Instruction Manual
Model 303B
Moisture Monitor

AMETEK

Process Instruments
455 Corporate Boulevard
Newark, DE 19702, USA

TQM
COMMITTED TO TOTAL QUALITY

PN A.303230001; Rev F

This Manual is a guide to the use of the 303B Moisture Monitor. Data herein has been verified and validated, and is believed adequate for the intended use of the instrument. If the instrument or procedures are used for purposes over and above the capabilities specified herein, confirmation of their validity and suitability should be obtained, otherwise AMETEK does not guarantee results and assumes no obligation or liability. This publication is not a license to operate under, or a recommendation to infringe upon, any process patents.

Safety Notes

Notes, cautions and warnings within the text of this manual are used to emphasize important and critical instructions.

WARNING: This equipment has been tested, and declared compliant with international standards for general safety in normal environments, as well as for use in NEC / CEC Class I, Division 2 areas containing flammable gasses in groups A, B, C, and D. Any use of this equipment in a manner not specified by the manufacturer may impair the original protection provided against personal injury or damage to the unit.

Health Hazards Precaution Data: if and when hazardous chemicals or adverse health factors affect the environment or use of the equipment, appropriate precautions are provided.

WARNING

Service operations given or implied in this manual should be performed only by AMETEK or other qualified personnel.

WARNING

If the unit is used to measure moisture in toxic or flammable gases, the GAS OUT must exhaust to an area deemed safe and appropriate by the local authority having jurisdiction. Take appropriate precautions.

WARNING

Take care when handling acetone, phosphoric acid and nitric acid in the various procedures.

WARNING

Check the sample line for leaks before and after connecting.

WARNING

If sampling a hazardous gas, shut off gas flow and purge the monitor before pressing the POWER switch (LED OFF) or removing the cell.

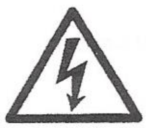
Warning Labels

These symbols may appear on or in the instrument. Be aware of their meanings.

PROTECTIVE CONDUCTOR TERMINAL

(BORNIER DE L'ECRAN DE PROTECTION)

Schutzerde



CAUTION - Risk of electric shock

(ATTENTION-RISQUE DE DÉCHARGE ÉLECTRIQUE)

Achtung - Hochspannung Lebensgefahr

CAUTION - (Refer to accompanying documents)

(ATTENTION-SE RÉFERER AUX DOCUMENTS JOINTS)

Achtung (Beachten Sie beiliegende Dokumente)

CAUTION - Hot Surface

(ATTENTION-SURFACE CHAUDE)

Achtung - Heiße Oberfläche

SPECIAL WARNINGS AND INFORMATION FOR USE OF THE 303B IN HAZARDOUS LOCATIONS

This Equipment is Suitable for Use in Class I, Division 2, Groups ABCD or Non-Hazardous Areas Only.

Warning - Explosion Hazard - Substitution of Components May Impair Suitability for Class I, Division 2.

AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2.

Warning - Explosion Hazard - Do Not Disconnect Equipment Unless Power Has Been Switched Off or the Area is Known to be Non-Hazardous

AVERTISSEMENT - RISQUE D'EXPLOSION - AVANT DE DECONNECTER L'EQUIPEMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACMENT EST DESIGNE NON DANGEREUX.

The 4-20 mA Current Loop Circuit Represents a Non-Incendive Field Wiring Connection for Class I, Div 2 Areas. The Maximum Length of Cable to be Used is 1,000 Feet (305m). Conductors, Connections, or Any Part of the 4-20mA Circuit Must Not Contain Cadmium, Magnesium, or Zinc in Order to Maintain the Non-Incendive Rating of this Unit.

Warning - If This Equipment is to Be Operated in a Class I Div 2 area, the Use of the External 12 Vdc Power Input Option is Strictly Prohibited.

AVERTISSEMENT - SI CET EQUIPEMENT EST UTILISE EN ZONE CLASSE I, DIVISION 2, L'UTILISATION DE L'OPTION "EXTERNE 12 VDC" EST ABSOLUMENT INTERDITE.

When the Controller Unit is to be Operated in a Hazardous Location, the "Alarm Relay Output" Feature is Acceptable for Switching External Circuits Having a Class I, Div 2, Groups ABCD Non-Incendive Output.

The Power Cord Supplied with the Analyzer is Suitable for Flexible Hazardous Location Connection. The Mains Plug Must be of the Locking and Grounding type.

This page intentionally left blank.

Table of Contents

Section 1 - OVERVIEW

Section 2 - INSTALLATION

Section 3 - OPERATION

Section 4 - MAINTENANCE

Section 5 - PARTS LIST

APPENDICES

Figure 1-1. AMETEK Model 303B Moisture Monitor

Section 1 - OVERVIEW

This manual describes operation; provides application, installation, and maintenance data; and lists user replaceable parts for the AMETEK Model 303B Moisture Monitor. Gas correction factor tables are given in Appendices A through C. A glossary of terms is given in Appendix D.

Purpose

The Model 303B measures the water vapor content of most gases, or a mixture of gases, in ppmv or lb/MMscf in Division 2 areas.

Description

The 303B (figure 1-1) is a small, compact, portable, weather proof (NEMA 3R) instrument that operates from an external ac or dc source, or an internal battery. An internal flow meter is provided for use as a flow indicator.

- The front panel contains ten membrane key switches, ten windows to view LEDs that show the status of the various functions, two transparent windows to view the flow meters and the output display, and two access holes for flow adjustment
- The electrolytic cell, the battery, and two pc boards (cpu/display and power supply) are mounted inside.
- The rear panel contains sample connector fittings, and watertight CGB connectors for the ac or dc power cord and the analog/output alarm wires.

Battery operating life is directly related to the moisture level being measured. At maximum moisture levels, power can be sustained for 24 hours; at low moisture levels, operation can be sustained for over 1 week.

While running, if for any reason external power is lost, the analyzer automatically switches to battery operation. On external power, the battery automatically recharges to full capacity, time permitting, in about 24 hours.

Sample Stream Requirements

Sampling technique is extremely important. Failure to observe needed precautions can result in poor response, incorrect readings, or both.

Sample gas pressure must be at least 70 kPa (10 psi) gauge or a booster pump must be used (either pressure on the inlet, or vacuum on the outlet). See Figure 1-2.

Foreign particles are removed from the gas by the 2-micron filter. The SAMPLE ADJUST flow controller must be set to 100 mL/min at 1 atmosphere. The built-in bypass system permits a portion of the sample gas to bypass the cell while 100 mL/min flows through it.

Bypassing increases sample flow, thereby reducing the time needed for sample to transit the line. Since sample flow is constant, the displayed reading corresponds exactly and linearly to ppm of water vapor in the sample.

The two most common installation errors are in selecting improper sizes and materials for sample lines and fittings between the sample source and the instrument. To assure good results:

- Select a take-off point representative of the sample.
- To minimize dry-down time and response, keep sample line as short as possible.
- Use no material in the inlet system which can absorb and desorb any amount of moisture or allow moisture permeation.
- Eliminate water absorbing materials.
- Insulate the system to eliminate large temperature swings.
- Maintain good pressure control.
- Keep the cell as dry as possible between uses.
- Remove contaminating substances from sample if possible.
- Filter out all particulate matter larger than 10 µm; if not, the internal filter will foul quickly.
- Be sure sample temperature does not exceed 40°C.
- Be sure the sample is free of oil mist.

Sample gas tubing (PN A.571061017) is recommended. It should be chemically cleaned and passivated, thermocouple grade 316 stainless steel. Copper, brass, and polycarbonate are not to be used. Most plastics or elastomer materials are unsatisfactory because of their relatively high moisture permeability. All tubing should be minimum length; [3 m (10 ft)] and ID; 3.2 mm [0.128 in. (1/8 in.)] OD is recommended. Use Teflon® fluorocarbon tape or American Sealants Co. Locktite® 545 on threaded connections. Do not use pipe, rubber, or similar cements. The sample system should be leak-checked periodically.

---

*Reg. U.S. Pat. & T.M. Off.

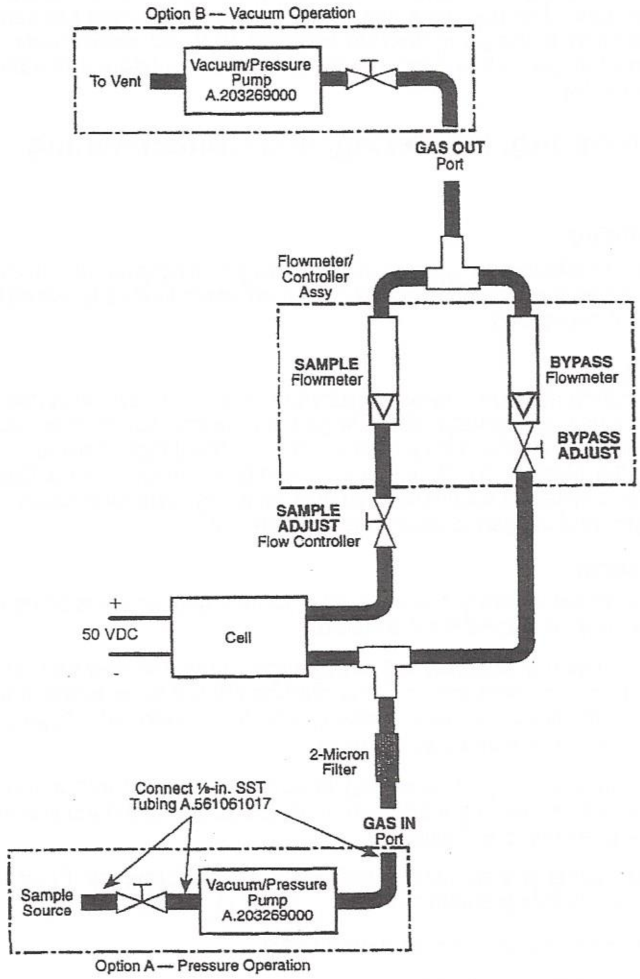


Figure 1-2. 303B Flow Diagram

Optimizing Response Time

The built-in bypass system is always used to optimize response time. Unless the sample gas is hazardous or costly, bypass flow should be as high as possible. The bypass system also is valuable with the instrument in portable service analyzing discrete samples. In these applications, bypass helps to purge gas cylinder valves, pressure regulators and tubing prior to sampling.

