PRO2000W

DILUTION PROBE
CONDITIONING ASSEMBLY

OPERATION MANUAL

March 1, 2001

Thermo
Environmental Instruments

Claims for Damaged Shipments

A. The PRO2000W dilution probe conditioning assembly is shipped ready for operation. Immediate inspection of the PRO2000W dilution probe conditioning assembly should follow upon receipt. Inventory of the container should be checked against the enclosed packing list. If there is a shortage of items, immediately contact Thermo Environmental Instruments. If the contents are damaged, the carrier and Thermo Environmental Instruments should be notified immediately.

B. The following documents are necessary to support claims:

1. Original freight bill and bill of lading.

2. Original invoice or photo copy of original invoice.

3. Copy of the packing list.

4. Photographs of damaged equipment and container.

NOTICE

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1.0 PRODUCT DESCRIPTION

1.1 Introduction

The Installation and Operation Manual provides instruction for basic installation, preventive maintenance, corrective maintenance, and trouble shooting procedures for the PRO2000W dilution probe conditioning assembly. This manual contains four sections:

Section 1 - Product Description: Hardware description, instrument operating parameters, and physical characteristics.

Section 2 - Theory of Operation: Complete functional description.

Section 3 - Installation and Operation: Instructions for installation and operation of the dilution probe conditioning assembly.

Section 4 - Maintenance: Routine inspection, trouble shooting, corrective procedures, and repair/replacement for major assemblies.

1.2 PRO2000W Description

The stack or duct mounted PRO2000W dilution probe conditioning assembly draws, conditions, and dilutes the process emissions to be transported for analysis. A tubing umbilical and wiring umbilical connect the dilution probe conditioning assembly to the analyzers, calibration gas supply, purge air supply, dilution air supply, and a remote probe controller assembly. The PRO2000W dilution probe conditioning assembly is composed of a NEMA 4X enclosure, a heated filter, dilution eductor, a probe barrel assembly, an umbilical termination assembly and optional equipment. The wiring umbilical has four (4) # 20 AWG shielded triads in a PVC jacket. The tubing umbilical contains four (4) ¼” and one (1) ½” Teflon tubes in a freeze protected PVC jacket.

1.3 Dilution Probe Conditioning Assembly Hardware

The PRO2000W dilution probe conditioning assembly consists of eight subassemblies used to condition, analyze, and transport the sample (refer to 7000 series Probe Box Assembly Drawings). These assemblies are as follows:

1. Probe Enclosure
2. Heated Filter, Dilution Eductor, and Probe Barrel Assembly
3. Tubing Umbilical Termination Assembly
4. Absolute Pressure Transducer
5. Power Entry
6. Low Voltage Control
7. Enclosure Light
8. Enclosure Heater

1.3.1 Probe Enclosure

The dilution probe conditioning assembly is housed in a fiberglass enclosure that measures approximately 18 inch(H), 16 inches(W), 10 inches(D). The enclosure is designed to protect instruments and electrical controls from highly corrosive atmospheres. The PRO2000W enclosure is fitted with four (4) stainless steel ½-13 x 3 bolts to connect to the sampling point (refer to Figure 3.1).

1.3.2 Heated Filter, Dilution Eductor, and Probe Barrel Assembly

The dilution probe assembly consists of a Hastelloy probe barrel and an eductor probe head as shown in Figure 1.3.2. An eductor assembly and a heated filter body make up the eductor probe head. A heated, high capacity, sub-micron filter is housed in a Teflon® filter body that is located within the Probe Head, and can be easily replaced during preventive maintenance. The sampling probe barrel is typically a section of pipe with an outer diameter of 0.67 inches and an inner diameter of 0.50 inches. Material for the probe barrel is selected for compatibility with the process stream and is typically supplied in Hastelloy C-276. The standard four (4) foot probe barrel has an approximate 5° bend to prevent excess water buildup within the probe barrel in saturated processes. The heated filter body is equipped with a 150 watt, 120 VAC heater and a temperature sensor (RTD). The heater and the RTD are terminated with Molex™ connectors.

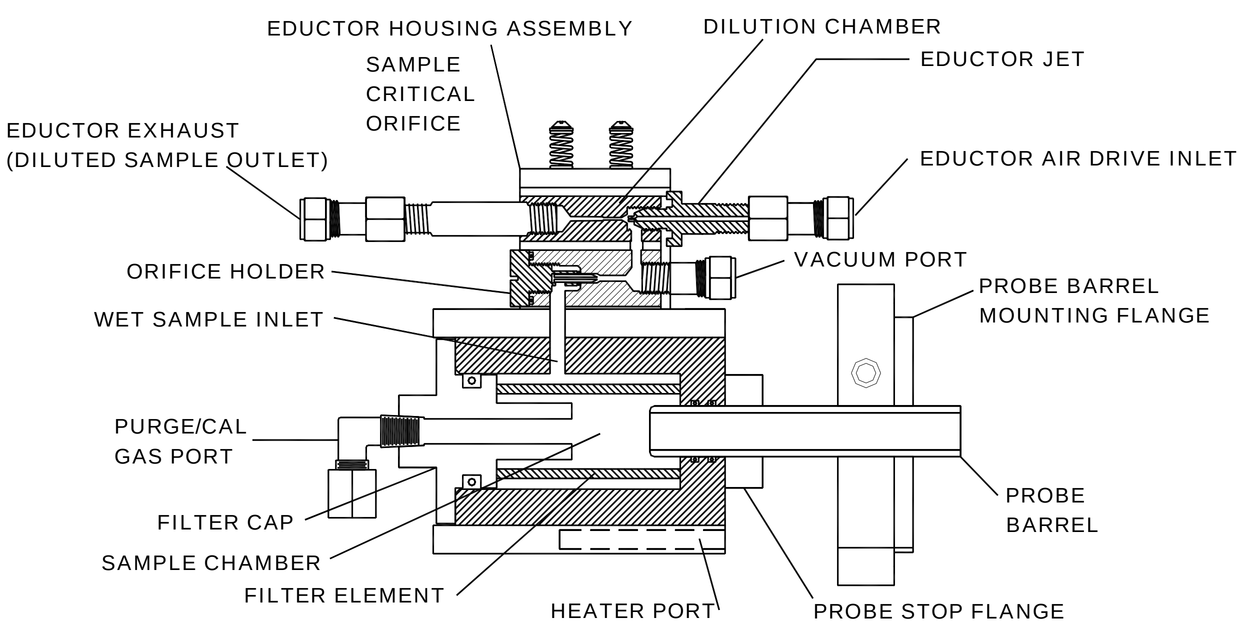

Figure 1.3.2 Dilution Probe Assembly

1.3.3 Tubing Umbilical Termination Assembly

The tubing umbilical termination assembly is comprised of an anodized aluminum angle bracket which holds the stainless steel tubing fittings for connection to the tubing umbilical as well as the cal gas check valve and the purge valve. The absolute pressure transducer is attached to the purge valve.

