Rosemount Analytical

MODEL 340

TRACE MOISTURE ANALYZER

INSTRUCTION MANUAL

081854-N

NOTICE

The information contained in this document is subject to change without notice.

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PREFACE

SAFETY SUMMARY

To avoid explosion, loss of life, personal injury and damage to this equipment and on-site property, all personnel authorized to install, operate and service the Model 340 Trace Moisture Analyzer should be thoroughly familiar with and strictly follow the instructions in this manual. **Save these instructions.**

DANGER is used to indicate the presence of a hazard which **will** cause **severe** personal injury, death, or substantial property damage if the warning is ignored

WARNING is used to indicate the presence of a hazard which **can** cause **severe** personal injury, death, or substantial property damage if the warning is ignored.

CAUTION is used to indicate the presence of a hazard which **will** or **can** cause **minor** personal injury or property damage if the warning is ignored.

NOTE is used to indicate installation, operation, or maintenance information which is important but not hazard-related.

WARNING: ELECTRICAL SHOCK HAZARD

Do not operate without doors and covers secure. Servicing requires access to live parts which can cause death or serious injury. Refer servicing to qualified personnel.

For safety and proper performance this instrument must be connected to a properly grounded three-wire source of power.

Alarm switching relay contacts wired to a separate power source must be disconnected before servicing.

WARNING: POSSIBLE EXPLOSION HAZARD

This analyzer is of a type capable of analysis of sample gases which may be flammable. If used for analysis of such gases, the detection section of the analyzer must be either in an explosion proof enclosure suitable for the hazard classification of the gas, or protected by a continuous dilution purge system in accordance with Standard ANSI/NFPA-496-1986 (Chapter 8) or IEC Publication 79-2-1983 (Section Three).

If explosive gases are introduced into this analyzer, the sample containment system must be carefully leak checked upon installation and before initial startup, during routine maintenance and any time the integrity of the sample containment system is broken, to ensure that the system is in leak proof condition. Leak check instructions are provided in Section 4.2.

Internal leaks resulting from failure to observe these precautions could result in an explosion, causing death, personal injury or property damage.

WARNING: HIGH PRESSURE GAS CYLINDERS

Fuel, air and calibration gas cylinders are under pressure. Mishandling of gas cylinders could result in death, injury or property damage. See General Precautions for Handling and Storing High Pressure Cylinders, in the rear of this manual.

CAUTION: PARTS INTEGRITY

Tampering or unauthorized substitution of components may adversely affect safety of this product. Use only factory documented components for repair.

SPECIFICATIONS - GENERAL

NON-PORTABLE ANALYZERS

CATALOG NUMBER 193000

AC Power[1]: 107 to 127 VAC 50/60 Hz ±0.5 Hz, 80 Watts maximum
Sample System Materials: 316 stainless steel, Viton, Teflon
Case: General purpose, panel mounting, purgeable[2]

CATALOG NUMBER 193001

AC Power[1]: 107 to 127 VAC 50/60 Hz ±0.5 Hz, 80 Watts maximum
Sample System Materials: Brass, aluminum, neoprene, Buna-N, stainless steel.
Case: General purpose, panel mounting, purgeable[2]

CATALOG NUMBER 193004

AC Power[1]: 107 to 127 VAC 50/60 Hz ±0.5 Hz, 80 Watts maximum
Sample System Materials: 316 stainless steel, Viton, Teflon
Case: *Detector module*: Class I, Group D, Division 1. [3]
Control Module: General purpose, purgeable[2]

PORTABLE ANALYZERS

CATALOG NUMBER 193005

AC Power: 107 to 127 VAC 50/60 Hz ±0.5 Hz, 20 Watts maximum
Sample System Materials: Brass, aluminum, neoprene, Buna-N, stainless steel.
Case: Portable with carrying handle.

CATALOG NUMBER 193006

DC Power: ±15 VDC from self-contained battery pack.
Sample System Materials: Brass, aluminum, neoprene, Buna-N, stainless steel.
Case: Portable with carrying handle.

[1] When requested by customer as a "special", the Model 340 Trace Moisture Analyzer has been modified for operation on 230 VAC power.
To verify AC power requirements for an analyzer, see the instrument name-rating plate.
If the instrument has the 230 VAC power modification, the following drawings are applicable:
780213 Schematic Diagram, 230 VAC Operation
780796 Pictorial Wiring Diagram, 230 VAC Operation

[2] Air purge. When installed with user supplied components, meets requirements of Type Z purge per ANSI/NFPA 496-1986, Chapter 2, for installation in Class I, Division 2 locations per National Electrical Code (ANSI/NFPA-70) for analyzers sampling non-flammable gases. Analyzer sample flammable gases must be contained in a suitable explosion proof enclosure or protected by a continuous dilution purge.

[3] Air purge. When installed with user supplied components, meets requirements of Type Z purge per ANSI/NFPA 496-1986, Chapter 2, for installation in Class I, Division 2 locations per National Electrical Code (ANSI/NFPA-70).

SPECIFICATIONS - PERFORMANCE

RANGES

0 to 10, 0 to 50, 0 to 100, 0 to 500, 0 to 1000 ppm H_2O by volume

ACCURACY

±5% of fullscale (not applicable to 0 to 10 ppm range or to hydrogen or oxygen sample stream containing less than 25 ppm H_2O

SENSITIVITY

Less than 1 ppm

BYPASS FLOW

Adjustable of 0 to 2 cubic feet per hour (940 cc/min.) is standard in non-portable instruments, and is obtainable for portable instruments through use of optional flowmeter accessory

AMBIENT TEMPERATURE

0°F to 120°F (-18°C to 49°C)

RECORDER POTENTIOMETRIC OUTPUT

All analyzers provide selectable output of 0 to 10 mV, 0 to 100 mV, 0 to 1 V, or 0 to 5 V

RECORDER CURRENT OUTPUT OPTION (FOR AC POWER ANALYZERS ONLY)

Plug-in circuit board provides 4 selectable outputs:

Output (mA)	Maximum Permissible Load (ohms)
0 to 5	800
1 to 5	8000
4 to 20	2000
10 to 50	700

SPECIFICATIONS - ALARM OPTION (PANEL MOUNT ANALYZERS ONLY)

SETPOINT ACCURACY

±1/2 of fullscale, or 25 mV

REPEATABILITY

1% of fullscale

SETPOINT RANGE

0 to 100% or 0 to 5 VDC, displayed on front panel meter

HYSTERESIS

2% of fullscale is standard, adjustable by changing resistor on circuit board

OUTPUT

(1) isolated (2) 190 VDC or VAC maximum, (3) 1.5 amperes AC or DC maximum

SPECIFICATIONS - SAMPLE

SAMPLE FLOW RATE

100 cc/minute

SAMPLE PRESSURE

Standard range 10 to 100 psig (69 to 690 kPa).

Low Pressure Sampling Accessory provides range of 10 inches mercury vacuum to +10 psig.

SAMPLE TEMPERATURE

32°F to 120°F (0°C to 80°C)

SAMPLE INLET/OUTLET CONNECTIONS

1/8 inch bulkhead tube fittings (Double ferrule compression type)

CUSTOMER SERVICE, TECHNICAL ASSISTANCE AND FIELD SERVICE

For order administration, replacement Parts, application assistance, on-site or factory repair, service or maintenance contract information, contact:

Rosemount Analytical Inc.
Process Analytical Division
Customer Service Center
1-800-433-6076

RETURNING PARTS TO THE FACTORY

Before returning parts, contact the Customer Service Center and request a Returned Materials Authorization (RMA) number. Please have the following information when you call: *Model Number, Serial Number, and Purchase Order Number or Sales Order Number.*

Prior authorization by the factory must be obtained before returned materials will be accepted. Unauthorized returns will be returned to the sender, freight collect.

When returning any product or component that has been exposed to a toxic, corrosive or other hazardous material or used in such a hazardous environment, the user must attach an appropriate Material Safety Data Sheet (M.S.D.S.) or a written certification that the material has been decontaminated, disinfected and/or detoxified.

Return to:

Rosemount Analytical Inc.
4125 East La Palma Avenue
Anaheim, California 92807-1802
USA

TRAINING

A comprehensive Factory Training Program of operator and service classes is available. For a copy of the *Current Operator and Service Training Schedule* contact the Technical Services Department at:

Rosemount Analytical Inc.
Phone: 1-714-986-7600
FAX: 1-714-577-8006

DOCUMENTATION

The following Model 340 Trace Moisture Analyzer instruction materials are available. Contact Customer Service or the local representative to order.

081854 Instruction Manual (this document)

1 INTRODUCTION

The Model 340 Trace Moisture Analyzer automatically and continuously measures water vapor concentrations, up to a maximum of 1000 ppm, in a gaseous sample stream. The determination is based on the simultaneous absorption and electrolysis of water. The instrument has a wide range of applications, in monitoring many gases used in manufacturing processes. (Suitable and unsuitable sample gases are listed in Section 1.2.)

Permissible sample pressure range for the standard instrument is 10 to 100 psig. Optional sampling accessories permit monitoring gas streams at atmospheric or sub-atmospheric pressures.

The analyzer provides direct readout on a front panel meter and a selectable output for an accessory potentiometric recorder. With all AC operated versions of the analyzer, a selectable output for a current type recorder is obtainable through use of an optional plug in the circuit board.

1.1 INSTRUMENT CONFIGURATIONS

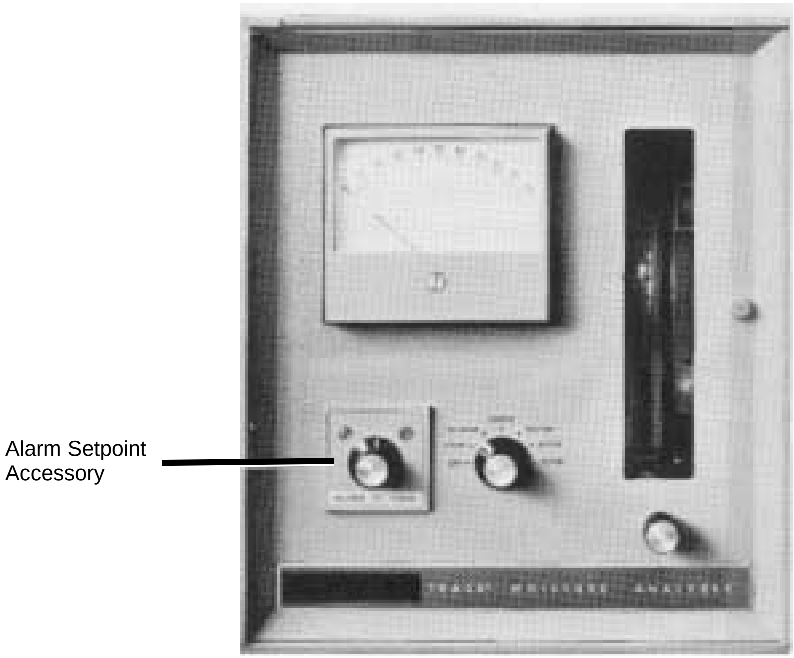
The Model 340 Analyzer is made in the following configurations:

1. Panel Mounted Analyzer, Figure 1-1, with detector, electronic circuitry, and operating controls housed in a single purgeable case. Available with internal flow system of either stainless steel (193000 Analyzer) or brass (193001 Analyzer).

2. The 193004 Explosion Proof Analyzer, Figure 1-2. Designed for use in the chemical, petrochemical, and petroleum industries, in applications where the sample stream contains flammable gases, or where explosive vapors may be present at the installation site. Control section is similar to that of the Panel Mounted Analyzer. Detector section is contained in an explosion proof housing that meets the requirements for installation under hazardous conditions specified as Class 1, Group D, Division 1, in the National Electrical Code. Flow system is of stainless steel.

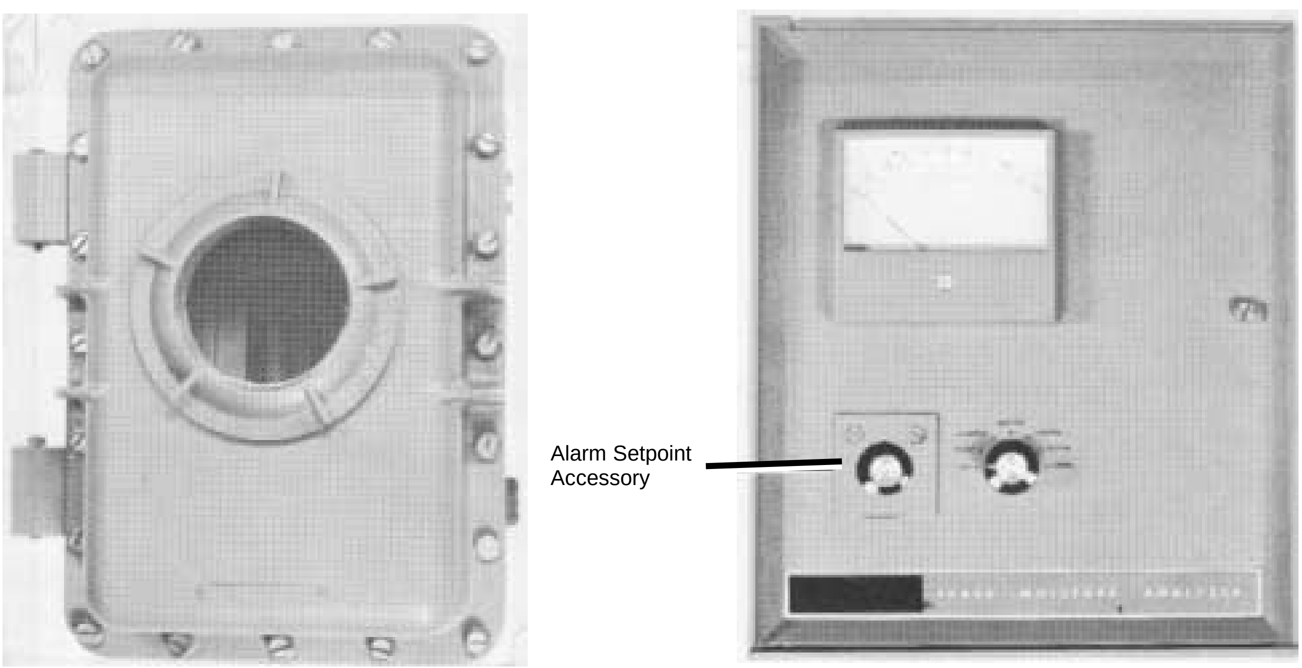
3. Portable Analyzer, Figure 1 -3. Available for operation on either 115 VAC, 50/60 Hz (193005 Analyzer) or ±15 VDC from a self contained battery pack (193006 Analyzer).

Except where specifically stated otherwise, information in this manual applies to all versions of the instrument.



Note:: Illustration applicable to 193000 and 193001 Analyzers

FIGURE 1-1. PANEL MOUNTED TRACE MOISTURE ANALYZER

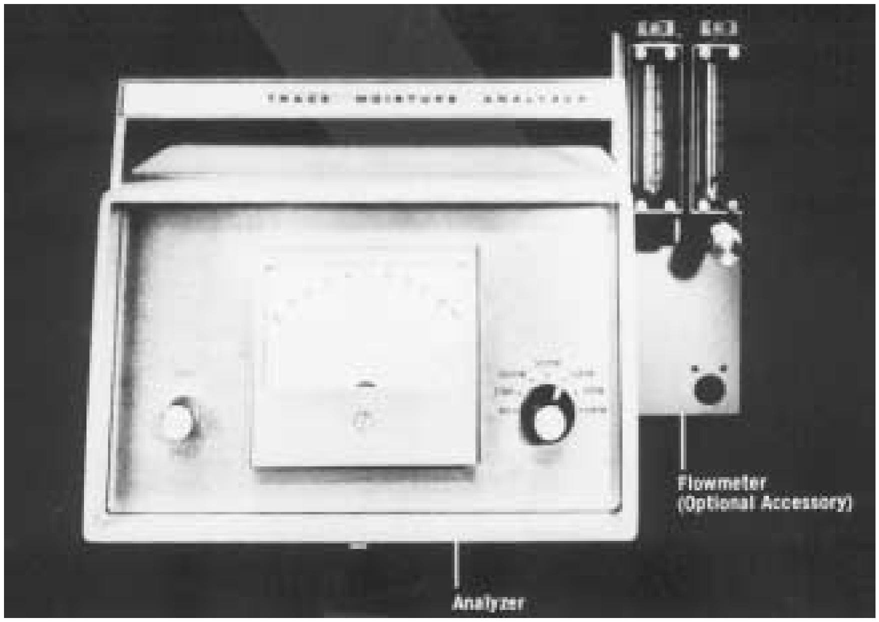


Detector Section

Control Section

Note:: This instrument is no longer available – Consult Factory

FIGURE 1-2. EXPLOSION-PROOF TRACE MOISTURE ANALYZER



Note:: Illustration applicable to 193005 and 193006 Analyzers

FIGURE 1-3. PORTABLE TRACE MOISTURE ANALYZER AND FLOWMETER ACCESSORY

1.2 SAMPLE GASES

WARNING: POSSIBLE EXPLOSION HAZARD

This analyzer is of the type capable of analysis of sample gases which may be flammable. If used for analysis of such gases, the detection section of the analyzer must be either in an explosion proof enclosure suitable for the hazardous classification of the gas , or, protected by a continuous dilution purge system in accordance with Standard ANSI /N FPA-496 -1986 (Chapter 8) or IEC Publication 79-2-1983 (Section Three).

