Meriam Instrument
a Scott Fetzer company
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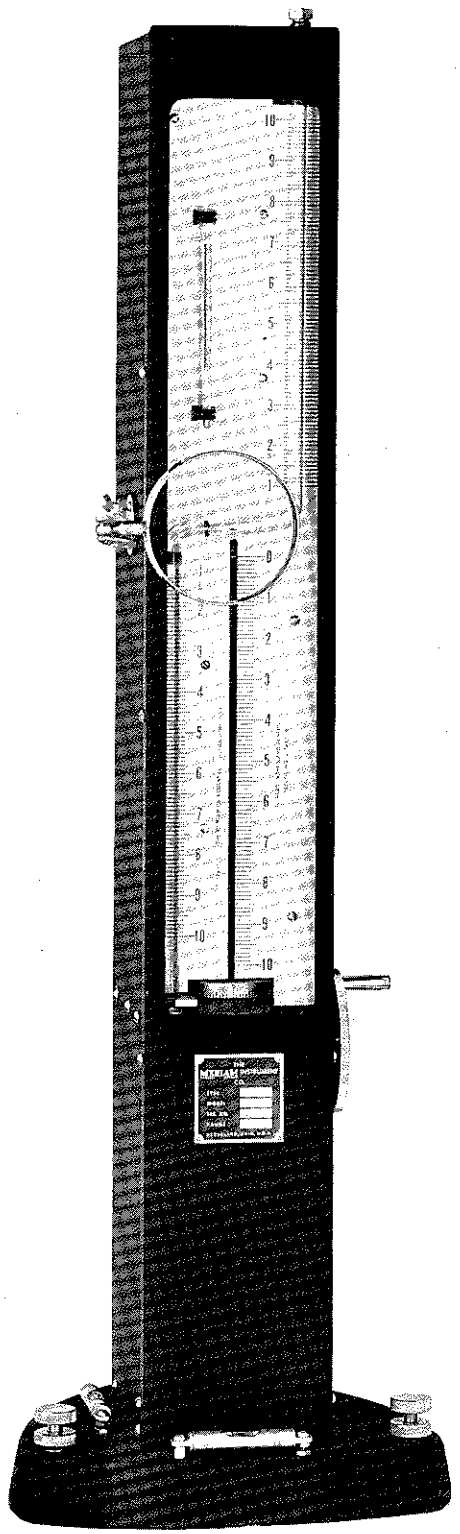
Instructions for

MODEL 34 FB2TM MICROMANOMETER



1. General

The Meriam Micromanometer is a sensitive manometer for indicating pressures, vacuums, or differential pressures to .001" water pressure. It is available in 10" and 20" ranges, designed for table mounting. Treated water must be used as the indicating fluid in the instrument.

The Micromanometer consists of a well type manometer with the well movable in a vertical plane by means of a precision ground lead screw. A uniformly graduated scale and micrometer graduated wheel are attached directly to the lead screw, providing direct reading indication of the well travel to .001". The glass indicating tube consists of two vertical legs with an inclined portion in the center. The angle of this incline tube is such to provide sensitivity for accurate indication. On the inclined portion a reference hairline has been etched into the glass and serves as the zero, or fixed reference, for the instrument.

2. Uncrating & Inspection

Carefully unpack the instrument and make a thorough check for any possible shipping casualties. Remove all protective cushions or plugs. If damaged, contact carrier and save the package.

3. Mounting

Mount the instrument vertically at the most suitable height for convenient reading on a table or bench. Be certain the instrument is level by adjusting the leveling screws and reading the built-in levels. The two precision levels mounted on the instrument base have been set at time of calibration and must not be readjusted.

4. Zero Adjustment

By rotating the handwheel on the right side of the instrument, set the well position indicator to the zero graduation of the well position indicator scale. Final set position is assured when the micrometer wheel at the bottom of the instrument is reading zero.

