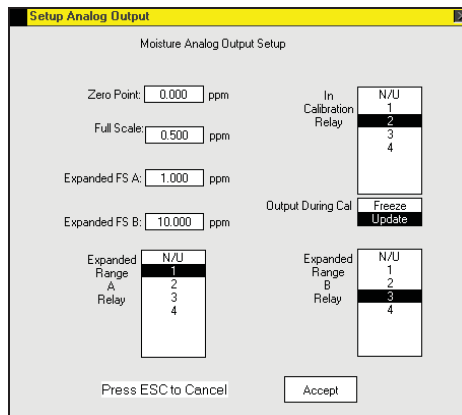


Figure 61: Analog Output Setup Screen



The In Calibration Relay can be enabled to signal that a zero calibration is in process. In addition, the user has the option to freeze the analog output or enable the analog output to update as the calibration progresses.

#### 7.4.10 Graph Setup

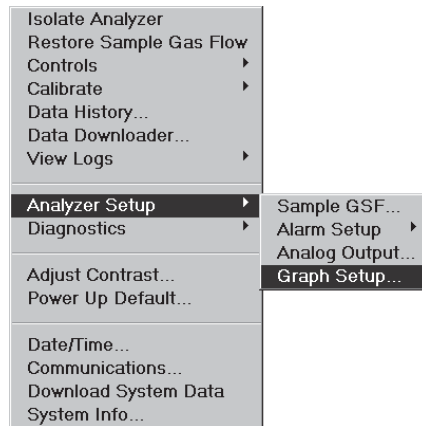


Figure 62: Graph Setup Menu

The graph setup is used to adjust the time scale on the main data display of the analyzer. A specific time interval in minutes can be chosen for the X-axis on that display. The minimum acceptable time is 3 minutes. The information on the display represents current data and will show a history of moisture concentration based on the given time span to the present. The Y-axis of the main data display is auto-ranging.

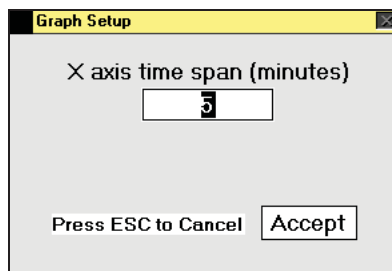


Figure 63: Graph Setup Screen

## 7.4.11 Diagnostics Menu

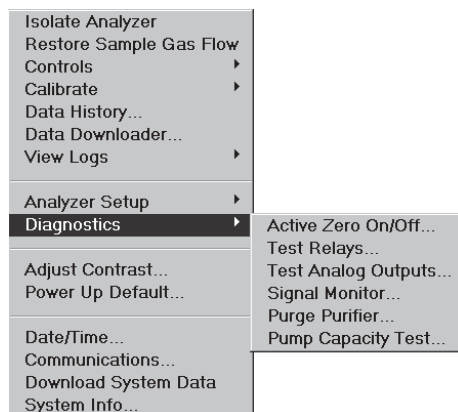


Figure 64: Diagnostics SubMenu

### 7.4.11.1 Active Zero On/Off

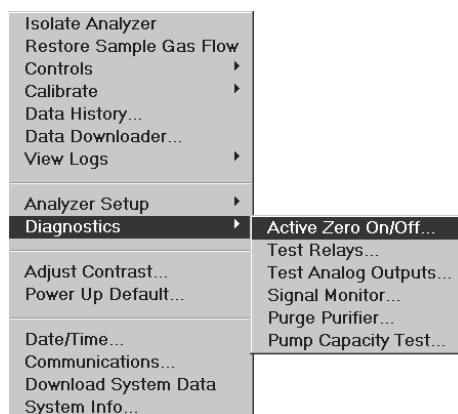


Figure 65: Active Zero Menu

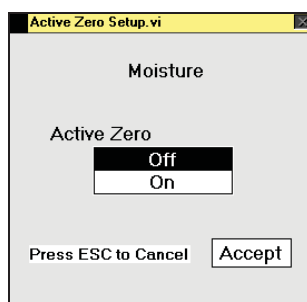


Figure 66: Active Zero Setup Screen

The Active Zero Offset feature is designed to automatically compensate for the analyzer's gradual zero baseline cleanup. This gradual cleanup is natural and occurs after a fresh

startup or after a prolonged or abnormally high moisture exposure. This feature ensures that accurate low ppb H<sub>2</sub>O readings can be made as soon as possible after initial startup, or after a high H<sub>2</sub>O upset event. It is similar to the User Zero Offset feature in that a small positive offset is added to the analyzer H<sub>2</sub>O readings (display and output) to compensate for the long term downward trending in the readings during cleanup. The Active Zero Offset provides an automatic addition of offset that occurs in miniscule steps, and within set guidelines, corresponding to predictable behavior during cleanup.

When Active Zero Offset is enabled through the Diagnostics Menu, the User Zero Offset feature is disabled and vice versa. While the User Zero Offset feature requires the user to enter a fixed positive offset value to accommodate the baseline cleanup, the Active Zero Offset does so automatically, and only when necessary.

The current Active Zero Offset value is shown in the Check/Adjust Zero screen as shown in Figure 26. It starts at a value of 0.00 ppb when the analyzer is first turned on, and then increments automatically as the analyzer applies offset to the readings. After each User Zero Calibration, the Active Zero Offset value is reset to 0.00 ppb and then automatically increments again as needed.

The Active Zero Offset is designed to operate when the zero baseline is falling at a rate less than 0.1 ppb/hr as would be the case after 1-2 weeks of initial operation. If user calibrations are performed sooner, the H<sub>2</sub>O readings may be decreasing too rapidly for the Active Zero Offset feature to operate properly and negative H<sub>2</sub>O readings may result.

If the Active Zero Offset value reaches 5 ppb a warning message CAL ZERO will flash in the system status block on the display instructing the user that a zero calibration should be performed. The maximum amount of offset that can be applied by this feature is 5 ppb. Any further downward trend (baseline cleanup) exceeding -0.3 ppb will result in negative readings until the next user calibration is performed resetting the Active Zero Offset value to zero.

If the Active Zero Offset feature is turned off, the User Zero Offset value will appear in its' place in the Check/Adjust Zero menu. The previous user Zero Offset value (if any) will reappear and immediately be applied to the live display readings. Likewise, if the Active Zero Offset feature is on, then its' value (if any) will appear and immediately be applied to the live readings.

#### **7.4.11.2 Test Relays**

The **Test Relays** screen, as shown in Figure 68, is used to assure that the relay outputs are functioning properly. When the Test Relays screen is selected, the NEXT key is used to move to the number field where the arrow keys (▲ and ▼) are used to choose the appropriate relay number. The NEXT key is then used to move to the Activate/Deactivate field where the arrow keys (▲ and ▼) are used to toggle between the two options. The NEXT key is then used to move to the Apply field where the Enter key is hit to change the relay state. This process can be repeated as often as needed. When done, the NEXT key is used to move to the Done field and the Enter key is hit to leave the screen. The condition of the relays before the test is restored when the test is concluded. See the section on relay ports found on page 31 for additional information.

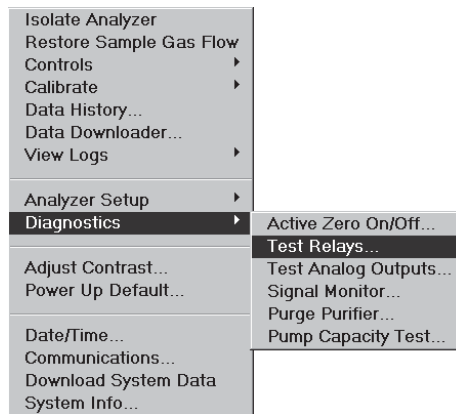


Figure 67: Test Relays Menu

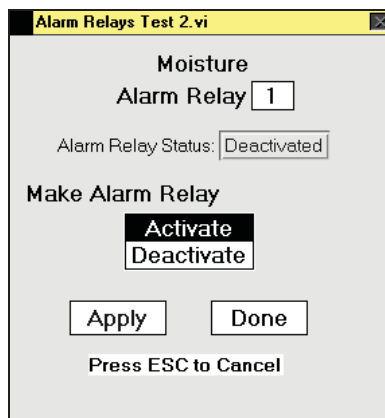


Figure 68: Test Alarm Relays Screen

### 7.4.11.3 Test Analog Voltage Output

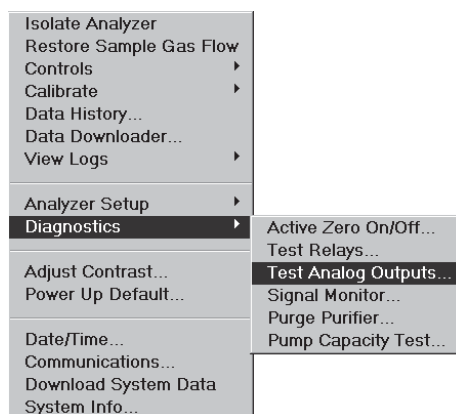


Figure 69: Test Analog Outputs Menu

The Test Output screen, as shown in Figure 70, is used to calibrate the analog recorder output. When the Test Output screen is selected, the NEXT key is used to move to the percentage field where the arrow keys (▲ and ▼) are used to choose the appropriate setting. The NEXT key is then used to move to the Apply field where the Enter key is hit to set the analog output to the selected value. The analog output response should match the value that was entered. For example, if 80 percent is entered for the percent full scale level, and the analog output is set for 0 to 10 VDC, the analog output is 8.000 VDC. This process can be repeated as often as needed. When done, the NEXT key is used to move to the Done field and the Enter key is hit to leave the screen. The condition of the analog output before the test is restored when the test is concluded. See the section on analog outputs found on page 30 for additional information.