Non-Interfering, Interfering, and Contaminating Gases

Non-Interfering

The cell is not affected by gases such as nitrogen, methane, and many aliphatic and aromatic hydrocarbons. The instrument is ideally suited for analysis of these gases.

Interfering

When analyzing moisture vapor in hydrogen, oxygen, or gas mixtures containing a high percentage of either gas, the display will read artificially high. On air for example, it may read up to 10 percent high. This is caused by the electrolysis of moisture formed by recombination of free hydrogen or oxygen. A recommended flow doubling technique to correct for hydrogen and oxygen is described in Section 3.

Contaminating

These substances damage the instrument or cell. Instrument readings may or may not be immediately affected.

Certain corrosive acid gases will corrode the tubing and flow control system, but will not harm the cell. The reading will not be affected until the damage is sufficient to cause line leaks, poor flow control, etc. Typical examples are chlorine and sulfur dioxide.

Certain unsaturated hydrocarbons gradually coat the cell with a polymeric coating The reading is affected gradually as the cell becomes inactive. A typical example is butadiene.

Entrained liquids and solids also can affect cell performance. Filtering usually prevents this problem.

Do not allow liquids to pass through the cell.

Interfering and Contaminating

Some substances will immediately contaminate the cell and cause incorrect readings. Typical examples are graphite dust, hydrogen fluoride, and ammonia.

Parameters Affecting Operation

Flow Calibration

The 303B is an easy to operate, but flow dependent instrument. To obtain an accurate moisture measurement the operator must set the sample flow to the equivalent of 100 mL/min at 1 atmospheric pressure and 25°C (77°F). If sample flow is off by ten percent, the measurement will generally also be off by ten percent. If the user is to achieve the specified accuracy, the simple flow setting procedure described in section 2-5, Sample System Hook Up, steps 4, 5 and 6, must be performed.

The 303B comes equipped with sample and bypass flow meters. These flow meters are not high precision devices and are to be used exclusively as flow indicators. We suggest the operator use a relatively high precision flow meter, such as a bubble-o-meter (soap bubble flow meter) to set the sample flow through the monitor. Of course, the external flow meter must be calibrated for the sample gas and the bubble-o-meter must be corrected for temperature and pressure.

Operating at a flow other than 100 mL/min at 25°C (77°F) and 1 atmosphere requires a display reading correction to obtain the proper ppm. In general, doubling the flow doubles the indicated moisture reading.

No cell calibration is needed because the measurement is quantitative and its response to moisture is linear from less than 1 to 1000 ppm, or 50 lb/MMscf.

Density

Sample flow must be readjusted if gases of different densities are analyzed.

NOTE

A flow meter will not be at the same point for a flow of 100 mL/min for two gases of different densities. Flow meters are calibrated for a specific gas at a specific temperature and pressure. Volumetric flow measuring devices such as the bubble-o-meter are not affected by different gas densities and will provide the correct flow independent of density (at constant temperature and pressure).

Pressure

Since the flow controller maintains a constant flow, sample input pressure changes do not affect instrument response. Pressure should be regulated between 70 and 700 kPa (10 and 100 psi) gauge, but the instrument can accommodate higher sample gas pressures if an external regulator is used to reduce the pressure to the 70 to 700-kPa range. Use an external pump for sample pressures below 70 kPa gauge.

Gas usually exits the system at atmospheric pressure. If the instrument is operated with a back pressure, an appropriate correction must be made to assure that flow through the instrument corresponds to 100 mL/min at 1 atmosphere and 25°C.

Temperature

A change in sample temperature does not affect the way the instrument measures moisture. It does, however, affect gas density and moisture absorbed in sample system parts.

The unit is calibrated to operate at 25°C. If operated at a different temperature, density change and the consequent change in moisture is based on °K (= °C + 273).

$$\text{Displayed\_Moisture\_Reading} = \frac{\text{Actual\_Moisture} \cdot [(273 + 25)}{(\text{Act\_temperature C} + 273)]}$$

The density change effect is about 0.33 percent/°C, but if the cell is calibrated with the bubble-o-meter with temperature compensation, all temperature/density effects are again 0.

Other effects a higher temperature may have is to release moisture held in system components, even that trapped in stainless steel tubing. The higher the tubing free carbon content, the higher is the moisture level it can trap. Also, oils, grease, and other hydroscopic compounds coating component walls can sorb and desorb moisture. As temperature rises, these components can release their moisture, which will be measured as if they were in the sample stream. The reverse also is true; as sample temperature falls, moisture will be absorbed into the components, lowering the moisture readings. The only fix is to remove all absorbing/desorbing parts from the system.

Cell

The cell converts the water-content of the sample gas passing through it to an electrical current. The cell determines the moisture by absorbing the gaseous water, and electrolyzing the absorbed water. This accounts for the high degree of accuracy and specificity, since the process is virtually unique for water and consumes at least 99.9 percent of the gaseous water at levels as low as 1.0 ppm or as high as 2000 ppm.

The assembly is cased in epoxy resin for mechanical protection. This normally precludes damage from any cause except objects which may enter through the cell ports.

If flow of a sample gas with a specific moisture content is constant, the moisture is absorbed and electrolyzed, producing a constant current. When flow is increased, electrolyzing current increases proportionally. Current is directly and linearly related to mass flow, and can be calculated from Faraday's law.

When these factors are considered for water being electrolyzed by a moisture cell, current in µA/ppm of water is given by IµA = (0.132 x flow) where flow is the sample flow in mL/min, measured at 100 kPa (1.00 atm) pressure and 25°C. For example, at 20 mL/min, 1 ppm of water produces 2.64 µA; 100 mL/min, 13.2 µA. The current is displayed as ppm.

Alarm Relay

The alarm relay has two contacts: normally open (NO) and normally closed (NC). With the relay OFF, NO contacts are open and NC contacts are closed. With the relay ON, NO contacts are closed and NC contacts are open.

There are two relay modes controlled by jumper JP2 (figure 2-2): low-power (pins 2 and 3) and fail-safe (pins 1 and 2). In low-power mode, the relay coil turns ON when the moisture reading is above the alarm set-point; the coil turns OFF with low ppm readings, such that battery power can be conserved.

The relay works against a single setpoint setting. In the fail-safe mode, the relay coil is ON when the moisture reading is below the alarm setpoint and OFF when the reading goes above the setpoint. Since the coil is normally ON with low readings, if power is lost accidentally, the coil turns OFF which, in turn, reverses the relay contacts as if a high ppm reading occurred; hence fail-safe.

The following chart lists all combinations of contacts, modes, and alarm conditions.

Condition	NO Contacts (pins 5, 6)	NC Contacts (pins 4, 5)
Low Power Mode Moisture Below Alarm Setpoint	Open	Closed
Low Power Mode Moisture Above Alarm Setpoint	Closed	Open
Fail-safe Mode Moisture Below Alarm Setpoint	Closed	Open
Fail-safe Mode Moisture Above Alarm Setpoint	Open	Closed
Loss of Power	Open	Closed

Special Functions

Cell Test (Display Cell Voltage Level)

The cell test function verifies that the cell power supply is operating properly. The voltage level of the 50VDC, 70-mA cell power supply is displayed. If a cell is very wet, the current needed to dry exceeds the power supply capacity and the voltage reading will drop. With 70 mA continuously drying the cell, power supply voltage will increase over time and the cell eventually will start to operate correctly. This voltage decrease protects the power supply from too-high load conditions. Readings taken in this condition should not be considered accurate.

Electrical Test (Display Logic Voltage Level)

The electrical test function verifies that the 5VDC power supply is operating correctly. This voltage powers the microprocessor and related logic integrated circuits (ICs), and should always be between 4.80 and 5.20 volts.

If this voltage is out-of-range, most likely the 303B will not operate at all and the function cannot be accessed. If this function shows an out-of-range condition, voltage must be measured directly at the power supply board to verify the voltage error, and the power supply board should be replaced. If the power supply voltage level is in-range when measured directly, the power supply ribbon cable or the cpu/display board needs to be replaced.

Stand-By Test (Keep Cell Dry While Transporting)

The stand-by function is used while transporting a 303B to maintain a dry cell. When this mode is started, all power is shut off, except to the cell and the microprocessor, which are powered from ac line power (if it is plugged-in) or from the battery. If ac line power is lost while in this mode, the 303B automatically switches to the battery. Power use is minimized to maximize battery life so that the cell can be maintained dry as long as possible. To save battery power, the 303B should, whenever possible, be plugged into ac line power.

Using this mode while transporting the 303B, the cell will stay dry, and be able to give accurate moisture readings almost immediately after hooking up at the new location.

Mathematical Operation

Moisture determination is based on a straight line formula. Cell current is converted to a digital number through an analog-to-digital (A/D) converter where further conversions can be done by the microprocessor. The overall formula is:

$$ppm = (A/D\_number \cdot factory\_gain \cdot gain) - offset$$

or

$$lb/mmscf = (A/D\_number \cdot factory\_gain \cdot gain \cdot 0.0476) - offset$$

By changing jumper JP4, PPM (pins 2,3) or LB/MMSCF (pins 1,2) can be displayed (figure 2-2). The jumper changes the microprocessor formulas automatically. Since 1 ppm = 0.0476 lb/mmscf, this factor is the only difference between the two formulas.

The factory_gain number converts the A/D_number to ppm values and is determined by applying multiples of 1.32 µA/ppm and calculating the correct factory_gain number for a particular display/cpu board. Through this, each instrument meets the published specifications. Since this calibration is so complex, it is not recommended that this number ever be changed. In case the number is accidentally overwritten or changed, a label attached to the display/cpu board has the factory_gain number inscribed. If a different multiplier is desired in the formulas, then use the gain number.

Gain and offset factors compensate for many different effects. Since their defaults are 1 and 0, they have no affect on the moisture readings. Gain is a multiplier of the moisture reading, such that if the reading is 88.4 ppm and gain is changed from 1.0 to 0.5, the reading would change to 44.2 ppm. Offset is a subtractor to the moisture reading, such that if the reading is offset is changed from 0.0 to 5.0, the moisture reading would change to 5.54 lb/mmscf.

The formulas above can be simplified to the following if you plan on using only the gain and offset.

$$Displayed\_moisture\_value = (Actual\_moisture\_value \cdot gain) - offset$$

If you need to calculate the actual moisture value after changing *gain* and *offset*, the formula is:

$$Actual\_moisture\_value = \frac{(Displayed\_moisture\_value + offset)}{gain}$$

Gain and *offset* values have limitations. Both have only one decimal place, which can be limiting if fine adjustments are needed when changing *gain*. Also, both values have a limited range of 0.0 to 655.3. Negative numbers are not allowed, which can limit some *offset* changes. The most important thing to remember is that the *offset* number is always subtracted, which makes it impossible to add moisture to the reading.