5. Filling

Mix 3 ounces of Meriam fluid concentrate with 29 ounces of distilled water to make 1 quart of indicating fluid, as directed on the label of the concentrate. Remove the fill plug on the well located inside the door on the back of the instrument housing. Adjust well to mid position with knurled wheel well adjustment.

Slowly pour approximately 4 fluid ounces of the mixed green indicating fluid into the well of the instrument, until the fluid level in the inclined portion of the glass tube is just short of the hairline. Air bubbles must not be retained in any portion of the indicating fluid system. Application of breath pressure by means of a clean rubber tube connected at the low pressure connection, will exercise the indicating column and remove all air bubbles which may have been entrapped during the filling procedure. Allow the instrument to set for a period of fifteen minutes to allow for any fluid to drain down.

For final set of the indicating column, release the locking screw of the well adjustment knurled wheel and raise or lower the instrument well until the fluid meniscus is positioned at the hairline reference on the inclined tube. Replace fill plug and lock the well adjusting screw.

6. Leveling

Again check the instrument levels to be certain both level bubbles are exactly between the two hairlines.

When level, tighten the lock nuts provided on the leveling screws.

7. Soaking Period–For Temperature Equalization

When the Micromanometer is moved from one temperature location to another temperature location, a 24 hour soaking period is recommended for temperature equalization. This same procedure is recommended following the filling procedure outlined under step 5 above. Recheck the fluid meniscus and readjust, if necessary.

8. Connection and Hook up for Operation.

In calibrating, the zero reference point of the instrument being calibrated should be aligned at the same vertical height as the reference calibration point on the micromanometer. This eliminates unequal head pressures.

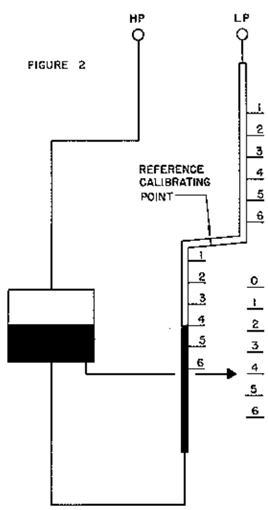


FIGURE 2

To measure pressure above atmospheric pressure very accurately, lower the well to the desired pressure with the crank handle located on the side of the mircomanometer. The fluid level in the tube will drop (Fig. 2). Use the micrometer wheel at the base of the unit to read to one thousandth of an inch. Connect the pressure source to the high pressure connection and make sure the low pressure connection is vented to atmosphere. Now apply pressure to bring the meniscus back to the reference calibration point (Fig. 3).

To continue to read pressures up scale, again lower the well to the desired pressure. The fluid in the tube will drop. Use the micrometer wheel to read to one thousandth of an inch. Apply pressure to bring the meniscus back to the reference calibration point.

To measure a vacuum, the procedure is exactly the same as above. Lower the well to the desired vacuum. The fluid level in the tube will drop. Use the micrometer wheel to read to one thousandth of an inch. Connect the vacuum source to the low pressure connection and make sure the high pressure connection is vented to atmosphere. Now apply vacuum to bring the meniscus back to the reference calibration point.

In measuring a differential pressure, the high pressure side is always connected to the well connection. The lower pressure side is always connected to the indicating tube. Follow the above out lined procedure.

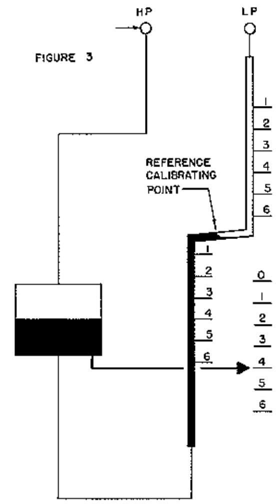


FIGURE 3

To use the micromanometer as a conventional manometer, set the well at the initial calibration position. Read the measured pressure, vacuum, or differential, using the scales immediately adjacent to the indicating tube legs.