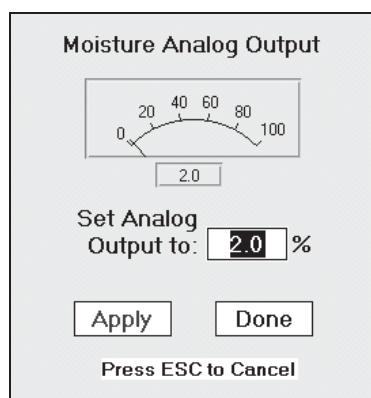


Figure 70: Test Analog Voltage Output Screen

#### 7.4.11.4 Signal Monitor

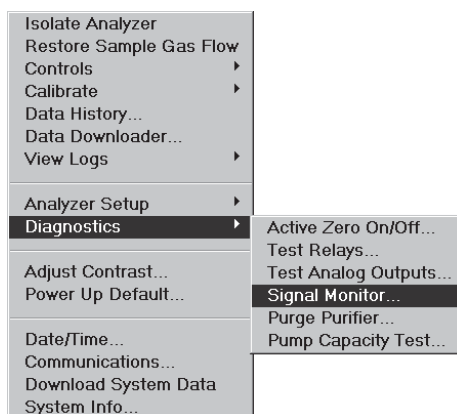


Figure 71: Signal Monitor Menu

The Signal Monitor depicts 18 system parameters in numerical order. Each parameter is unique for each system. In the event of a system error, these parameters can be used as a diagnostic tool. See page 51 for additional information on system errors.

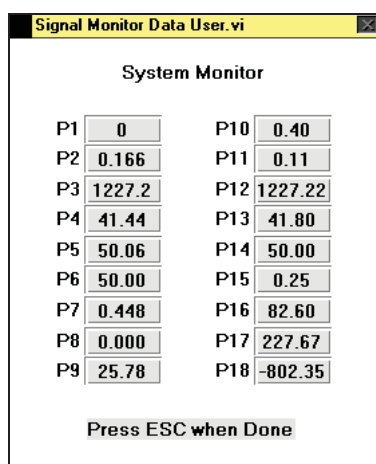


Figure 72: Signal Monitor Screen

#### 7.4.11.5 Purge Purifier

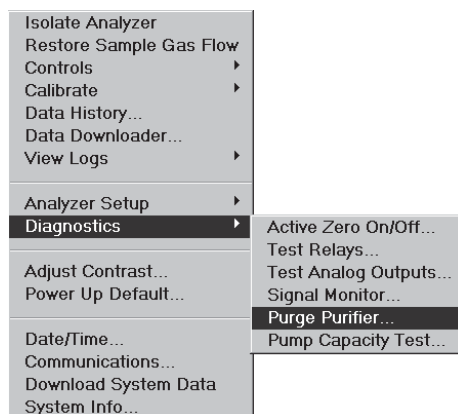


Figure 73: Purge Purifier Menu

When installing or replacing a purifier, the plumbing is inevitably exposed to ambient air. The key is to install the purifier quickly in order to minimize the duration of the exposure and therefore reduce the amount of time it takes the analyzer to release moisture from the wetted surfaces.

NOTE: When the analyzer is shipped from the factory, the plumbing is purged, filled with N2 and the purifier fittings are capped.

Installation of the purifier, no matter how quick, will allow ambient air to enter the plumbing and when gas flow is restored, the air will be sent into the system resulting in an increase in the moisture reading. As a result it is mandatory that the purifier plumbing be cycle purged before use.

The analyzer includes a system to automate the purge process by alternately flowing gas through and around the purifier. The process is repeated numerous times to eliminate all effects of wetted surfaces due to exposure to ambient air.

Select Purge Purifier from the Diagnostics screen and Figure 74 will appear. Use the Next key to toggle OK, and when ready press Enter and Figure 75 will appear.

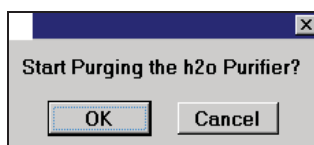


Figure 74: Purge Start

As the timeline progresses, the analyzer is going through a preset sequence of cycles which alternately flow the process gas through the zero and process legs of the gas panel. During this time, the analyzer should not be used for process measurements. The purge cycle can be terminated at any time by hitting the Esc key which will bring up Figure 76. Use the Next key to toggle between the options and use the Enter key to either end the process or, by canceling, allow it to continue. When the process is complete, control of the analyzer will be returned to the user.

NOTE: When purging a purifier it is important to use clean process gas that is very low in moisture and oxygen concentration.

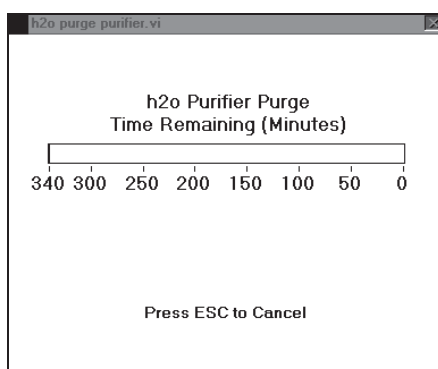


Figure 75: Purifier Purge Time Line

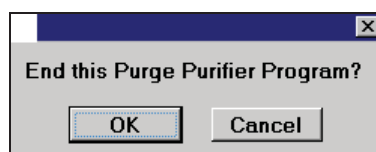


Figure 76: Purge Cancel

### 7.4.11.6 Pump Capacity Test

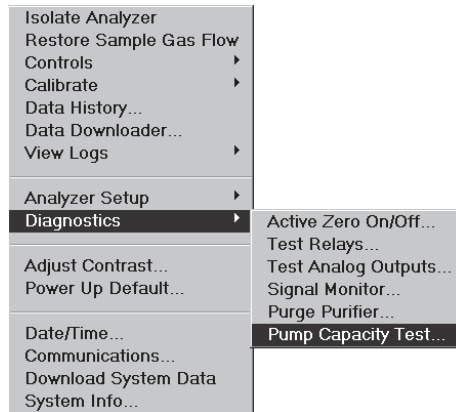


Figure 77: Pump Capacity Test Menu

The pump capacity test can be used to determine the ultimate vacuum that the aspirator or pump is capable of pulling, and as a result its' capacity to pull sufficient sample through the analyzer. The test is automatic in nature, in that once started, the analyzer isolates the moisture cell by closing the upstream and downstream valves and then the vacuum is monitored for 20 seconds and is displayed on the screen. Any pressure lower than 115 Torr is considered acceptable. If the aspirator or pump is unable to pull 115 Torr, a failure is indicated by the appearance of Figure 79 and the recommendation to rebuild the pump or check for leaks. At the end of the 20 second test, whether the aspirator or pump passes or fails, the user must hit Escape to return to the main display.

After the pump test is complete, an entry is automatically put in the pump capacity test log as shown in Figure 48. See page 52 for additional information on the pump test log.

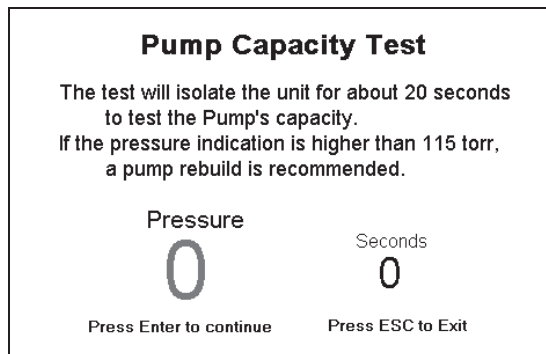


Figure 78: Pump Capacity Test

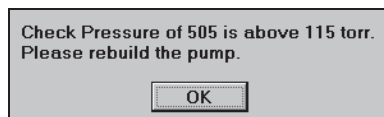


Figure 79: Pump Pressure Failure



Date & Time	Notes	h2o	torr
12/23/2009 16:05	pump capacity test	13.3	198.00
12/23/2009 16:05	pump capacity test	13.3	113.00
12/23/2009 16:04	pump capacity test	13.3	119.00
10/22/2009 14:26	pump capacity test	6.3	111.00
10/22/2009 14:26	pump capacity test	6.3	111.00
10/22/2009 14:26	pump capacity test	6.3	111.00
10/22/2009 14:24	pump capacity test	5.8	111.00
10/22/2009 14:23	pump capacity test	5.7	111.00
10/06/2009 15:02	pump capacity test	3.9	92.00

↓more  
Press ESC when Done

Figure 80: Pump Capacity Test Log

## 7.4.12 Adjust Contrast

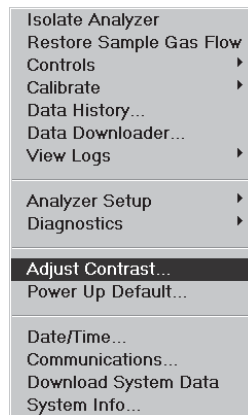


Figure 81: Adjust Contrast Menu

This screen allows the user to modify the contrast of the front display screen. From the System menu, select Adjust Contrast. Use the up and down arrows (▲ and ▼) as indicated to make adjustments. Hit ESC on the key pad when done.

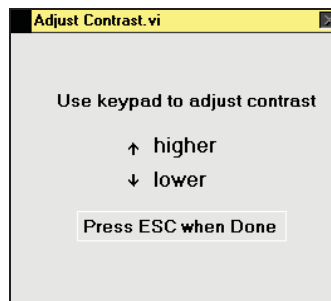


Figure 82: Adjust Display Contrast Screen

### 7.4.13 Power Up Default

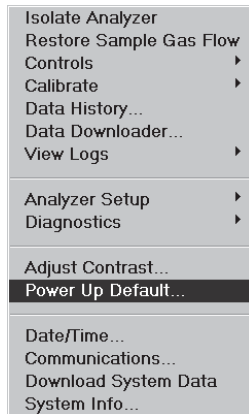


Figure 83: Power Up Default Menu

The Power Up Default SubRoutine allows the user to determine the various default states during analyzer power up. The power up states are useful because they determine whether, for instance, the sensor is protected from ambient air contamination or whether it is configured the best way for rapid station to station transfer and measurement.

Use the **NEXT** key to move from field to field. Use the up and down arrows (▲ and ▼) to move between the selections within the field. When done use the **NEXT** key to move to the **Accept** field and hit the **Enter** key. Pressing the **ESC** at any time will make no changes and will return to the main data display

**NOTE:** If the analyzer auto-reboots due to a system error 20006, the power-up defaults are ignored and the analyzer returns to the mode of operation found immediately before the error. This reboot action is identified in the system error log as an error 222. See page 51 for additional information on system error codes.