1.3.4 Absolute Pressure Transducer

The absolute pressure transducer is mounted on top of the purge valve and produces a 4 to 20 milliamp signal that represents 0-15 psia. When the absolute pressure transducer option is ordered with the system, the 2-way purge valve is replaced with a 3-way version.

1.3.5 Power Entry

The power entry is configured to supply a power to the conditioning assembly. The minimum power requirement is 120 VAC, 1020 watts, 60 Hz. 120V AC is supplied to power disconnect DC-1. From DC-1, 120V AC is distributed to Terminal Block TB-1, where the fuse protection is located, and distributed to the purge valve, heated filter, enclosure heater and enclosure utility light and outlet. Refer to the dilution probe wiring diagram for the fuse schedule.

1.3.6 Low Voltage Control

The low voltage control package consists of two solid state relays, fuse holders and fuses to interface the heated filter heat element and the purge valve to low voltage control (3-32 V DC).

1.3.7 Enclosure Light

The enclosure light is equipped with a 60 watt incandescent lamp and a grounded 120 VAC utility outlet. Power available to the outlet is limited to 180 watts with the light on and 240 watts with the light off.

1.3.8 Enclosure Heater

The optional enclosure heater is located on the bottom right hand side of the enclosure (refer to 7000 Series Probe Box Assembly Drawing). The assembly consists of one 800-watt heat element, a 30-cfm fan, and an adjustable thermostat switch.

The fan motor runs continuously as long as power is supplied to the probe conditioning enclosure heater. While the heat element cycles on and off according to the temperature inside the enclosure. The temperature of the enclosure is maintained at $100^{o}F$ by the adjustable thermostat.

1.4 Tubing and Wiring Umbilicals

The tubing and wiring umbilicals are the main link between the dilution probe assembly and the analyzer rack.

1.4.1 Tubing Umbilical

The tubing umbilical supplies purge and purge air, dilution air, calibration gas, and the sample return line for the analyzers in the analyzer rack. Purge air is supplied by the ½” Teflon® tube at 60 psi to the purge valve. Dilution air is supplied by the ¼" Teflon® tube at 30 psi from the dilution air regulator. Calibration gas is supplied by a ¼" clear Teflon® tube at 30 psi (limited to 2500 cc by flow control orifice) connected to the cal gas inlet. The sample outlet is connected to a 1/4" clear Teflon® tube to supply the analyzers in the analyzer rack with diluted sample.

1.4.2 Wiring Umbilical

The table below list the wiring umbilical triads, as well as their function and range:

Table 1.4.2 Wiring Umbilical

Pair Number:	Function:	Signal:
1	Heated Filter Temperature Control	0-24VDC Pulse Modulation
2	Purge Valve Control	0/24VDC
3	Heated Filter RTD Signal	RTD
4	Absolute Pressure	4-20Milliamp

1.5 Specifications

The PRO2000W dilution probe conditioning assembly was designed to operate within the following specifications:

Power Requirements:	120 VAC, 1,020 Watts
Power Connection:	CSA/UL Approved screw terminal. Terminal wire capacity up to 10 AWG
Ambient Operating Temperature Range:	-20°C (-4°F) to 50°F (122°F)
Maximum Process Temperature:	538°C (1000°F)
Calibration Gas Flow Rate	2.0 L/min minimum, 2.5 L/min maximum
Enclosure Temperature:	37.7°C ± 3°C (100°F ± 5°F)
Instrument Air Supply:	400 kPa (60 PSIG) minimum, 550 kPa (80 PSIG) maximum via 1/2 inch tubing - 0.300 inch I.D. min.
Eductor Flow Rates:	
Heated Eductor Assembly:	
Sample Flow:	approx. 50-300 cc/min
Dilution Flow	approx. 5-10 L/min
Heated Eductor/Filter Body	
Temperature:	140.5°C (285°F)± 5.5°C (10°F)
Materials of Construction:(Standard)	
Enclosure:	Fiberglass
Mounting Method	½-13 Stainless Steel bolts (4 supplied) for connection to standard 4 inch 150# pipe flange
Sample Orifice:	Quartz
Eductor Jet:	Torlon™ or suitable material
Orifice Holder Body:	Torlon™ or suitable material
Eductor Body:	Torlon™
Heated Filter Body:	Torlon™ or suitable material
Probe Barrel:	Hastelloy - C276
Connecting Lines/	
Sample Lines:	Teflon®
Calibration Lines	Teflon®
Weight:	
Dilution Probe Conditioning Assembly:	17.7 kg (39 lbs)
Dimensions	18”H x 16”W x 10”D

2.0 THEORY OF OPERATION

2.1 General

The PRO2000W dilution probe conditioning assembly extracts a continuous sample from a stack or duct and delivers a clean dry gas for transport to a gas analysis system.

2.2 Gas Flow Functional Description

Operation of the dilution probe conditioning assembly consists of three modes: Sampling, Purge, and Calibration Modes.

2.2.1 Sampling Mode

Process gas enters the sampling system at the probe tip and flows down the probe at a low flow rate of 50-300 cc/min. Particles larger than 15 microns settle out on the probe walls due to the low sample velocity.

From the sampling probe, the gas enters the heated filter chamber shown in cross section in Figure (2.2.1). The filter body is heated and controlled by an external temperature controller and cartridge heating element at a temperature between 135°C - 146.1°C (275°F - 295°F). The sample gas then flows from the heated filter chamber through the heated filter and exits from the heated filter body through the filter chamber outlet. The filter element is selected for its inertness to the process gas and is usually a glass fiber element with a Teflon® binder having a collection efficiency rating of 0.1 micron. The filter element may be replaced by removing the filter cap sealed with an 0-Ring.

The sample gas is extracted from the process using a precision low flow eductor assembly that is driven by instrument quality air. The heated eductor assembly pulls the sample flow through the heated filter for dilution and transportation to a remote or local analysis system.

The Dilution Eductor Assembly functions as follows:

A regulated source of instrument air is connected to the dilution/eductor jet through the pressure regulator and pressure gauge located in the probe controller. The pressure regulator is a precision regulator that regulates the air pressure to within .3kPa (0.04 PSI) for a 70kPa (10 PSIG) change in input pressure. The flow through the air jet creates the vacuum that pulls the sample gas through the dilution probe conditioning system. This flow is also the dilution air used to dilute the sample gas to lower concentrations, therefore, the air supply quality and pressure are important to the probe.

The dilution eductor air flow rate is set and controlled by a dilution critical orifice that is part of the air jet. The air critical orifice is operated at 200kPa (30 PSIG). The sample gas critical orifice is operated with a pressure drop greater than 50kPa (15 in. Hg).

The dilution air and sample gas flow rate may be set by selecting different orifice combinations. Dilution flow rates between 5 and 10 liters/min may be chosen in combination with different process sample gas flow rates between 50 and 300 cc/min to yield dilution ratios between 16:1 and 100:1.

The process sample gas and dilution air are combined within the eductor, and the diluted sample gas exits the dilution eductor assembly through the eductor exhaust port.