If explosive gases are introduced into this analyzer, the sample containment system must be carefully leak checked upon installation and before initial startup, during routine maintenance and any time the integrity of the sample containment system is broken, to ensure that the system is in leak proof condition. Leak check instructions are provided in Section 4.2.

Internal leaks resulting from failure to observe these precautions could result in an explosion causing death, personal injury or property damage.

Determination of whether a sample stream of a particular composition is suitable for monitoring depends on its compatibility with the construction materials in a) the detector cell, and b) the instrument flow system. In all instruments, the detector cell utilizes a thin film of phosphorous pentoxide (P_2O_6) on rhodium electrodes. Depending on the intended application of a given instrument version, its internal flow system is constructed of either stainless steel (for corrosion resistance) or brass (for non-corrosive sample gases only).

1.2.1 SUITABLE SAMPLE GASES

Elemental Gases

Argon, Helium, Neon, Nitrogen, Oxygen, Hydrogen.

Inorganic Gaseous Mixtures and Compounds

Air, Carbon Dioxide, Carbon Monoxide, Sulphur Dioxide, Sulphur Hexafluoride.

Organic Gaseous Compounds

Butane, Ethane, Freon 12 , Methane, Propane, Halogenated Hydrocarbons.

1.2.2 UNSUITABLE SAMPLE GASES

Gases that react with P206 to produce additional water

Example: alcohols, HF.

Gases that react with construction materials of the instrument

Gases that react with P_2O_6 to alter required absorption characteristics of the P_2O_6 film

Examples: ammonia, amines.

Gases that polymerize to form a solid or liquid phase (they gradually desensitize the detector cell by coating or clogging)

Example: Unsaturated hydrocarbons - alkynes, alkadienes and alkenes.

Gases that contain particulate solid or liquid materials such as dust and dirt found in furnace atmosphere gases.

These must be avoided or filtered out upstream; oil mist or dust from some types of dryers can clog the detector cell or desensitize the P_2O_6 film by forming a layer over the film.

2 INSTALLATION

2.1 FACILITY PREPARATION

Sections 2.1.1 through 2.1.4 provide information that may be required prior to installation.

2.1.1 OUTLINE AND MOUNTING DIMENSIONS

For significant dimensions of the instrument, refer to the appropriate Drawing at the back of the manual.

2.1.2 INTERCONNECTION DIAGRAM (EXPLOSION PROOF ANALYZERS ONLY)

Drawing 194759 shows electrical interconnection for the 193004 Explosion Proof Analyzer.

Note::

Separate conduits should be used for the power cable and the interconnection cable.

2.1.3 LOCATION

Ambient temperature range for all analyzers is 0°F to 120°F (-18°C to 49°C). Additional requirements, specific to the various analyzer configurations, are given in the following:

193000 and 193001 Panel Mounted Analyzers

Install in a clean area, not subject to excessive vibration or extreme temperature variations. Preferably, the instrument should be mounted near the sample stream, to minimize transport time.

193004 Explosion Proof Analyzer

Detector Section: Criteria for installation site are proximity to sample point, protection from environment, and accessibility for servicing. Protect the unit adequately against shock and extreme vibration.

Control Section: Principal criteria for the installation site is that it must be outside the hazardous area. Hazardous locations are defined in Article 500 of the National Electrical Code. An additional consideration is convenience in taking readings and servicing the unit.

2.1.4 UTILITY SPECIFICATIONS

Electrical power requirements are listed in the following table:

193000 and 193001 Panel Mounted Analyzers 193004 Explosion Proof Analyzer	107 to 127 VAC 50/60 Hz, 80 watts
193005 Portable Analyzer	107 to 127 VAC, 50/60 Hz, 20 watts
193006 Portable Analyzer	± 15 VDC from self contained battery pack

2.2 UNPACKING

Unpack instrument carefully. For a list of items supplied in the shipping kit, refer to Section Ten.

2.3 ELECTRICAL CONNECTIONS

Depending on the particular options used, electrical setup may entail insertion of various selector plugs into appropriate positions in the associated circuit boards. Locations of circuit boards and other components within the several analyzer configurations are shown in Figures 2-1 and 2-2. Locations of selector plugs on the individual circuit boards are shown in Figure 2-3.

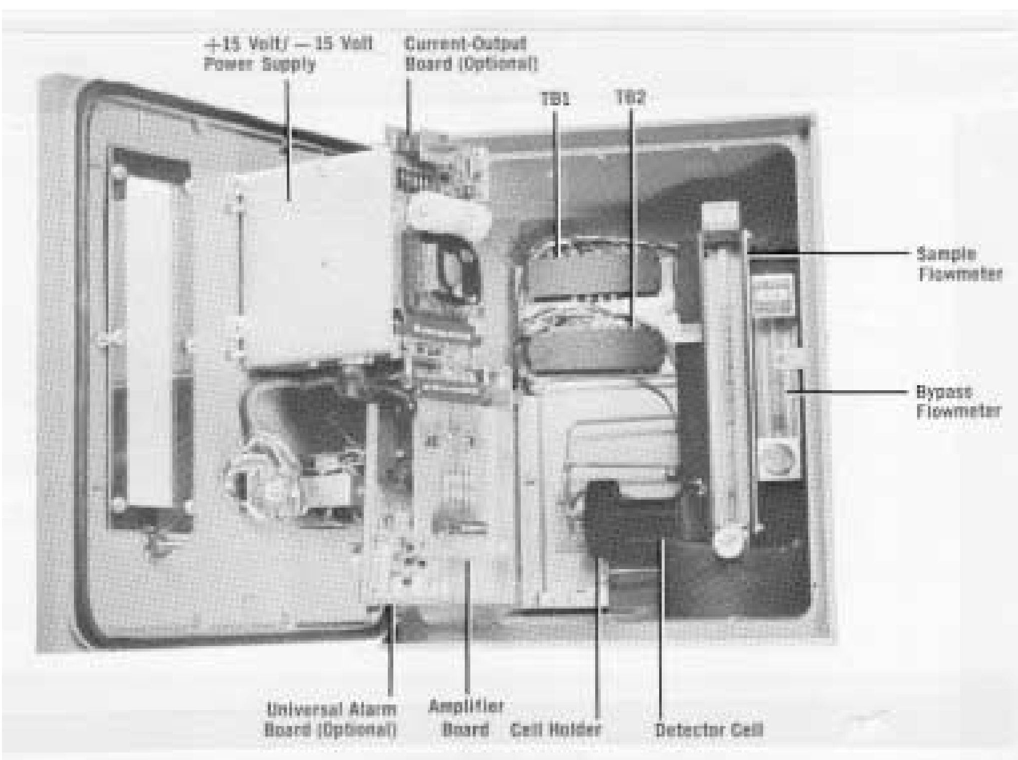


FIGURE 2-1. INTERIOR OF PANEL MOUNT ANALYZER

Make electrical connections in the following sequence:

1. If a recorder is to be used, select the particular output required and make the appropriate cable connections as explained in Section 2.3.1 (potentiometric recorder) or Section 2.3.2 (current recorder). All analyzers provide potentiometric output. Current output is obtainable from AC operated instruments only, through use of the optional current output circuit board.

2. If an alarm system is to be used, select the desired function and connect the output as explained in Section 2.3.3 Alarm output is obtainable from panel mounted instruments only, through use of the Alarm Setpoint Accessory and Universal Alarm Board in combination.

3. With Explosion Proof Analyzer, interconnect detector and control modules per Section 2.3.4.

4. Supply electrical power to analyzer per Section 2.3.5.

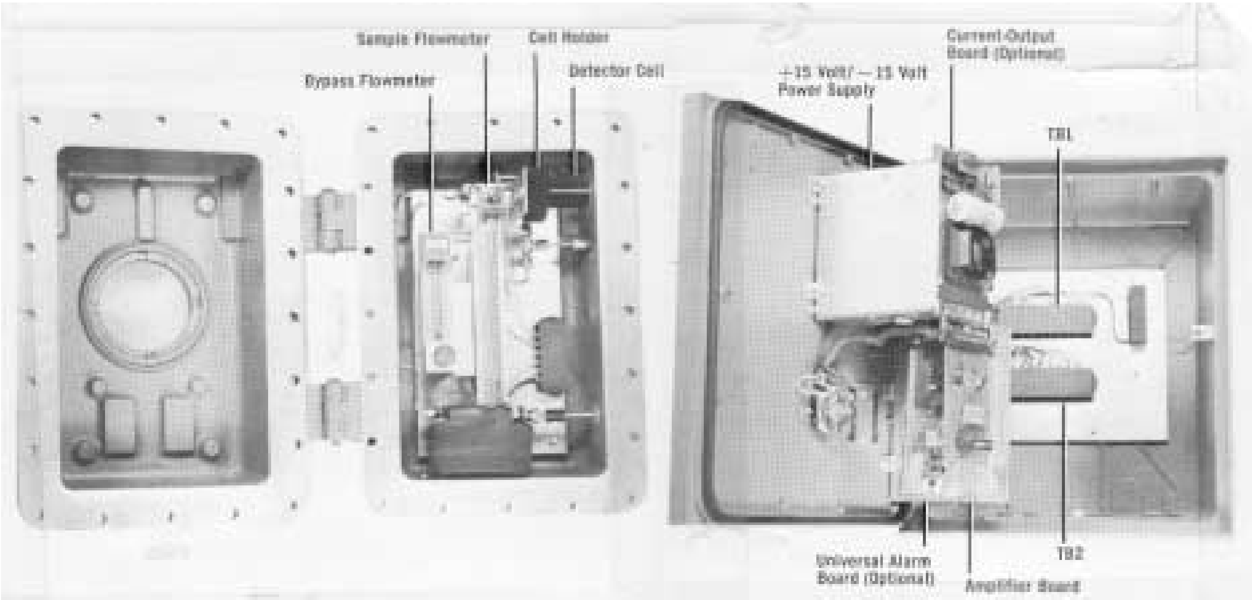


FIGURE 2-2. INTERIOR OF EXPLOSION PROOF ANALYZER

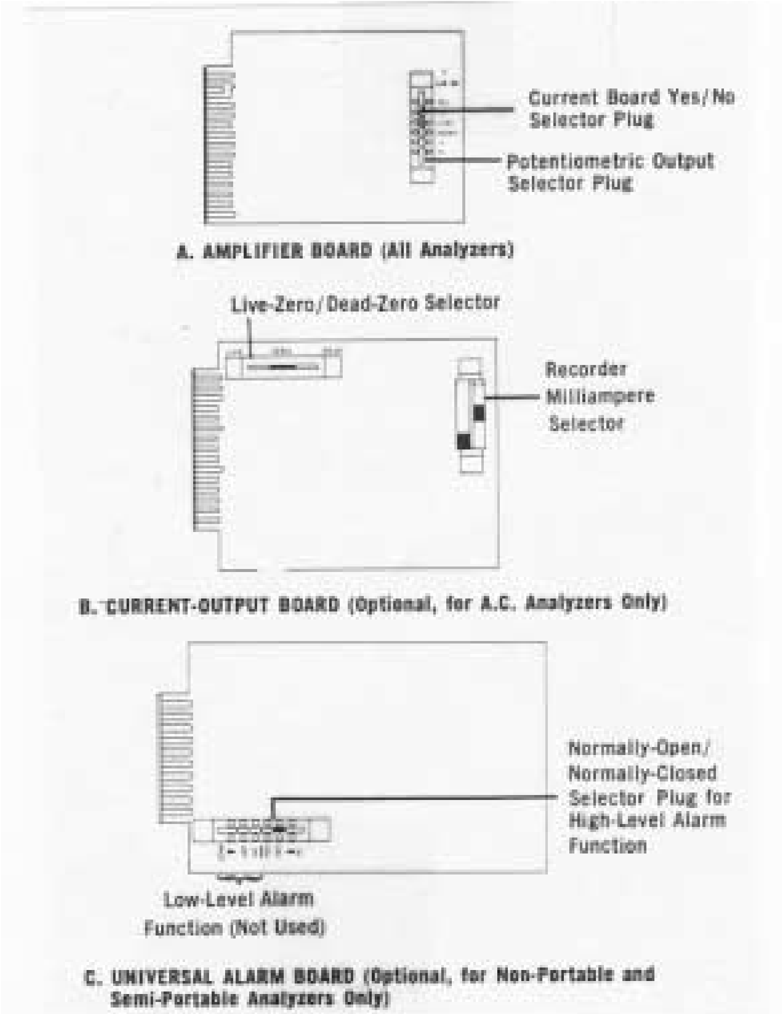


FIGURE 2-3. LOCATIONS OF SELECTOR PLUGS ON CIRCUIT BOARDS

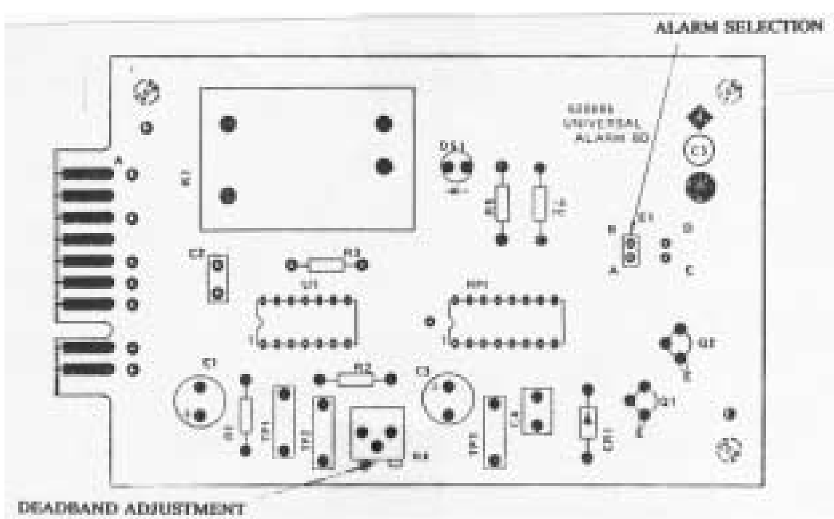


FIGURE 2-4. UNIVERSAL ALARM BOARD CONNECTIONS

2.3.1 OUTPUT SELECTION AND CABLE CONNECTIONS FOR POTENTIOMETRIC RECORDER

To use a potentiometric recorder:

1. At multi-pin receptacle on amplifier circuit board, A of Figure 2-3, insert two shorting plugs as follows:

   a. Insert plug between pair of pins designated NO in area marked CUR. BD. YES/NO. (This connection routes amplifier output signal through voltage divider, as explained in Section 7.3.2.)

   b. Insert plug between pair of pins with labeled designation that corresponds to desired output. Options are 10 mV, 100 mV, 1 volt, and 5 volts.

2. Connect appropriate leads of shielded recorder cable to POT. REC. and terminals, and SHLD terminal, on output terminal strip.