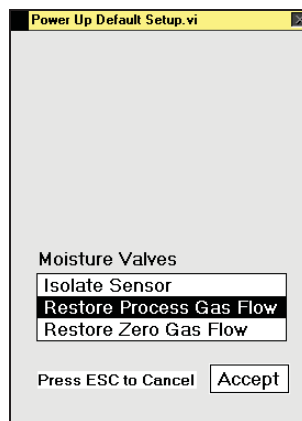


Figure 84: Power Up Default Screen

## 7.4.14 Date/Time

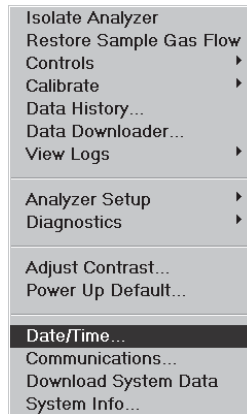


Figure 85: Date/Time Menu

The Date/Time Screen is used to set various calendar and clock related parameters.

The **Next** key is used to move from field to field, and the arrow keys (▲ and ▼) are used to change the numerical digits and units.

When in the Time Zone field the left and right arrow keys toggle through the various options. When done the **Next** key is used to move to the **Accept** field and the **Enter** key is hit.

Hitting the **Esc** key at any time will exit the screen with no changes and return the user to the main data display.

NOTE: The time is not automatically adjusted for daylight savings and must be changed manually.

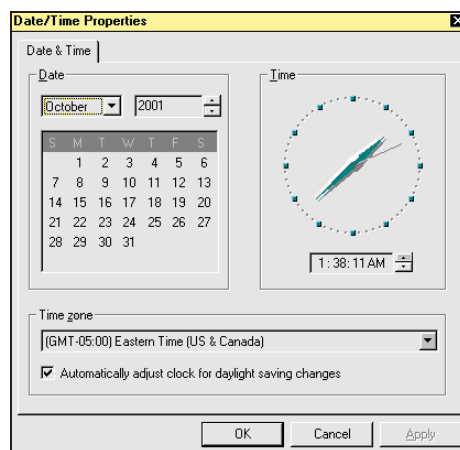


Figure 86: Date/Time Setup Screen

## 7.4.15 Communications

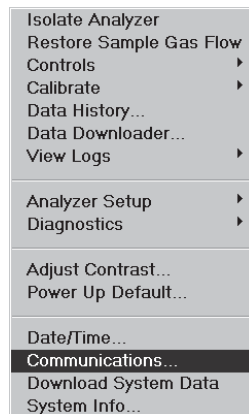


Figure 87: Communications Menu

The Communications screen is used to set parameters related to serial PC communications. Accessed from the **System** menu, the **Next** key is used to move from field to field, and the arrow keys (**▲** and **▼**) are used to change the numerical digits as well as to select the baud rate. When done the **Next** key is used to move to the **Accept** field and the **Enter** key is hit. See page 29 for additional information.

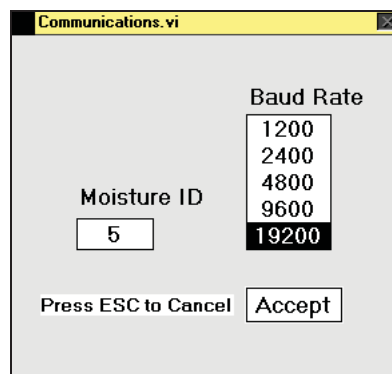


Figure 88: Communications Setup Screen

## 7.4.16 Download System Data



Figure 89 Down Load System Data Menu

In the event that problems develop with the analyzer, the contents of the internal system data files can easily be downloaded to a USB memory stick, and the files can either be mailed or e-mailed to Delta F for evaluation. Install a memory stick into the external USB socket located behind the front door and on the left side of the analyzer. After hitting Enter from the Download System Data menu, Figure 90 will appear.

The system downloads data for ten days ending with the date set on the screen as shown in Figure 90. The current date is set automatically but can be changed to capture activity at a specific time other than the last 10 days. To change the date, use the **Next** key to move between fields and use the arrow keys (▲ and ▼).

Hit **Enter** and the download process will begin and a time bar will appear as in Figure 92. The process should only take a minute or two and when complete control will be returned to the user.

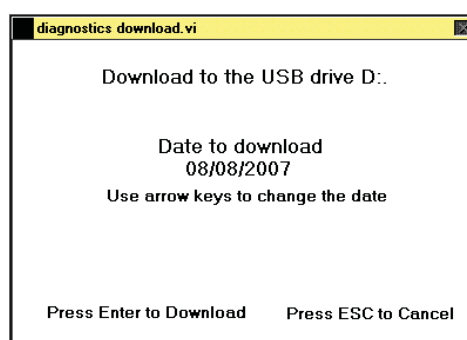


Figure 90: Insert Media

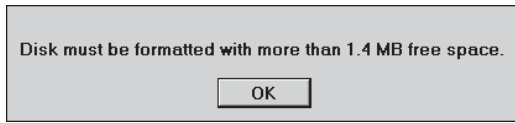


Figure 91: Media Warning

If there is insufficient space available on the media a warning will appear as in Figure 91.

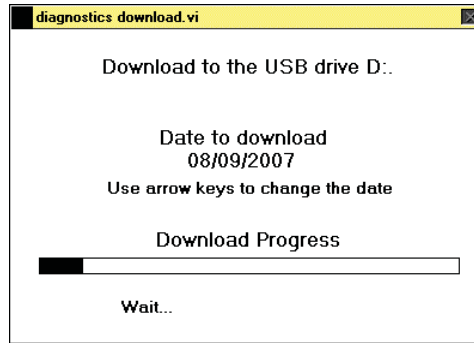


Figure 92: Down Load Time Line

The file name is automatically created and includes the date and time that the data was recorded as well as the serial number of the analyzer. All files are then automatically compressed and loaded as one file on the memory stick, which can then be used to forward the information to Delta F for evaluation.

#### 7.4.17 System Info

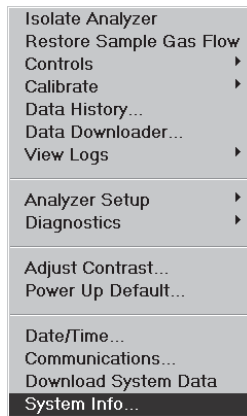


Figure 93: System Info Menu

The System Info screen gives the user information regarding the configuration of the analyzer as well as the version of firmware currently installed. The Service Menu is password protected. Contact the factory regarding this function.

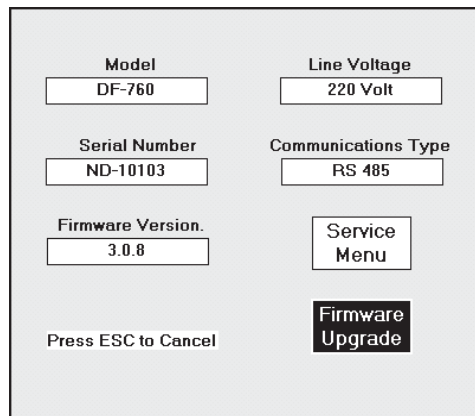


Figure 94: System Info Screen

#### 7.4.17.1 Firmware Upgrade

While the Firmware Upgrade box is highlighted, hitting the Next key will bring up the Firmware Upgrade dialog box as in Figure 95 below.

Place the memory stick in the USB port located behind the front door. When ready hit the Yes, Proceed key and follow the instructions. At the conclusion of the upgrade the analyzer will automatically reboot.

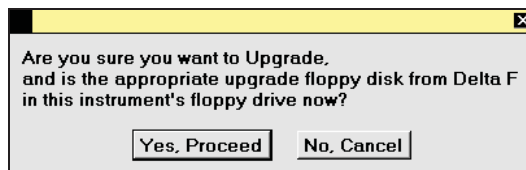


Figure 95: Firmware Upgrade





# 8 Sample Gas Preparation and Delivery

## 8.1 Introduction

It is important to note key differences in each parameter to ensure a properly functioning system. Parameters such as flow, pressure, and background gas will have major effects on total system performance.

## 8.2 Sample Flow Rate and Pressure

Proper moisture analyzer operation is dependant upon the pressure of the sample gas. For each sample gas, there is a unique pressure range that the analyzer must operate under. See Table 7 for the proper settings. Proper analyzer operation is contingent upon maintaining the sample pressure for a given background gas within this range. The pressure can be adjusted by balancing the inlet regulator setting with the throttling valve in the aspirator or, if equipped, with the needle valve in the vacuum pump assembly.

Background Gas	Pressure
N <sub>2</sub>	200 +/- 20 Torr
Ar	330 +/- 20 Torr
He	780 +/- 20 Torr
H <sub>2</sub>	350 +/- 20 Torr
O <sub>2</sub>	350 +/- 20 Torr

Table 7: Sample Outlet Pressure

## 8.3 Flow Rate Effects on Sensor Performance

Assuming a leak-free system, flow rate changes will have minimal effects on the performance of the moisture cell.

## 8.4 Sample Gas Scale Factor

### 8.4.1 Background Gas Effects on Indicated Flow Rate

If the molecular weight of the background gas is much different from N<sub>2</sub>, the flowmeter reading is not accurate. The bypass loop flowmeter mounted on the rear of the DF-700 series Moisture Analyzer is calibrated for use in air (or N<sub>2</sub>). Most other gases have molecular weights within  $\pm 25$  percent of air. Since the required flow rate is not extremely critical most gases produces reasonably correct readings. The exceptions are light gases

such as Helium and Hydrogen whose flow rates should be set to approximately one-third that of Nitrogen.

## **8.5 Flammable Sample Gas**

There is nothing within the analyzer sample system that can ignite a flammable sample gas. However, it is critical to ensure that the sample gas does not escape from the sample system into the analyzer enclosure, or the room, where ignition is possible.

Also, the analyzer enclosure can be purged with nitrogen, or the entire Analyzer can be mounted in a purged enclosure, so that any sample gas that escapes the plumbing is diluted.

# 9 Service

## 9.1 Return Material Authorization number

If an analyzer has to be returned to the factory, the shipper will have to obtain a Return Material Authorization number from Delta F by calling the Service Line at (781) 935-5808 or sending a written request via their Service Fax Line at (781) 932-0053. See the *Shipping* section for more details.

## 9.2 Maintenance

### 9.2.1 Storage Conditions

If the analyzer is to be stored for extended periods of time, be sure that the temperature of storage location does not exceed 50° C (122° F). Storage in direct sunlight can cause temperatures to exceed the recommended limits even though ambient temperatures may be below the maximum temperature.

### 9.2.2 Moisture Cell Maintenance

None required.