By changing *offset* it is possible to have a negative displayed moisture value; a negative value will flash. When *offset* is 0, it is impossible to have a negative moisture value.

Listed on the following pages are some examples of what these factors can do, both to lb/mmscf and ppm readings.

Zeroing Example

By supplying a zero-moisture calibration gas, the analyzer may not dry down to 0. If the analyzer stops drying down at 3.2 ppm, an *offset* of 3.2 can be entered to have the display read 0.0. This is probably the most common use for the *offset* factor.

If the analyzer later dried down below 3.2 ppm, the display would flash indicating that the value is negative. For example, to get a 0.0 reading if 0.3 were flashing, *offset* must be changed from 3.2 to 2.9.

Flow Compensation Example

The analyzer requires a 100-mL flow to operate properly, but if the process can supply only a 50-mL flow, *gain* can compensate. For example, the reading is 112.0 ppm at a 100-mL flow; when flow is reduced to 50 mL, 56.0 is displayed. To show the correct moisture, *gain* can be increased from 1.0 to 2.0, causing the display to increase back to 112.0 ppm.

The same can be applied in reverse. For a 4.75 lb/mmscf reading at 100mL/min, and increasing the flow to 200 mL flow, 9.50 is displayed. To display the correct moisture, *gain* can be decreased from 1.0 to 0.5, causing the reading decrease back to 4.74 lb/mmscf.

Change the 4 to 20-mA Output Range Example

These examples change the 4 to 20-mA output, but the display will not show the correct ppm readings.

For example, if you want to have readings from 50 to 100 ppm be mapped into the 4 to 20-mA output at 0 to 100 percent, *gain* must first be changed from 1.0 to 2.0. This changes the ppm readings from 50 to 100 to 100 to 200. Then, by changing *offset* from 0.0 to 100.0, the readings change again from 100 to 200 to 0 to 100. Then, simply set the 4 to 20-mA range to 0 to 100; the 50 to 100 ppm readings then will be 0 to 100 percent of the 4 to 20-mA output. As stated earlier, 0 to 100 ppm will be displayed even though the real moisture levels are 50 to 100 ppm.

The mathematics to map a specific range into another range are listed below. This technique assumes that *gain* and *offset* are at their default values, 1.0 and 0.0.

Actual ppm Values = Act_low and Act_high
Mapped Into Values = Map_low and Map_high

(Map_high – Map_low)
Gain = ------------------------------

(Act_high – Act_low)

Offset = (*Gain* • Act_low) – Map_low

In the first example the calculations are:

Actual ppm Values = 50 ppm and 100 ppm
Mapped Into Values = 0 ppm and 100 ppm

$$Gain = \frac{(Map\_high - Map\_low)}{(Act\_high - Act\_low)}$$

Gain = (100 – 0) / (100 – 50)
= (100) / (50)
= 2.0

Offset = (*Gain* • Act_low) – Map_low
= (2.0 • 50) – 0
= 100.0

Since the goal is to get 50 to 100 ppm to be 0 to 100 percent on the 4 to 20-mA output , the above example could have been mapped into the 0 to 10-ppm range. The following shows the calculations for mapping 50 to 100 ppm into the 0 to 10-ppm range.

Actual ppm Values = 50 ppm and 100 ppm
Mapped Into Values = 0 ppm and 10 ppm

$$Gain = \frac{(Map\_high - Map\_low)}{(Act\_high - Act\_low)}$$

Gain = (10 – 0) / (100 – 50)
= (10) / (50)
= 0.2

Offset = (*Gain* • Act_low) – Map_low
= (0.2 • 50) – 0
= 10.0

Specifications

Operating Environmental Range	0° to 52°C 10-90% RH Non-Condensing Pollution Degree 2 0-2000 Meters Altitude
Sample gas Temperature Range	10° to 50°C
Temperature Stability	0.5 % per °C
Maximum Inlet Pressure	690 kPa (100 psi) gauge
Minimum Inlet/Outlet Pressure	Differential 69 kPa (10 psi) gauge
Calibrated Flow Rate Adjustment	
Sample:	25 to 250 mL/min
Bypass:	50 to 1000 mL/min
Nominal Sample Flow Rate	100 mL/min at 1 atmosphere, with air or a comparable unit of sample
Nominal Bypass Flow Rate	500 mL/min, with air or a comparable unit of sample
Display Range	
0.0 to 999.9 ppm:	One decimal place
1000 to 9999 ppm:	No decimal place
0.00 to 99.99 lb/mmscf:	Two decimal place
100.0 to 999.9 ppm:	One decimal place
1000 to 9999 ppm:	No decimal place
Sensitivity	0.1 ppm (0.01 lb/mmscf)
Gain Adjustments	0.0 to 655.3, ppm and lb/mmscf)
Offset Adjustment	0.0 to 655.3, ppm and lb/mmscf
Accuracy	
1000 to 1999 ppm:	±5 % of full scale
10.0 to 99.9 ppm:	±5 % of reading
10 to 100 lb/mmscf:	±5 % or 0.2 ppm, whichever is greater
1.00 to 9.9 lb/mmscf:	±5 % of reading
0.00 to 0.99 lb/mmscf:	±5 % or 0.02 lb/mmscf, whichever is greater.
Noise	< 0.2 ppm when below 10 ppm < 0.02 lb/mmscf, when below 1.0 lb/mmscf
4 to 20-mA dc Analog Out	
Linearity:	±2 %
Noise:	±2 %
Maximum Load Resistance:	625 ohms

Specifications (continued)

Alarm Relay	Normally open and normally closed contacts; rated for resistive loads only: 1 A, 24 Vac/dc For inductive loads, derate by 50%. Assumes use of dc protection diode or ac MOV device
Alarm Setpoint	0.0 to 6553, ppm and lb/mmscf • From 0.0 to 999.9, 0.1 resolution • From 1000 to 6553, 1.0 resolution
Power Supply	
AC	90-130 Vac, 47-63 Hz, 20W 180-260 Vac, 47-63 Hz, 20W Jumper selectable
DC	12 - 14 Vdc, external and internal, 1A Max ext.
Electrical Classification	• NEC/CEC Class I, Division 2, Group A, B, C, D • Electrical Installation Category II
Enclosure Classification	NEMA 3R
Dimensions	30.5 mm (12 in) deep 22.3 mm (8.8 in) wide 11.4 mm (4.5 in) high
Weight (fully optioned)	= 6.4 kg (14 lb)
Factory Defaults	
Factory Gain:	Specified on board label
Gain:	1.00
Offset:	0.0
Alarm Setpoint:	2000 ppm or 100 lb/mmscf
Analog Output Range:	0 to 2000 ppm or 0 to 100 lb/mmscf
Approvals	EU LVD EN61010-1,UL 3101, CSA #1010.1 UL 1604, CSA #213 EU EMC EN50081-1, EU EMC EN50081-2

This page intentionally left blank.

Section 2 - INSTALLATION

General

This section provides instructions to connect and apply power to the 303B and to connect it to a sample source. Refer to Appendices B and C for additional sampling considerations and parameters affecting operation.

Inspection

Inspect the instrument for damage. It is the user's responsibility to report shipping damage to the carrier and to file a claim for damage.

Connections

Analog Output / Alarm

1. Remove the screws and the cover. Check that all electrical and tubing connections are secure.
2. If used, feed the recorder and/or alarm wires through the 4-20 mA ANALOG OUTPUT gland (figure 2-1); connect the analog output wires to JP1-1 (+) and -2 (–) on the display board; connect the alarm wires to JP1-4 (NC), -5 (COM), and -6 (NO) (figure 2-2).

Power

The Ametek 303B moisture monitor is equipped with three power source options. The unit may be powered from either of two external power sources or an internal battery. Information on the characteristics and limitations regarding these sources are described below:

AC Mains Operation

1. The 303B is shipped with the internal AC/DC power supply board jumpered and fused for the mains line voltage ordered by the customer (i.e. 120 vs. 240 VAC) .

WARNING

This configuration must not be altered by the operator! Only qualified service personnel may access the interior of the unit to change this setting and fuse. The rear panel label must be clearly re-marked to indicate the new AC source information. If qualified personnel are not available to perform these tasks, contact Ametek Service.

The 303B is shipped with three feet (.91m) of nondetachable,extra-hard usage (Class 1, Div 2 requirement), AC power cord, preterminated at the unit. For European and other overseas products, this cable will be of the CENELEC Harmonized type. In addition, the wire size will be .82 mm2, or equivalent, for 10 amp use, and have the international insulation color code of brown, light blue, and green/yellow stripe. In the case of use in North America the cable will be U.L. 62 and/or CSA C22.2 No. 49, 18 AWG, and have the North American color code of black, white, and green. In addition, if a molded cord set is supplied, it will be properly approved for North American use or Harmonized for European application.

If the above supplied power cable is not sufficient due to length, or unique specification, the user may replace the cordage (for use in non-hazardous areas), but must abide by the following safety requirements:

- Adhere to nationally recognized standards for cordage for use with this type of equipment, having the power requirements stated in this manual and for use in the intended environment.
- Retain the original connection characteristics in the new connection and have the connection performed by qualified service personnel. This includes:
    - Protective ground connection, see Fig. 2-3.
    - Proper connection to AC disconnect connector at the internal power supply.
    - New cordage diameter must be compatible with the strain relief provided.
    - Strain relief must be tightened securely as to not allow slippage when cordage is pulled or pushed from the outside.
    - Allow six inches of loose power wire inside the unit.

If the unit is to be hard wired into the installation's power system it must be done so in a safe area only and treated as permanently connected equipment and installed according to the local, nationally recognized procedures for equipment of this type and stated power requirements. The installation must have the following characteristics in addition to the above:

- Have a separate disconnect device such as a switch or circuit breaker included as part of the building installation. The power rating for the disconnect should be sized to accommodate the requirements stated on the rear of the unit.
- This device must be in close proximity to the equipment as to be in easy reach of the operator.
- This device must be marked as the disconnecting device for this equipment.

If a mains plug is to be attached to the end of the original cordage, it must comply with the relevant, nationally recognized specifications and/or standards for detachable mains plugs for the stated power requirements of this equipment. If the unit is to be operated in a hazardous location, the plug must be of the grounded and locking type.