3. Connect recorder end of output cable as required for the particular recorder span:

   a. For recorder with span of 10 mV, 100 mV, 1 volt, or 5 volts, connect cable directly to recorder input terminals, making sure polarity is correct.

   b. For recorder with an intermediate span, i.e., between the specified values, connect cable to recorder via a suitable external voltage divider, as shown in Figure 2-5.

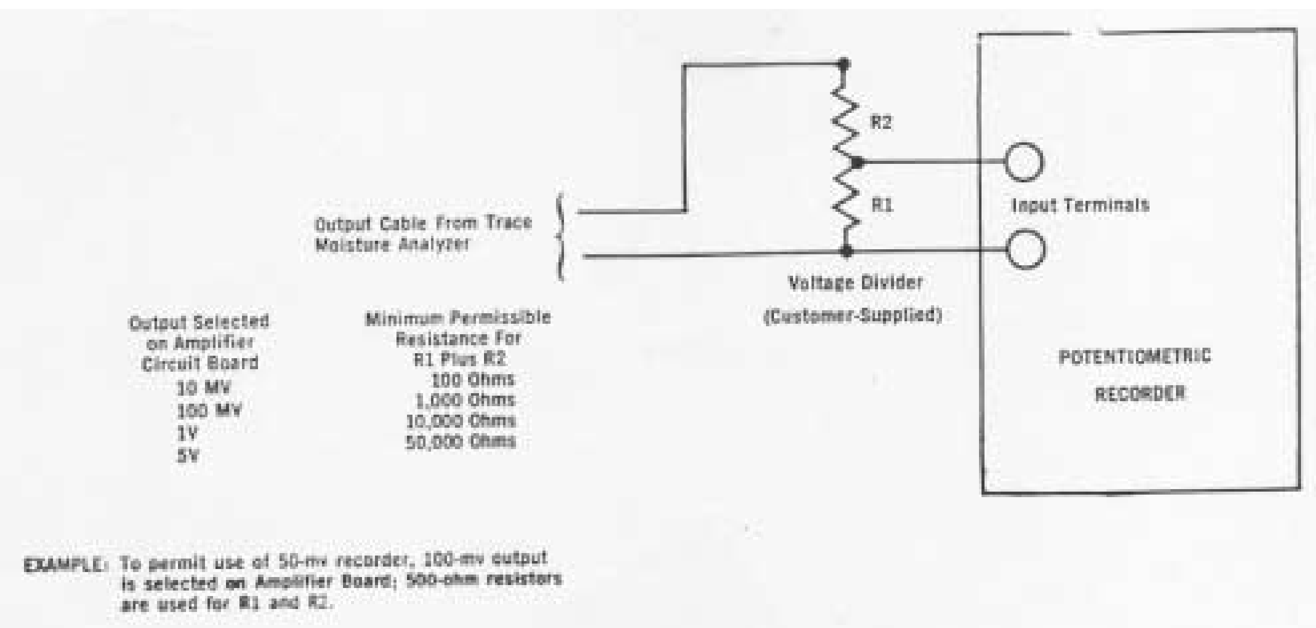


FIGURE 2-5. CONNECTIONS FOR POTENTIOMETRIC RECORDER WITH INTERMEDIATE SPAN

2.3.2 OUTPUT SELECTION AND CABLE CONNECTIONS FOR CURRENT RECORDER (AC ANALYZERS ONLY)

To use a current recorder:

1. Connect appropriate leads of shielded recorder cable to CUR. REC. and "-" terminals, and SHLD terminal, on output terminal strip. For location of terminal strip, refer to appropriate illustration of Figures 2-1 through 2-4.

2. Connect recorder end of output cable to recorder input terminals, making sure polarity is correct.

Note:

Combined resistance of recorder and associated interconnection cable must not exceed value in following table.

Recorder Span (ma)	Maximum Permissible Load (ohms)
0 to 5	800
1 to 5	8000
4 to 20	2000
10 to 50	700

3. At multi-pin receptacle on amplifier circuit board, A of Figure 2-3, insert shorting plug between pair of pins designated YES in area marked CUR. BD. YES/NO. (This connection routes amplifier output signal through current output board.)

4. Verify that current output board is properly in place in its connector.

5. On current output board, B of Figure 2-3, insert two plugs in their receptacle, in the position appropriate to the desired recorder:

   a. Live Zero/Dead Zero Selector: For 0 to 5 mA recorder, orient plug so its arrow points to end of receptacle labeled DEAD. For 1 to 5, 4 to 20, or 10 to 50 ma recorder, orient plug so arrow points to end labeled LIVE.

   b. Recorder Milliampere Selector: Orient plug so that the side with the labeled designation corresponding to the desired ma current range faces outward, and covers the REC MA label on the current output board. Sides of plug are labeled 0-5, 1 -5, 4-20, and 10-50.

2.3.3 ALARM OUTPUT CONNECTION AND ALARM FUNCTION SELECTION (OPTIONAL, FOR PANEL MOUNTED ANALYZERS ONLY)

The optional Alarm Setpoint Accessory and Universal Alarm Board are used in combination to provide an alarm output that actuates an external, customer supplied alarm and, or process control device whenever the water vapor concentration of the sample stream exceeds a pre-selected level.

If so specified, the analyzer is factory assembled to include the Alarm Setpoint Accessory and Universal Alarm Board. Alternatively, these two items are obtainable in the form of the 630695 Alarm Kit, intended for subsequent installation in an analyzer not originally equipped with alarm function.

Setup procedure for alarm systems is described in the following steps. If internal alarm components have been installed previously in the analyzer, proceed directly to Step 4; otherwise, first perform Steps 1 through 3.

1. Mount Alarm Setpoint Accessory in cutout in analyzer door. Refer to appropriate illustration of Figures 1-1 through 1-3.

2. Refer to Figure 2-3. At receptacle 15 remove shorting plug; insert plug P5 of multi-conductor cable from Alarm Setpoint Accessory.

3. Insert Universal Alarm Board into corresponding connector. Refer to appropriate illustration of Figures 2-1 through 2-3.

4. Connect input leads from external alarm system to ALARM OUTPUT terminals on terminal strip TB1. For location of terminal strip, refer to appropriate illustration of Figures 2-1 through 2-3.

5. At multi-pin receptacle on universal alarm board, Figure 2-4, insert the function jumper in the position appropriate to the desired alarm function.

   a. If ALARM OUTPUT terminals are to provide a normally open circuit, place jumper El in the A, B position. The ALARM OUTPUT circuit will now close when water vapor content exceeds pre-selected level.

   b. If ALARM OUTPUT terminals are to provide a normally closed circuit (as in a fail-safe system), insert jumper El in the C, D position. The ALARM OUTPUT circuit will now open when water vapor content exceeds the pre-selected level

Note:

In Trace Moisture Analyzers, the LOW N.O. and LOW N.C. positions are normally not used.

Select on of the desired alarm set point is explained in Section 3.4.

2.3.4 SETTING THE DEADBAND

The desired deadband may be set with the appropriate adjustment of R4 on the Universal Alarm Board (Figure 2-4). The deadband may be adjusted from 2% of fullscale (counterclockwise limit) to 10% of fullscale (clockwise limit).

2.3.5 ELECTRICAL INTERCONNECTION FOR EXPLOSION PROOF ANALYZER

Interconnect detector and control modules as shown in Drawing 194759. The P/N 835495 Interconnection Cable is supplied, as ordered, in any desired length up to a maximum of 1000 feet (305 M).

Within the detector module, a user supplied 14 gauge ground lead must be connected to the marked ground terminal and securely attached to a suitable earth ground.

CAUTION

The explosion proof detector module must be wired in accordance with the requirements of the National Electrical Code (NEC) (NFPA No. 70) for Class 1, Group D, Division 1 hazardous locations, especially Sections 501 -4 and 501 -5, and any other applicable national and/or local codes.

2.3.6 ELECTRICAL POWER CONNECTION

WARNING: ELECTRICAL SHOCK HAZARD

For safety and proper performance AC instruments must be connected to a properly grounded three wire source of electrical power.

AC Analyzers. Connect to an AC source of 107 to 127 volts, either 60 ±0.5 Hz or 50 ±0.5 Hz Panel mounted instruments require field wiring by installer. Portable AC analyzer has integral North American 3 prong power cord. If power outlet does not have third (ground) contact, use an adapter to provide proper grounding.

Portable DC Analyzer. Insert battery pack in place.

2.4 SAMPLE CONNECTIONS AND SAMPLE HANDLING RECOMMENDATIONS

Locations of sample inlet and outlet ports in the various analyzer configurations are shown in the engineering drawings located at the back of the manual. All analyzers have 1/8 inch bulkhead, compression type tubing fittings.

A suitable gas handling system is required to deliver sample to the analyzer at the proper pressure and flow rate. Acceptable sample pressure range for the standard analyzer is 10 to 100 psig. A sample pressure outside this range necessitates installation of an appropriate accessory. Refer to Table 2-1.

Although installation of a sampling system is essentially straightforward, problems resulting from an improperly designed system can have a highly adverse effect on analyzer performance. Therefore, special care in planning the installation is required to ensure maximum reliability and accuracy.

In designing a sample system, refer to the following general rules, which are applicable to all installations and all analyzer configurations.

1. Use of stainless steel tubing throughout is strongly recommended. Its smooth walls and passive surfaces minimize moisture adsorption. Other metals, and plastics, increase system response time and decrease accuracy. Some plastics are entirely unsatisfactory, because of permeability to water vapor.

2. Tubing and other components in contact with sample must be scrupulously clean. Dirt and oil absorb water. Recommended cleaning procedure for tubing is as follows:

   a. Wash with acetone.

   b. Pass cleaning solution (10% nitric acid and 5% hydrofluoric acid in aqueous solution) through tubing until effluent is essentially colorless.

   c. Rinse with water and then with acetone.

   d. Purge with clean, dry, nitrogen or air.

3. Minimize internal surface area of sample system by using minimum length, minimum diameter lines. Generally, 1/8 inch o.d. tubing is recommended.

4. Provide high velocity sample flow. Where pressure reduction is required before sample enters the instrument, an important factory is to locate the pressure regulator as near the process stream as possible.

5. Use minimum number of valves and fittings, each is a potential source of leaks.

6. Select components for minimum leakage and moisture absorption. With pressure regulators: (a) advise manufacturer of extreme low leakage requirements, (b) choose units with metallic, not elastomeric, diaphragms. Use packless valves wherever

possible. Where pipe fittings are required, seal with Teflon tape, not pipe thread compound.

7. Avoid dead ended passages, voids, and blind holes. They permit accumulation of stagnant gases, resulting in sluggish system response.

2.5 PURGE CONNECTIONS AND REQUIREMENTS

If required for safety, the detector and/or control section(s) of any non-portable instrument except the Explosion Proof Analyzer may be purged with clean, dry air or suitable inert gas. For locations of purge fittings, refer to the Outline and Mounting Dimension Drawings located at the back of the manual.

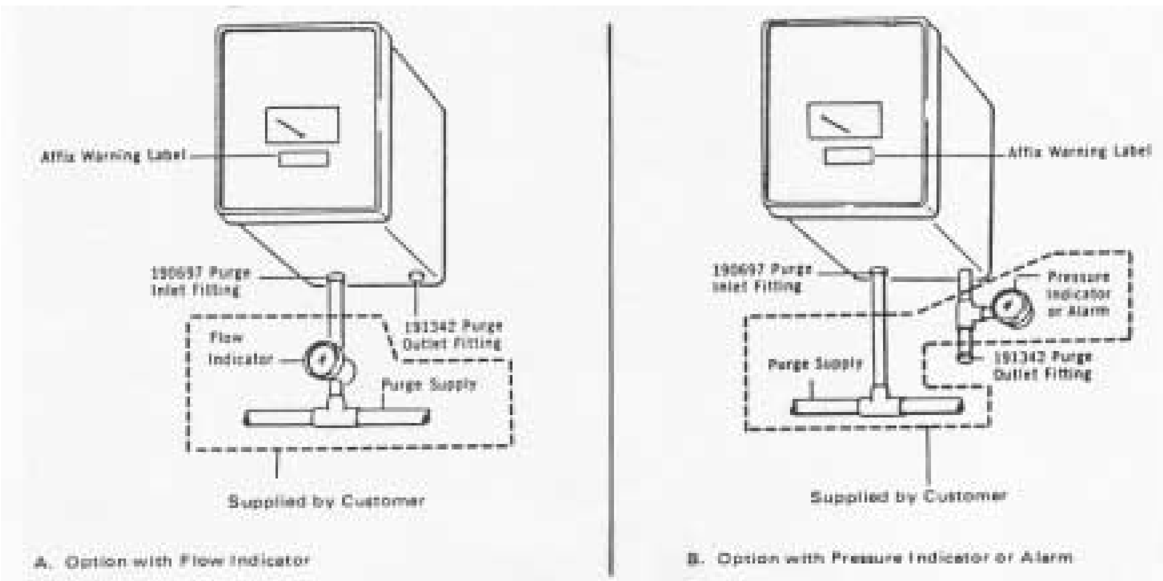


FIGURE 2-6. INSTALLATION OF PURGE KIT

If equipped with P/N 191343 optional air purge kit and installed with user provided components per these instructions, the analyzer may be located in a Class 1, Division 2 area as defined by the National Electrical Code (ANSI/NFPA 70). This kit is designed to provide Type Z protection in accordance with Standard ANSI/NFPA 496-1986, Chapter 2, when sampling nonflammable gases. For flammable samples the analyzer must be equipped with a continuous dilution purge system in accordance with ANSI/NFPA 496-1986 Chapter 8 or IEC Publication 79-2 (1983) Section Three. Consult factory for recommendations on sample flow limitations and minimum purge flow requirements. This kit consists of the following items:

PART NUMBER	DESCRIPTION
190697	Purge Inlet Fitting
191342	Purge Outlet Fitting
082787	Warning Label
856156	Sealant

Installation options are shown in Figure 2-6. Use only clean, dry, air or suitable inert gas for the purge supply. Recommended supply pressure is 20 psig., which provides a flow of approximately 4 liters per minute (8.4 cfh), and a case pressure of approximately 0.2 inch H20 (50 Pa). With a flow rate of 4 liters per minute, four case volumes of purge gas pass through the instrument case in ten minutes.

All conduit connections through the instrument case must be sealed thoroughly with a suitable sealant. The sealant, to be applied from the interior of the case, must thoroughly cover all exiting leads as well as the conduit fitting.

Note:

The warning label must be attached by the user in order to conform to requirements of the standard.

SAMPLE PRESSURE	ACCESSORY DEVICE
10 inches Hg vacuum to + 10 psig	Low Pressure Sampling Accessory (630600 Accessory, for 60 Hz operation; or 630601 Accessory, for 50 Hz operation)
10 to 100 psig	None required.
100 to 2500 psig	A suitable pressure reducing regulator.

TABLE 2-1. ACCESSORY DEVICES FOR SAMPLE PRESSURE RANGES

NOTES

3 OPERATING CONTROLS AND INDICATORS

Preparatory to startup and operation, it is recommended that the operator familiarize himself with the instrument controls, described in the following Sections.

All Trace Moisture Analyzers incorporate similar operating controls; however, locations of these controls differ in the various instrument configurations. Refer to appropriate illustration of Figures 3-1 through 3-4.

3.1 RANGE SELECTOR SWITCH AND METER

The Range Selector Switch provides a choice of five operating ranges: 1000, 500, 100, 50 or 10 ppm. Range designations signify the value of a fullscale meter reading, in parts per million of water by volume (v/v). The meter scale is calibrated from 0 to 100%.

The STDBY position deactivates instrument readout, but maintains the electronic circuitry in energized condition, permitting immediate resumption of operation when Range Switch is turned to a numbered position. In standby mode, current flows continuously through the electrolytic cell to keep it dry.

At all times when sample gas is flowing through the cell, electrical power should be on and Range Selector Switch should be at either a numbered position or the STDBY position. Unless an electrical current is drying the cell, a prolonged flow of wet sample gas could wash the desiccant coating from the cell electrodes.

The OFF position removes electrical power from all circuits. Normally, this switch position is used only during instrument servicing, and then but briefly.

3.2 SAMPLE FLOW CONTROL VALVE AND SAMPLE FLOWMETER

The Sample Flow Control Valve is provided in all instruments.