### 9.2.3 Vacuum Pump Maintenance

If equipped, the vacuum pump requires periodic maintenance in order to maintain proper pressure and individual installations will ultimately determine the appropriate maintenance interval. A good working pump will pull down to 120 torr, but when pump performance degrades to the point that proper pressure cannot be attained, a significant improvement in performance can often be achieved by simple cleaning of the cylinder and piston assembly. A rebuild kit is available from Delta F to return the pump to original specifications. See the list on page 83 for cleaning fluid and rebuild kit part numbers.

#### 9.2.3.1 Cleaning Vacuum Pump Piston and Cylinder Assembly

1. Disconnect power and vent all lines
2. Remove head bolts, head, gasket and valve plate assembly (note orientation of head)
3. Remove cylinder and shims.
4. Clean residue from walls using a soft cloth and non-petroleum, non-oil based solvent.

5. Replace cylinder including all shims. Be sure to orient the shims exactly the same as they were removed.
6. Install valve plate, head gasket and head
7. Install head bolts and torque to 80 in-lbs.

## 9.2.4 Gas Purifier Maintenance

### 9.2.4.1 Gas Purifier provides a low moisture calibration gas (Zero Gas)

The Gas Purifier removes moisture from typical trace level sample gas stream to provide sub-ppb moisture concentrations for use as a zero reference gas during Analyzer calibration. Calibration systems are supplied with a 3000 ppm-hr purifier. Replacement purifiers can be ordered from the Delta F Corporation.

#### NOTE



*The gas purifier supplied by Delta F Corporation has a finite life that is greatly affected by the source gas moisture level, flow rate, and duration of sampling. Always minimize the time sampling from the purifier and ensure that the source gas is below 50 ppb for optimal life expectancy..*

### 9.2.4.2 Determining When to Change the Purifier

In time the active component in the purifier becomes depleted and moisture breakthrough occurs. On the occasion that the process gas (containing low levels of moisture) is flowed through the zero purifier and the moisture reading does not reduce, then the purifier is expended and needs to be replaced.

### 9.2.4.3 Preparation for Gas Purifier Removal and Installation

#### NOTE



*Read the installation instruction and prepare all tools and parts for a **quick** installation. Tools and supplies must be readily available and all preparations to the calibration system must be done **before** removing the new purifier from its packaging.*

Removal and installation requires the following tools and parts:

- 1 3/8 -inch open end wrench (for purifier body)
- 3/4 -inch open end wrench (for VCR fitting on calibration panel)
- Two VCR-type gaskets and retainers Delta F P/N 60300241 or Cajon P/N

## 9.2.5 Gas Purifier Removal/Installation Procedure

### NOTE



*The gas purifier is designed to operate with low ppb (<50 ppb) inlet gas. Exposure to ambient air can seriously reduce the useful life of the purifier.*

1. Shut off the vacuum source and wait 5 minutes for the pressure to equalize. *This step is critical in order to minimize the possibility of an ambient intrusion.*
2. Using the moisture gas valve control screen (see page 37) start the gas flow through the zero purifier.
3. Write the installation date on the gas purifier label.
4. Install new gaskets and retainers on the purifier. Gently replace the cap nuts on the purifier to minimize exposure to ambient air.
5. Open the door and locate the purifier position. See page 13.
6. If installing a new purifier at initial startup, remove the VCR plugs installed in the plumbing system allowing gas to escape from the lower plug.
7. If replacing a spent purifier, remove the purifier allowing gas to escape from the lower fitting.
8. Remove both VCR-type cap nuts from the new purifier and quickly install the purifier **with the arrow pointing up**. It may be necessary to slightly spring the calibration system plumbing to insert the gas purifier. Be sure not to scratch the gasket surfaces.
9. Screw the fitting nuts at both ends finger-tight allowing gas to escape for two minutes.
10. Using a backup wrench tighten the nut at the bottom of the purifier 1/4 turn beyond finger-tight and allow the gas to escape from only the top fitting for an additional two minutes. Then tighten the top fitting 1/4 turn beyond finger-tight.
11. Turn the vacuum source on and continue to allow the gas to flow through the purifier for 24 hours or until the original analyzer reading is achieved.

After installation is complete, low ppb process gas must be allowed to flow through the gas purifier to purge ambient gas from the gas lines and valves. Effective purging of the system can be accomplished by repeatedly opening and closing the valves in the process and zero legs to start and stop the flow of gas. To automate this purge process see the purifier purge routine found in the diagnostics menu (see page 66).

## NOTE



*When installing a gas purifier, be very careful. During installation slightly spring the plumbing apart to provide ample clearance to insert the gas purifier **with the arrow pointing up**. The gas purifier sealing surfaces must not be dragged across the gaskets or their retainers.*

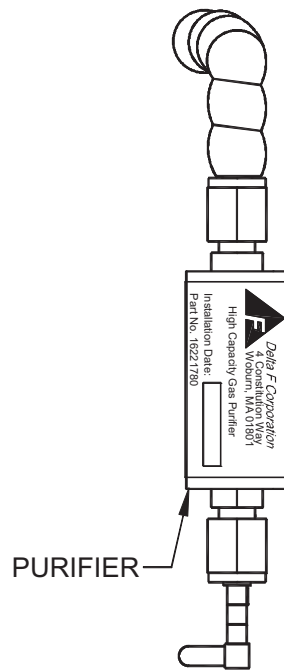


Figure 96: Gas Purifier Installation

## 9.3 Replaceable Parts List

When ordering parts, please be certain to supply the model number and serial number of your analyzer.

PART NO.	PART DESCRIPTION
	<u>Printed Circuit Boards</u>
10424570	Moisture Board
54000001	Front Display
	<u>Hardware Items</u>
14241410	Aspirator
63000308	Vacuum Pump – 110 VAC
63000309	Vacuum Pump – 240VAC
63000004	Vacuum Pump Rebuild Kit
76000018	Vacuum Pump Cleaning Fluid
65000100	Vacuum control needle valve
16342050	Purifier – Non reactive – Green Label
	Gas Panel Ass'y with heater – w/o purifier
60300241	VCR Gasket
60300268	VCR Filter Gasket
45002363	Fuse 6.3 Amps (110VAC)
45002331	Fuse 3.15 Amps (220VAC)
59017237	Power Cord – 110 VAC
10425870	Linear Power Supply
47500000	Switching Power Supply
49600512	USB Memory Stick/Flash Drive

Table 8: Replaceable Parts List





## 9.4 Troubleshooting the DF–750 NanoTrace Analyzer

### 9.4.1.1

The DF-700 series moisture analyzer constantly performs internal monitoring of the analyzer operation. In the event of a failure a system alarm will be displayed on the front panel. In addition the failure will be logged in the System Error Log (see page 51). In the event of a system alarm contact Delta F with information as displayed in the log as well as on the Signal Monitor screen as shown on page 65.

## Shipping

If it is necessary to return the analyzer to the factory or ship it to another location, follow the packaging and shipping procedure below in order to prevent damage to the analyzer during shipment.

1. Isolate the analyzer gas path properly by following the steps on page 35.
2. Turn off the power switch. Disconnect any source of AC power from the analyzer.
3. Disconnect all external electrical connections (alarms, data output, communications etc.).
4. Mark each for reattachment later.
5. Ensure that all internal components are adequately secured and put the analyzer in its original container.

If the analyzer is being returned to the factory, call Delta F at (781) 935-5808 to obtain a **Return Material Authorization number**. Clearly mark the Return Material Authorization number on the outside of the shipping container and on the packing list.

The analyzer should be returned (freight prepaid) to:

Delta F Corporation  
4 Constitution Way  
Woburn, MA 01801-1087



# 10 Theory of Operation

## 10.1 The Moisture Measurement

### 10.1.1 Moisture and the IR Spectrum

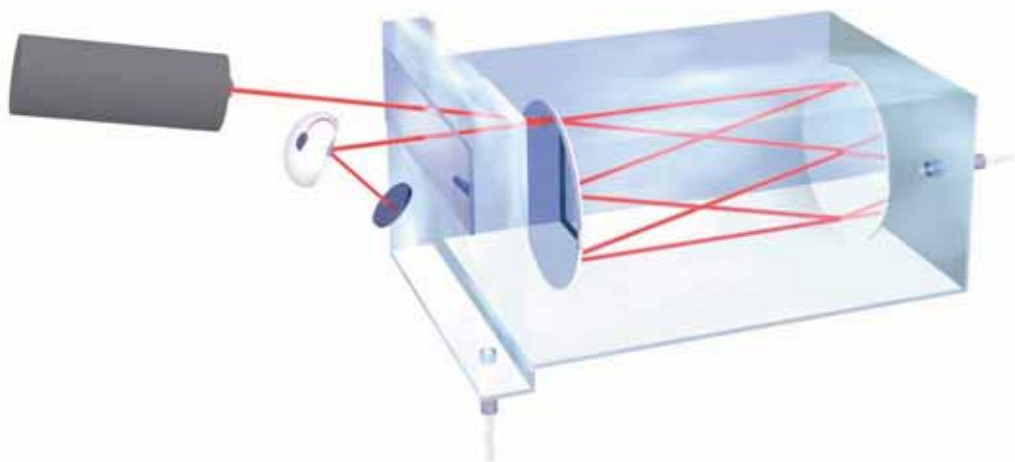


Figure 97: Schematic of Moisture Cell

The Nanotrace Moisture analyzer uses infrared (IR) absorption as its detection method. IR absorption is but a subset of the overall field of “spectroscopy,” which measures the interaction of light and matter.

The basis of absorption spectroscopy is when an electromagnetic wave (i.e., the scientific description of “light”) with a particular wavelength impinges on a substance that absorbs a fraction of the total electromagnetic radiation. The wavelength of radiation is well known, for instance, in differentiating colors in the visible light spectrum.

In the infrared spectral region, the wavelength of light overlaps with discrete absorptions created by molecular vibrations. IR absorption is often used in diagnosing molecular composition based on “fingerprints” of these absorptions over a wide wavelength range. Conversely, if the strength of a single vibrational absorbance is known, a single wavelength is often used to determine the amount of a particular substance. This is how we measure moisture.

## 10.1.2 Absorption Spectroscopy

The relationship that defines absorption spectroscopy is known as Beer's Law. Beer's Law equates, in rigorous terms, the concentration of any absorbing molecule based on absorbed light intensity at a particular wavelength, given knowledge of the molecule's absorption strength and the "path length" of the sample medium.