NOTE

Hazardous location operation: For use in Class I, Div 2 locations, AC power connection must be made using three feet maximum of agency approved extra-hard usage power cable, terminated with a plug of the grounded and locking type. See NEC section 501-3b6 or CEC 18-172,174.

When the 303B is connected to the AC power mains, the internal battery will either be in a state of recharge, or full charge, maintained by the internal battery charger portion of the power supply. Note that the front panel AC LED is illuminated.

External DC Operation (12Vdc, negative ground, vehicular)

WARNING

This option is available for safe area operation only. Do not attempt to operate this equipment or charge the battery using this option in a hazardous (classified) location!

The 303B is supplied with approximately 12 feet (4m) of low voltage cable, terminated at one end with a standard vehicular male cigarette/accessory plug. The unterminated end is to be inserted through the designated 12 V strain relief on the rear panel and terminated into the AC/DC power board connector at J1 as per Fig. 2.2.

Using the supplied auto lighter plug and cable, connect its black and white leads to J1-5 (+) and J1-4 (-) respectively. Tighten the strain relief securely so that the dc power lead cannot be pulled or pushed through the strain relief from the outside.

The plugged end is intended for insertion into the fused, mating connector of a 12 VDC, negative ground vehicle, only. The value of this fuse should be 1A minimum, with a voltage rating of 18Vor greater. This external connection is not intended to be energized by devices such as DC power supplies, battery chargers, generators, and the like.

WARNING

Non-adherence to the above requirements, or use of the equipment in a manner not specified in this manual, may impair the protection against fire, electrical shock and damage, originally provided by this equipment.

When the 303B is properly connected to a vehicle, the internal battery will be in a state of recharge or full charge, maintained by the internal battery charger portion of the power supply. Note that the front panel AC LED does not illuminate during external DC operation.

Internal DC Operation

The 303B provides an internal 12V, sealed lead acid battery for portable use. There are no special connections or preparations needed to use this feature. Note that the front panel AC LED does not illuminate during internal battery use.

2. Check that jumper plug JP4 on the display board is set for your reading; pins 1 and 2 for ppm, pins 2 and 3 for lb/mmscf.
3. Check that jumper plug JP2 is set as desired for your alarm operation; pins 1 and 2 (F) for fail-safe (relay actuated with readings below setpoint, or pins 2 and 3 (L) for low power (relay actuated with readings above setpoint).
4. Check that the cell leads are secure in plug JP6.
5. Check that the keyboard cable is secure in plug JP5.
6. Check that the power supply cable is secure in plug JP3.
7. Connect the power plug (if used) to either the ac or dc supply.

Start-Up

1. Press the POWER key (LED ON). The analyzer goes through a self check of EEPROM and LED/display, followed by a display of the software revision number (P X.XX). With POWER ON and no sample flow, electrolysis will gradually *dry* the cell.
2. Press the CELL TEST key. The CELL TEST and an ANALOG RANGE key LED will flash and the displayed value will read toward 15.00 (volts). If the display reads below 8.0 (volts), the cell is not dry enough for accurate moisture measurements. Wait until the display reads greater than 12.0 (volts) before continuing.
3. Press the CELL TEST key (LED OFF). Wait for the display to stabilize.

Alarm Setpoint Input

1. Press the ALARM key. The ALARM, +, and – LEDs will flash and the last alarm setpoint will be displayed.
2. Press the + or – key to increment or decrement the setpoint to the desired value.
3. When the desired value is displayed, press ALARM to store the value; **ProG** will be displayed until the value is stored.

NOTE

If the STANDBY, CELL TEST, ELECT TEST, 0-1000, 0-2000, or DISPLAY LIGHT key is pressed during the routine, the new value is not stored and normal moisture measuring begins.

Sample System Hook-Up

1. Do the leak test given in Section 4-6.

WARNINGS

If the instrument is used to measure moisture in toxic or flammable gases, the GAS OUT must exhaust to an area deemed safe and appropriate by the local authority having jurisdiction.

To prevent damage to the moisture cell, it is necessary to purge your sample line prior to connecting the analyzer. Failure to do so may void the warranty.

2. Connect a source of gas at 70 to 700 kPa (10 to 100 psi) gauge with a moisture content of less than 100 ppm to the GAS IN fitting. Nitrogen, instrument air, argon, or helium are commonly used.
3. Close the BYPASS ADJUST valve. *Do not over tighten.*
4. Connect a precision flow meter such as the bubble-o-meter (figure 2-4) to the GAS OUT fitting. The 303B flow meters must be calibrated for all sample gases (refer to Appendix E for correction factors).
5. Set the SAMPLE ADJUST so that the external flow meter indicates 100 mL/min at 25°C (77°F) and 1 atmosphere.
6. Note the reading on the 303B internal flow meter. You may want to mark the tube with a permanent marker.
7. Select the lowest ANALOG RANGE that does not cause the recorder to read full scale.
8. Continue to operate until the displayed moisture level stabilizes.
9. If operating on dc (internal battery), unplug the ac power at the source. The AC POWER LED should go out and the display reading may fluctuate slightly. This slight difference between ac and dc operation is normal and will disappear over a short period of time.
10. If the monitor is operating correctly, shut off sample gas and press the POWER switch (LED off). If it is not operating correctly, review these procedures to ensure they have been properly followed, and read the following manual sections. There are troubleshooting procedures in Section 4.
11. Install the cover and tighten the screws.

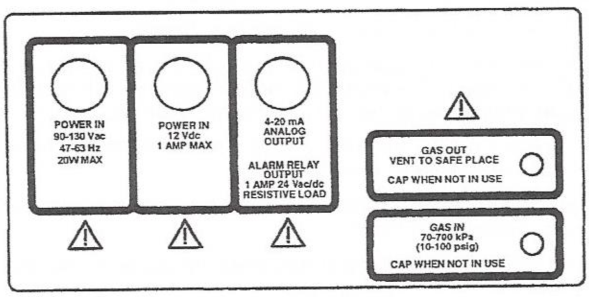
Pressure / Vacuum Pump Use

WARNING

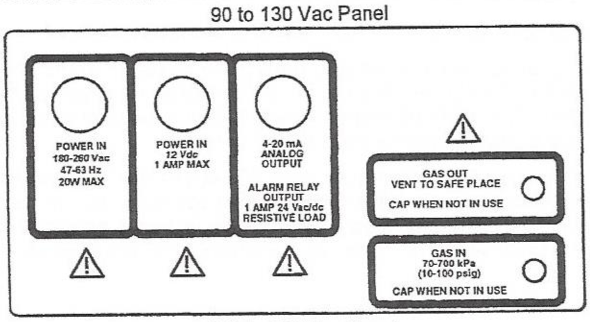
If the monitor is used to sample moisture in toxic or flammable gases, the GAS OUT must exhaust to an area deemed safe and appropriate by the local authority having jurisdiction.

Due to the SAMPLE ADJUST flow controller restriction, if your sample pressure is less than 69 kPa (10 psi) gauge, you must increase the pressure with either a pressure (option A in figure 1-2) or a vacuum pump (option B). An AMETEK pump (PN A.203269000) can be used in either configuration. Keep in mind that some pressure pumps will add moisture to the sample. If you plan to run your monitor with a vacuum pump, proceed as follows:

1. Disconnect the line from the GAS IN or OUT fitting and interconnect it with a tube union. Connect the pump to the union. Check the connection for leaks.
2. Connect the pump outlet or the GAS OUT fitting to vent in a safe area if sampling a hazardous gas.



90 to 130 Vac Panel



180 to 260 Vac Panel

Figure 2-1. Rear Panel

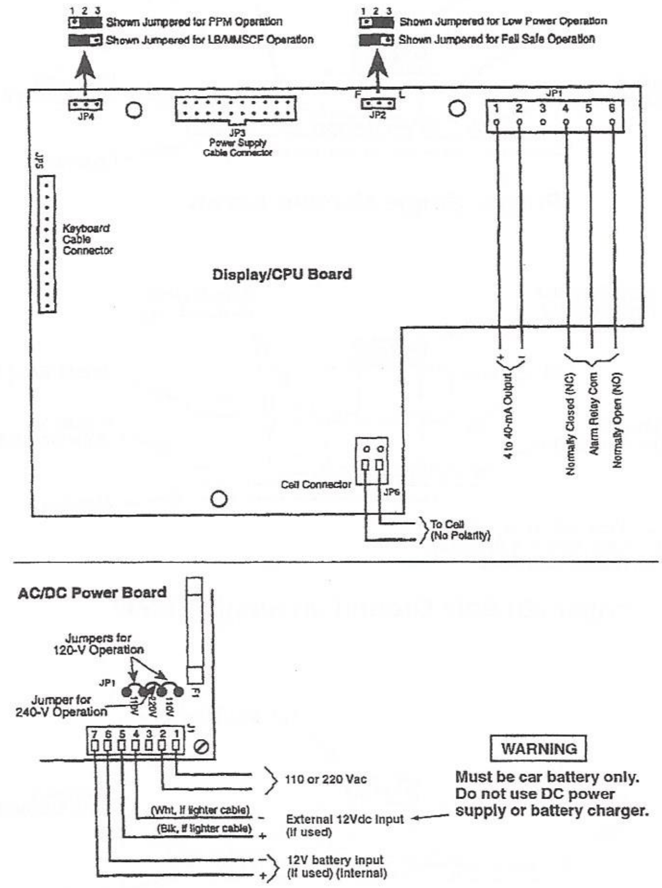
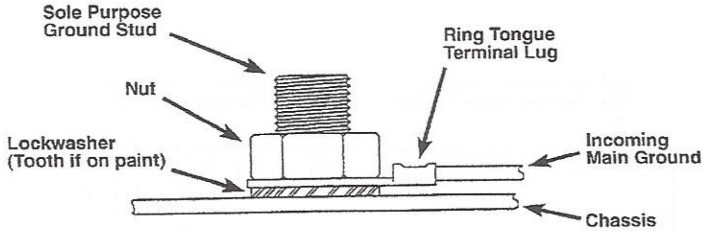
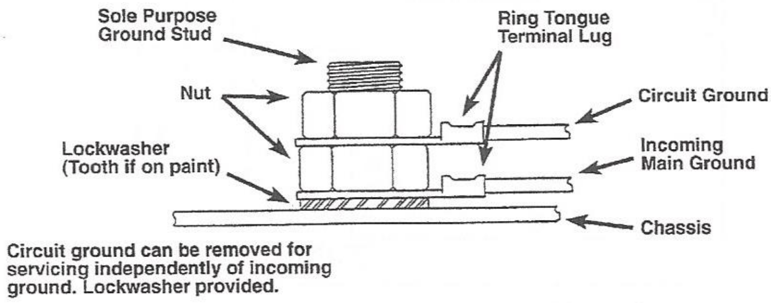