CAUTION: SAMPLE FLOW CONTROL VALVE

To avoid damage to valve stem and seat, never over-tighten Sample Flow Control 'Valve.

The Sample Flowmeter is a standard feature in all panel mount instruments. For use with portable instruments, the Sample Flowmeter is incorporated into the optional Flowmeter Accessory.

The Sample Flow Control Valve adjusts the flow of sample gas through the electrolytic cell. The Sample Flowmeter indicates resultant nominal flow. Refer to Section 4.3.

3.3 BYPASS FLOW CONTROL VALVE AND BYPASS FLOWMETER

The Bypass Flow Control Valve and Bypass Flowmeter are standard features of all panel mount instruments. For use with portable instruments, these two items are incorporated into the optional Flowmeter Accessory.

The valve adjusts the bypass flow. Resultant flow rate is indicated by the flowmeter. Bypass flow is adjustable from 0 to 2 cubic feet per hour (approximately 940 cc/min). Increasing the bypass flow decreases system response time.

3.4 CONTROLS OF ALARM SETPOINT ACCESSORY (PANEL MOUNT ANALYZERS ONLY)

The Alarm Setpoint Accessory is used, in combination with the Universal Alarm Board, to actuate various alarm and, or, control systems.

Initially, the Alarm Setpoint Switch is turned to position A, causing the meter to display the alarm setpoint. Then, Setpoint Adjustment A is turned with a screwdriver to obtain the desired meter reading. Afterward, the Alarm Setpoint Switch is turned to OPERATE. During subsequent operation, if the water vapor concentration of the sample stream exceeds the selected level, the alarm circuit will actuate the external alarm system.

Note:

In Trace Moisture Analyzers, position B of the Alarm Setpoint Switch, and Setpoint Adjustment 8, are inoperative.

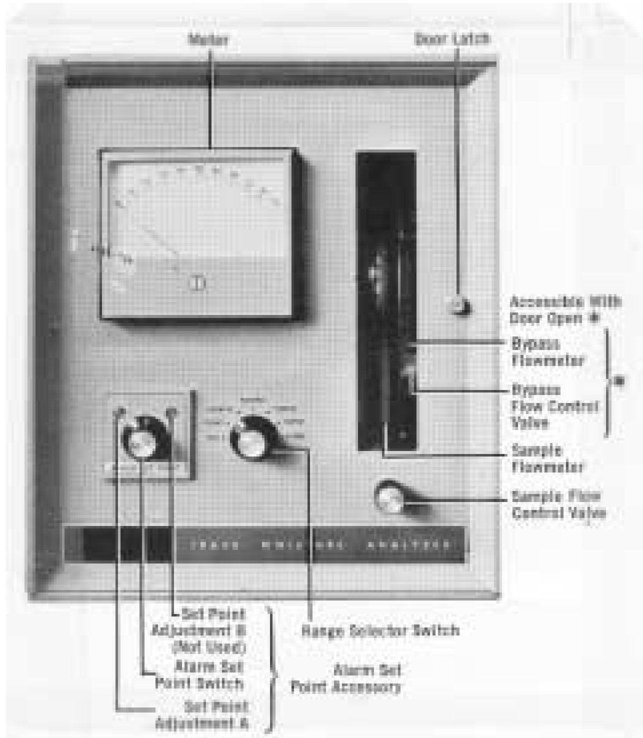
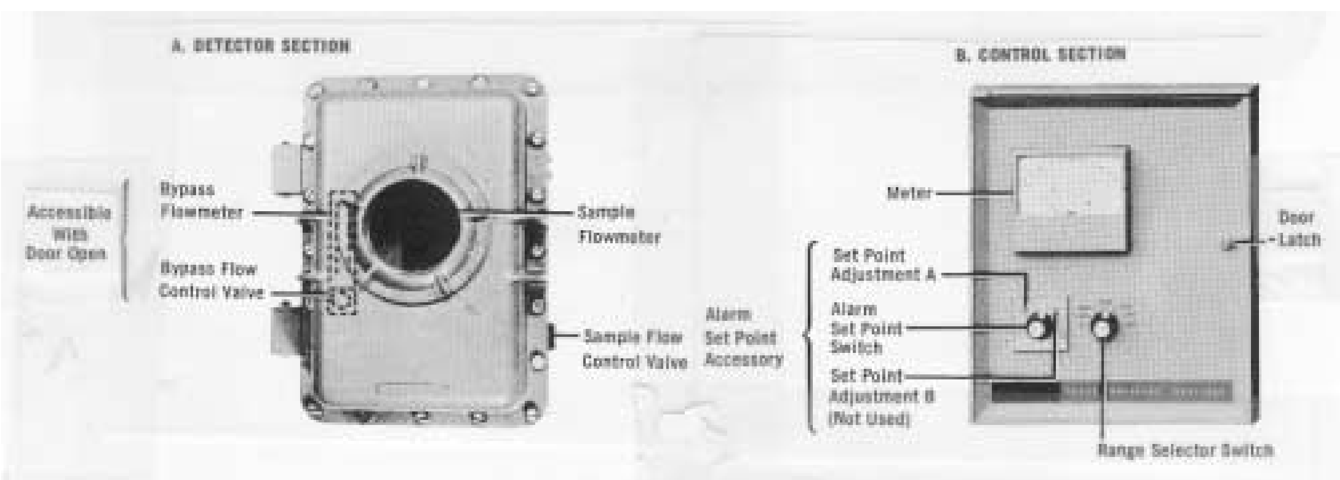


FIGURE 3-1. OPERATING CONTROLS OF PANEL MOUNT ANALYZER



NOTE: THIS INSTRUMENT IS NO LONGER AVAILABLE - CONSULT FACTORY

FIGURE 3-2. OPERATING CONTROLS OF THE EXPLOSION PROOF ANALYZER

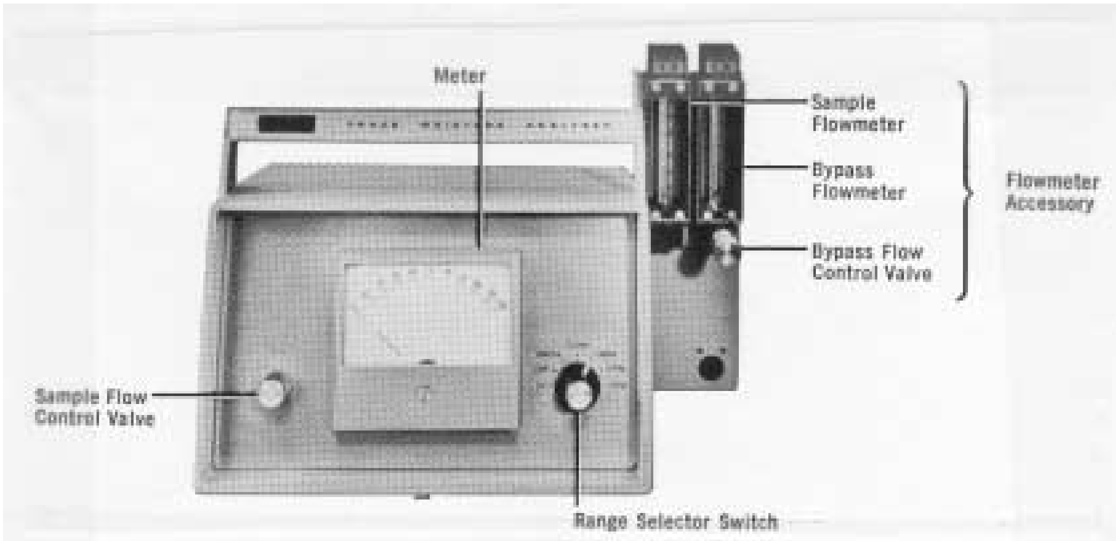


FIGURE 3-3. OPERATING CONTROLS OF THE PORTABLE ANALYZER AND FLOWMETER ACCESSORY

4 STARTUP PROCEDURE – SYSTEMS UTILIZING PRESSURIZED SAMPLE GAS

DANGER: POSSIBLE EXPLOSION HAZARD

This analyzer is of the type capable of analysis of sample gases which may be flammable. If used for analysis of such gases, the detection section of the analyzer must be either in an explosion proof enclosure suitable for the hazard classification of the gas, or, protected by a continuous dilution purge system in accordance with Standard ANSI/NFPA-496-1986 (Chapter 8) or IEC Publication 79-2-1983 (Section Three).

If explosive gases are introduced into this analyzer, the sample containment system must be carefully leak checked upon installation and before initial startup, during routine maintenance and any time the integrity of the sample containment system is broken, to ensure that the system is in leak proof condition. Leak check instructions are provided in Section 4.2.

Internal leaks resulting from failure to observe these precautions could result in an explosion causing death, personal injury or property damage.

Note:

If the instrument does not function properly during startup and calibration procedure, use the tests and adjustments described in Section 9, Service.

This section is applicable to all analysis systems except those utilizing the Low Pressure Sampling Accessory. If this accessory is used, refer to Section Five.

Before attempting operation, complete the following procedures, in the sequence given.

1. Initial dry-down, Section 4.1
2. System leak check, Section 4.2.
3. Instrument calibration, by appropriate procedure of Section 4.3.

4.1 INITIAL DRY-DOWN

CAUTION: ELECTROLYTIC CELL DAMAGE

To avoid damaging the electrolytic cell, read the following instructions before beginning the dry-down procedure.

1. Before supplying gas to sample inlet, close Sample Flow Control Valve, but do not over-tighten. Turn Range Selector Switch to STDBY. Current will now flow through electrolytic cell, thus drying it.

2. Dry down the sample line and other elements of the sample handling system as follows:

   a. Supply purging gas to sample inlet at a pressure of between 10 and 100 psig. Use of dry inert gas such as bottled nitrogen is recommended, particularly if sample contains corrosive or reactive components such as chlorine, hydrogen chloride, hydrogen sulfide, hydrogen, oxygen or unsaturated hydrocarbons. However, if sample stream consists of an non-reactive substance such as nitrogen, argon, helium, freon, methane, etc, use of bottled inert gas is unnecessary; the sample stream itself may be used as the purge gas.

   b. Establish a considerable bypass flow (2 cfh if sufficient gas is available). With panel mounted analyzer (or portable analyzer utilizing bypass feature of Flowmeter Accessory) bypass is initiated by opening the Bypass Flow Control Valve. Purge system for several hours.

3. Check dry-down of electrolytic cell by turning Range Selector Switch to 1000 ppm position; meter should read on-scale. As cell dries down, turn Range Selector Switch to successively lower numbered positions, always keeping the meter on-scale. Continue until meter reads on-scale on desired operating range.

4. Check dry-down of the sample handling system as follows:

   a. Slightly open the Sample Flow Control Valve to obtain a comparatively low flow; i.e., about 20 cc/min as indicated by Sample Flowmeter (or other flow measuring device used with portable analyzer).

   b. Turn Range Selector Switch to 1000 ppm; meter should read on-scale.

   When meter reads on-scale on 1000 ppm range, turn Range Selector Switch to successively lower numbered positions, always keeping the meter on-scale. Continue until meter reads on-scale on desired operating range.

CAUTION: ELECTROLYTIC CELL DAMAGE

If meter goes off-scale on 1000 ppm range, sample handling system is insufficiently purged. To avoid damaging the electrolytic cell, close Sample Flow Control Valve and continue the purging procedure of Step 2.

5. Prepare for sample monitoring as follows:

    a. Return Range Selector Switch to 1000 ppm.

    b. Pass sample gas through instrument, if a different purge gas has been used during dry-down.

    c. Set Sample Flow Control Valve for flow of approximately 1000 cc/min, as indicated by Sample Flowmeter (or other auxiliary flow measuring device used with portable analyzer). Exact flow required for accurate readout will be determined subsequently, as explained in Section 4.3.

    d. Turn Range Selector Switch to successively lower numbered positions, always keeping meter on-scale, until meter reads on-scale on desired operating range.

At levels below 10 ppm, a longer period of time is required to reach a constant reading. This is due to the need to establish an equilibrium between the low level of moisture being measured and the sample line components in contact with the sample. To demonstrate this, apply a heat gun to the incoming sample line and observe the moisture change. This procedure can also be used to accelerate the dry-down time of a "wet" sampling system.

When monitoring gas cylinders or in other non-continuous sampling, use of a nitrogen purged manifold to keep the amount of sample line exposed to ambient air as small as possible will help reduce dry-down time.

4.2 SYSTEM LEAK CHECK

An essential part of startup is elimination of even the smallest leaks from the sample handling system, both internal and external to analyzer. Note that water vapor will diffuse through a leak into a high pressure gas system even though the overall gas flow is outward from the system. Movement of moisture through the leak is determined by the difference in water vapor partial pressure across the leak, not the total pressure differential.

Small, hard to detect leaks are generally more troublesome than gross leaks; gas from a large leak tends to sweep away humid air from the vicinity and provide a surrounding blanket of sample gas. However, no leakage should be tolerated. Leak detection and elimination can be time consuming and frustrating. To minimize expenditure of time, use either or both of the following leak check procedures.

4.2.1 SOAP SOLUTION OR SNOOP METHOD

To test for leakage:

1. Connect sample handling system to sample source and to Trace Moisture Analyzer. Sampling system should utilize a packless block valve for connection to the source, and will probably incorporate a pressure regulator and/or a relief valve.

2. Adjust sample pressure to a value slightly below the setting of the pressure relief valve (if provided) or to about 50 psig (350 kPa) (if relief valve not provided).

3. Close Sample and Bypass Flow Control Valves on Trace Moisture Analyzer.

4. Apply soap solution or SNOOP (P/N 837801) to all fittings and connections. Tighten any

5. fittings where leakage is evident by bubbling or foaming.

4.2.2 VARIABLE BYPASS METHOD

The following alternative or supplemental leak test is applicable to all panel mounted analyzers, and also to portable analyzers that utilize the bypass feature of the Flowmeter Accessory. Usually, leakage from a given source into the sample system is relatively constant. Thus, leakage may be detected by varying the bypass flow rate while maintaining a constant sample flow rate through the electrolytic cell. For example, assume the sample stream has a given moisture level, and that a leak passes a small, constant flow of water vapor into the sample system. With a high bypass flow, a large percentage of the water entering the system through the leak passes through the bypass flowmeter to vent, and does not go through the electrolytic cell. If the bypass flow rate is reduced, however, a greater amount of the water vapor that leaks into the system is carried through the cell. Consequently, indicated moisture level is higher with a low bypass flow rate than with a high bypass flow rate.

Thus, the criterion for absence of leakage in the system is that indicated moisture level must be independent of bypass flow rate. After each change of bypass flow rate, allow sufficient time for the sample system to equilibrate before reading the meter.

4.3 INSTRUMENT CALIBRATION

Trace Moisture Analyzers are calibrated for direct readout in ppm H_2O by volume, based on a sample flow of 100 cc/min at 70°F (21°C) and 14.7 psia (760 mm Hg). If sample conditions are other than those stated, appropriate corrections must be made.

Nominal flowmeter setting required for air sample gas under the specified conditions is 100. Compensation for the particular sample gas and, or, barometric pressure is made by using an appropriately chosen flowmeter setting, which may offer considerably from the nominal value of 100. If great accuracy is not required, the flowmeter setting required may be computed as explained in Sections 4.3.1 and 4.3.2. For utmost accuracy, however, the flowmeter should be calibrated experimentally, as explained in Section 4.3.3.

Temperature corrections, (applicable to portable analyzers only), are explained in Section 4.3.3.

4.3.1 COMPUTATION OF SAMPLE FLOWMETER SETTINGS

Typical sample flowmeter settings required for various gases at a pressure of 14.7 psia (760 mm Hg, normal value at sea level) are listed in Table 4-1.

SAMPLE GAS	FLOWMETER SETTING (CC/MIN)
Air	100
Argon	127
Carbon Dioxide	86
Hydrogen	46
Helium	103
Nitrogen	97
Oxygen	115
Methane	61
Propane	52
Butane	49
Sulfur Hexafluoride	100
Natural Gas	60

Values are flowmeter readings corresponding to 100 cc/min flows of the gases listed, with sample outlet vented to atmospheric pressure at sea level (14.7 psia). Values are applicable only to Brooks flowmeters, These values were determined experimentally, on a single flowmeter. For greatest accuracy, proper setting for the individual flowmeter should be determined experimentally, by the most appropriate method of Section 4.3.3.