The heated eductor assembly pulls sample gas from the heated filter chamber into the heated eductor sample inlet. It is then carried through the sample critical orifice into the dilution chamber for dilution (see Figure 2.2.1).

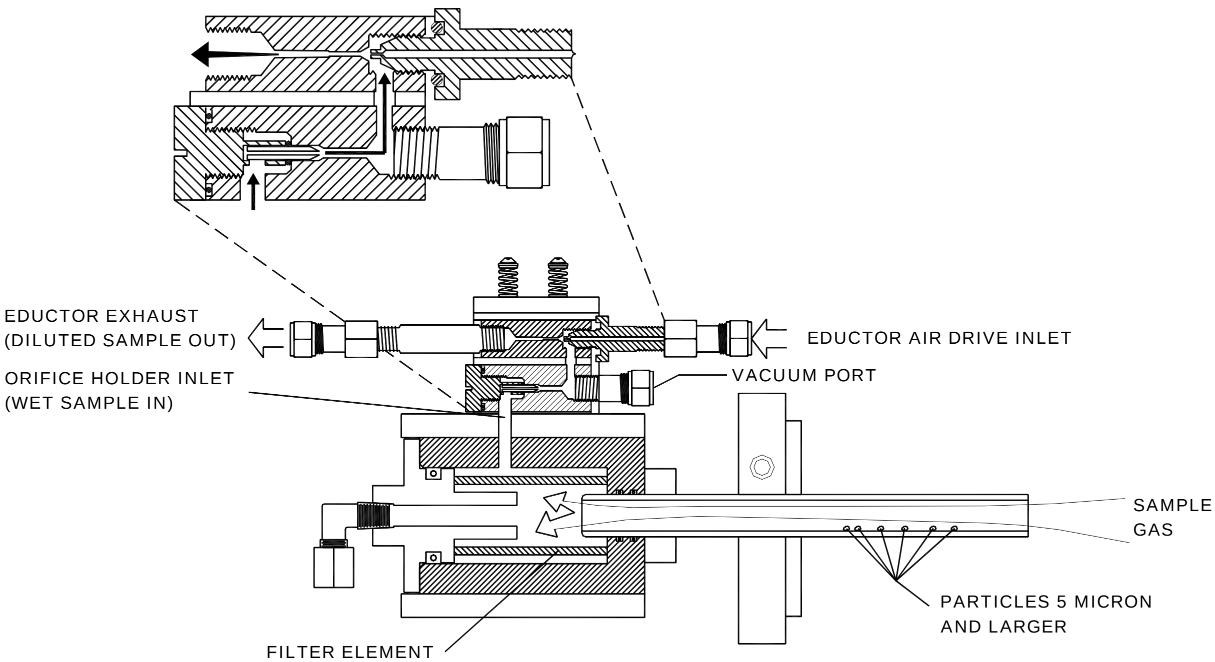

Figure 2.2.1 Probe Head Flow Diagram

The eductor's sample critical orifice is fabricated from quartz. The orifice is controlled to a temperature between 140.5°C ± 5.5°C (285°F ± 10°F) and is contained within the orifice holder. From the orifice, the process gas passes to the vacuum cavity of the dilution eductor. The dilution eductor assembly is heated by an extension of the heated aluminum housing.

From the eductor exhaust port, the diluted process gas passes to the air manifold and then into a vent bulkhead on the conditioning assembly enclosure. A portion of the diluted sample is pulled through a sample bulkhead and unheated Teflon® sample line by a sample transport pump to the remote analysis system. The sample transport assembly may be eliminated in some cases if the distance between the probe assembly and the remote analyzer is 50 feet or less.

Typical transport flow rates from the conditioning assembly to an external analysis system are in the range of 1.5 to 3 liters per minute. This gives the analytical instruments a response time of 2 to 5 minutes, depending upon application. This response time is adequate for most process control and environmental monitoring requirements.

System response time requirements have been met with the PRO2000W dilution probe conditioning assembly by a three-step process: the sample is extracted from the stack, filtered and then diluted.

A further simplification of the gas conditioning system is dilution of the process stream immediately at the sample source using dry air with dew points in the range of -40.0°C to -73°C (-40°F to -100°F). The dew point of the gas stream leaving the PRO2000W is largely a function of the dew point of the dilution air. Dilution ratios of 16:1 to 100:1 are easily achieved. The exit sample dew point of -37°C to -12°C (-35°F to 11°F) allows use of freeze protected sample lines in all but the most extreme environments.

2.2.2 Purge Mode

A purge cycle occurs periodically to clear various sections of the dilution probe assembly from moisture and particulate matter. The purge solenoid valve is operated automatically through a controller in the remote or local analysis system. Purge frequencies may vary from every 15 minutes for applications with extremely heavy particulate concentrations to several hours for cleaner applications. The purge pulse lasts approximately 10 seconds. Longer purge times could result in dilution probe cooling.

Particulate matter is removed from the probe barrel and the heated filter by the periodic introduction of high pressure purge air from the purge solenoid valve into the filter body through the heated filter cap, exiting into the process through the probe barrel. The heated filter purge is used to remove particulate buildup from the inside surface of the heated filter. When the particulate is dislodged, it is carried out of the filter chamber and through the probe barrel with the purge air.

2.2.3 Calibration Mode

The PRO2000W dilution probe conditioning assembly is calibrated by passing a gas of known concentration through all the components in the sample analysis system and adjusting the response of the gas analysis system to equal the value of the known calibration gas. Calibrating in this manner allows for compensation of the total system for losses in filter elements or other pneumatic components, changes in dilution air flow rates and in process gas flow rates. A typical calibration gas flow path is as follows:

From the calibration cylinder, the calibration gas flows from a flow controlling device and calibration gas valve located in a remote or local gas analysis system through the calibration gas line to the PRO2000W dilution probe conditioning assembly calibration gas inlet. The gas enters the Dilution Probe through the calibration check valve and then into the filter body through the purge/calibration gas inlet. The calibration gas check valve allows the flow of calibration gas to be initiated remotely through a controller in the remote or local analysis system. The calibration valve is located as close as possible to the purge/calibration gas inlet to prevent process condensation from forming in the calibration line between calibrations. From the heated filter body, the calibration gas passes through all system components at the same flow rates and conditions as the process sample gas.

3.0 INSTALLATION AND OPERATION

3.1 Site Location and Preparation

The 40 CFR Performance Specification Two (2) provides a guide to proper site selection and lists several points that should be considered for most applications. The most accurate readings will usually be obtained when the guidelines of Performance Specification Two (2) are followed.

The PRO2000W dilution probe conditioning assembly is installed on a four (4) inch pipe flange. The pipe flange must be installed on a pipe nipple extending six (6) inches from the outer wall of the stack. The nipple is used to allow clearance behind the conditioning assembly for installation of nuts on the four (4) ½-13 x 3 inch stainless steel mounting bolts. Also allow a clear space, at least the width of the probe enclosure, in front of the enclosure door to allow the door to be opened. The four (4) inch pipe flange must be aligned as shown in Figure 3.1. A slip-type pipe flange is recommended to insure that the conditioning assembly can be leveled.