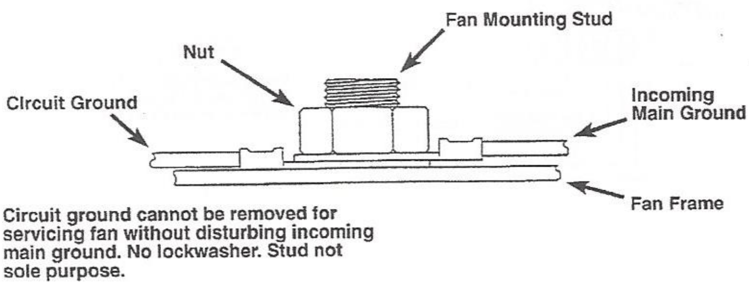
Figure 2-2. Interconnection Diagram (illustration)



Proper Single Ground Screw



Proper Multiple Ground on Single Screw



Improper Multiple Ground on Single Screw

Figure 2-3. Proper and Improper Grounding Methods

1. Wet the entire inside of the bubble-o-meter (tube) with a dilute liquid detergent or shampoo solution through the top of the tube.
2. Tilt the tube sideways and turn it to wet the entire inside surface.
3. Hold the tube upright and check that the liquid level in the rubber bulb is slightly below the Y arm. If level is too high, bubbles will flow without squeezing the bulb. Pour out some of the liquid if this happens.
4. Connect the bottom Y inlet port to a gas source with rubber or plastic tubing.
5. Measure the gas flow rate by carefully squeezing the bulb to form a single bubble and, with a stopwatch, timing its transit time between two adjacent calibration marks.

NOTES

When making precision measurements, use the gas law equations to correct for ambient temperature and vapor pressure, and water tension above the soap solution; be sure to add distilled water occasionally to compensate for evaporation.

When making measurements at low flow rates with gases like helium or hydrogen, form several films ahead of the one being timed to prevent gas loss by diffusion through the film.

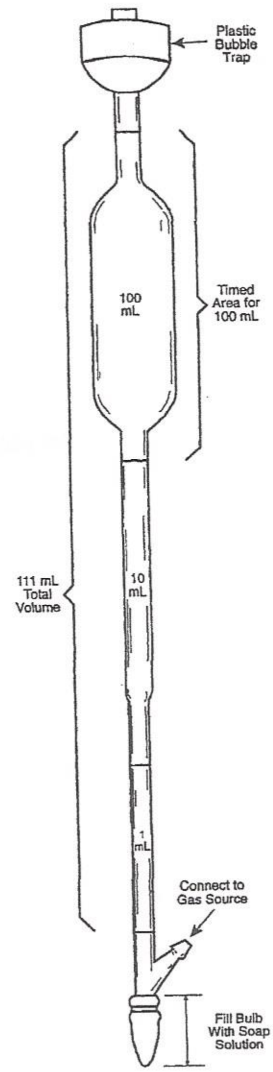


Figure 2-4. Bubble-O-Meter (PN A.303030006)

This page intentionally left blank.

Section 3 - OPERATION

Controls and Indicators

Control	Function	Normal Measuring
BYPASS flow meter	Sets and reads bypass gas flow rate.	Mid-scale.
SAMPLE flow meter	Reads sample flow rate.	100 cc/min at 1 atm
Moisture display	Liquid crystal display (LCD) shows moisture value or other data depending on mode.	Moisture reading
SAMPLE ADJUST	Screwdriver adjustment for sample flow rate	As needed for SAMPLE flow meter reading
BYPASS ADJUST	Screwdriver adjustment for reference flow rate	As needed for BYPASS flow meter reading
ANALOG RANGE keys and LEDs	Keys enable selection of one of four 4 to 20-mA output ranges. LED indicates which range is active	One of the four LED must always be ON
+ key	Plus key increments value selections for gain, offset, factory gain, and alarm setpoint entries.	Not applicable
– key	Minus key decrements value selections for gain, offset, factory gain, and alarm setpoint entries.	Not applicable
DISPLAY LIGHT key	Back lights the display for about 1 minute	As needed
ALARM key and LED	Enables alarm setpoint adjustment with + and – keys.	LED ON if moisture reading is above alarm setpoint.
STANDBY key and LED	Places the unit in a standby mode by reducing power consumption.	Not applicable
ELEC TEST key and LED	Tests 5V power supply.	Not applicable
CELL TEST key and LED	Tests cell 50V power supply.	Not applicable
AC POWER LED	ON when the unit is plugged into ac outlet.	ON (if on ac power)
POWER key and LED	Turns instrument power ON and OFF.	ON
ofst key	Enables changing offset parameter when key is pressed at power-up (refer to Parameter Setting in Section 4).	Not applicable
gain key	Enables changing gain parameter when key is pressed at power-up (refer to Parameter Setting in Section 4).	Not applicable

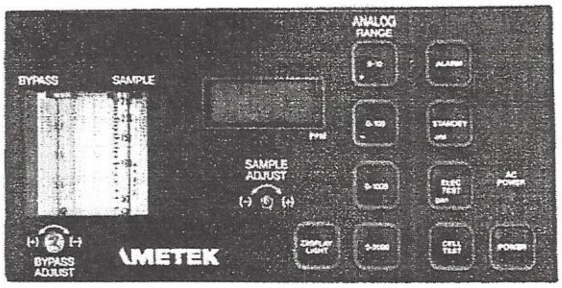


Figure 3-1. Front Panel Controls and Indicators

Operating Procedure (Checklist)

With the instrument connected to a sample gas stream, proceed as fo l-lows:

1. Press the POWER key (LED ON). The system will run through a series of test displays, then start displaying moisture values.
2. Check sample gas for:
   - **Pressure** — Regulated 69 to 690 kPa ±5 percent (10 to 100 psi) gauge ±5 percent
   - **Flow** — ≈ 100 mL/min at 1 atmosphere
   - **Bypass** — ≈ mid-scale
   - **GAS IN temperature** — between 10°C and 50°C

   NOTES

   Refer to the Parameters Affecting Operation — Temperature in Section 1 for temperature variation factor.

   To prevent cell saturation, always shut sample gas off before turning the monitor off.

3. Press the desired ANALOG RANGE key. The LED of the selected RANGE will turn ON.

Transportation

When the instrument is being moved from place to place, cap the GAS IN and OUT fittings to prevent moisture and dirt from entering the lines. If the time lapse between use is less than twenty four hours (on average), the STANDBY switch should be pressed (LED ON) while not in use. This provides a low current to keep the cell dry through electrolysis. Cell equilibration time prior to the next analysis then is reduced. This current draw will not significantly discharge the battery.

Flow Doubling Technique

WARNING

If the instrument is used to measure moisture in toxic or flammable gases, the GAS OUT must exhaust to an area deemed safe and appropriate by the local authority having jurisdiction. Take appropriate precautions.

The effect of electrolyzed reformed water can be easily determined. The reformation of water is constant and independent of flow within the instrument range. Generally, the error resulting from air or oxygen streams can be as high as 10 percent. Use the following technique to reduce this effect:

1. Adjust sample flow to 100 mL/min and note the moisture content.
2. Readjust sample flow to 200 mL/min and note the moisture content.

Moisture Value = Reading at 200 mL/min - reading at 100 mL/min

This page intentionally left blank.

Section 4 - MAINTENANCE

WARNINGS

FIRE AND EXPLOSION: If this equipment is operating in a location that may contain flammable gas or is being used to sample a hazardous gas, AC power must be disconnected from a remote, safe area before performing maintenance or parts replacement. DO NOT USE THE AC POWER PLUG AS A DISCONNECT! DO NOT ATTEMPT TO DISCONNECT THE INTERNAL BATTERY IN THIS SITUATION!

Service operations given or implied in this section should be performed only by AMETEK or other qualified personnel. There are no operator-replaceable parts internal to the unit.

General

Frequency of analyzer maintenance depends almost entirely on the condition of the sample stream being monitored. A clean sample will provide years of trouble free analyzer operation, while a dirty sample can cause the analyzer cell to fail in hours. No special tools are needed to maintain the unit.

WARNING

Take proper precautions when handling acetone, alcohol, phosphoric acid, and nitric acid in the various procedures.

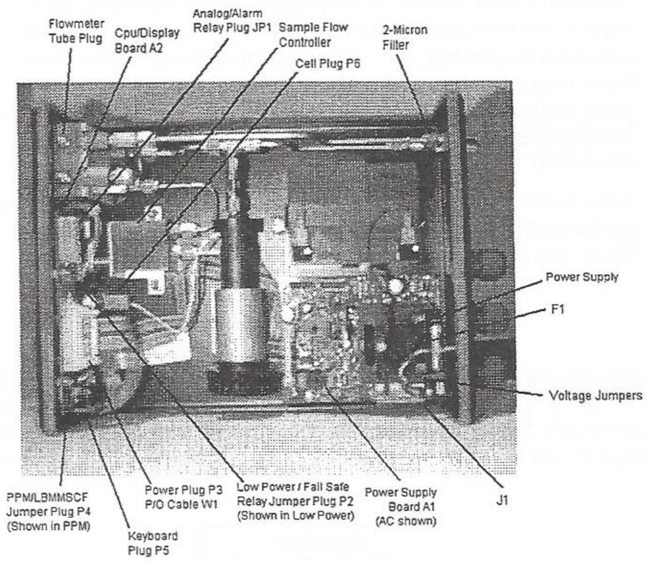


Figure 4-1. Moisture Monitor Interior View

Parts Replacement

Cell or O-Ring Seals (figures 4-1 and 5-3)

1. Turn off power using front panel switch and disconnect the unit from the power source.
2. Shut off sample flow *at the source* and purge the line. Shut off purge.
3. Remove the screws and lift off the cover.
4. Unplug JP6 from the display board, loosen the screws, and remove the cell leads from the connector.
5. Release the cell from its case. Use the cell pull tab.
6. Remove the o-rings from the nozzles. Spread a thin coat of Halocarbon 25-20M grease (PN A.201631001) uniformly over the new rings and place the seals on the nozzles.