TABLE 4-1. TYPICAL SETTINGS FOR SAMPLE FLOWMETER

ELEVATION ABOVE SEA LEVEL (FEET)	NORMAL BAROMETRIC PRESSURE		
	PSIA	MM OF MERCURY	INCHES OF MERCURY
0	14.7	760	30.0
350	14.5	750	29.5
700	14.3	740	29.2
1050	14.1	730	28.9
1400	13.9	720	28.4
1750	13.7	710	28.0
2100	13.5	700	27.5
2450	13.3	690	27.2
2800	13.2	680	26.8
3200	13.0	670	26.4
3600	12.8	660	26.1
4000	12.6	650	25.7
4400	12.4	640	25.3
4800	12.2	630	24.9
5200	12.0	620	24.5
5600	11.8	610	24.1
6050	11.6	600	23.7
6500	11.4	590	23.3
6920	11.2	580	22.9
7410	11.0	570	22.5
7900	10.8	560	22.1

TABLE 4-2. NORMAL BAROMETRIC PRESSURES FOR VARIOUS ELEVATIONS

For gases not listed in Table 4-1, the approximate flowmeter setting required under standard conditions may be computed from the following equation:

$$FS_{sample} = FS_{air} \quad \frac{V_{sample}}{V_{air}}$$

Where: FS_{sample} = flowmeter setting for sample gas

FS_{air} = flowmeter setting for air (nominal value is 100)

V_{sample} = viscosity of sample gas

V_{air} = viscosity of air

Viscosity values are determined from handbook data; units must be the same for both air and sample gas.

Example: Sample gas is hydrogen, viscosity 90 micropoise at 25°C; viscosity of air at this temperature is 182 micropoise.

$$FS_{sample} = 100 \times \frac{90}{182} = 49.5$$

4.3.2 PRESSURE (ELEVATION) CORRECTIONS TO COMPUTED FLOWMETER VALUES

The sample flowmeter is factory calibrated at sea level, with outlet end vented to atmospheric pressure (14.7 psia). At elevations appreciably above sea level, the flowmeter setting must be changed appropriately to compensate for reduced barometric pressure. The required sample flowmeter setting may be determined from the following equation:

$$FS_{op} = FS_{cal} \times \frac{14.7 \text{ psia}}{\text{barometric pressure at instrument}}$$

Where: FS_{op} = sample flowmeter setting required for operation

FS_{cal} = sample flowmeter setting during calibration as determined from Table 4-1, computed from the equation of Section 4.3.1

If actual barometric pressure at the installation site is not known, use Table 4-2 to determine normal barometric pressure at the elevation involved.

The following example will clarify use of the equation.

Example: What flowmeter setting is required for carbon dioxide sample gas in an instrument at an elevation of 4000 feet?

Solution: From Table 4-1, flowmeter setting required for CO_2 at sea level is 86. Therefore,

$$\text{setting for 4000 feet} = 86 \times \frac{14.7}{12.6} = 100.3$$

4.3.3 EXPERIMENTAL CALIBRATION OF SAMPLE FLOWMETER

For utmost accuracy, the sample flowmeter should be calibrated experimentally, at the installation site, with the particular sample gas. Such calibration compensates automatically for effects of sample gas and barometric pressure. Alternative methods are the following:

Liquid Displacement

This method is suitable for all sample streams except those containing water soluble gases, such as SO_2 or CO_2. A graduated cylinder filled with water is inverted into a beaker of water. Gas from the instrument outlet is brought by hose to the bottom of the cylinder. The time required to displace a given quantity of water from the cylinder is a measurement of the flow rate. (An error, negligible for most applications, is introduced by the pressure of the water column in the cylinder and by the small amount of sample gas that dissolves in the water.)

Soap Bubble Flow Measurement

This method is suitable for all sample streams except those containing water soluble gases or hydrogen (which diffuses through the soap film). The method requires use of a 50 cc laboratory burette, preferably fitted with a 3-way stop cock.

The detergent or solution will move up the burette in a series of flat film disks, ultimately traveling about 1/2 to 1 inch apart. With a stopwatch, time one of these "plates" as it passes the initial 50 cc mark and ascends to the 0 cc graduation. Repeat the procedure until reproducibility is satisfactory. Back pressure is insignificant, and corrections for atmospheric pressure and temperature usually are not necessary.

4.3.4 TEMPERATURE CORRECTIONS (PORTABLE ANALYZERS ONLY)

Operation of portable analyzers at temperatures above or below 70°F results in a readout error. Factors involved are the gas law influence and the effect on the flowmeter.

It is desired to correct for temperature effects, take all meter readings with sample flowmeter set at the correct value for operation at 80°F. Then, algebraically add the following correction to each meter reading.

Correction = 0.003 x (actual reading) x (actual temperature, °F - 70)

Example 1: Meter reads 50 ppm at 90°F
Required correction = 0.003 x 50 x (90-70) = + 3 ppm
Corrected reading = 50 + 3 = 53 ppm

Example 2: Meter reads 100 ppm at 50°F
Required correction = 0.003 x 100 x (50-70) = 6 ppm
Corrected reading = 100 - 6 = 94 ppm

5 STARTUP PROCEDURE – SYSTEMS UTILIZING THE LOW PRESSURE SAMPLING ACCESSORY

Note:

If the instrument does not function properly during startup and calibration procedure, use the tests and adjustments described in Section Nine, Service.

The Low Pressure Sampling Accessory permits use of a Model 340 Trace Moisture Analyzer to monitor gas sources at reduced pressures ranging from 10 inches of mercury vacuum to + 10 psig. Typical applications include measuring moisture concentrations in blanketing gases and in dry boxes.

The accessory is available in two versions: 630600 Accessory for 115 VAC, 60 Hz operation; and 630601 Accessory for 115 VAC, 50 Hz operation. They differ only in the electrical frequency requirement.

Normally, startup and operation of a low pressure trace moisture analysis system entail use of two different interconnection configurations, in turn.

1. Preparatory to initial operation, the system is temporarily connected as shown in A of Figure 5-1, to obtain an exact, experimental calibration of the Sample Flowmeter in the Trace Moisture Analyzer. In this configuration, the accessory supplies pressurized sample to the analyzer inlet.
2. For subsequent normal operation, the system is connected as shown in B of Figure 5-1. In this configuration, the accessory applies a vacuum to the analyzer outlet, thus establishing a pressure differential which causes sample to enter the analyzer inlet.

To set up the analysis system for operation, perform the procedures described in the following Sections, in the sequence given.

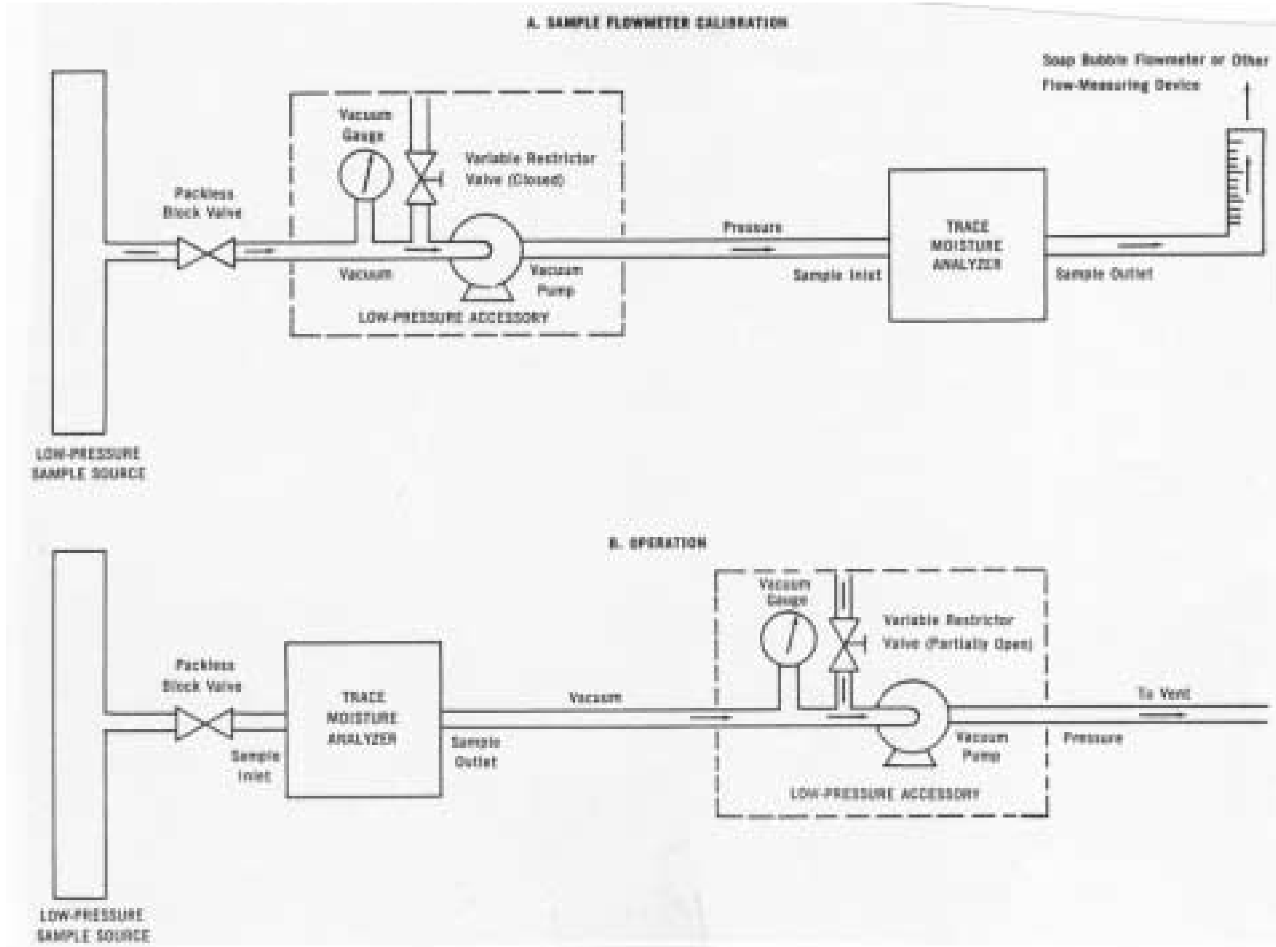


FIGURE 5-1. INTERCONNECTION OF LOW PRESSURE ANALYSIS SYSTEM

5.1 CALIBRATION PROCEDURE FOR SAMPLE FLOWMETER OF TRACE MOISTURE ANALYZER

To permit computation of the correct flowmeter setting required for low pressure operation, it is necessary first to determine the setting required for a flow of 100 cc/min of the particular gas, with flowmeter outlet vented to atmospheric pressure. The latter value is listed, for various pure gases, in Table 4-1 . Generally, these data are accurate to better than ± 10 %. If greater accuracy is desired, or if the application involves a sample gas of unknown characteristics, the Sample Flowmeter should be calibrated experimentally, as explained in the following steps.

1. Connect Trace Moisture Analyzer, Low Pressure Accessory, and soap bubble flowmeter (or other accurate flow measuring device) in calibration configuration, A of Figure 5-1. Sample Flowmeter of analyzer now discharges to atmospheric pressure.

2. On Trace Moisture Analyzer, turn Range Selector Switch to STDBY; fully close Sample Flow Control Valve; fully open Bypass Flow Control Valve (if provided).

Note:

At all times when gas is flowing through the analyzer, electrical power should be on, and Range Selector Switch should be at either STDBY or a numbered position. This precaution protects the electrolytic cell from possible overloading with excessive I moisture.

3. Adjust controls on Low Pressure Accessory as follows:

   a. Fully open Variable Restrictor Valve.

   b. Start vacuum pump.

   c. Close Variable Restrictor Valve.

4. Adjust controls on Trace Moisture Analyzer as follows:

   a. Adjust Sample Flow Control Valve so Sample Flowmeter reads approximately 100.

   b. Close Bypass Flow Control Valve.

   c. Readjust Sample Flow Control Valve so Sample Flowmeter gain reads approximately 100.

   d. Measure actual flow rate with soap bubble flowmeter, or by gas or liquid displacement (Section 4.3.3). On basis of the result obtained, readjust Sample Flow Control Valve to obtain actual flow of approximately 100 cc/min. Such trial and error adjustment can be continued until an exact flow of 100 cc/min is obtained; however, this approach can be time consuming. Therefore, a suggested alternative method is to measure the flow at several different settings on the Sample Flowmeter. Plot a curve of actual flow values versus Sample Flowmeter settings. Interpolation on this curve will indicate the Sample Flowmeter setting required for a sample flow of 100 cc/min.

5. Turn off vacuum pump.

CAUTION: PUMP DAMAGE

Do not run vacuum pump longer than is required to obtain flowmeter calibration. Prolonged operation under these conditions may damage pump.

6. Connect Trace Moisture Analyzer and Low Pressure Accessory in normal operating configuration, B of Figure 5-1. Hereafter, system will remain in this configuration unless recheck of flowmeter calibration is desired.

5.2 OPERATING PARAMETER SELECTION

Proper operation of the low pressure analysis system is dependent on selection of a compatible combination of readings on: (1) the Vacuum Gauge of the Low Pressure Accessory, and (2) the Sample Flowmeter of the Trace Moisture Analyzer. The following Sections explain selection of these parameters.

5.2.1 VACUUM READING

Within the Trace Moisture Analyzer, the Sample Flowmeter discharges directly to the sample outlet, (as shown in Figure 7-1). Therefore, during the flow measurement procedure of Section 5.1, the Sample Flowmeter discharged to atmospheric pressure as shown in A of Figure 5-1.

During subsequent operation, the Sample Flowmeter will discharge into a vacuum, indicated on the gauge of the Low Pressure Accessory, as shown in B of Figure 5-1. The vacuum is adjustable via various valves in the system. Proper vacuum reading depends on sample supply pressure. Basic consideration is that the pressure differential must be sufficient to ensure adequate sample and bypass flows through the analyzer. Commonly, a vacuum of 10 inches Hg is used, at least for initial trial operation.

5.2.2 SAMPLE FLOWMETER SETTING

Model 340 Trace Moisture Analyzers are factory calibrated for direct readout in ppm H20 by volume, based on a sample gas flow of 100 cc/min at a pressure of 30 inches of mercury (normal barometric pressure at sea level). Compensation for the particular operating pressure is made through use of an appropriately chosen setting for the Sample Flowmeter. Compute the proper operating setting from the following equation.

$$FS_{op} = FS_{atm} \times \frac{P_{atm}}{P_{atm} - P_{vg}}$$

Where:

FS_{op} = Required reading on Sample Flowmeter for normal operation (with reading of P_{vg} on vacuum gauge of Low Pressure Accessory).

FS_{atm} = Reading obtained on Sample Flowmeter, during calibration, with actual sample flow of 100 cc/min discharged to atmospheric pressure.

P_{atm} = Absolute atmospheric pressure, in inches of mercury. For maximum accuracy, use the actual barometric pressure at the installation site. If this value is not known, use Table 4-2 to determine the normal barometric pressure at the particular elevation.

P_{vg} = Reading on vacuum gauge of Low Pressure Accessory during normal operation.

Example:

At a sea level installation, an instrument system is connected in the calibration configuration, A of Figure 5-1. With the particular sample gas flowing, the soap bubble flowmeter indicates an actual flow of 100 cc/min discharged to atmospheric pressure, while the Sample Flowmeter in the analyzer reads 85.

The system is now connected in the operating configuration, B of Figure 5-1. What is the required reading on the Sample Flowmeter?

Solution: FS_{atm} = 85

P_{atm} = 30 in. Hg. (normal value at sea level)

P_{vg} = 10 in. Hg.