9. Theory

The fundamental relationship for pressure expressed by a liquid column is:

$$p = P_2 - P_1 = \rho g h$$

p = differential pressure
P_1 = pressure applied to the low pressure connection
P_2 = pressure applied to the high pressure connection
ρ = mass density of the liquid (specific gravity)
g = acceleration of gravity
h = height of the liquid column

In gage pressure readings, P_1 is equal to zero (atmospheric), simplifying the equation to:

$$p = \rho g h$$

As simple as manometry is certain aspects are often overlooked. Manometry is a function of both density and gravity. These two values are not constant. Density is a function of temperature and gravity is a function of latitude and elevation. Because of this relationship some ambient conditions must be selected as standard, so pressure bears a fixed definition.

Standard conditions for mercury used as a unit of pressure:

Gravity: 980.665 cm/sec^2 (32.174 ft/sec^2) at sea level and 45.544 degrees latitude

Temperature: 0°C (32°F) density = 13.5951 g/cm^3.

Standard conditions for water used as a unit of pressure:

Gravity: 980.665 cm/sec^2 (32.174 ft/sec^2) at sea level and at 45.544 degress latitude

Temperature: 4°C (39.2°F) density = 1 g/cm^3.

Though it is recommended that the valve of a water column as a unit of pressure be at 4°C, its universal acceptance has been slow. For instance in aeronautics 15°C (59°F) is used. The American Gas Association uses 15.56°C (60°F). In orifice flowmeter work 20°C (68°F) is commonly used.

In recognizing that manometers may be read outside standard temperature and gravity, corrections can be applied to improve the accuracy of a manometer reading at any given condition.

10. Temperature Corrections

Manometers indicate the correct pressure at only one temperature. This is because the indicating fluid density changes with temperature. If water is the indicating fluid, an inch scale indicates one inch of water at 4°C only. On the same scale mercury indicates one inch of mercury at 0°C only. If a reading using water or mercury is taken at 20°C (68°F) then the reading is not an accurate reading. The error introduced is about 0.4% of reading for mercury and about 0.2% of reading for water. Since most manometers are read at temperatures well above the standard temperature, corrections are needed. A simple way of correcting for the temperature error is to ratio the densities.

$$\text{(Standard) } \rho_o g h_o = \text{(Ambient) } \rho_t g h_t$$

$$h_o = \frac{\rho_t}{\rho_o} \times h_t$$

h_o = corrected height of the indicating fluid to standard temperature

h_t = height of the indicating fluid at the temperature when read

ρ_o = density of the indicating fluid at standard temperature

ρ_t = density of the indicating fluid at the temperature when read

Using this method is very accurate, when density/ temperature relations are known. Data for 1000 green concentrate is readily available. It is formulated to have the same density as water at 20°C and closely follows the density/temperature relationship for water.

11. Gravity Corrections

The need for gravity corrections arises because gravity at the location of the instrument governs the weight of the liquid column. Like the temperature correction, gravity correction is a ratio.

$$\text{(Standard) } \rho_o g_o h_o = \text{(Ambient) } \rho_t g_t h_t$$

$$h_o = \frac{g_t \rho_t}{g_o \rho_o} \times h_t$$

g_o = standard gravity – 980.665 cm/s^2

g_t = gravity at the instruments location

Gravity values have been determined by the U.S. Coast and Geodetic Survey at many points in the United States. Using these values, the U.S. Geodetic Survey may interpolate and obtain a gravity value sufficient for most work. To obtain a gravity report, the instruments latitude, longitude, and elevation are needed. For precise work you must have the value of the gravity measured at the instrument location.