Many are familiar with Beer's Law as it is conventionally used in analytical laboratories:

$$A_{\lambda} = \log(1/T)_{\lambda} = \log(I_0/I)_{\lambda} = 2.303 \times \epsilon_{\lambda} \times b \times C$$

$A_{\lambda}$   $\equiv$  Absorbance at wavelength  $\lambda$

$T$   $\equiv$  Transmittance

$I_0$   $\equiv$  Reference Intensity of Light

$I$   $\equiv$  Measured Intensity of Light after Absorption

$\epsilon_{\lambda}$   $\equiv$  Molar Absorptivity at wavelength  $\lambda$

$b$   $\equiv$  Path length

$C$   $\equiv$  Molar concentration

In this embodiment, a solution with a broad absorbance band is dialed to a wavelength within the band, where a substance's molar absorptivity is known, and the concentration of that substance is determined. The substance is usually a liquid solution, placed in a 1 cm cuvette, and the concentration is expressed in moles/liter.

This same Law can have units reassigned to determine absolute numbers of molecules per cubic centimeter, useful in gaseous measurements:

$$A_{\lambda} = \ln(I_0/I)_{\lambda} = \sigma_{\lambda} \times b \times N$$

$\sigma_{\lambda}$   $\equiv$  Molecular Cross Section ( $\text{cm}^2/\text{molecule}$ ) at wavelength  $\lambda$

$N$   $\equiv$  Molecular Density ( $\text{molecules}/\text{cm}^3$ )

The values  $\sigma$  and  $\epsilon$  are related primarily by Avogadro's Number. If the molecular density of an absorbing substance in gas, such as moisture, is known, it can be compared to the number of molecules in an ideal gas, resulting in a report of parts per billion (PPB). In gases, this concentration is also known more specifically as parts per billion in volume (PPB<sub>v</sub>).

# 11 Safety

## 11.1 General Warnings

### DANGER



*Potentially hazardous AC voltages are present within this instrument. Leave all servicing to qualified personnel. Disconnect the AC power source when installing or removing: external connections, the sensor, or the electronics.*

### CAUTION



*Do not setup or operate the Analyzer without a complete understanding of the instructions in this manual. Do not connect this Analyzer to a power source until all signal and plumbing connections are made.*

### CAUTION



*This analyzer must be operated in a manner consistent with its intended use and as specified in this manual.*

### EMI DISCLAIMER



*This Analyzer generates and uses small amounts of radio frequency energy. There is no guarantee that interference to radio or television signals will not occur in a particular installation. If interference is experienced, turn-off the analyzer. If the interference disappears, try one or more of the following methods to correct the problem:*

- Reorient the receiving antenna.
- Move the instrument with respect to the receiver.
- Place the analyzer and receiver on different AC circuits.



# 11.2 Material Safety Data Sheet (MSDS) for Gas Purifier Packing



## MATERIAL SAFETY DATA SHEET

### Non-Reactive (N) Gas Purifier Media

AERONEX, INC. • 6975 Flanders Drive • San Diego, CA 92121 TEL 858 452 0124 • FAX 858 452 0229

Delta F Part Number: 16233880  
Patent: U.S 6,059,859

#### SECTION 1 - PRODUCT IDENTIFICATION

**Trade name and Synonyms:** Non-Reactive (N) Gas Purifier media  
**Chemical name:** Titanium Dioxide and Sodium Aluminosilicate  
**Formula:**  $TiO_2, Na_3[(AlO_2)_8(SiO_2)_{106}] \cdot xH_2O, Al_2O_3$   
**Product CAS No.:** Chemical mixture  
**Product use:** Non-Reactive gas purifier, removes moisture and other molecular impurities from  $O_2$ , Clean Dry Air, Noble Gases,  $SF_6$ , and  $NF_3$  gas.

#### SECTION 2 – COMPOSITION / INFORMATION ON INGREDIENTS

##### Hazardous components in the solid mixture inside the purifier body

<u>COMPONENT</u>	<u>CAS No.</u>	<u>%</u>
Silicon Oxide (synthetic)	7631-86-9	20-30
Aluminum Oxide	1344-28-1	20-30
Quartz	14808-60-7	1-3
Titanium Dioxide	13463-67-7	50-80
Sodium Oxide	1313-59-3	5-10
Graphite, Synthetic	7782-42-5	1-3
Magnesium Oxide	1309-48-4	1-5

Note: See Section 8 for Exposure Limits and Section 11 for Toxicological Information

#### SECTION 3 – HAZARDS IDENTIFICATION

##### EMERGENCY OVERVIEW:

Gray Pellets and Tan beads mixture.

Odorless

Flash Point: Not Determined

**Suspected Cancer Hazard:** Risk of cancer depends on route, duration and level of exposure.

Causes eye, skin and respiratory tract irritation. May cause allergic skin and respiratory reaction. Harmful if swallowed. May cause gastrointestinal irritation, headache, nausea, vomiting and diarrhea.

This product will remain stable when housed in the purifier body.

When the Sodium Aluminosilicate is first wetted, the product can heat up to the boiling point of water. Flood with water to cool down. Repeated and prolonged inhalation of crystalline silica in the form of quartz from occupational sources may cause cancer.

##### Routes of Entry:

Eyes? YES    Skin? YES    Inhalation? YES    Ingestion? YES

##### Potential Health Effects:

EYE CONTACT causes irritation.

SKIN CONTACT causes irritation and may cause sensitization or allergic reactions which may be accentuated by heat and humidity.

INHALATION causes upper respiratory irritation. Prolonged or repeated overexposure to TITANIUM may cause lung damage. Repeated and prolonged inhalation of crystalline silica in the form of quartz from occupational sources may cause cancer.

INGESTION is harmful. May cause nausea, abdominal discomfort, vomiting and diarrhea.

**Carcinogenicity:** Titanium Dioxide

NTP? NO            IARC? NO            OSHA? NO

**Carcinogenicity: Sodium Aluminosilicate**

NTP? YES            IARC? YES            OSHA? YES

The International Agency for Research on Cancer (IARC) has classified crystalline silica as Group 2A, "probably carcinogenic to humans." The NTP and OSHA classify Quartz as a known carcinogen.

**Chronic Health Hazards:**

Refer to Potential Health Effects and Carcinogenicity.

**Medical Conditions Generally Aggravated by Exposure:**

May aggravate existing medical conditions such as allergies, dermatitis, asthma, bronchitis or any other respiratory ailment.

NOTE: See Section 8 for Exposure Limits, Section 11 for Toxicological Information and Section 12 for Ecological Information.

**SECTION 4 – FIRST AID MEASURES**

In the unlikely event that the purifier media is liberated from the purifier body these health hazards may arise from inhalation, ingestion, and or/contact with the skin and/or eyes

**Eye Contact:** Immediately flush eyes with plenty of water for at least 15min. Call a physician.

**Skin Contact:** Immediately wash skin with soap and plenty of water. If irritation persists, call a physician.

**Inhalation:** Remove to fresh air. If breathing is difficult, oxygen should be administered by qualified personnel. Call a physician.

**Ingestion:** Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.

\*NOTE: Sodium Aluminosilicate is a desiccant and generates heat as it absorbs water. The used product can contain material of hazardous nature.

**SECTION 5 – FIRE-FIGHTING MEASURES**

**Flash Point:** Not Determined

**Auto-Ignition:** Not Applicable

**LEL:** Not Applicable

**UEL:** Not Applicable

**NFPA Hazard Classification: Titanium Dioxide**

Health: 0            Flammable: 0            Reactivity: 0

**HMIS Hazard Classification: Titanium Dioxide**

Health: 1\*            Flammable: 0            Reactivity: 0

\* Indicates the possibility of chronic health effects. See Chronic Health Hazards in Section 3 for more information

**NFPA Hazard Classification: Sodium Aluminosilicate**

Health: 0            Flammable: 0            Reactivity: 1

**HMIS Hazard Classification: Sodium Aluminosilicate**

Health: 1\*            Flammable: 0            Reactivity: 1

\* Indicates the possibility of chronic health effects. See Chronic Health Hazards in Section 3 for more information

**Extinguishing Media:** Use water, carbon dioxide or foam.

**Special Fire-Fighting Procedures:** Wear NIOSH/MSHA approved positive-pressure self-contained breathing apparatus and protective clothing as specified in 29 CFR 1910.156.

**Unusual Fire and Explosion Hazards:** This product will remain stable when housed in the purifier body. Toxic emissions are possible in a fire situation.

**SECTION 6 – ACCIDENTAL RELEASE MEASURES**

Sodium Aluminosilicate is a desiccant and generates heat as it absorbs water. **Allow media to cool before taking any action.**



Contain spillage and scoop up or vacuum. Avoid dusting. Notification of the National Response Center (800-424-8802) may be required. Refer to EPA, DOT and applicable state and local regulations for current response information.

It is recommended that each user establish a spill prevention, control and countermeasure plan (SPCC). Such plan should include procedures applicable to proper storage, control and clean up of spills, including reuse or disposal as appropriate (see Section 13: Disposal Consideration).

**\*\*Note\*\*** In the unlikely event that the purifier media is liberated from the purifier body the above procedures should be followed. Additionally, proper exposure controls and personal protection equipment should be used (see Section 8: Exposure Control/Personal Protection), and disposal of the material should be in accordance with Section 13: Disposal Considerations.

#### SECTION 7 - HANDLING AND STORAGE

**\*\*Note\*\*** In the unlikely event that the purifier media is liberated from the purifier body the following procedures should be observed.