Substituting these values in the equation,

$$FS_{op} = 85 \times \frac{30}{(30 - 10)} = 128$$

5.3 SETUP FOR NORMAL OPERATION

With Trace Moisture Analyzer and Low Pressure Accessory connected in normal operating configuration, B of Figure 5-1, proceed as follows:

1. Set controls on Trace Moisture Analyzer as follows:

CONTROL	POSITION
Range Selector Switch	STDBY
Sample Flow Control Valve	FULLY CLOSED
Bypass Flow Control Valve	FULLY CLOSED

2. Adjust controls on Low Pressure Accessory as follows:

   a. Fully open Variable Restrictor Valve.

   b. Start vacuum pump.

   c. Adjust Variable Restrictor Valve for reading of 10 inches Hg (or other selected value) on Vacuum Gauge.

3. On Trace Moisture Analyzer, open Bypass Flow Control Valve until ball Bypass Flowmeter is within the upper third of the flowmeter tube, but not against the upper stop. Before proceeding further, allow instrument to dry down for at least one hour, and preferably for several hours.

4. On Trace Moisture Analyzer, open Sample Flow Control Valve until Sample Flowmeter indicates the value calculated from the equation given in Section 5.2.2.

5. Note reading on vacuum gauge of Low Pressure Accessory; if unchanged from Step 2c, proceed directly to Step 6.

   If reading has changed, re-compute the sample flowmeter setting by substituting the present vacuum reading in the equation. Then, readjust the Sample Flow Control Valve to obtain the calculated reading on the Sample Flowmeter. To obtain the particular flowmeter setting at the given vacuum reading, it may be necessary to adjust valves in the following sequence:

   Sample Flow Control Valve on analyzer
   Bypass Flow Control Valve on analyzer
   Variable Restrictor Valve on accessory

6. Turn Range Selector Switch to lowest range which gives an on-scale reading. Allow instrument to dry down for at least several hours, and preferably overnight.

7. Check reading on Sample Flowmeter; if other than correct value, readjust Sample Flow Control Valve as required.

8. Turn Range Selector Switch to lowest range which gives an on-scale reading.

System is now in operation. For additional information on routine operation, refer to Section Six.

If the system utilizes a portable Trace Moisture Analyzer, and if the operating temperature differs appreciably from 70°F, temperature corrections may be desirable. Refer to Section 4.3-4.

6 OPERATION

After completing system startup, use following operating procedure:

1. Turn on sample gas.

2. Verify that sample flowmeter reading is equivalent to 100 cc/min at 14.7 psia (760 mm Hg) and 70°F (21.1°C). Refer to Section 4.3. (If Low Pressure Sampling Accessory is used, check readings on both its vacuum gauge and the sample flowmeter of the Trace Moisture Analyzer. Refer to Section 5.2.)

3. Turn Range Selector Switch to appropriate position. Meter (and recorder, if used) will now automatically and continuously indicate the water vapor content of the sample stream, in parts-per-million by volume. To convert readings into weight-per-volume or weight-per-weight units, multiply by the appropriate factor from Table 6-1. To convert readings into ice point temperatures, use the curve of Figure 6-1.

6.1 RECOMMENDED CALIBRATION FREQUENCY

At least once a week, note reading on sample flowmeter. If reading deviates from correct value, as previously determined, readjust Sample Flow Control Valve.

Less frequently, calibration of the sample flowmeter should be rechecked by one of the methods from Section 4.3.3. Flowmeter characteristics may change gradually with internal deposition of dirt and other contaminants. Proper frequency for the calibration check depends on the particular sample stream, and is therefore best determined by experience.

6.2 SHUTDOWN

Normally, electrical power is never removed from the analyzer. Exceptions are (1) brief power turn off as required for routine maintenance; and (2) power turn off during prolonged shutdown of several weeks or more.

During periods of inactivity, Range Selector Switch should be left at STDBY. In standby mode, current flows through the electrolytic cell, thus keeping it dry and ready for immediate use upon resumption of operation.

If analyzer is to be used on a semi-continuous basis, e.g., during daylight working hours only, sampling system should incorporate shutoff valve(s) to prevent entry of moist air during inactive periods.

TO CONVERT B TO A MULTIPLY BY:	A	B	TO CONVERT A TO B MULTIPLY BY:
10^4	PPM (v/v)	Volume %	10^{-4}
$(MW/1.8) \times 10^3$	PPM (v/v)	Weight %	$(1.8/MW) \times 10^{-3}$
10^3	PPM (v/v)	ml/Liter	10^{-3}
1.25×10^3	PPM (v/v)	mg/Liter	8.04×10^{-4}
35.4	PPM (v/v)	ml/Cu. Ft.	2.83×10^{-2}
43.8	PPM (v/v)	mg/Cu. Ft.	2.28×10^{-2}
2.86×10^3	PPM (v/v)	Grain/Cu. Ft.	3.5×10^{-4}
$(MW/1.8) \times 10^2$	PPM (v/v)	mg/Gram	$(1.8/MW) \times 10^{-2}$
$(MW/8.2) \times 10^3$	PPM (v/v)	Gram/Pound	$(8.2/MW) \times 10^{-3}$
$(MW/1.26) \times 10$	PPM (v/v)	Grain/Pound	$(1.26/MW) \times 10^{-1}$
$(MW/1\ .8) \times 10^5$	PPM (v/v)	Pound/Pound	$(1.8/MW) \times 10^{-6}$
20	PPM (v/v)	Pound/MMCF (CF $\times 10^6$)	5×10^{-2}

Note: MW = molecular weight of the gas involved.

TABLE 6-1. CONVERSION FACTORS FOR WATER VAPOR CONCENTRATIONS

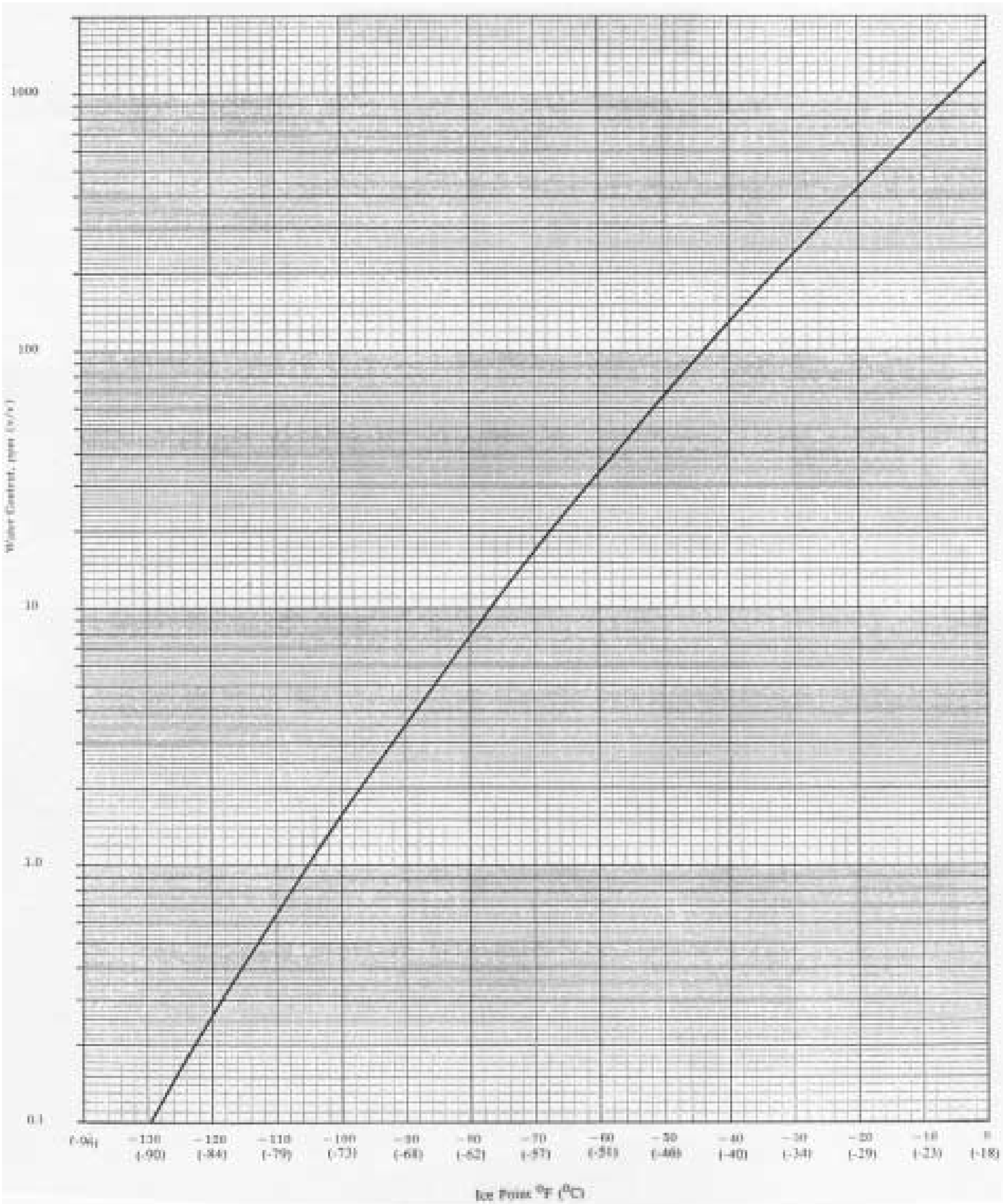


FIGURE 6-1. ICE POINT VS. PARTS-PER-MILLION H_2O BY VOLUME

NOTES

7 INSTRUMENT THEORY

7.1 PRINCIPLE OF OPERATION

Trace moisture determination is based on the simultaneous absorption and electrolysis of water. The sensor is an electrolytic cell. Inside the molded plastic cell, the sample flows through a tube formed of two slightly separated rhodium wire helices. The outer surface of the tube is a substrate that firmly secures the wires in place. The inner surface is a thin film of desiccant, meta phosphoric acid, which absorbs water vapor from the sample.

A regulated DC voltage is applied between the helical electrodes, causing a current to flow through the film and thus electrolyze the absorbed water. The current is directly proportional to the water vapor content of the sample. The instrument is calibrated to provide direct readout of sample moisture in ppm by volume (for sample flow of 100 cc/min at 70°F and 14.7 psia). If desired, readings may be converted into various weight-per-volume and weight-per-weight units through use of the corresponding conversion factors listed in Table 6-1.

7.2 FLOW SYSTEM

Internal flow system of the analyzer is shown in Figure 7-1. To provide sample flow through the system, a suitable pressure differential must be established between sample inlet and outlet. In most applications, the inlet is connected to a pressurized sample source; the outlet discharges to atmospheric pressure. In applications utilizing the Low Pressure Sampling Accessory, the inlet is connected to a comparatively low-pressure sample source; and a vacuum is applied to the outlet.

The Sample Flow Control Valve is adjusted so that flow through the electrolytic cell is equivalent to 100 cc/min under standard conditions (70°F, 14.7 psia). The sample flowmeter is calibrated by its manufacturer for direct readout in cc/min under the following conditions: 1) sample gas, air; 2) temperature, 70°F, (21.1°C); 3) flowmeter outlet vented to atmospheric pressure at sea level (14.7 psia). For ultimate accuracy, however, the user should recalibrate the sample flowmeter for the particular sample gas, and for the actual discharge pressure if significantly less than 14.7 psia. In an analyzer used to monitor sample from a pressurized source, the flowmeter outlet is at the local barometric pressure. This may be considerably less than 14.7 psia if the installation site is at an appreciable elevation above sea level. Refer to Section 4.3. With the Low Pressure Sampling Accessory, the flowmeter outlet discharges into a vacuum, necessitating the special calibration considerations explained in Section 5.2.

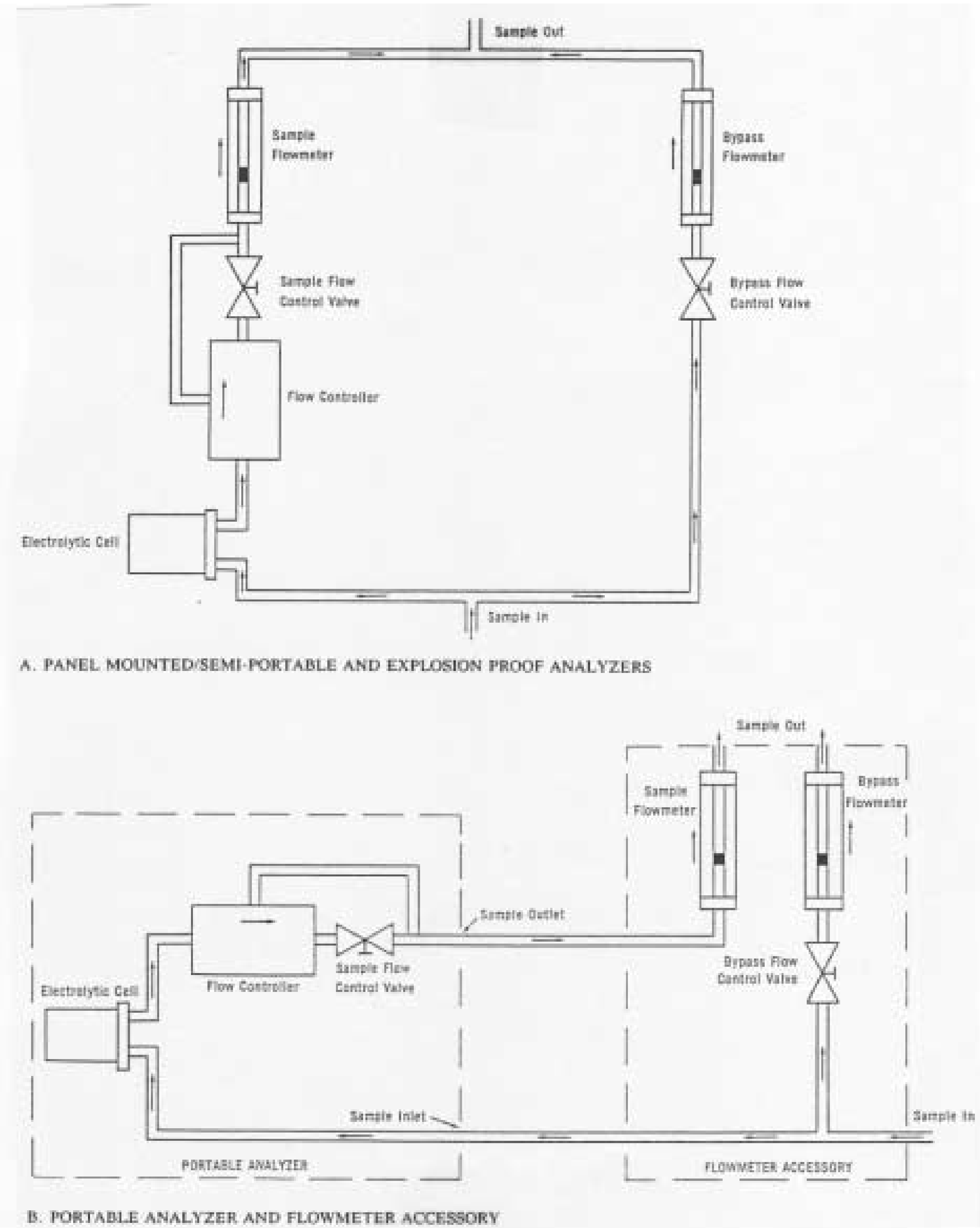


FIGURE 7-1. SCHEMATIC DIAGRAM OF INTERNAL FLOW SYSTEM

To stabilize sample flow at the established level, the system incorporates a flow controller. The controller has two sides, separated by a diaphragm. One side connects to the upstream end, and the other side to the downstream end, of the Sample Flow Control Valve. Any pressure imbalance across the diaphragm causes an internal valve within the controller to open or close until equilibrium is achieved. At equilibrium, reached after initial flow through the system, a constant flow is maintained through the cell.

The Bypass Flow Control Valve and bypass flowmeter, if used, permit a portion of the sample to circumvent (bypass) the cell. Opening the bypass valve results in a high velocity flow through the sample lines, thus minimizing transport time lag.

7.3 ELECTRONIC CIRCUITRY

The following Sections discuss electronic circuitry of the Trace Moisture Analyzer. For overall schematic and pictorial diagrams of the particular instrument version, refer to the appropriate figures listed in the following table. Details of individual circuits are shown in separate schematic and pictorial diagrams, as referenced in the overall diagrams.