The dilution probe conditioning assembly should be installed in a location that will allow maintenance personnel access to the front of the enclosure. All maintenance can be performed from the front of the unit.

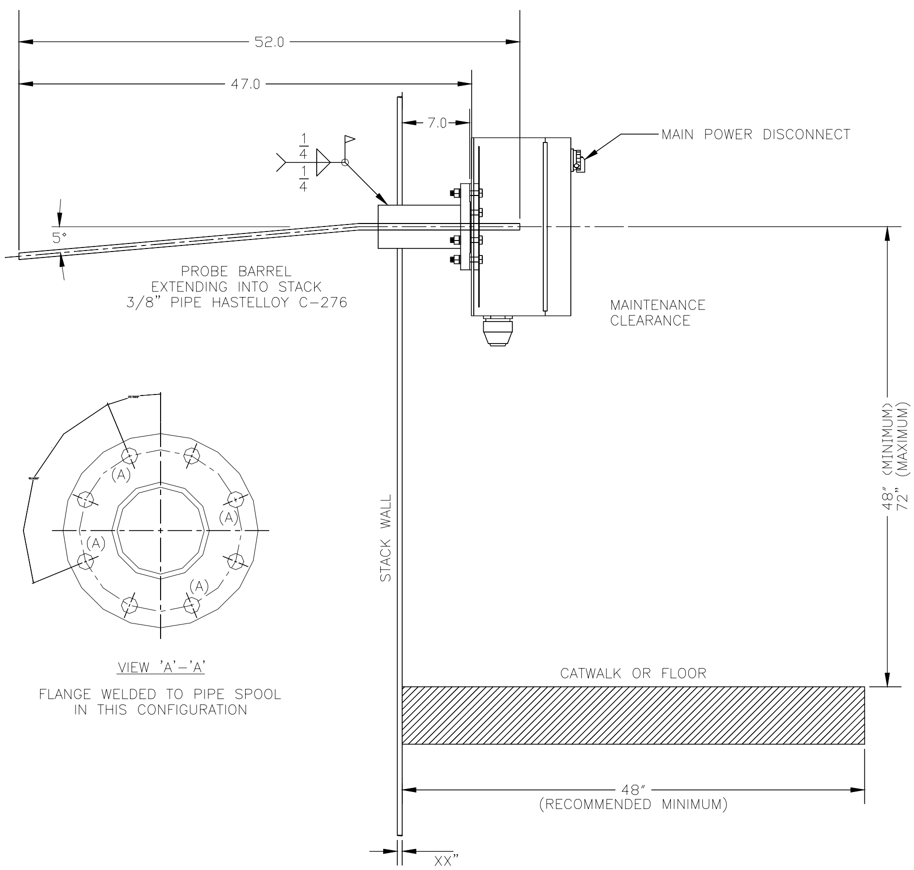

Figure 3.1 Enclosure Mounting Diagram

3.2 Limitations at the Probe Site

The placement of the PRO2000W dilution probe conditioning assembly is important to achieve its maximum reliability.

3.2.1 Stack Temperature Extremes

The PRO2000W probe barrel was supplied using Hastelloy C-276 or Teflon® lined Hastelloy C-276 (or other suitable material specific to the application). The Teflon® lined Hastelloy probe barrel may be used at temperatures up to 190.5°C (375°F) and up to six (6) feet in length. It is best to use the shortest possible probe barrel length for response times.

3.2.2 Ambient Temperature Extremes

The PRO2000W dilution probe conditioning assembly may be operated at a maximum ambient temperature of -20°C to 50°C (-4°F to 122°F). This upper temperature is selected to assure proper operation of the solenoid valves contained in the enclosure. Optimum operation of the sampling system will always be achieved if a sampling location is selected with moderate temperatures.

3.2.3 Process Pressure

The sampling system should not be installed in sampling locations that have pressures which exceed 1.2kPa (+5 in. H_2O) or -2.5kPa (-10 in. H_2O). Positive pressure ducts are a special problem in that maintenance procedures are complicated by process gases escaping into the area of the maintenance personnel when the filter body is opened for maintenance. Positive pressure stacks or ducts may be easily sampled if a small portion of the stream can be vented to atmosphere and the probe then allowed to sample this atmospheric vent. The probe typically extracts between 50 and 300 cc/min, so only a small bypass flow is required.

3.3 General Installation

The dilution probe conditioning assembly is shipped in two separate containers. The conditioning assembly is installed first and then the probe barrel is installed through the back of the conditioning assembly into the stack. To install the dilution probe conditioning assembly, perform the steps as outlined in the following three sections.

3.3-1 Dilution Probe Conditioning Assembly

Conditioning Assembly Installation

Install the conditioning assembly on the four (4) inch flange using a proper flange gasket and four ½-13 inch stainless steel nuts (see Figure 3.1).

Probe Head Removal

A) Open the conditioning assembly door and locate the dilution probe head. Carefully cut and remove the shipping tie wrap from the probe head and support bracket.

B) Note the placement of all four (4) Teflon® tubes connected to the probe head. Loosen each of the Teflon® connecting tube fittings and remove the tubes.

C) Disconnect the cartridge heater and RTD from the probe box wiring cable.

D) Loosen the probe head securing wing nut, located underneath the support bracket.

E) Remove the probe head from the bracket and place in a safe clean area during probe barrel installation.

Probe Barrel Installation

A) Inspect the probe barrel assembly for proper flange spacing and orientation (factory set) (see Figure 3.3.1 and 7000 series drawings).

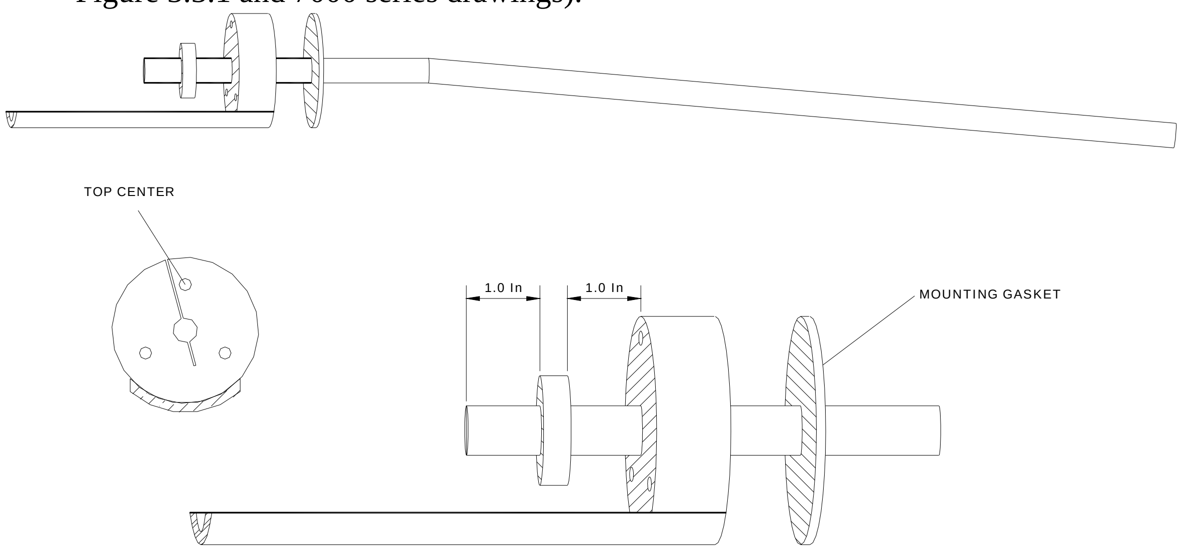

Figure 3.3.1 Dilution Probe Barrel Assembly

B) Install the probe flange gasket (factory supplied) over the process end of the probe barrel to be used to seal process gases from the conditioning assembly enclosure.