Notify Safety personnel. **Allow media to cool before taking any action.** Wash thoroughly after handling media. Keep container closed. Avoid breathing dust. Keep away from sunlight, heat or fire. Store in cool, dry location away from incompatible materials

#### SECTION 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION

<b>Exposure Limits Ingredients:</b>	<b>PEL-OSHA</b>	<b>TLV-ACGIH</b>
Silicon Oxide (synthetic) CAS NO.: 7631-86-9	15mg/m <sup>3</sup> (Total Dust) 5mg/m <sup>3</sup> (Respirable)	10mg/m <sup>3</sup> (Inhalable Fraction) 3mg/m <sup>3</sup> (Respirable)
Aluminum Oxide CAS NO.: 1344-28-1	15mg/m <sup>3</sup> (Total Dust) 5mg/m <sup>3</sup> (Respirable)	10mg/m <sup>3</sup> (Inhalable Fraction)
Quartz CAS NO.: 14808-60-7	Total Dust: 30/(%SiO <sub>2</sub> +2) Respirable Dust: 10/(%SiO <sub>2</sub> +2)	0.05mg/m <sup>3</sup> (Respirable)
Titanium Dioxide CAS NO.: 13463-67-7	10mg/m <sup>3</sup> (Total Dust) 5mg/m <sup>3</sup> (Respirable Dust)	10mg/m <sup>3</sup> (Total Dust)
Sodium Oxide CAS NO.: 1313-59-3	Not Established	Not Established
Graphite, Synthetic CAS NO.: 7782-42-5	2.5mg/m <sup>3</sup> (Respirable Dust)	2mg/m <sup>3</sup> (Respirable Dust)
Magnesium Oxide CAS NO.: 1309-48-4	10mg/m <sup>3</sup> (Fume, total dust) 5mg/m <sup>3</sup> (Fume respirable fraction)	10mg/m <sup>3</sup> (Fume)

Unless otherwise noted, all values are reported as 8-hour Time-Weighted Averages (TWAs) and total dust (particulates only). All ACGIH TLVs refer to the 1998 Standards. All OSHA PELs refer to 29 CFR Part 1910 Air Contaminants: Final Rule. January 19, 1989.

**Respiratory Protection:** A NIOSH/MSHA-approved respirator recommended for dust if media is liberated from purifier body.

**Ventilation:** General; local exhaust ventilation as necessary to control any air contaminants to within their PELs or TEVs during exposure to media

**Protective Equipment:** Chemical goggles as needed to prevent irritation. Rubber or neoprene gloves. Body protection as necessary to prevent skin contact.

#### SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

**Appearance:** Grey Pellets and Tan Beads

**Odor:** Odorless

**Specific Gravity (H<sub>2</sub>O=1):** 1.0 g/cc (Bulk Density)

**Melting Point:** Not Determined

**Vapor Pressure (mm Hg):** Not Applicable

**Vapor Density (Air=1):** Not Applicable

**Evaporation Rate:** Not Applicable

**% Solubility in Water:** Insoluble

**pH:** Not Determined

#### SECTION 10 – STABILITY AND REACTIVITY

**Stability:** Generally considered stable housed inside purifier body or when properly installed in Inert Gas Systems. Purifier may heat up if used with corrosive gases.

**Avoid:** Heat and humidity.

**Incompatibility (Materials to Avoid):** Strong acids and strong oxidizing agents. When the Sodium Aluminosilicate is first wetted, the product can heat up to the boiling point of water. Flood with water to cool down.

**Hazardous Decomposition or By-Products:** Toxic emissions may be released in a fire situation. Thermal decomposition may produce oxides of Titanium. Any material retained (such as hydrocarbons) by this product is reasonably expected to be released during decomposition.

**Polymerization:** Polymerization is not expected to occur.

#### SECTION 11- TOXICOLOGICAL INFORMATION

Chemical Name	%Wt.	LD50	LC50
Sodium Aluminosilicate CAS NO.: Chemical Mixture	20-30	*32,000mg/kg Rat, Oral *2,000mg/kg Rabbit, Dermal	Not Available
Titanium Dioxide CAS NO.: 13463-67-7	60-80	5000mg/kg Rat, Oral	Not Available
Sodium Oxide CAS NO.: 1313-59-3	1-3	Not Available	Not Available
Graphite, Synthetic CAS NO.: 7782-42-5	1-3	Not Available	Not Available
Magnesium Oxide CAS NO.: 1309-48-4	1-5	Not Available	Not Available

\*The toxicological data has been taken from products of similar composition.

NOTE: See Section 3, 8 and 12 for additional information.

#### SECTION 12 – ECOLOGICAL INFORMATION

**Ecotoxicity:** No data available.

**Environmental Fate:** No data available.

#### SECTION 13 – DISPOSAL CONSIDERATIONS

**US EPA Waste Number:** Not Regulated

Federal, State, and Local disposal laws and regulations will determine the proper waste disposal/recycling/reclamation procedure. All waste materials should be reviewed to determine the applicable hazards (testing may be necessary). Disposal requirements are dependent on the hazard classification and will vary by location and the type of disposal selected.

**\*\*NOTE\*\*** Chemical additions, processing or otherwise altering this material may make the waste management information presented above incomplete, inaccurate or otherwise inappropriate.

As local regulations may vary; all waste must be disposed/recycled/reclaimed in accordance with Federal, State, and Local environmental control regulations.

#### SECTION 14 – TRANSPORT INFORMATION

##### INTERNATIONAL

**UN Number:** Not Applicable

##### UNITED STATES

**EPA Waste Number:** Not Regulated

**DOT Classification:** Not Applicable

**DOT Proper Shipping Name:** Not Applicable

**Packing Group:** Not Applicable

##### CANADA

**PIN Number:** Not Applicable

**TDG Class:** Not Applicable

**EC DGL:** Not Applicable

## SECTION 15 – REGULATORY INFORMATION

### US FEDERAL REGULATIONS

TSCA: IN TSCA

#### SARA 311 and 312 Hazard Categories

**Immediate (Acute) Health Hazard:** Yes

**Delayed (Chronic) Health Hazard:** Yes

**Fire Hazard:** No

**Reactivity Hazard:** No

**Sudden Release of Pressure:** No

**SARA Section 313 Notification:** None

**OZONE DEPLETING SUBSTANCES (ODS):** This product neither contains nor is manufactured with an ozone depleting substance subject to the labeling requirements of the Clean Air Act Amendments 1990 and 40 CFR Part 82.

**VOLATILE ORGANIC COMPOUNDS (VOC):** None

### US STATE REGULATIONS

**CALIFORNIA:** The State of California has a regulation (Proposition 65) which identifies specific chemicals known to the State of California to cause cancer or birth defects. Proposition 65 requires a disclosure for products sold within the State of California containing an identified chemical. The following information is required by the State of California for this product:

**\*WARNING: This product contains chemicals known to the State of California to cause cancer.**

**Components:** Silica, crystalline

**VOLATILE ORGANIC COMPOUND (CARB):** Not determined

### CANADIAN REGULATIONS

**DSL/NDSL:** DSL

**WHMIS Classification:** Class D Division 2 Subdivision A  
Class D Division 2 Subdivision B

### EUROPEAN REGULATIONS

**EINECS:** Yes

### OTHER REGULATIONS

**MITI (Japan):** Yes

**AICS (AUSTRALIA):** Yes

## SECTION 16 – OTHER INFORMATION

**Prepared by:** Aeronex Inc., Research and Development Department

**Phone Number:** See Header

All information within this document is believed to be accurate and current. Aeronex does not guarantee the information to be all-inclusive and shall not be held accountable for any damage caused from this product.



# 12 Warranty

Delta F Corporation warrants each instrument manufactured by them to be free from defects in material and workmanship at the F.O.B. point specified in the order, its liability under this warranty being limited to repairing or replacing, at the Seller's option, items which are returned to it prepaid within one year from delivery to the carrier and found, to the Seller's satisfaction, to have been so defective.

In no event shall the Seller be liable for consequential damages. NO PRODUCT IS WARRANTED AS BEING FIT FOR A PARTICULAR PURPOSE AND THERE IS NO WARRANTY OF MERCHANTABILITY. Additionally, this warranty applies only if: (i) the items are used solely under the operating conditions and in the manner recommended in the Seller's instruction manual, specifications, or other literature; (ii) the items have not been misused or abused in any manner or repairs attempted thereon; (iii) written notice of the failure within the warranty period is forwarded to the Seller and the directions received for properly identifying items returned under warranty are followed; and (iv) with return, notice authorizes the Seller to examine and disassemble returned products to the extent the Seller deems necessary to ascertain the cause of failure. The warranties stated herein are exclusive. THERE ARE NO OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED, BEYOND THOSE SET FORTH HEREIN, and the Seller does not assume any other obligation or liability in connection with the sale or use of said products.



# 13 Index

## 4

4-20mA Outputs, 30

## A

Active Zero On/Off, 62  
Add Location, 49  
Adjust Contrast, 69  
Alarm Setup, 56  
Alarm Setup, Moisture, 57  
Analog Output Setup, 60  
Analog Signal Outputs, 30  
Analog Voltage Output, 23  
Analog Voltage Output Test, 64  
Analyzer  
  Specifications  
    General, 9  
    Moisture, 9  
    Warranty, 97  
Analyzer Installation, 14  
Analyzer Setup, 53  
Analyzer Shut Down, 21  
Analyzer Start Up, 19  
AutoZero, 43  
AutoZero Setup, 44

## B

Back Flow Prevention System, 37  
Backflow Prevention System, 21

## C

case purge, 103  
Cautions, 7  
  Important Warnings, 7  
  Symbols and Explanations, 7  
Check/Adjust Zero, 39  
Communications, 72

## D

Data Download, 47  
Data History Routine, 45  
Date/Time, 71  
Delete Location, 49  
Diagnostics Menu, 62  
Display Setup, Moisture, 61  
Download System Data, 73

## E

Error Codes, 51  
External Devices, Connecting to  
  4-20mA Outputs, 30  
  Analog Signal Outputs, 30  
  Relay Ports, 31  
  Serial Communications, 29  
External Devices, Connecting to, 29

## F

Fan Failure, 55  
Fan Failure Alarm, 56  
Firmware Upgrade, 75

## G

Gas Delivery System, 19  
Gas Flow and Pressure Regulation, 20  
Gas Purifier Maintenance, 80  
Gas Scale Factor, GSF, 77  
Gas Valves, Moisture, 37  
Graph Setup, 61

## H

Hydrogen Service, 103  
Hydrogen Service Safety System, 23

## I

In Calibration Relay, 61  
Installation and Setup, 13  
  Electrical Connections, 16  
  Pneumatic Pressure Gas Connections, 15  
  Sample Gas Connections, 15  
Isolate Analyzer, 35

## K

Key Lock, 23

## M

Main Menu  
  Controls Menu, 36  
Maintenance, 79  
Manual Zero, 41, 42  
Moisture Alarm Setup, 57  
Moisture Calibrate Menu, 39