INSTRUMENT	SCHEMATIC DIAGRAM
Panel Mounted and Explosion Proof Analyzers	DWG 194754
AC Operated Portable Analyzer	DWG 194757
DC Operated Portable Analyzer	DWG 194749

7.3.1 ELECTROLYTIC CALL AND SWITCH ASSEMBLY (ALL ANALYZERS)

During operation, the electrolytic current flows through the cell and through one of five range resistors, depending on the setting of Range Selector Switch S1. The resultant signal developed across the particular range resistor is applied to the input of a DC operational amplifier circuit utilizing a high gain DC amplifier on the amplifier circuit board (Section 7.3.2). Switch S1 provides the capability of changing the sensitivity of the current measuring circuitry, to permit selection of different operating ranges.

Switch S1 and range resistors R3 through R7 are contained in the Switch Assembly. Also mounted on the switch assembly are resistors R1 and R2, which constitute a feedback divider for the amplifier circuit.

7.3.2 AMPLIFIER CIRCUIT BOARD (ALL ANALYZERS)

The amplifier circuit board, DWG 624265, contains the following circuits and components:

1. ***High Gain DC Amplifier.*** Utilized in the amplifier circuit described in Section 7.3.1.

2. ***Potentiometric Output Selector***. The Potentiometric Output Selector consists of a multi-pin receptacle and two associated shorting plugs. The combination constitutes a switch, labeled S1 on the circuit board. Plug functions are the following:

a. ***Plug for CUR BD, YES/NO Selector***. If potentiometric output is desired, the plug is inserted between the pair of pins labeled NO. This connection routes the amplifier output signal through a voltage divider to circuit ground.

   If current output is desired, the plug is inserted between the pair of pins labeled YES. This connection routes the amplifier output signal to the current output board, described in Section 7.3.3..

b. ***Plug for Numbered Pairs of Pins.*** To match instrument output of the desired potentiometric recorder, a shorting plug must be inserted between the corresponding pair of numerically labeled pins, thus selecting the appropriate tap on the voltage divider mentioned in item "a", proceeding. Choices are 10 mV, 100 mV, 1 V and 5 V. Circuit parameters are such that, with the plug in the position appropriate to the particular recorder, a signal voltage level of + 5 V at the amplifier output results in a fullscale recorder deflection.

7.3.3 CURRENT OUTPUT BOARD (OPTIONAL FOR AC ANALYZERS ONLY)

The current output circuit board, DWG 624263, contains the following circuits and components.

1. ***Emitter follower stage***. Darlington connected transistors Q23 and Q24 are used to convert the signal from the amplifier board into an output suitable for driving a current recorder.

   To protect Q23 and Q24 from accidental overload, a current limiting circuit is provided. An increase in output current causes a corresponding increase in voltage across resistor R1 33, and therefore in the emitter to base voltage for transistor Q27. If output current momentarily becomes excessive, conduction through Q27 increases sufficiently to render Q23 and Q24 non-conducting, thereby decreasing output current.

2. ***Diode rectifiers CR10, CR11, and filter capacitor C30.*** These elements, together with one center-tapped secondary of transformer T2 of the ±15 Volt Power Supply (Section 7.3.4), constitute a floating power supply for the emitter follower stage.

3. ***Offset current generator, providing the capability of an output compatible with a live zero, current type recorder.*** Distinguishing characteristics of the live zero systems is that when input to the amplifier is zero, the signal applied to the recorder is not zero. Instead, it is equal to 20% of the recorder input current required for a fullscale deflection. Thus, zero signal current is 1 mA for a 1 to 5 mA recorder, 4 mA for a 4 to 20 mA recorder, and 10 mA for a 10 to 50 mA recorder.

   The offset current generator provides a choice of three constant currents. An exact -10 volts is applied to the base of Q20A by a network consisting of reference diode CR12 and associated resistors (R83, R84, R85, and R86), connected between ground and the -15 volt supply. The collector voltage of Q20B drives the base of Q21; the emitter of Q21 drives the base of Q22 to maintain the required voltage at the base of Q20B. Section S913 of Recorder Milliampere Selector S9 selects the appropriate constant current by connecting the corresponding resistor: R86 for 1 mA, or R88 for 10 mA. (The output selection function of S9 is performed by Section 5.9.A described in Item 5.)

4. ***Live Zero/Dead Zero Selector.*** This combination of a multi-pin receptacle and an associated r eversible plug constitutes a switch, labeled S10 on the current output circuit. Alternative choices are the following:

   a. A DEAD ZERO switch position (used only with a 0 to 5 mA recorder) connects the recorder between the emitter follower output and the load resistance.

   b. A LIVE ZERO switch position (used with 1 to 5, 4 to 20 and 10 or 50 mA recorders) connects the recorder between ground and the negative terminal of the emitter follower power supply.

5. ***Recorder Milliamp Selector***. This combination of a multi-pin receptacle and an associated 4-position plug constitutes a switch, labeled S9 on the circuit board. The plug provides a choice of four outputs, to permit use of a current recorder with a fullscale span of 0 to 5, 1 to 5, 4 to 20 or 10 to 50 mA. Circuit parameters are such that, with the plug in the position appropriate to the particular recorder, a signal voltage level of +5 volts at test point TP11 of the current output board results in a fullscale recorder deflection.

7.3.4 ±15 VOLT POWER SUPPLY (AC ANALYZERS ONLY)

The ±15 Volt Power Supply provides power for the electronic circuitry of AC operated analyzers. (Power for the portable DC analyzer is normally provided by a ±15 volt battery pack.)

As shown in DWG 619710, power transformer T1 has three secondaries, used as follows:

1. A 38 VAC center tapped secondary powers both 15 volt supplies through diode bridge CR1 and filter capacitors C1 and C4.

   The adjustable positive regulator, VR1, is set by voltage divider R1, R2 and R3, and its output is applied to pin A of the PCB and to test point TP1. R2 is adjustable and should be set to 15 ±0.75 VDC.

   The negative DC, regulated by VR2, is applied to pin D of the PCB.

   The center tap is the Common reference for both + 15 and - 15 volt supplies and is applied to pin B of the PCB and to test point TP2.

   Both outputs are used by amplifier board. In addition the -15 volt output is used by the offset current generator in the optional Current Output Board (Section 7.3.3).

2. The 90 volt secondary drives a rectifier circuit consisting of diodes CR10 and CR11, and filter capacitor C30. These components are on the optional Current Output Board. This transformer winding and its associated circuit components constitute a floating power supply for the emitter follower stage. Refer to Section 7.3.3.

3. The 9.5 VAC secondary drives a + 5 volt supply not used in this instrument.

7.3.5 ALARM SETPOINT ACCESSORY AND UNIVERSAL ALARM BOARD (OPTIONAL, FOR PANEL MOUNT ANALYZERS ONLY)

The Alarm Setpoint Accessory, DWG 194760, and the Universal Alarm Board are used in combination to provide the basis for various alarm and/or control systems. Such systems are completed by the addition of appropriate, external, customer supplied components, depending on the requirements of the application and the preferences of the user.

For versatility in use with diverse instruments, the Alarm Setpoint Accessory incorporates two independent, adjustable, setpoint circuits, designated "A" and "B". If both circuits are used, each drives a separate Universal Alarm Board. However, the Trace Moisture Analyzer uses only circuit "A" and a single Universal Alarm Board to provide the high level alarm function.

8 MAINTENANCE

Most maintenance of the Trace Moisture Analyzer involves the electrolytic cell. The following Sections describe recommended maintenance procedures. For location of cell and associated holder in the particular instrument configuration, refer to appropriate illustration of Figures 2-1 through 2-4.

8.1 CARE OF THE ELECTROLYTIC CELL

To minimize absorption of moisture, the cell should be kept sealed. Never leave it open to air longer than absolutely necessary. Adherence to this practice will increase cell life, and will cause response time to be dependent primarily n the dryness of the gas handling system external to the instrument.

8.2 REPLACING ELECTROLYTIC CELL

To replace the electrolytic cell:

1. Remove electrical power from analyzer.

2. Unscrew cell holder and remove cell. If cell is to be re-sensitized, use procedure of Section 8.3.

3. Remove and discard old 0-rings; replace with new ones.

Note:

New 0-rings should be installed whenever cell is replaced. New 0-rings are supplied with each replacement cell. O-rings are also obtainable separately under Part 834499 (two required).

4. Set replacement or re-sensitized cell in position. Tighten cell holder.

5. If, inadvertently, cell has been subjected to prolonged exposure to high moisture levels, repeat initial dry-down procedure of Section 4.1.

6. Make leak check of Section 4.2.2. Analyzer is now ready for normal operation.

8.3 CLEANING AND RE-SENSITIZING ELECTROLYTIC CELL, USING P/N 642257 KIT

The following instructions are shipped with the kit. The kit contains enough material for three recharges.

WARNING: HAZARDOUS CHEMICAL

Phosphoric acid (H_3P0_4) is irritating to the skin, mucous membranes, eyes and respiratory tract. Direct contact causes burns. Avoid contact with eyes and skin and avoid breathing fumes. Use in hood or well ventilated place. Wear goggles, rubber gloves and protective clothing.

In event of contact flush with water and obtain medical assistance.

1. Remove cell from instrument.
2. Flush cell with distilled water until effluent no longer gives acidic indication on litmus paper or pH meter.
3. Flush with 10 CC of distilled water. Blow cell interior dry with dry nitrogen.
4. Aspirate full concentration (85%) Reagent Grade phosphoric acid (H_3PO_4), supplied, through cell to fill inner bore completely with acid.
5. Push a 6 inch (152 mm) length of teflon coated fiberglass string, supplied, through bore of cell so at least 1/2 inch (13 mm) projects from each port of cell. String will remain in place until completion of Step 8.
6. With a tissue, wipe off any excess acid displaced from cell. Resistance from either cell terminal to the metal shell of the hygrometer cell should be greater than 10 megohms. If not, clean cell exterior with a cotton swab wetted with distilled water.
7. Set flow controller on instrument for zero flow, then replace cell in instrument.
8. Supply nitrogen to instrument and set flow controller for 10 cc/min. Apply power to instrument and allow to dry down for 24 to 48 hours.
9. Remove cell from instrument; remove string from cell; replace cell in instrument.
10. With cell now recharged, instrument may be restored to operation. If recorder trace is noisy, i.e., noise level greater than 3% of fullscale;
    a. Remove cell from instrument.
    b. Run a 6 inch (152 mm) length of the Teflon coated fiberglass string back and forth within the cell bore, as with use of dental floss.

c. Again restore instrument to service and check noise level. It may be necessary to repeat this step.

11. Do not re-use the string as excess acid may be introduced into the cell.

NOTES

9 SERVICE

WARNING: ELECTRICAL SHOCK HAZARD

Servicing this instrument requires access to shock hazard level voltages which can cause death or serious injury. Refer servicing to qualified personnel.

Alarm switching relay contacts wired to a separate power source must be disconnected before servicing.

The most common symptoms of a malfunctioning analyzer are subnormal or zero meter reading, Section 9.1; off-scale meter reading, Section 9.2; and erratic meter reading, Section 9.3.

9.1 SUBNORMAL OR ZERO METER READING

The most probable causes of subnormal or zero meter reading are the following:

1. Lack of power supply output voltage. To check, measure voltage. Zero voltage may be due to the following:

   a. Instrument is not plugged in, or is not turned on.

   b. Fuse is burned out.

2. Cell element has become coated with inert material, has been "poisoned" by sample gases, or has lost its desiccant film. Refer to Section 8.3 for instructions in cell cleaning and re-sensitizing.

9.2 OFF-SCALE METER READING

Possible causes of an off-scale meter reading are the following:

1. Electrolytic cell is partially short-circuited. Remove cell. With an ohmmeter, measure resistance between cell terminals. Resistance should be 5,000 to 20,000 ohms or more; if less than this, clean and re-sensitize cell (per Section 8.3) or replace it.

2. Moisture content of sample stream or sample handling system exceeds 1000 ppm. Run dry nitrogen, cylinder gas, or other suitable dry gas through sampling system and

analyzer to determine if instrument dries down properly. Meter should read on-scale within 20 to 30 minutes.

9.3 ERRATIC METER READING

Erratic readings may be caused by any of the following factors,

1. Flow control is poor. Test as follows:

    a. Perform leak check as explained in Section 4.2.2.

    b. At instrument inlet, connect a suitable dry gas with a pressure regulator. Pressure should be variable from 10 to 100 psig.

    c. Bring pressure to 10 psig. Vary the Sample Flow Control Valve setting. Flow rate should be adjustable above and below 100 cc/minute.

    d. Bring pressure to 100 psig. Vary Sample Flow Control Valve setting. Flow rate should be adjustable above and below 10 cc/minute.

    e. Again bring pressure to 10 psig. Set flow rate to 100 cc/minute. Vary inlet pressure from 10 to 100 psig. Flow rate should not vary more than ±10 cc/minute.

    f. If flow control is unsatisfactory, clean flow controller.

2. Electrolytic cell is partially plugged. Remove and inspect cell; if plugged, clean it as directed in Section 8.3.

3. Cell is partially short-circuited. Remove cell. With an ohmmeter, measure resistance between cell terminals. Resistance should be 5,000 to 20,000 ohms or more; if less than this, clean and re-sensitize cell or replace it.

10 REPLACEMENT PARTS

The following parts are recommended for routine maintenance and troubleshooting of the Model 340 Trace Moisture Analyzer. If the troubleshooting procedures do not resolve the problem, contact your local Rosemount Analytical service office.

WARNING: PARTS INTEGRITY

Tampering or unauthorized substitution of components may adversely affect safety of this product. Use only factory documented components for repair.

10.1 CIRCUIT BOARD REPLACEMENT POLICY

In most situations of circuit board malfunction, it is more practical to replace the board than to attempt isolation and replacement of the individual component. The cost of test and replacement will exceed the cost of a rebuilt assembly from the factory. As standard policy, rebuilt boards are available on an exchange basis. The price, with return of a repairable board, is less expensive than that of a new assembly. Each rebuilt assembly carries a one-year warranty.

Because of the exchange policy covering circuit boards, the following list does not include individual electronic components. If circumstances necessitate replacement of an individual component which can be identified by inspection or from the schematic diagrams, obtain the replacement component from a local source of supply.

10.2 SELECTED REPLACEMENT PARTS

FLOW REGULATOR DIAPHRAGM

Order the replacement flow regulator diaphragm directly from Brooks. The part number for the Viton diaphragm (used in brass regulators) is Brooks part number 8206h18084. For the Teflon diaphragm (used in the stainless steel regulators), request the equivalent part number.

HEATER - 45 WATT

The built-in thermoswitch (set for 140°F ±5°) mounted on the bottom of the regulator (PN 193123) is attached with RTV silastic rubber.

NEEDLE VALVES – SAMPLE FLOW

The part number for brass is 876807, for stainless steel is 876806.

O-RINGS – ANALYZER CELL

The part number is 834499.

BATTERIES – DC OPERATION

The mercury battery part number is 652347 (package of two). The 7.5 VDC batteries used in older analyzers are no longer available. A conversion to mercury batteries kit (PN 652329) is available.

CELL - ANALYZER

The part number for the cell is 193190.

DOOR ASSEMBLY – PANEL MOUNT INSTRUMENTS

Refer to Figure 10-1.