C) Insert the probe barrel assembly through the flange port hole in the back of the conditioning assembly with the bend downward. Align the three-hole probe mounting flange and flange gasket to the three-hole pattern of the conditioning assembly flange port hole.

D) Insert the three (3) supplied 1/4-20 X 1 inch bolts through the probe mounting flange into the threaded holes, and tighten.

E) Coat the polished probe tip surface with a liberal amount of silicone based high vacuum grease. This allows a proper o-ring seal of the probe head.

Probe Head Installation

NOTE: Before initial installation of the dilution probe assembly, and after any probe head maintenance, the tests described in Sections 4.8 and 4.9 of this manual should be performed. The probe pre-test verifies that the probe assembly is leak free and has the proper flow rates.

A) Reinstall the probe head by sliding the probe head over the polished probe tip. The rear of the probe head is usually tilted upward during installation to allow clearance for the sample outlet tubing fitting.

B) Reinstall all items removed during steps B and C of Probe Head Removal Section:

1) Connect the eductor dilution air

2) Connect the eductor exhaust tube

3) Connect the calibration/purge tube

4) Connect the vacuum line tube.

5) Connect the probe filter heater cartridge.

6) Connect the RTD temperature assembly.

Check all connections and confirm that the cartridge heater and RTD temperature are installed to their maximum depth.

3.3.2 Air Supply

NOTE: Do **NOT** apply air pressure to the conditioning assembly until Start-up, Section 3.5. This section is for air line connection only.

The air supply must have a dew point of at least -40°C (-40°F). A low dew point will prevent condensation in the unheated sample line and reduce sample loss. The air supply should have a minimum pressure of 400kPa (60 PSIG) to ensure an adequate purge. The typical Thermo Environmental Instruments air clean-up assembly meets these requirements.

Connect a ½ inch OD minimum air supply line to the instrument air inlet of the conditioning assembly. The instrument air supply inlet is accessed through a ½ inch stainless steel compression tube fitting located at the bottom of the fitting bracket assembly.

3.3.3 Sample and Calibration Gas Lines

Connect the Teflon® sample and calibration gas lines to the appropriate ¼ inch compression type tube fittings located at the bottom of the fitting bracket assembly. The maximum length for the sample and calibration lines varies with individual applications. (Refer to the specific installation drawings for each application.)

3.3.4 Vacuum Line

Connect the Teflon® vacuum line to the appropriate 1/8 inch compression type tube fitting located at the bottom of the fitting bracket assembly.

3.3.5 Sample Vent Line

A ¼ inch rubber grommet is supplied for the sample vent to the outside of the probe box. **NOTE:** The sample vent/eductor exhaust should never be restricted or pressurized.

3.3.6 Power

A standard 120 VAC, 15A service is required to operate the PRO2000W dilution probe conditioning assembly. Service must be supplied using 12 AWG minimum. For long runs where voltage drops may occur, 10 AWG may be used.

Connect the power to Disconnect Switch DC-1, TB-1, and the Grounding Screw, (See 7000 Series Drawings). DC-1 is a UL and CSA approved Disconnect Switch rated for 10 AWG wire, 20 Amps AC. A power cable entry to the conditioning assembly is supplied through a ¾ inch conduit fitting.

3.3.7 Control and Data Lines

Connect signal lines using specified shielded cable for data acquisition and control lines for calibration and purge valve. A cable entry to the Conditioning Assembly is supplied through a 1 inch CGB. (Refer to specific installation drawings for each application.)

3.4 Absolute Pressure Transducer Checkout Procedure.

A) Obtain the current barometric pressure reading in inches of Hg.

B) At the dilution probe assembly, locate the stack pressure signal at TB1 terminals 15(-) and 14(+). Place an ammeter in series with this signal to measure 4-20 mADC. The pressure transducer range is 0-15 psia.

C) Remove the calibration gas inlet tube at the heated filter assembly to allow the pressure transducer to measure the current barometric pressure. The 4-20 mADC signal should track barometric pressure in psia. (output= [(16*current barometric pressure (inches of Hg)/30.54)+4)]mA). There are no field repairs or alignment procedures for this component.

D) Reconnect the calibration gas tube to the heated filter assembly. Remove the ammeter and reconnect the pressure transducer cable.

3.5 Dilution Probe Conditioning Assembly Start-Up

A) The dilution probe conditioning assembly start-up procedure may be performed only after the installation procedure outlined in the first part of this chapter has been completed and all wiring and tubing connections have been rechecked for accuracy.

B) Ensure that the dilution air regulator the dilution probe assembly in has been turned off. This will keep moisture from contaminating the system while the temperature setpoints are reached.

C) Apply power to the dilution probe assembly by turning on the rotary power switch. Using a digital thermometer, check the temperatures of the heated filter assembly (a thermocouple port has been drilled into both (assemblies). Ensure that the temperature is approaching the setpoint. When the temperature has stabilized, return to the probe controller for the next step.

D) Ensure that the temperature controller indicates a temperature that is within 10 ^{o} F of the setpoint.

E) Using a thermocouple, verify the heated filter temperature is 275-295^{o}F

F) If the optional enclosure heater was purchased, verify the enclosure temperature is 100^{o}F.

G) Turn on the main air supply from the air clean-up assembly and adjust the probe controller dilution air supply to 200kPa (30 PSI)

H) Complete the leak, flow, and vacuum test outlined in section 4.8and 4.9.

I) Initiate a purge cycle on the dilution probe conditioning assembly.

The PRO2000W dilution probe conditioning assembly is now ready to be calibrated with the complete monitoring system.

4.0 MAINTENANCE

4.1 General

The following procedures are designed to allow the maintenance technician to accomplish all necessary maintenance procedures on the PRO2000W dilution probe conditioning assembly. With the exception of changing the heated filter element, none of these procedures are to be considered as normal maintenance, and should only be performed in the event of a calibration failure, other trouble shooting procedure, or after disassembly of the heated filter/eductor assembly.

4.2 Required Maintenance Equipment

To perform maintenance on the sample system, the following equipment is required.