Where a high degree of accuracy is not necessary and values of local gravity have not been determined, calculations for differences from local gravity can be obtained. Gravity at a known latitude is:

$g_x = 980.616\,(1 - 0.0026373 \cos 2x + 0.0000059 \cos^2 2x)$
g_x = gravity value at latitude x, sea level (cm/sec^2)

x = latitude (degrees)

The relationship for inland values of gravity at elevations above sea level is:

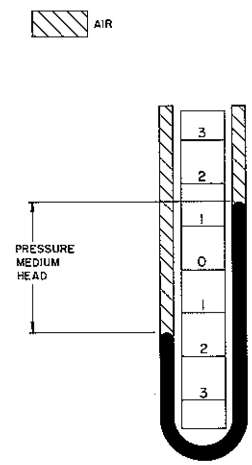
$g_t = g_x - 0.000094H + 0.00003408\,(H - H')$ (cm/sec^2)

H = elevation (feet) above mean sea level

H' = average elevation (feet) of the general terrain within a radius of 100 miles of the point.

The second term may be eliminated when H' is unknown, but the accuracy of the gravity determination will decrease. The degree of inaccuracy is determined by how far H' varies from H. In mountainous terrain this error could be large.

12. Pressure Medium Head Correction



Commonly a differential pressure is measured by the height of the fluid column. Actually the differential pressure, measured by the indicating fluid height, is the difference between density of the fluid column and the density of an equal height of the pressure medium. The density of the latter column is defined as the head correction. This is illustrated on the U-tube manometer.

The relationship is:

$$\rho_o g_o h_o + \rho_{pm} g_t h_t = \rho_t g_t h_t$$

$$h_o = \frac{g_t(\rho_t - \rho_{pm})}{g_o \rho_o} \times h_t$$

Where: ρ_{pm} = density of the pressure medium

The most common pressure medium is air. With air, 0.0012g/ cm^3 is commonly used as standard density. In precise work air density can be determined exactly knowing the temperature, pressure and relative humidity of the air.

13. Reading

For consistent results, it is necessary that the liquid meniscus observation method be duplicated for each reading.

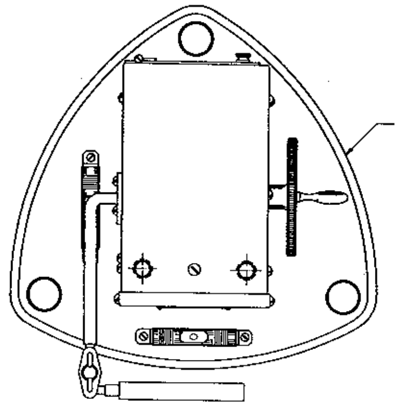
To duplicate factory calibration procedure, read to the lowest indicated liquid level as measured by the hairline at which the original zero was set.

14. Maintenance

There are few moving parts in the Micromanometer and they seldom require maintenance.