Item	Part Number	Description	Qty
1	193152	Door, Instrument	1
2	194781	Meter	1
3	190889	Door Lock	1
4	816808	Knob	1
5	816816	Knob, Skirted	1
6	194746	Nameplate	1
7	193169	Window	1
8	823481	Connector – 15 Pin (J1, J2, J4)	3
9	000596	Clamp, Cable	2
10	194756	Harness, Wiring	1
11	193154	Door, Chassis	1
12	193170	Bracket, Support	1
13	193155	Switch, Attenuator	1

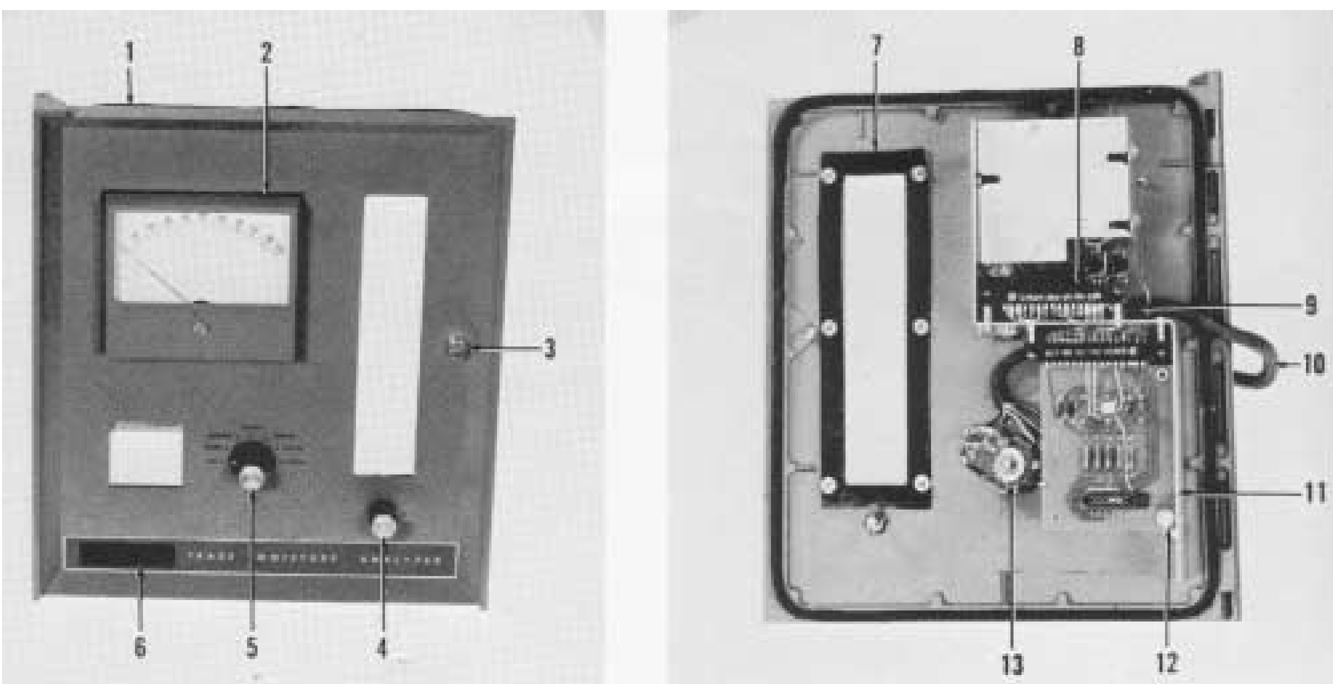


FIGURE 10-1. 194782 DOOR ASSEMBLY – PANEL MOUNT INSTRUMENT

CHASSIS ASSEMBLY

Refer to Figure 10-2.

Item	Part Number	Description	Qty 194776	194777	194778	194784
1	193175	Collar, Flowmeter	1	1	1	1
2	194779	Holder, Lamp	2	2	2	2
3	810156	Fitting, Tee	2	2	0	0
	016487	Fitting, Tee	0	0	2	2
4	866025	Flowmeter SS	1	1	0	0
	866024	Flowmeter	0	0	1	1
5	630184	Tubing, SS – Sample In	1	1	0	0
	630185	Tubing – Sample In	0	0	1	1
6	193123	Heater (R1)	1	1	1	1
7	193159	Shield, Lamp	1	1	1	1
8	860001	Lamp, Incandescent (DS1)	1	1	1	1
9	194735	Flowmeter Assembly SS	1	1	0	0
	194736	Flowmeter Assembly	0	0	1	1
10	193183	Tubing	1	1	0	0
	193184	Tubing	0	0	1	1
11	194723	Chassis	1	1	1	1
12	866026	Fitting, Elbow	1	1	0	0
	812890	Fitting, Elbow	0	0	1	1
13	193189	Manifold Assembly	1	1	1	1
14	193195	Pin, Contact	2	2	2	2
15	193158	Bracket, Manifold	1	1	1	1
16	630181	Tubing – Sample Out	1	1	0	0
	630182	Tubing – Sample Out	0	0	1	1
17	194766	Diode Assembly	1	1	1	1
18	001867	Terminal Block (TB1, TB2)	1	2	2	1
19	805947	Fuseholder	0	1	1	0
	008395	Fuse 1 Amp (F1)	0	1	1	0
20	829587	Fitting, Combination	1	1	0	0
	817743	Fitting, Combination	0	0	1	1

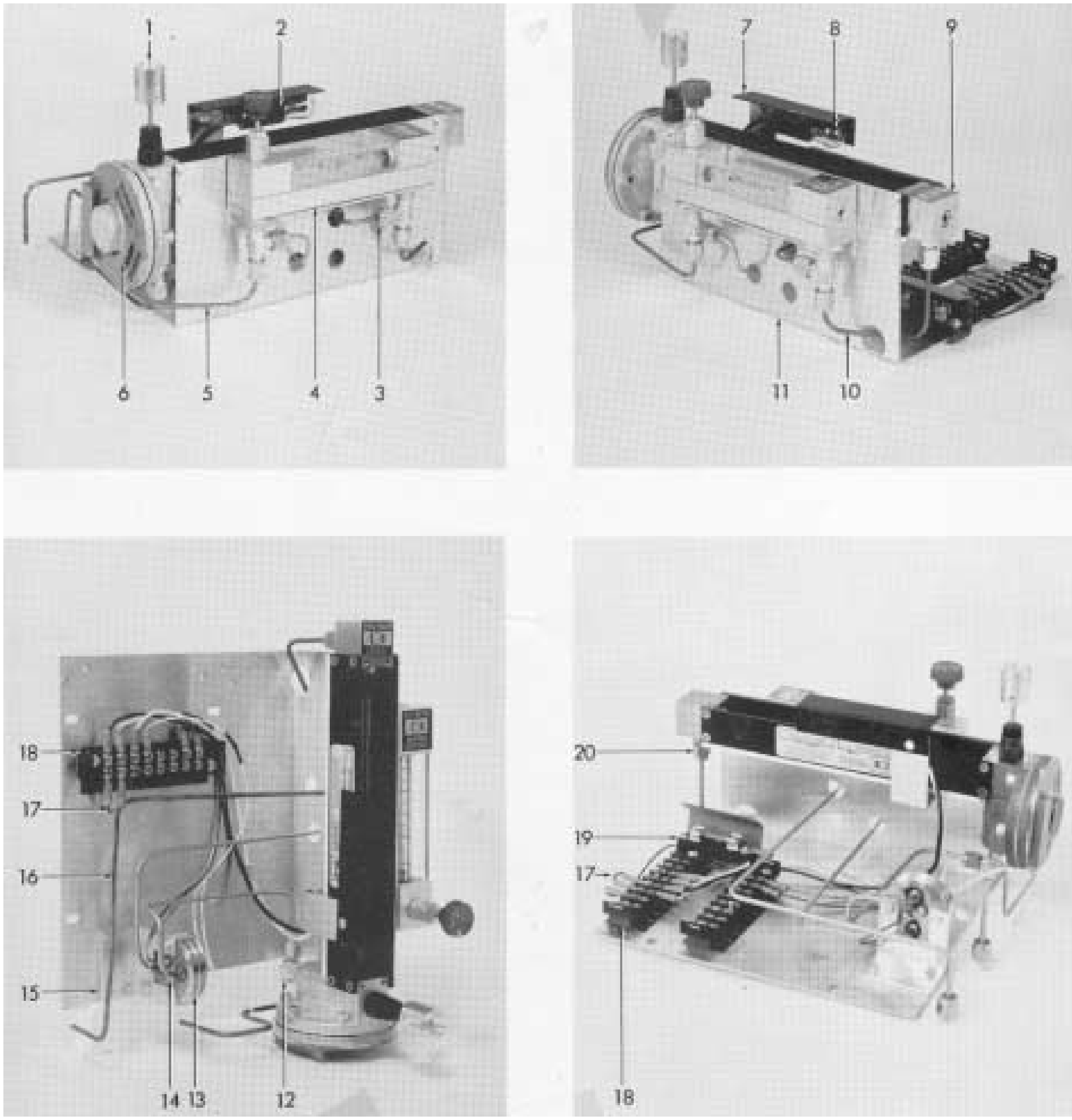


FIGURE 10-2. CHASSIS ASSEMBLY

193005 PORTABLE AC TRACE MOISTURE ANALYZER

Refer to Figure 10-3.

Item	Part Number	Description	Qty
1	193129	Cover	1
2	193150	Nameplate	1
3	816816	Knob, Skirted	1
4	194753	Meter (M1)	1
5	095845	Gasket, Meter	1
6	823690	Knob	1
7	193179	Bezel	1
8	816951	Bumper	2
9	194748	Regulator, Flow	1
10	812890	Fitting, Elbow	1
11	193146	Manifold Assembly	1
12	193138	Harness, Wiring	1
13	823481	Connector (J1, J2, J3)	3
14	866016	Spacer, Threaded	4
15	809892	Screw, Pan Head	
16	808264	Washer, Split-Lock No. 4	
17	811756	Washer, Flat No. 4	
18	079350	Clamp, Cable	
19	079347	Washer, Cable Clamp	
20	809916	Screw, Pan Head 6-32 x 1 / 4	
21	809889	Screw, Pan Head 4-40 x 3/8	
22	193114	Panel, Front	1
23	193155	Switch, Attenuator	1
24	630190	Tubing, Outlet	1
25	866021	Fitting, Combination	1
26	193195	Pin, Contact	
27	193141	Panel	1

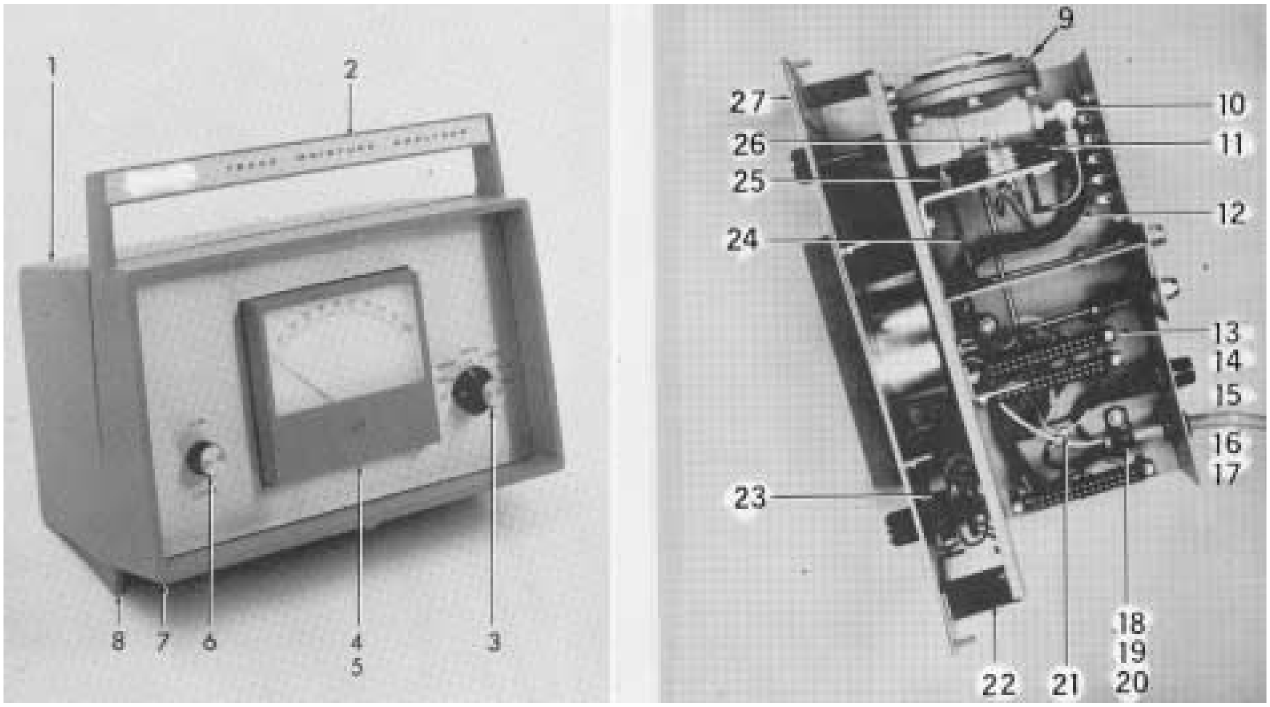


FIGURE 10-3. 193005 PORTABLE AC TRACE MOISTURE ANALYZER

194772 FLOWMETER ACCESSORY

Refer to Figure 10-4

Item	Part Number	Description	Qty
1	810062	Flowmeter	1
2	023381	Flowmeter	1
3	025033	Window	1
4	023377	Knob	1
5	193173	Bracket	1
6	016488	Fitting, Elbow	1
7	630192	Tube, Outlet	1
8	630193	Tube, Inlet	1
9	810156	Fitting, Tee	1

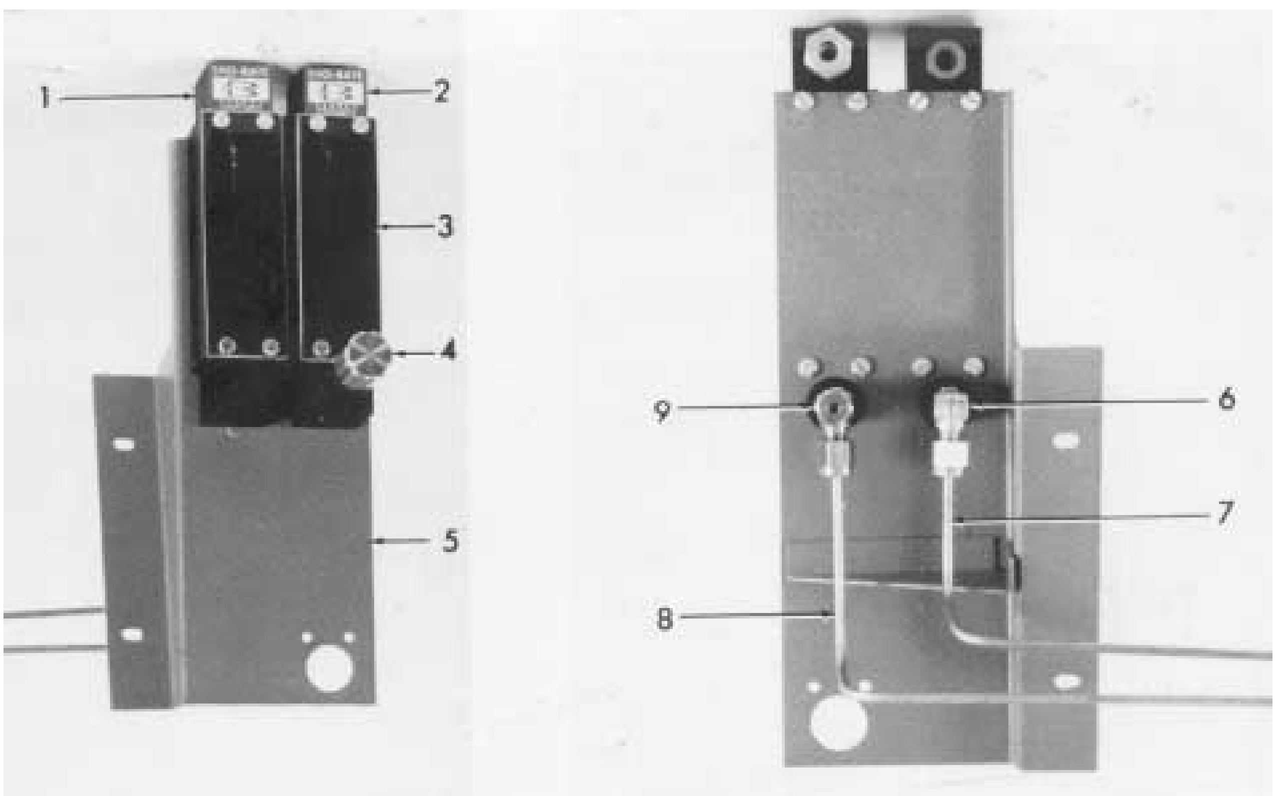


FIGURE 10-4. 194772 FLOWMETER ACCESSORY