A. Vacuum gauge 0-100kPa (0-30)in. Hg
B. Flow meter 0-500 cc/min, Thermo Environmental Instruments P/N 29020006 or equal
C. Flow meter 0-10 L/min, Thermo Environmental Instruments P/N 29020009 or equal
D. Temperature meter 0-260°C (0-500°F)
E. Tweezers (to remove quartz orifice)
F. 2 ea. 1/4" tube cap (Teflon®)
G. 2 ea. 1/8" NPT (female) pipe cap
H. Probe Adapter 3/8" pipe to 1/4" tube, Thermo Environmental Instruments P/N 07990000
I. Vacuum Pump 70kPa (20 in. Hg), Thermo Environmental Instruments P/N 26006022 or equal
J. Normal Hand Tools
K. High Vacuum Silicone Grease, Thermo Environmental Instruments P/N 16000003 or equal.

4.3 Heated Filter Replacement

NOTE: The existing heated filter must be replaced with a new one each time the filter cap is removed, (the filter is slightly crushed to seal). Once a crushed filter is removed, it will not seal properly and should not be used again.

A) Turn off the dilution air regulator to prevent any contamination in the critical orifice while the filter cap is removed.

B) Remove the three nuts that secure the heated filter cap.

C) Remove the main filter cap by pulling straight back on the filter cap wire cable. The filter cap has a snug fit with an o-ring seal.

D) Remove the filter from the mandrel of the heated filter cap.

E) Inspect the filter body and cap for particulate accumulation around the filter seats. Clean the filter body and seat by wiping with a soft cloth.

F) Lubricate the cap O-Ring with a light coating of silicone based high vacuum grease.

G) Install the **new** filter element onto the cap mandrel, then insert the cap and filter into the filter body.

H) Align the screw holes in the cap with the screw holes in the body and press the cap into the filter body. Reinstall the nuts. <u>Hand tighten the nuts only.</u>

4.4 Quartz Orifice Replacement

The quartz orifice may be changed by removing the orifice holder access screw. The orifice is sealed in the bore by an O-Ring and may be removed by grasping the orifice with a pair of tweezers and pulling straight back. If the O-Ring does not come out with the orifice, remove the O-Ring with the tweezers. Install a new orifice by placing the orifice O-Ring on the orifice and inserting the larger end of the orifice into the orifice bore of the access screw. Install the access screw into the orifice holder body until the face of the screw seats firmly against the exterior o-ring.

4.5 Probe Head Removal

A) Note the dilution air pressure setting, adjust dilution air pressure regulator to 0 psi and remove power from the probe box.

B) Disconnect the vacuum line from the vacuum port on the orifice holder.

C) Disconnect the air supply tubing to the eductor air jet.

D) Disconnect the sample tubing from the eductor exhaust.

E) Disconnect the purge/calibration tubing from the filter cap.

F) Loosen the filter body wing nut.

G) Disconnect the heater assembly and RTD assembly located at the rear of the filter body.

H) Remove the probe head from the probe barrel.

I) Prior to reinstalling probe head, coat the polished probe tip surface with a liberal amount of silicone-based high vacuum grease. This allows a proper o-ring seal of the probe head. Installation of the probe head is the reverse order of removal.

4.6 Orifice Holder Assembly Removal

A) Remove probe head as described in section 4.5.

B) Remove the eductor assembly housing insulated cover.

C) Remove the four (4) ring screws and remove the flat washers and springs.

D) Remove the eductor assembly top cap.

E) Remove the eductor jet assembly and the orifice holder assembly from the eductor assembly housing. Gently break the modules apart at the gasket.

F) Clean the sealing gasket by removing all hardened vacuum grease. Lubricate the gasket with a fresh thin coat of silicone high vacuum grease. Do not get any grease in gasket opening.

G) Reassemble the eductor assembly in the reverse order of disassembly, being sure to align the block passages with the gasket opening.

H) The top plate springs measure 1/2 inch uncompressed. Tighten the nuts until the spring height is approximately 3/8 of an inch.

I) Reinstall the probe head.

J) Return air supply to exact previous pressure.

4.7 Eductor Jet Body Removal

The eductor block may be removed as follows:

A) Remove the probe head as described in section 4.5.

B) Remove the eductor assembly housing insulated cover.

C) Remove the four (4) spring screws and remove the four (4) flat washers and springs.

D) Remove the eductor assembly top cap.

E) Remove the eductor jet assembly and the orifice holder assembly from the eductor assembly housing. Gently break the two modules apart at the gasket. The eductor jet assembly can now be repaired or replaced.

F) Clean the sealing gasket and the jet body mounting surfaces by removing all hardened vacuum grease. Lubricate the gasket with a fresh thin coat of silicone high vacuum grease. Avoid getting any grease in the gasket opening.

G) Reassemble the eductor assembly in the reverse order of disassembly, being sure to align the block passages with the gasket opening.

H) The top plate springs measure 1/2 inch uncompressed. Tighten the nuts until the spring height is approximately 3/8 of an inch.

I) Reinstall the probe head.

J) Return air supply to exact previous pressure.

4.8 Probe Head Leak Test

Cap the eductor air inlet (dilution air) and the eductor exhaust, then connect a hand held vacuum pump as shown in Figure 4.8.

Install a probe adapter fitting into the heated filter o-ring port as shown in Figure 4.8. Pull a vacuum of 70kPa (20 in. Hg), minimum, with the vacuum pump as shown on the vacuum gauge and record this value. The vacuum reading must not drop by more than 1.7kPa (0.5 in. Hg) in 1 minute.