Moisture Controls Menu, 36  
Moisture Data History Routine, 45  
Moisture Display Setup, 61  
Moisture Temperature Range Alarm, 58

## **N**

nitrogen case purge, 103

## **O**

Operating Voltage, 23  
Options, 23

## **P**

Power Up Default, 70  
Pressure Range Alarm Setup, 58  
Pre-Zero purifier purge, 45  
Procedure  
    Gas Purifier Removal/Installation, 81  
Pump Capacity Test, 68  
Pump Capacity Test Log, 52  
Pump case purge, 103  
Purge Purifier, 66  
purge, pre-zero, 45  
purge, pre-zero purifier, 45  
Purifier Removal/Installation Procedure, 81

## **R**

Relay Ports, 31  
Relays, Test, 63  
Restore Sample Gas Flow, 36

## **S**

Safety, 89  
    Symbols and Explanations, 89  
Sample Flow Rate, 77  
Sample Gas Flammability, 78  
Sample Gas Preparation and Delivery, 77  
    Background Gas Effects, 77  
    Flow Rate Effects  
        Sensor Performance, 77  
    Sample Gas Flammability, 78  
    Sample GSF, 77  
Sample GSF, 54, 77

Service, 79  
    Maintenance  
        Gas Purifier, 80  
        Gas Purifier, when to change, 80  
        Storage Conditions, 79  
    Replaceable Spare Parts List, 83  
    Return Material Authorization number, 79  
    Shipping, 85  
        Return Material Authorization number, 85  
Set Location, 48  
Set Zero Gas Valves, 41  
Signal Monitor, 65  
Specifications, 9  
System Alarm Setup, 59  
System Data Download, 21  
System Error Codes, 51  
System Info, 74

## **T**

Test Analog Voltage Output, 64  
Test Relays, 63  
Theory of Moisture Measurement, 87  
Theory of Operation, 87

## **U**

User Interface, 33  
    Data Display Screen, 33  
    Keypad, 33  
    Main Menu, 34  
    Menu Structure, 34  
User Zero Offset, 40

## **V**

Vacuum Pump Maintenance, 79  
View Location, 48  
View Moisture Logs, 50

## **W**

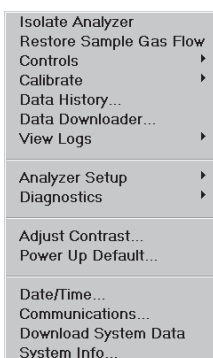
Warranty, 97

## **Z**

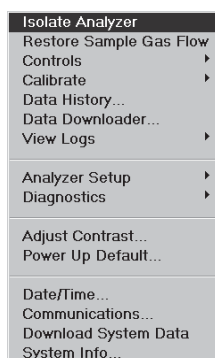
Zero Log, 50



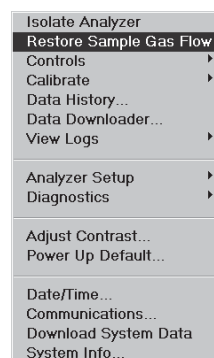
# 14 Appendix A – User Menu Screens



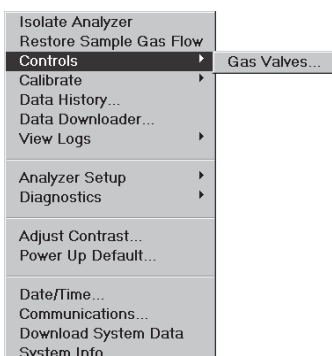
Page 34



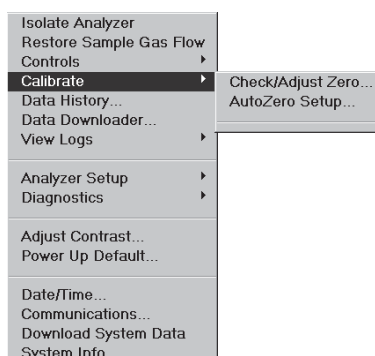
Page 35



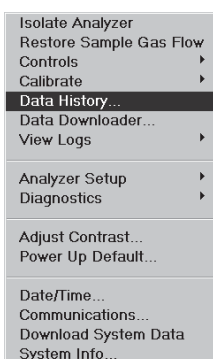
Page 36



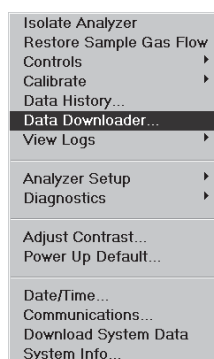
Page 36



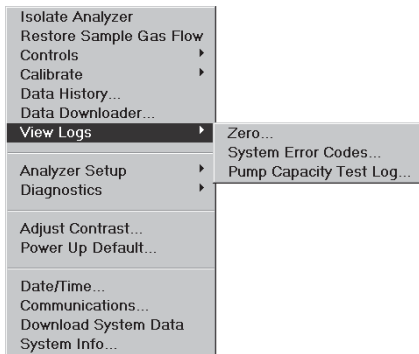
Page 39



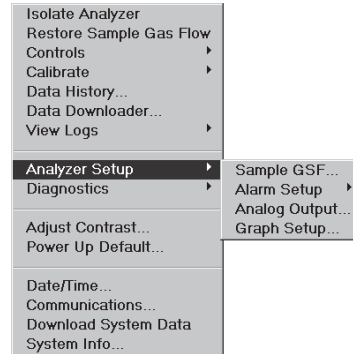
Page 46



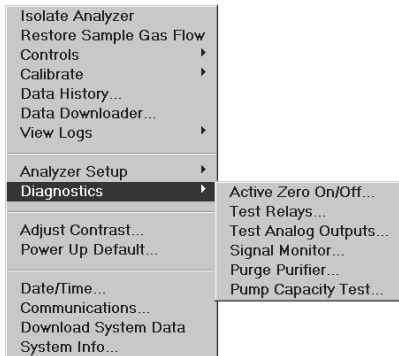
Page 47



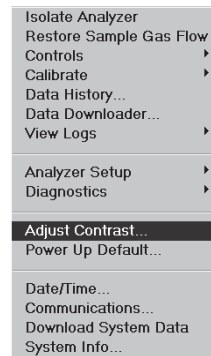
Page 50



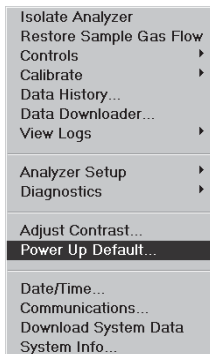
Page 53



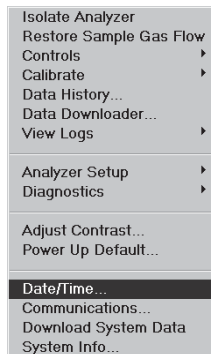
Page 62



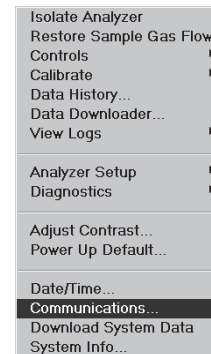
Page 69



Page 70



Page 71



Page 72



Page 73



Page 74

# 15 Appendix B – Hydrogen Service Safety System

The **Hydrogen Service Safety System** is designed to safeguard the DF-750 from explosion hazards when operating on hydrogen sample gas under normal pressure and flow conditions as described in this manual. The instrument chassis and the remote pump, if equipped, are both protected by maintaining a safe condition within their respective enclosures.

If equipped with this option at the time of shipment from the factory, the analyzer will be set for Hydrogen operation through the GSF screen and the Hydrogen Safety Service System will automatically be enabled.

## 15.1 Instrument

- **Air circulation fans** pull air in through the front door (and vent through the rear) of the chassis. The fans are rated at 50 cfm (125 cfm max) which will maintain the internal chassis space below the lower explosive limit (LEL)<sup>1</sup>.
- **Sample delivery interlock valve** blocks flow of sample gas from entering the instrument chassis under various conditions as described below. It consists of a normally closed pneumatically actuated UHP springless diaphragm valve positioned on the sample inlet bulkhead.
- **Analyzer case purge valve** introduces nitrogen purge flow into the chassis upon closure of the sample delivery interlock valve. It consists of a normally open pneumatically actuated valve which feeds a customer supplied and regulated source of nitrogen purge gas through a bulkhead on the rear of the cabinet.<sup>2</sup>
- **Instrument controls and logic**<sup>3</sup> default, manage and actuate the above mentioned components to maintain safe operating conditions.

## 15.2 Vacuum Pump

- If equipped with this option, **an enclosure** equipped with a nitrogen case purge is provided for the vacuum pump to maintain a safe condition. In addition, an interlock is provided to detect and react to loss of Nitrogen purge flow. See Figure 99 on page 108.

## 15.3 Installation

If equipped with this safety system, the analyzer installation procedure is modified as follows:

- The pump enclosure must be mounted to a nearby wall or inside the rack shared by the analyzer. See Figure 99 on page 108.

- The sample gas inlet connection is made to an interlock valve mounted at the sample gas inlet on the rear of the analyzer. NOTE: The installation of this option changes the sample inlet connection to female VCR, from male.
- The sample gas outlet is connected by a ¼ inch metal tube from the analyzer sample outlet, to the needle control valve (supplied loose), and then to the sample inlet on the pump enclosure.
- A customer supplied and regulated source of nitrogen purge gas is connected to both the ¼ inch compression fitting on the case purge valve mounted on the rear of the analyzer as well as to the 1/8 inch compression purge inlet fitting on the vacuum pump enclosure.
- If required, the pump enclosure sample outlet and/or analyzer sample outlet need to be connected by ¼ inch metal tube and compression fittings to an appropriate exhaust system.
- The pump power cord is connected from the rear of the analyzer to the pump enclosure.

## 15.4 Operation

- Before power is applied to the analyzer, the moisture cell is in an isolated state as the internal inlet and outlet valves are closed. In addition, the external sample interlock valve is closed and the case purge valve is open allowing customer supplied and regulated Nitrogen gas to purge the analyzer cabinet.

When power is applied, and only after the system has verified proper exhaust fan operation, the system automatically opens the external sample interlock valve to enable gas flow and the case purge valve is closed.

NOTE: The back flow prevention screen (see page 21) will be displayed and the user must hit **ESC** to acknowledge the screen and remove it.

After approx. 5 minutes, the Warming Up indication will disappear and the user is then free to open the internal inlet and outlet valves to the moisture cell.