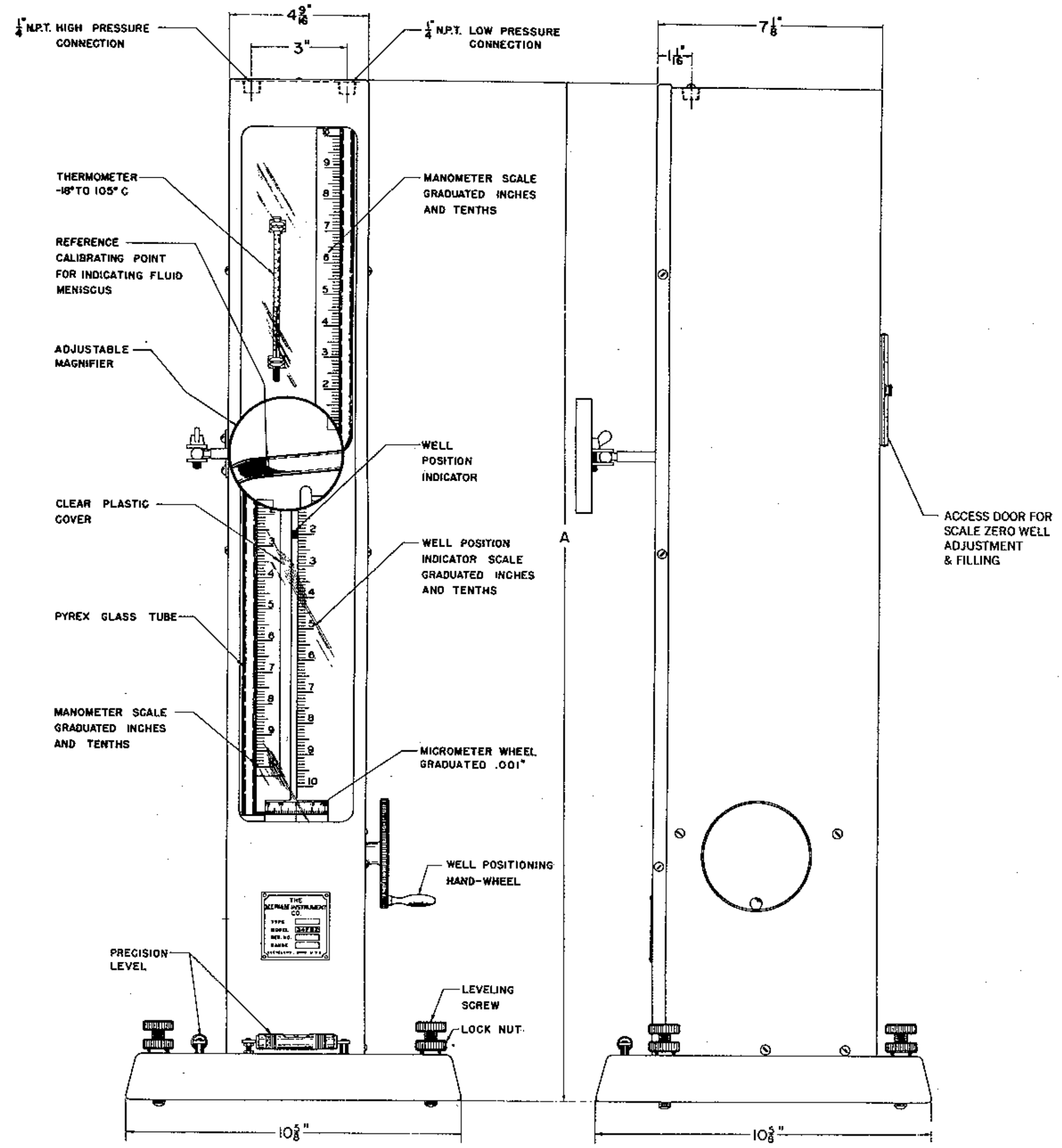
The only normal maintenance is occasional cleaning of the tube and replacement of the indicating fluid. The simplest procedure is: Raise the well to the uppermost position; connect a flexible tube from the low pressure connection to a bucket or sink to catch the fluid; apply 10 to 15 psi clean air to the high pressure connection and blow out the indicating fluid. Refill the instrument as described in Section 5. Replace fill plug and blow indicating fluid out again. This should clean the instrument. Refer again to Section 5 for final filling and zero setting.

If the indicating tube is still dirty, remove the instrument cover as follows: Remove cover window and well positioning handwheel; remove cover mounting screws, one on top and 5 on each side; lift cover straight up, exposing the instrument mechanism. Remove the flexible tubing from the hose nipples at the well indicating tube. Use Meriam mini brush 915AA to clean tube from bottom and top ends of indicating tube. Also brush out the flexible tubing you have removed. Flush the well with indicating fluid which is an effective cleaning agent. Replace flexible tubing from well to indicating tube and again flush system with fluid by filling and applying air pressure as described above. Replace cover, window and hand wheel and again fill and zero the Micromanometer.



RANGE INCHES OF WATER	A	APPROX. SHIPPING WEIGHT
10	36″	145 LBS.
20	60″	200 LBS

RANGE MM	A	APPROX. SHIPPING WEIGHT
254	914 MM	65.8 Kg
508	1524 MM	90.7 Kg



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