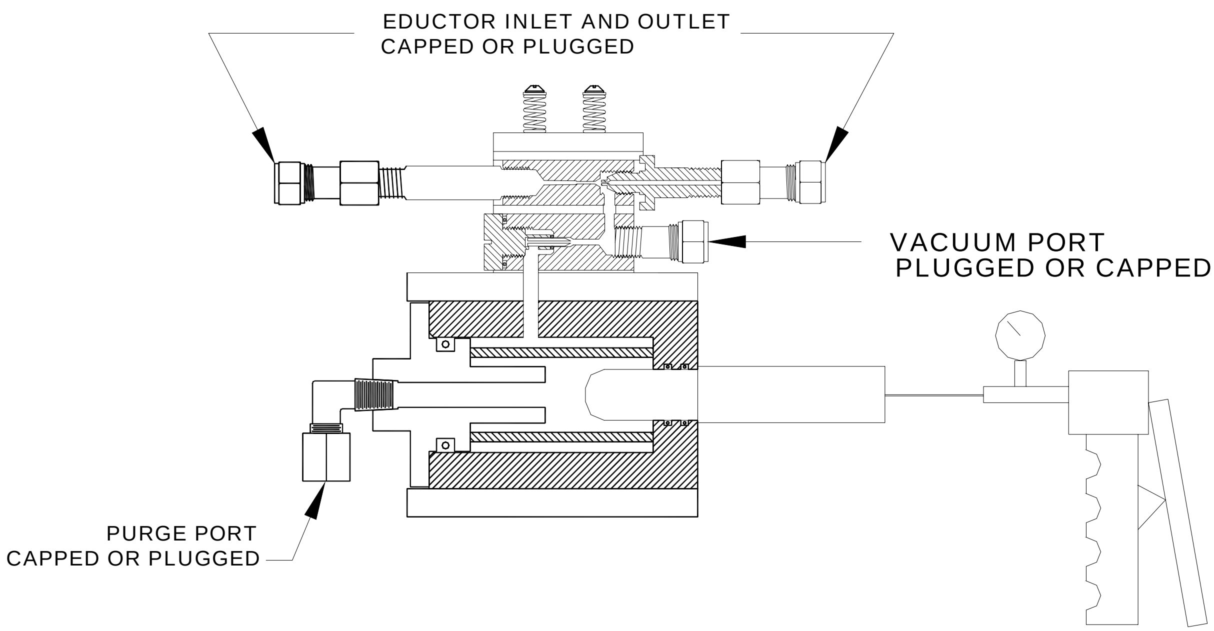

Figure 4.8 Leak Test Configuration

4.9 Probe Head Flow Test

The Dilution Probe may be supplied with various jets to accomplish different dilution ratios. Refer to the specific system flow diagram supplied with the system to obtain the proper flow rates.

Connect a mass flow meter in-line to the eductor exhaust port as shown in Figure 4.9. This flow rate should be approximately the same value as the value recorded on the system flow diagram.

Install the probe adapter fitting into the filter body O-Ring port and cap the purge/calibration port as shown in Figure 4.9. Connect a mass flow meter to the probe adapter fitting. This flow rate should be approximately the same value as the value recorded on the system flow diagram.

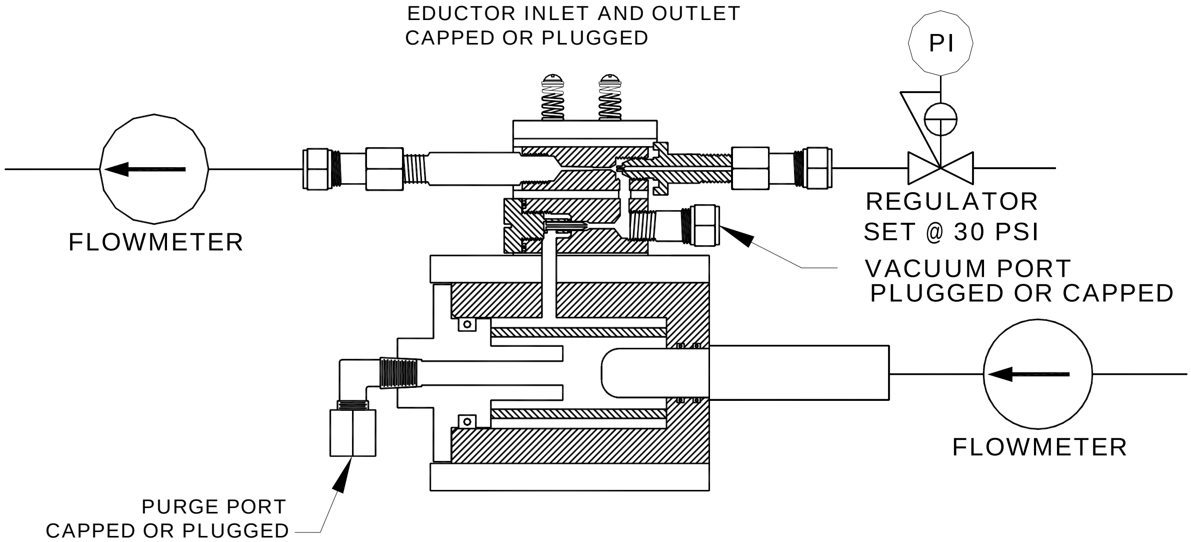

Figure 4.9 Eductor Flow Test Configuration

4.10 Eductor Vacuum Test

Connect the hand held vacuum pump to the eductor inlet port as shown in Figure 4.10, below. The hand held vacuum pump is used for its vacuum gauge only. With the instrument air pressure of 30 PSIG (200kPa) supplied to the eductor air jet, the eductor must pull a minimum of 17 inches Hg vacuum.

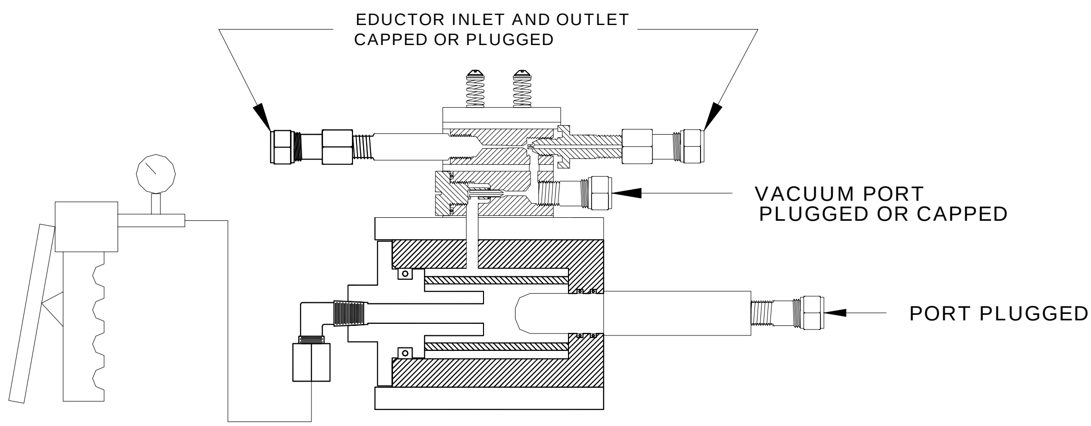

Figure 4.10 Eductor Vacuum Test Configuration

4.11 Trouble Shooting

4.11.1 Zero Drift - Full System

Zero drift is independent of the dilution system, as any dilution of a zero gas will still cause a zero indication on the analyzer. Analyzer zero drift may be caused by trace levels of the measured gas in the dilution air supply. Either obtain the dilution air from a different source or install suitable air cleanup devices to remove the gas of interest. Check the analyzer location for large temperature changes or other changes in the analyzer utilities. See system manual for zero drift calculations.

4.11.2 Span Drift - Full System

Span drift may be caused by many different variables throughout the monitoring system. Most problems with the sampling system will be indicated by a failure to pass the daily span calibration. Failure to pass the daily calibration is subdivided into several different problem areas. Within these areas, a possible problem is listed that would cause a high or low indication on daily calibration. For each possible problem, a corrective action is also listed. See system manual for span drift calculations.

4.11.3 Low Sample Flow Rate

Possible Problem - Plugged Orifice

Corrective Action - Change Orifice

Possible Problem - Leak around filter cap.

Corrective Action - Clean O-Ring and apply high vacuum grease.
Replace O-Ring.

Possible Problem - Leak at probe connection to filter body.