- On analyzer shut-down, or in the event of a power failure or fan failure, the moisture cell is automatically isolated with internal valves, the external sample interlock valve closes to block sample flow from entering, and the purge valve opens to allow Nitrogen purge into the analyzer enclosure.
- The pump case purge system continuously feeds a customer regulated supply of nitrogen into the pump enclosure to (1) maintain the oxygen level well below the maximum safe level (5% for hydrogen) in the event that the pump diaphragm fails and leaks sample gas into the enclosure and (2) maintain appropriate flow for adequate pump cooling. The purge flow rate is set to 30 scfh as indicated on a rotometer mounted on the side of the pump enclosure. An in-line flow switch will

trip at a flow rate of less than 26 scfh assuring adequate flow. Loss of purge flow breaks the contacts in the flow switch, which in turn trips a mercury relay that removes power to the pump.

- To disable the Hydrogen Safety Service System, use the GSF screen to indicate that hydrogen is not included in the process gas by entering 0%. See page 54 for additional information on setting GSF.

#### CAUTION



The purge flow out of the pump enclosure may contain sample gas and should be appropriately vented.

#### CAUTION



After passing through the moisture cell and orifice, the sample is under vacuum and any leak in the system would result in ingress of ambient rather than release of sample gas to ambient. Accordingly, the sample outlet should be vented appropriately to assure adequate dilution.

#### CAUTION



The Hydrogen Service Safety System is designed to be safe as provided by the factory when operating as described in the Operating Instruction Manual. **DO NOT** make additional penetrations in the enclosure. If there is a need to do so, please contact the factory. Additional penetrations made in the enclosure (or failure to properly fasten the enclosure door) will allow additional influx of ambient oxygen and may defeat the case purge safety mechanism. A pressure relief valve is installed to prevent over pressurization of the enclosure.

#### CAUTION



Do not open the pump enclosure door unless AC power is shut off.

#### CAUTION



The operator is obligated to assure proper operation of the analyzer air flow system as designed. Do not impede air flow at the inlet in the front door or at the exhaust fan outlets on either side of the cabinet in the rear.

## NOTES

<sup>1</sup> For hydrogen, which has a lower explosive limit (LEL) of 4%, the maximum allowable influx in event of an internal leak would be 120 scfh, whereas the normal flow as defined in the Operating Instruction Manual is about 1/10<sup>th</sup> that at approximately 14 scfh.

<sup>2</sup> Use of the analyzer case purge is at the customer's discretion. It most likely is not necessary since in the event of sample delivery interlock, the sample feed is blocked from entering the chassis and the only open flow path through the system is dissipation of remaining sample in the bypass, which would be vented externally, or in the event of an internal leak, would be volumetrically insignificant.

<sup>3</sup> The pneumatic control for the sample interlock and case purge valves is provided by an internal 12 VDC solenoid.

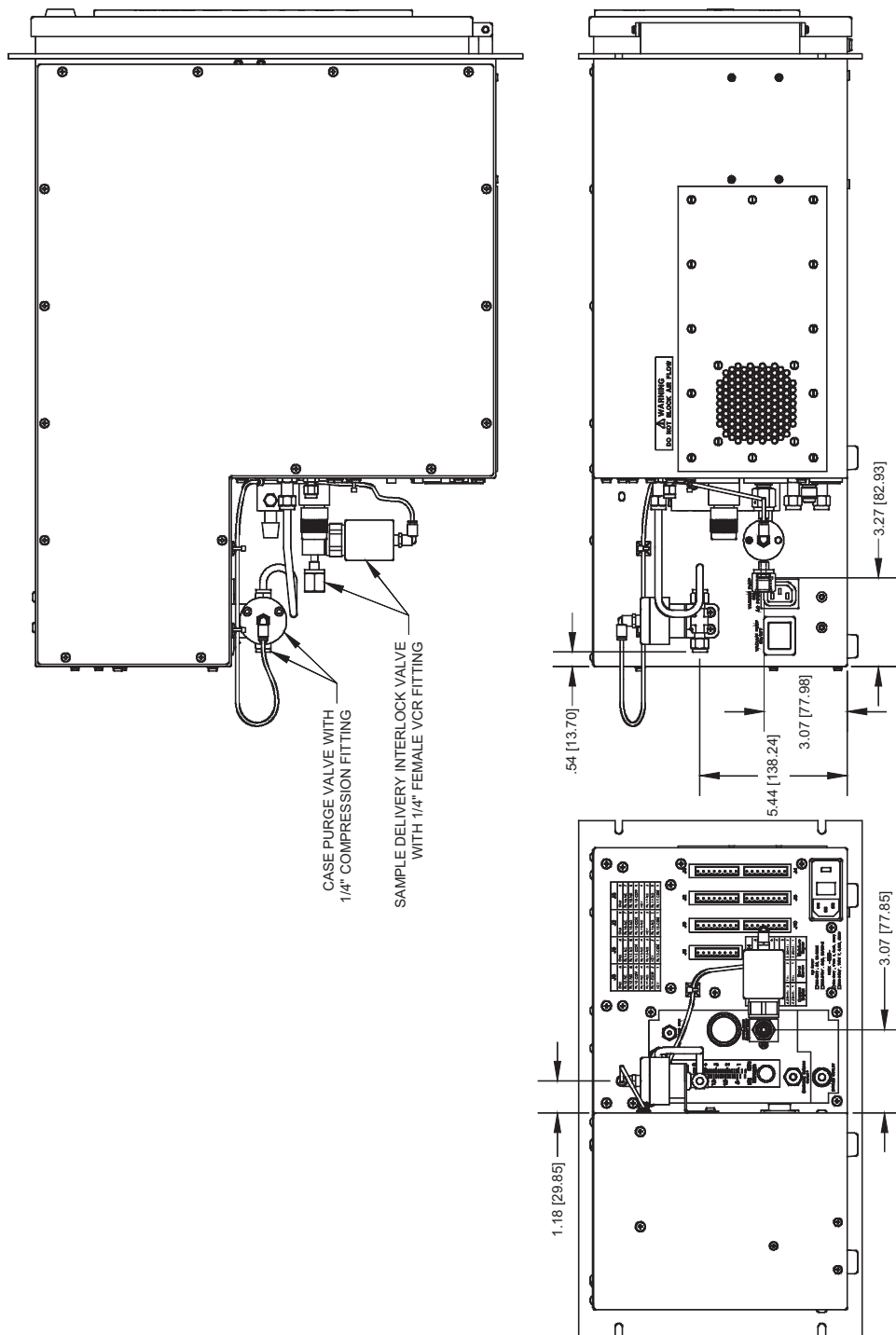


Figure 98: Hydrogen Service Safety System

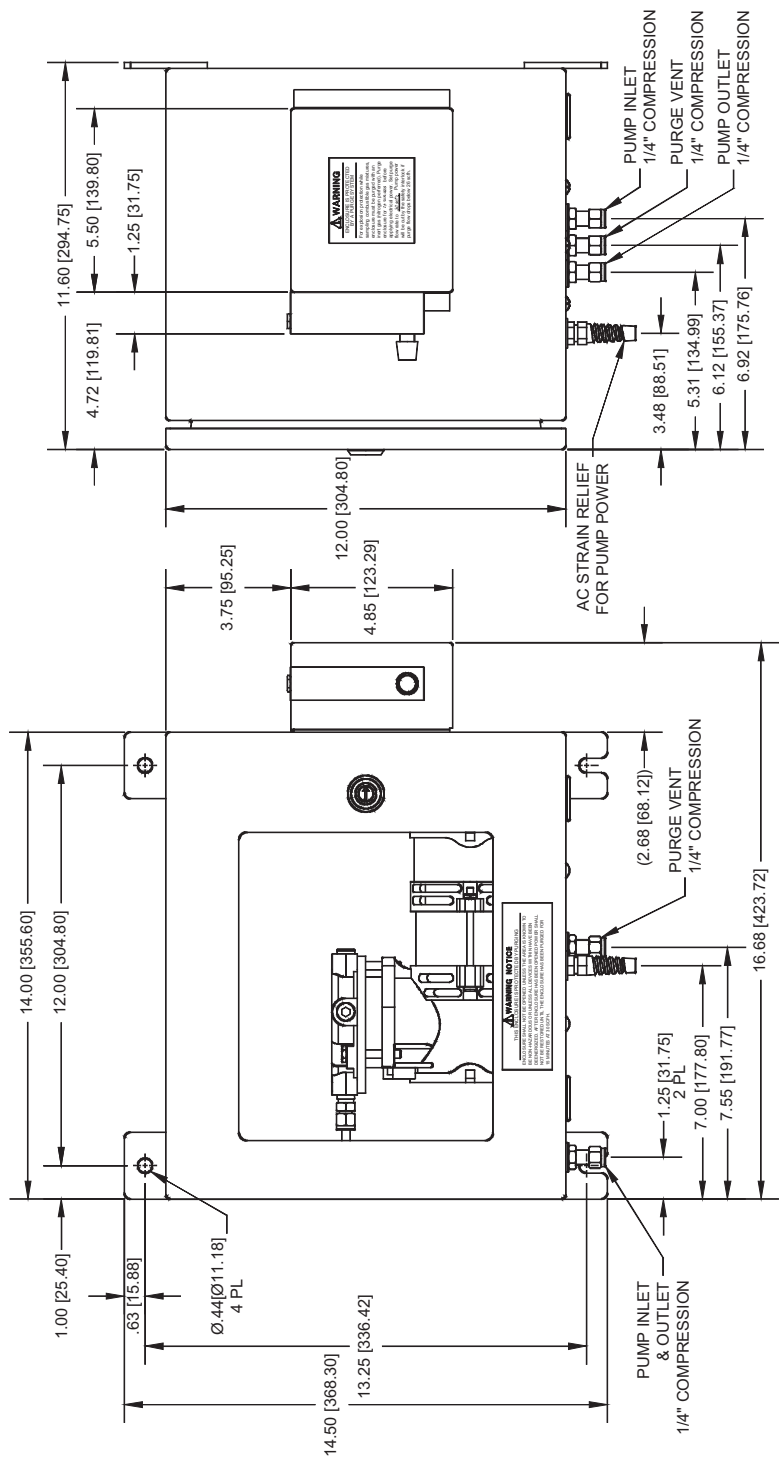


Figure 99: Pump Purge Option