Flow Controller (figure 4-1)

1. To gain access, do steps 1, 2, and 3 of the Cell or O-Ring Seal procedure above.
2. Loosen the two tubing ferrule nuts at the flow controller and disconnect the lines.
3. Remove the mounting nuts and lift out the flow controller and bracket.
4. Remove the screw and remove the flow controller from the bracket.

Flow meter Tubes (figure 4-1)

1. To gain access, do steps 1, 2, and 3 of the Cell or O-Ring Seal procedure above.
2. Disconnect the "U" tube between the top fittings.
3. Remove the two screws and the plastic cover from the assembly.
4. With a hex wrench, loosen the plug over the glass tube in the assembly top and remove the tube. Using a piece of tape on the glass makes replacement easier.
5. Be sure the glass tube is centered on the top and bottom seals and the grounding wire is around the tube before tightening the top plug.

NOTE

Do not tighten the screws on the plastic cover or the cover might break.

Power Supply PC Board (figure 4-1)

1. To gain access, do steps 1, 2 and 3 of the Cell or O-Ring procedure above.
2. Loosen the screws and remove the power-in wires from J1; remove the ribbon plug from J2.
3. Remove the four mounting screws and board from its mounting.

Main AC Fuse (figure 4-1)

1. Remove power supply as per above.
2. Locate fuse F1 on the power supply board near the transformer.
3. Lift out F1 and test with an ohm meter. If open, use appropriate fuse type stated in Section 5.
4. If fuse blows again, replace power supply pc board.

Battery (figure 4-1)

1. To gain access, do steps 1, 2 and 3 of the Cell or O-Ring procedure above.
2. Remove the wire terminals from the battery. Note that red wire is on + terminal.
3. Remove the two bracket nuts, move the bracket to the side, and lift out the battery.
4. If new battery does not fix problem, check polarity. Allow 24 hours for initial charge.

Warning

On battery replacement, use only AMETEK A.303020001, nominal 12Vdc @ 5 Amp hour.

CPU/Display Board

1. To gain access, do steps 1, 2 and 3 of the Cell or O-Ring procedure above.
2. Remove connectors P6, P1, P3, and P5.
3. Remove the three mounting nuts and the board.

Cell Cleaning, Flushing, and Recoating

The cell coating may be contaminated, dirty, oil covered, or washed out by liquid. These conditions are indicated by an incorrect reading on a known gas.

Particulate matter may cause a short or a partial short. Shorts are indicated by a very high display reading, or a noisy or steady high reading on a known gas. Regardless of whether the cell is shorted, contaminated, or washed out, it must be replaced or repaired. New cells are available from AMETEK, or they may be repaired as follows:

NOTE

This procedure must be done under laboratory conditions. Chemicals and solvents used must be chemically pure, reagent grade, and free from particulate matter. The syringe and o-ring used (figure 4-2) must be free from contaminants and foreign matter.

1. Use a glass hypodermic syringe with a non-metallic tip (figure 4-2) and flush the cell with distilled water. Do not use a needle on the syringe. Insert the small end of the syringe into the cell port with just enough force that the o-ring makes a good pressure seal.
2. Flush the cell with acetone, alcohol, or other suitable solvent to remove contaminants.
3. Repeat with distilled water and with acetone. This flushing renders the cell inactive.
4. Blow the acetone from the cell with clean dry air.
5. Place the cell in the monitor with sample flow off. If the reading is more than 1 ppm, rewash the cell (step 1). If the reading is less than 1 ppm, recoat the cell as follows:

CAUTION

The phosphoric acid (85 percent H_3PO_4 in water) and acetone must be chemically pure, reagent grade. The solution must be freshly prepared.

a. Prepare a solution of 2 parts phosphoric acid to 8 parts acetone by volume.

b. Use a clean glass syringe with a non-metallic tip and fill the cell with the coating solution.

c. When the cell is completely filled, withdraw the solution with syringe.

d. Pass about 100 mL/min of dry gas (air, nitrogen, etc.) through the cell for 15 to 20 minutes to evaporate the acetone. Acetone must be completely removed from the cell before using it. A thin coating of phosphorus pentoxide will remain.

e. After the acetone is completely removed, place the cell in the monitor and continue to pass dry gas, per above, for an additional 30 minutes without power applied. Then run an analysis until the meter stabilizes, which may take up to 24 hours. If the reading does not stabilize, the cell may be shorted; replace it.

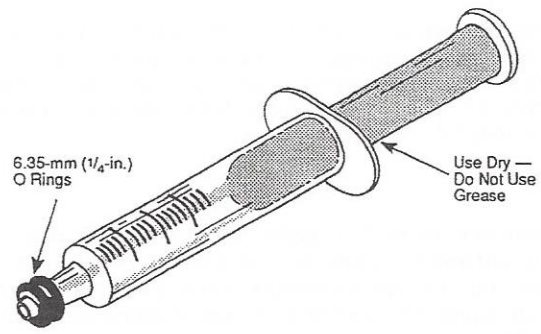


Figure 4-2. Syringe Used for Cell Flushing

Testing

Leak Test

The following test will assure that the monitor is free from leaks that will interfere with proper operation.

1. Cap off the GAS OUT fitting.
2. Attach a 0 to 1000-kPa (150-psi) leak-free pressure gauge and leak-free shutoff valve to the GAS IN fitting (the gauge must be between the valve and the monitor).
3. Connect a regulated source of clean, dry, pressurized gas (N_2, instrument air, etc.) to the shutoff valve. With the valve closed, adjust gas pressure to 700 kPa (100 psi) gauge. Slowly open the valve and allow pressure in the monitor to equilibrate. Ensure that the monitor pressure gauge reads 700 kPa (100 psi) and adjust if necessary. Close the shutoff valve and disconnect the gas source from the IN fitting.
4. After 60 minutes, note the pressure. It should not drop more than 34 kPa (5 psi) gauge.
5. If pressure test is satisfactory, remove the gauge, shutoff valve, and caps. Proceed to other tests in this section.
6. If gauge pressure has dropped more than 14 kPa (2 psi), repressurize to 700 kPa (100 psi) and check all connections for leaks with a soap solution. Repair leaks as needed.
7. Repeat steps 3 through 6 until a gauge pressure drop of less than 14 kPa (2 psi) is noted.
8. Remove pressure gauge, shutoff valve, and caps. Proceed to other tests in this section.

Gas Flow Operational Test

1. Check all fittings for tightness.

WARNING

If you use a hazardous gas, be sure the bubble-o-meter is vented to a safe place.

2. Connect a flow device such as a bubble-o-meter or a flow meter to the GAS OUT fitting. Since it is more accurate, a bubble-o-meter is preferred.
3. Adjust sample gas pressure to about 3.4 bar (50 psi) gauge.
4. Vary sample gas pressure between 1.4 and 6.9 bar (20 and 100 psi) gauge and check that flow does not vary more than ±5 percent.

Power Supply Voltage Tests

1. Press POWER key (LED ON).
2. Disconnect the ribbon cable plug from power supply board connector J2.
3. Measure the voltages shown in figure 4-3 on each J2 pin using small clip leads. If any voltage is > ±10 percent, replace the power supply board.
4. If all voltages are ok, connect the ribbon cable plug and do a:
   - **Cell Test** to check the 50-volt supply. Unplug the cell at JP6. If the displayed voltage is not between 47 and 53, replace the power supply board.
   - **Electrical Test** to check the 5-volt supply. If the displayed voltage is not between 4.7 and 5.3, replace the power supply board.
   - **Output Test** to check the 4 to 20-mA output. Disconnect the leads from JP1-1 and -2 and attach a dc voltmeter in their place (+ to -1). If the voltmeter does not read between 13 and 17, replace the cpu/display board.

Troubleshooting

Troubleshooting Table 4-1 localizes a faulty assembly. It is not intended to isolate a faulty component.

Memory Errors Er01 and Er02

Both these displayed errors are associated with the Analog Range, Alarm Setpoint, *Gain*, *Offset*, and *Factory Gain* variable parameters stored in electrically erasable read-only memory (EEPROM). EEPROM retains parameter values on power shut-down so they can be reenabled on power-up. A coding scheme — checksum — is stored with the data to make sure the data does not change during storage.

On power-up, the stored parameters are read and checked against the checksum. If there is a problem with checksum reading, read error **Er01** is displayed. If there is a problem storing values during parameter value entering, write error **Er02** is displayed. Only the Analog Range parameter entry does not give a display feedback when it is stored correctly. For either error, power-down and reenter the parameters as directed in the procedures on pages 4-7 and 4-8.

Display and LED Test

On power-up, all LEDs and display segments sequence through the set pattern shown in the following chart at a half-second-per-step rate. The LEDs will flash ON and OFF at about a four-per-second rate. Observing the sequence closely lets you see if any LED or segment is not working. Although the POWER and AC POWER LEDs are not part of the sequence, they will be ON whenever the monitor is connected to an ac supply and the unit is powered up.

		Flashing LED Positions							
STEP	DISPLAY	CELL TEST	ELEC TEST	STAN BY	ALAR	ANALOG RANGE Bottom		to	Top
1	8.8.8.8	ON	ON	ON	ON	ON	ON	ON	ON
2	0 0 0 0	ON							
3	1 1 1 1	ON	ON						
4	2 2 2 2	ON	ON	ON					
5	3 3 3 3	ON	ON	ON	ON				
6	4 4 4 4	ON	ON	ON	ON	ON			
7	5 5 5 5	ON	ON	ON	ON	ON	ON		
8	6 6 6 6	ON	ON	ON	ON	ON	ON	ON	
9	7 7 7 7	ON	ON	ON	ON	ON	ON	ON	ON
10	8 8 8 8	ON	ON	ON	ON	ON	ON	ON	ON
11	9 9 9 9	ON	ON	ON	ON	ON	ON	ON	ON
12	P x.xx	ON	ON	ON	ON	ON	ON	ON	ON

In step 12, P x.xx represents your software revision number, which can be helpful to identify software upgrades. This should be the same number written on the cpu/display board cpu PROM.

Parameter Settings

Offset

Offset subtracts from the moisture readings.

1. Press the POWER key (LED OFF). Hold the STANDBY key (LED ON) and press the POWER key (LED ON) until the STANDBY, +, and – LEDs flash.
2. Press the + or – key to increment or decrement the display to the desired valve.
3. When the desired value is displayed, press ELEC TEST to store the value; **ProG** will be displayed until the value is stored, followed by the normal LED/display test.

NOTE

If the ALARM, CELL TEST, 0-1000 (50), 0-2000 (100), or DISPLAY LIGHT key is pressed during the routine, the new value is not stored and normal moisture measuring begins.