Corrective Action - Clean probe tip and O-Rings area.
Apply silicone grease to probe and O-Rings.
Replace O-Rings.

Possible Problem - Leak between orifice holder and eductor body.

Corrective Action - Tighten compression springs to specification (See Section 4.7,H).
Clean gasket and apply high vacuum grease.

Possible Problem - Leak between vacuum port fitting and orifice holder body.

Corrective Action - Reapply Teflon tape to fitting and reinstall fitting in orifice holder body.

Possible Problem - Low sample vacuum

Corrective Action - Check probe assembly for leaks.
Check eductor exhaust line for restriction.

Possible Problem - Leak in external components connected to purge/calibration port.

Corrective Action - Check external fittings for leaks.
Check external valves for port to port leaks.

4.11.4 High Sample Flow Rate

Possible Problem - Leak around orifice

Corrective Action - Either replace:
1. Orifice or
2. Exchange the Orifice Holder Assembly

Possible Problem - Leak between vacuum port fitting and orifice holder body.

Corrective Action - Reapply Teflon tape to fitting and reinstall fitting in orifice holder body.

4.11.5 Low Flow Rate at the Eductor Exhaust

Possible Problem - Eductor air jet plugged.

Corrective Action - Replace air jet.

Possible Problem - Restricted eductor exhaust tubing.

Corrective Action - Check internal and external exhaust vent tubing for restrictions and proper length of vent tube stub of 1/2 inches.

Possible Problem - Pressure Regulator not adjusted correctly or defective.

Corrective Action - Adjust or replace regulator.

4.11.6 High Flow Rate at the Eductor Exhaust

Possible Problem - Regulator pressure set too high.

Corrective Action - Reduce Regulator Pressure.

Possible Problem - Leak around sample orifice.

Corrective Action - Replace Jet O-Ring for quartz orifices.

Possible Problem - Leak between orifice holder and eductor body.

Corrective Action - Clean and lubricate gasket with high vacuum grease or replace gasket if necessary.

Possible Problem - Leak between vacuum port fitting and orifice holder body.

Corrective Action - Reapply Teflon tape to fitting and reinstall fitting in orifice holder body.

4.11.7 Low Eductor Vacuum

Possible Problem - Leak between orifice holder and eductor body.

Corrective Action - Clean, lubricate and tighten compression springs to specification (See Section 4.7, H) or replace gasket.

Possible Problem - Eductor exhaust restricted.

Corrective Action - Check internal and external exhaust vent tubing for restrictions and proper length of vent tube stub of 1/2 inches.

Possible Problem - Defective eductor assembly.

Corrective Action - Replace eductor assembly.

4.11.8 Low Span Reading

Possible Problem - Dirty main filter element.

Corrective Action - Replace filter element.

Possible Problem - Sample orifice plugged.

Corrective Action - Replace orifice.

Possible Problem - Leak at filter body cap.

Corrective Action - Clean or replace filter cap o-ring. Check purge/calibration gas inlet filter.

Possible Problem - Leak at probe/filter connections.

Corrective Action - Clean probe and O-Ring area.
Apply silicone grease.
Replace O-Rings.

Possible Problem - Leak at orifice holder or eductor gaskets.

Corrective Action - Clean or replace gaskets.

Check spring setting (section 4.7,H).

Possible Problem - Eductor air pressure too high.

Corrective Action - Adjust regulator.

Possible Problem - Defective regulator.

Corrective Action - Replace regulator.

Possible Problem - Leak between vacuum port fitting and orifice holder body.

Corrective Action - Reapply Teflon tape to fitting and reinstall fitting in orifice holder body.

4.11.9 High Span Reading

Possible Problem - Leak around sample orifice.

Corrective Action - Replace orifice holder o-ring on orifice holder assembly.

Possible Problem - Eductor air pressure set too low.

Corrective Action - Adjust regulator.

Possible Problem - Plugged eductor air jet.

Corrective Action - Clean jet or replace the eductor assembly.

5.0 RETURNING ASSEMBLIES FOR REPAIR

Should it become necessary to return any assembly, sub-assembly, or component for repair or replacement, contact the factory prior to shipment for specific information such as return authorization number, shipping instructions, price, time to repair, etc. Also include pertinent facts describing the nature of the problem. Ship all components to the following address:

Thermo Environmental Instruments
P.O. BOX 2470, 45 FIR ST.
WALDRON, AR 72958 U.S.A.

5.1 Obtaining Replacement Parts

The following information must be included in all purchase orders for parts:

A. Thermo Environmental Instruments Model and S/N of major assembly
B. Part Number (found in parts tables)
C. Description of part

5.2 Spare Parts List, PRO2000W Dilution Probe Assembly

Table 5.2 PRO2000W Recommended Spare Parts

Part Number	Description	Recommended Quantity
16000007	Chemical, Heat Sink	1*
16000003	Chemical, Silicone Grease	1*
25503015	O-Ring, Viton	1*
26002018	Filter, 0.1 Micron	10
26010083**	Orifice Holder Assembly, Quartz, Wet, W/Vacuum Port	1*
26010019**	Eductor, Assy, 10L/Min.	1*
26004062**	Orifice, Quartz, 5L/Min., 50:1, 130CC/Min.	4*
45500008**	Valve Assembly, 3-Way	1*

Table 5.2 PRO2000W Recommended Spare Parts (continued)

Part Number	Description	Recommended Quantity
53010036	Heater Assy, Cartridge, 150 Watt	1*
53040007	RTD Assy, Surface mount, 900 Series	1*
25501002	Eductor Gasket	1*
25503011	O-Ring , Eductor Jet	1*
25503012	O-Ring, Filter Body	1*
25503021	O-Ring, Probe	2*

* THESE PARTS ARE RECOMMENDED AS A MINIMUM FROM THE S.T.I. SERVICE DEPARTMENT TO AID IN ACQUIRING 98 % UP TIME.
**These items are site specific and depend upon the options selected.
Teflon® is a registered trademark of E. I. duPont de Nemours & Company, Inc.

Torlon™ is a trademark of Amoco Chemical Company

Printed in the U.S.A.

Revision Record

Publication #PRO2000W-0010

6.0 LIST OF DRAWINGS

DRAWING NUMBER	REV	SHEET #	DESCRIPTION
07020012	1	1 OF 2	IFED, ASSY, STI2000W, W/O PROBE
26010019	1	1 OF 1	EDUCTOR ASSEMBLY, 10L, TORLON
26010021	1	1 OF 1	EDUCTOR ASSEMBLY, 5L, TORLON
26010083	1	1 OF 1	HOLDER, ASSEMBLY, QUARTZ, WET, TORLON W/VACUUM PORT
XXXX7131	0	1 OF1	SOURCE DILUTION PROBE WIRING DIAGRAM
XXXX7151	0	1 OF 2	SOURCE EXTRACTIVE PROBE ASSEMBLY
XXXX7151	0	2 OF 2	SOURCE EXTRACTIVE PROBE ASSEMBLY