Gain

Gain adjustment enables a value to be entered to compensate for non-standard ranges or flow limitations.

1. Press the POWER key (LED OFF). Hold the ELEC TEST key (LED ON) and press the POWER key (LED ON) until the STANDBY, +, and – LEDs flash.
2. Press the + or – key to increment or decrement the display to the desired valve.
3. When the desired value is displayed, press STANDBY to store the value; **ProG** will be displayed until the value is stored, followed by the normal LED/display test.

NOTE

If the ALARM, CELL TEST, 0-1000 (50), 0-2000 (100), or DISPLAY LIGHT key is pressed during the routine, the new value is not stored and normal moisture measuring begins.

Factory A/D Gain

Factory A/D gain linearizes the cpu/display board to the moisture cell.

1. Press the POWER key (LED OFF). Hold both ELEC TEST and STANDBY keys (LEDs ON) and press the POWER key (LED ON) until the STANDBY, ELEC TEST, + and - LEDs flash.

2. Press the + or - key to increment or decrement the display to the desired value.
3. When the desired value is displayed, press STANDBY to store the value; **ProG** will be displayed until the value is stored, followed by the normal LED/display test.

NOTE

If the ALARM, CELL TEST, 0-1000 (50), 0-2000 (100), or DISPLAY LIGHT key is pressed during the routine, the new value is not stored and normal moisture measuring begins.

Table 4-1. Troubleshooting Chart

Symptom	Possible Cause	Corrective Action
No display	Power cord not plugged in	Plug in power cord
	Blown Fuse	Replace fuse (F1)
	Faulty power supply board	Replace power supply board
Display reads over range	Temporarily saturated cell	If normal reading is not obtained in 1 hour, continue drydown
	Saturated cell	Shut off sample flow at the source and allow cell to dry. Keep 303B operating electrically
Display reading erratic (noisy)	Shorted cell	Replace the cell
	Varying sample flow	Replace the flow regulator
	Intermittent short	Replace the cell
	Faulty power supply board	Replace power supply board
Display reading low on gas with a known moisture content	Low gas flow rate	Check and adjust flow rate
	Clogged filter or dirty smaple flow valve	Replace filter. Replace flow regulator
	Contaminated or dirty cell, or partially inactive phosphorous pentoxide	Remove, flush and recoat cell
Display reading high on gas with a known moisture content	High gas flow rate	Check and adjust flow rate
	Leak in sample system	Do a leak test
	Dirty flow meter	Replace flow regulator
	Shorted or partially shorted cell	Remove, flush and recoat cell
Flow slow or erratic	Clogged filter or flow meter	Replace filter or flow regulator
AC POWER LED does not light with unit connected to ac supply	Blown fuse F1	Replace fuse

Table 4-1. Troubleshooting Chart (Continued)

Symptom	Possible Cause	Corrective Action
After power up, display shows **Er02**	Checksum read error detected during alarm, analog range, *gain offset* or *factory gain* read	Reenter parameter values as directed in procedure on pages 4-7 and 4-8
After power up, display shows **Er01**	Checksum write error detected during alarm, analog range, *gain offset* or *factory gain* write	Reenter parameter values as directed in procedure on pages 4-7 and 4-8
Display flashing 9999	Gain or moisture level too high	Do a cell test for high moisture level, or reset the gain or factory gain values as directed in procedures on page 4-9
ELEC TEST, +, and - LEDs flashing	In gain adjust mode; display shows offset value	Press any key to exit without saving displayed value; press ELEC TEST to exit and save value
STANDBY, +, and - LEDs flashing	In offset adjust mode; display shows offset value	Press any key to exit without saving displayed value; press STANDBY to exit and save value
ELEC TEST, STANDBY, +, and – LEDs flashing	In factory gain adjust mode; display shows factory gain value	Press any key to exit without saving displayed value; press ELEC TEST and STANDBY to exit and save value
ALARM, +, and – LEDs flashing	In alarm adjust mode; display shows alarm setpoint	Press any key to exit without saving displayed value; press ALARM to exit and save value.
STANDBY (display blank) LEDs flashing	In standby - battery power save mode	Press STANDBY to return to moisture analysis.
ELEC TEST and any one ANALOG RANGE LEDs flashing	In electrical test mode	Press ELEC TEST to exit.
CELL TEST and any one ANALOG RANGE LEDs flashing	In cell test mode	Press CELL TEST to exit.
Analyzer will not turn off in battery mode	Low Battery	Recharge the battery by running the analyzer in the AC power mode.

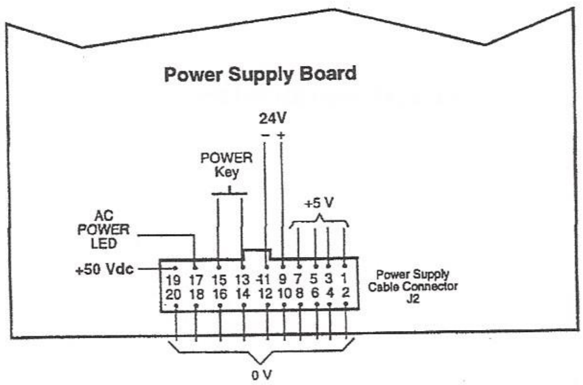


Figure 4-3. Power Supply Board Voltages

This page intentionally left blank.

Section 5 - PARTS LIST

General

This section lists parts AMETEK considers practical to stock and supply for replacement. The parts are listed in Table 5-1 and identified by reference designation or item numbers in Figures 5-1, 5-2, and 4-1.

Parts Ordering Information

To obtain replacement parts, contact any of the regional offices listed below and include the part number and description. To ensure that you receive the correct part for your monitor, be sure you include the instrument type and its serial and/or model number.

AMETEK Process Instruments
455 Corporate Boulevard
Newark, Delaware 19702, USA
Phone: 302-456-4400 (Main)
800-537-6044 (Service)
800-222-6789 (Ordering)
Fax: 302-456-4444

AMETEK Precision Instruments Europe GbmH
(EU Representative)
Rudolf-Dieselstrasse 16
D-40670 Meerbusch
Germany
Phone: 49-21-59-9136-0
Fax: 49-21-59-9136-39

AMETEK Process Instruments France
3 Avenue des Courdriers
Z.A. de l'Observatoire
78180 Montigny Le Bretonneux
France
Tel: 33 130 64 89 70
Fax: 33 130 64 89 79

AMETEK Process Instruments
305 Wells Fargo, Suite A-7
Houston, Texas 77090, USA
Phone: 281-631-0837
Fax: 281-631-0845

AMETEK Singapore PVT. Ltd.
10 Ang Mo Kio Street 65
#05-12 Techpoint
Singapore 569059
Republic of Singapore
Phone: 65-484-2388
Fax: 65-481-6588

AMETEK Taiwan
14-F-1, No. 37 San Ming Road
Section 2, Pan Chiao
Taipei, Taiwan, R.O.C.
Phone: 886-2-9634683
Fax: 886-2-9634713

Table 5-1. Parts List

Figure/ ID No.	Description	Part No.
4-1/A1	Power Supply PC Board, 120V AC/DC	A.303304901
4-1/A1	Power Supply PC Board, 220V AC/DC	A.303305901
4-1/F1	• Fuse, 0.5 A (120V) Littlefuse 314.50 F Type	A.205219004
4-1/F1	• Fuse, 0.25 A (240V) Littlefuse 314.25 F Type	A.205219002
4-1/A2	CPU/Display PC Board, PPM	A.303202901
4-1/A2	CPU/Display PC Board, LB/MMSCF	A.303202901
—	• PROM IC U3	A.303250901
4-1/W1	Ribbon Cable Assy	A.303231901
3-1/A3	Front Panel Overlay (PPM)	A.303211901
3-1/A3	Front Panel Overlay (LB/MMSCF)	A.303211902
2-1	Back Panel Overlay (120 V)	A.303212901
2-1	Back Panel Overlay (240V)	A.303212902
4-1/BT1	Battery 12 V, 5 Amp-Hour	A.203626001
—	Battery Bracket	A.303213003
4-1	Flowmeter Assy, Bypass	A.303209901
—	Flow Controller Bracket	A.303213001
4-1	Flow Controller, Sample	A.280807005
4-1-4	Cell Case Assy w/Cap	A.303235901
4-1	• Cell Cap	A.303033000
5-1-1	• O-Ring Seal, 2.89 mm ID	A.202813006
4-1	Cell Bracket	A.303213002
—	Electrolytic Cell	A.303229901
4-1	Filter Assy (F-1)	A.571025002
	• Inline Filter Frit, 2 μm, Replacement	A.233303002
—	Bulkhead Fitting	A.203332002
2-1	Cable Gland	A.280374006
—	Cable Gland Locknut	A.280374005
—	Feet (8-32-3/8 screw)	A.202161000
—	Plug, Sample Adjust	A.202216001
—	Power Cord, Auto Lighter	A.303256901
—	Instruction Manual	A.303230001

Accessories		
Figure	**Description**	**PartNo.**
2-1	Bubble-O-Meter	A.303030006
5-2	Vacuum/Pressure Pump	A.203269001
5-2	Coalesing Oil Filter	A.303165901
5-2	Pressure Reducer	A.510150901
—	Heated Pressure Reducer (230 V, Div 1)	A.259889003
—	Heated Pressure Reducer (115 V, Div 1)	A.259890003
—	Heated Pressure Reducer (230 V, CENELEC)	A.259891001
5-2	Carrying Case	A.303255901
1-2	Tubing, Stainless Steel, 1/8-in. OD, 10-ft length	A.571061017

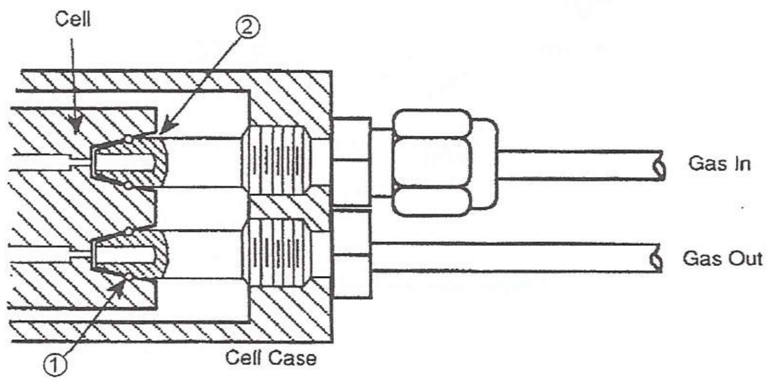


Figure 5-1. Cell and Case Assembly

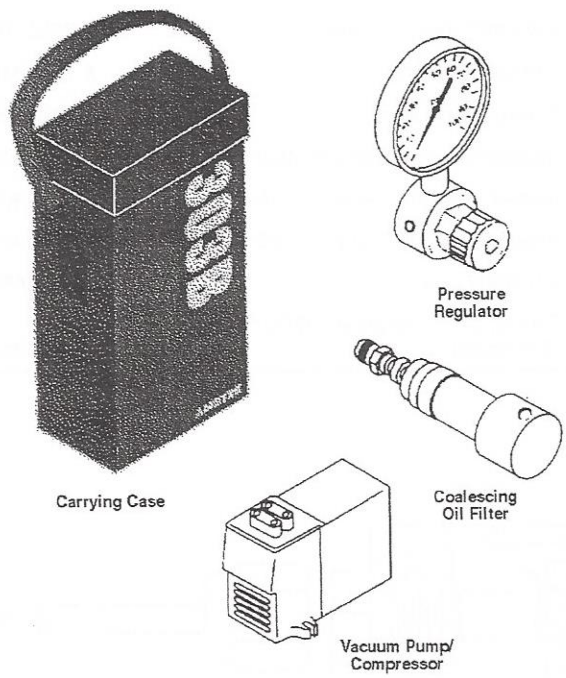
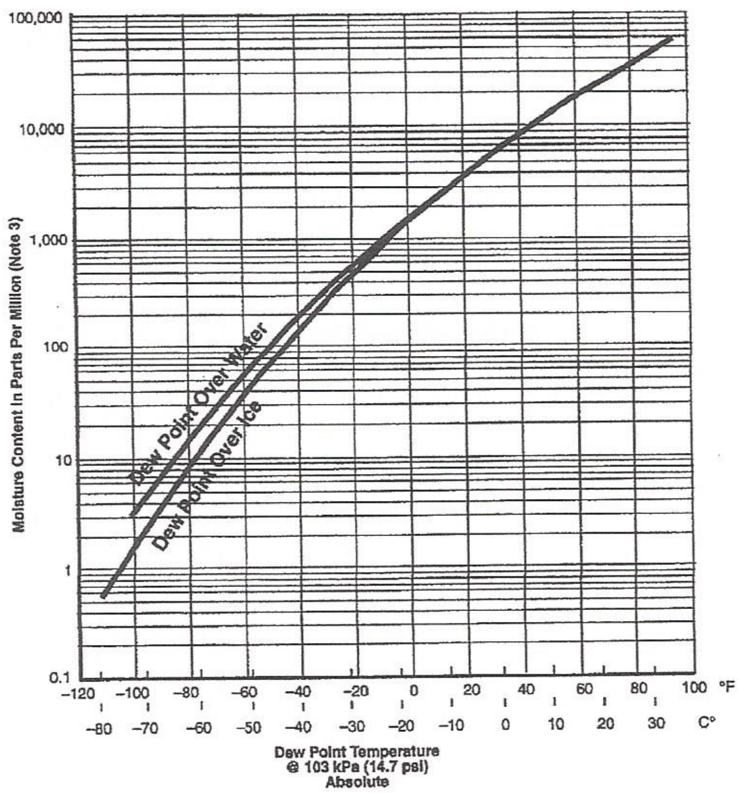


Figure 5-2. Accessories

Appendix A



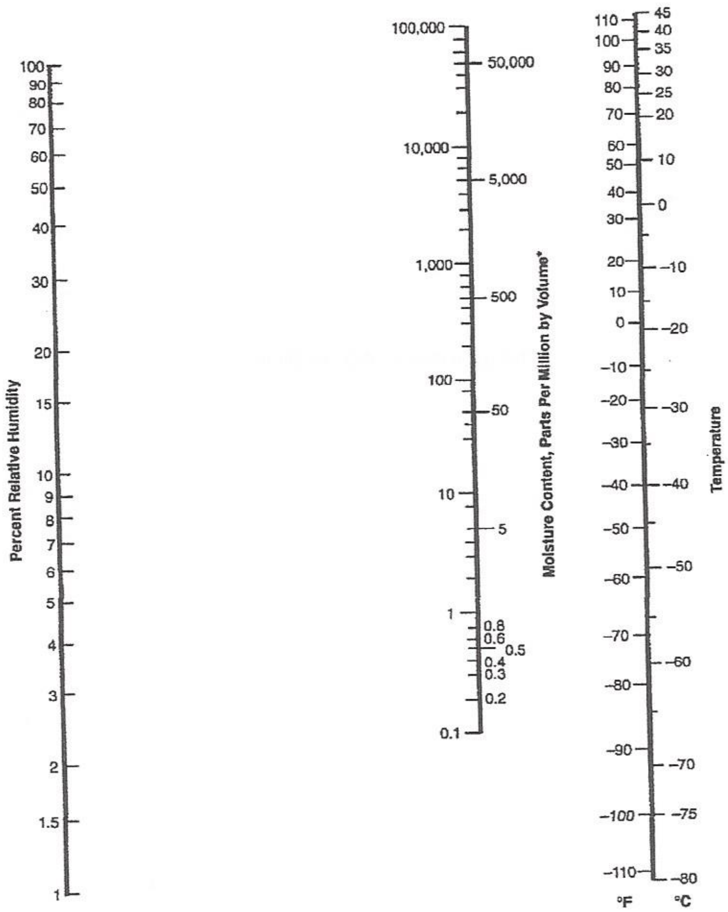
NOTES

1. The graph is based on standard atmospheric pressure. See figure C-1 for relationship at other pressures.
2. The graph relates absolute moisture levels, as obtained on the 303B, to dew point in either °F or °C.
3. To convert ppm to lb/mmscf, multiply the ppm value by 0.0476.

Figure A-1. Conversion Chart (PPM H_2O to Dew Point)

This page intentionally left blank.

Appendix B



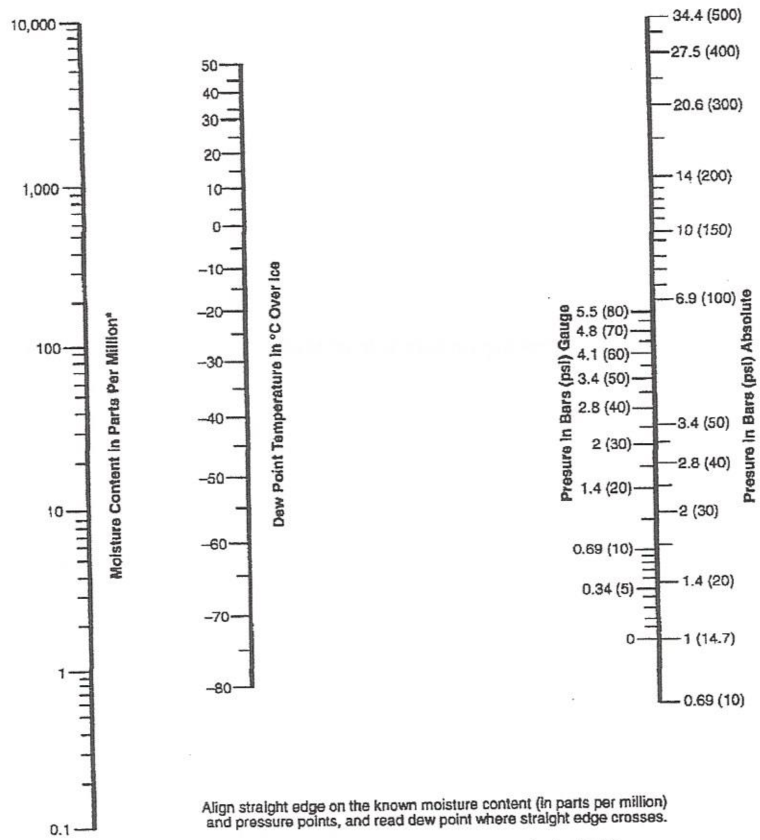
With a known moisture content in parts per million at a given temperature, place a straight edge across these values on the proper scales, and read the value of the relative humidity where the expended straight edge crosses.

* To convert ppm to lb/mmscf, multiply the ppm value by 0.0476.

Figure B-1. Nomogram, Conversion of PPM H_2O to Relative Humidity

This page intentionally left blank.

Appendix C



Align straight edge on the known moisture content (in parts per million) and pressure points, and read dew point where straight edge crosses.

* To convert ppm to lb/mmscf, multiply the ppm value by 0.0476.

Figure C-1. Nomogram, Determination of Dew Point with Pressure

This page intentionally left blank.

Appendix E

Divide desired flow rate by the following correction factors to obtain proper flow meter setting.

Flow meter Correction Factors (Approximate)	
Argon	0.85
Butadiene	0.73
Butane	0.71
Carbon Monoxide	1.01
Ethane	0.98
Ethylene	1.02
F-22	0.58
F- 12	0.49
134A	0.53
Helium	2.69
Isobutane	0.71
Isobutylene	0.72
Methanes	1.35
Nitrogen	1.01
Oxygen	0.95
Propane	0.81
Propylene	0.83

$$X = \frac{\text{Mole weight of gas}}{28.95 \text{ (Mole weight of air)}}$$

Correction Factor = $\sqrt{1/X}$

This page intentionally left blank.

Appendix D

lb/MMscf Pounds of water per million cubic feet of sample. (A temperature must be specified.)

Electrolytic Cell Cell with two electrodes coated with a phosphorus pentoxide desiccant. Water vapor is absorbed by the desiccant and electrolyzed by current passing through the cell.

Saturated Cell A condition where the phosphorus pentoxide coating has absorbed so much water that cell drying is required.

Flooded Cell A condition of extreme saturation. The phosphorus pentoxide coating is dissolved, so that recoating is necessary.

Water Hang-Up Water trapped or absorbed onto the system walls or fittings.

Tramp Water Water which has entered a sample stream from a source other than the source being sampled.

System Equilibrium A system condition where water is absorbed onto the system walls at the same rate as it is given off.

Entrained Dirt Dirt carried by a sample stream.

Dew Point (H_2O) Temperature at which water vapor begins to deposit as liquid.

System Response Time Sample system volume divided by the flow.

Speed of Response The time for the moisture analyzer to reach 63 percent of its final reading after a step change in moisture content.

XX_XX In mathematical terms, a single variable using two or more words.

This page intentionally left blank.