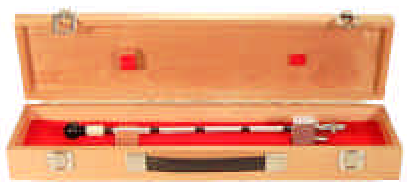
OPERATION MANUAL

Model IC-17, IC-18, IC-80, IC-1000

November 2001



Far West Technology, Inc.

330 South Kellogg Ave, Suite D

Goleta, CA 93117

GENERAL INFORMATION

This instrument is manufactured in the United States of America by:

Far West Technology, Inc.
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Far West Technology has been manufacturing radiation measuring devices since 1972.

REPAIR SERVICE

Although we design and manufacture our instruments to a high standard, we realize that repairs are sometimes necessary. If you believe service is needed on this instrument please call our service department before shipping the instrument to us for repair; often we can help you with simple problems. If you do decide to return it to us for repair then please include:

1. Contact person's name
2. Organization or Company name
3. Address
4. Phone number of contact person
5. Description of the problem
6. Anything else you may think important

We will inform you of the repair charges and wait for your authorization before we repair your instrument.

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I. INTRODUCTION

The Ionization Chambers fabricated by Far West Technology, Inc. are three terminal devices, i.e. there is a grounded guard ring between the signal and high voltage insulators. This prevents leakage currents between the sphere, which is at high voltage, and the collecting electrode. The three terminal construction also minimized stem effects. The voltage gradient between the signal lead and the stem, which is common to non-guarded ionization chambers, is drained off by the guard electrode. Typically, the irradiation of the stem contributes less than 0.1% of the ionization chamber response. For exposure rates of 1 x 10^4 R/hr the stem would contribute 1 x 10^{-12} amps.

The insulators used in the construction are polystyrene for signal and nylon for high voltage. The ionization chamber shell and the central collecting electrode are most commonly made of tissue equivalent plastic, but can be made of air or bone equivalent plastic, graphite, magnesium, iron, or other materials upon request.

The signal connector is a BNC, type UG256 B/U, and is on the connector block at the end of the stem. It should be connected to a feedback type electrometer so that the signal lead is at or near ground potential. The high voltage connector, on the block, is an MHV (optional SHV) type 931/U. This connector is connected to a high voltage power supply providing + and – voltages of 100 to 500 volts.

II. OPERATION

The ionization chamber is connected to the electrometer with low noise cable (such as Malco 250/3834-0000) which has a graphite coating on its insulator to minimize motion induced charge generation. The high voltage supply should be connected with cable made for that use, such as RG/59 cable. Caution should be exercised since the ionization chamber shell is at high voltage and is conductive.

With the cable connections completed and the electronic equipment at operating temperature, the power supply is set at +250 volts and potential applied to the chamber. In the absence of a radiation field the current observed should be approximately 2 x 10^{-15} amperes or less. If a current of the proper magnitude is obtained, switch the high voltage by a 10 volt step. This change of voltage will induce a step function on the current of approximately 10^{-12} amperes for a two foot length of cable, and correspondingly less for a longer cable. The current will return to the typical values of 2 x 10^{-15} amperes depending on the time constant of the electrometer. If the step function is observed, it demonstrates that all cable connections are complete and the system is operational.

The calibration factors supplied with the FWT ionization chambers are referenced to 760 mm Hg and 22° C. If other pressures and temperatures are used a correction factor must be applied, as the ion chamber is open to the atmosphere. The factor would be:

$$F = \frac{273+T}{295} + \frac{760}{P}$$

Where F is the Corrrction Factor, T is the temperature in degrees C and P is the pressure in mm Hg (Torr). The exposure rate may be calculated by:

Rate = (I x F) (Calibration Constant)

Where I is the observed current in amperes and the calibration constant is in R/coulomb. The final exposure rate would be in R/second. If you prefer to use the Coulombs readings on your electrometer, substitute coulombs for I in the above formula and the rate would be in R/time (of exposure).

III. SATURATION VERIFICATION

The operating voltage is plus or minus 250 volts. A variable high voltage supply may be used to verify the saturation current. The ionization current (at constant exposure) may be plotted against the reciprocal of the voltage (1/V). Extrapolation to 0 on the 1/V axis would mean the current value for an infinite voltage, or true saturation current. When the same procedure is followed with a negative voltage, a slightly different extrapolated saturation value may be obtained. The average of the plus and minus currents represents the true exposure rate. Care should be taken with voltages around 500 volts to avoid arc-over inside the ionization chamber. A more linear extrapolation is produced by plotting 1/I against $1/V^2$.

Typically the collection efficiency of greater than 99% is produced using operating voltage of 250 volts at exposure rates of 3×10^5 R/h or less. One should use a correction value derived from the measured saturation value if needed. Avoid operation at voltages above 250 volts were arc-over is more likely to occur.

IV. TISSUE EQUIVALENT GAS

Ionization chambers calibrated with tissue equivalent gas flow are so indicated on the calibration data sheet. The gas composition is 64.4% CH_4, 32.5% CO_2, and 3.1% N_2 by volume. Flow rates of cc per minute are recommended to avoid pressure changes or electrostatic effects.

V. EQUILIBRIUM CAPS

Thin walled ionization chambers used with Co60 or high energy gamma ray sources need an additional thickness of a plastic material surrounding the sensitive volume to provide electron equilibrium. The total equilibrium thickness for Co60 should be at least 425 mg/cm^2 (we standardly use 569 mg/cm^2). Thin walled ionization chambers are normally calibrated using a buildup cap with a wall thickness of 400 mg/cm^2. When ionization chambers are furnished without a buildup cap, such a cap has been used for calibration.

VI. HIGH PRECISION MEASUREMENTS

The standard experimental procedure is assumed to be the direct reading of an electrometer meter. There are two methods of experimental technique which may be used to increase the precision by an order of magnitude.

1. Use an external voltage source to buck the feedback voltage, using the electrometer as a null detector. The bucking voltage can be read from the voltage source settings or with a digital voltmeter. This method is useful on either the coulombs or the ampere range. The individual capacitors on some electrometers should be measured with a picoampere source if the coulomb range is used.

2. If the electrometer uses an analog meter for readout, use a digital voltmeter to measure the recorder output. This is particularly straight forward and reliable after an initial calibration with a picoampere source. Precision of plus or minus 0.5% or better are readily achieved with these methods using ordinary care.

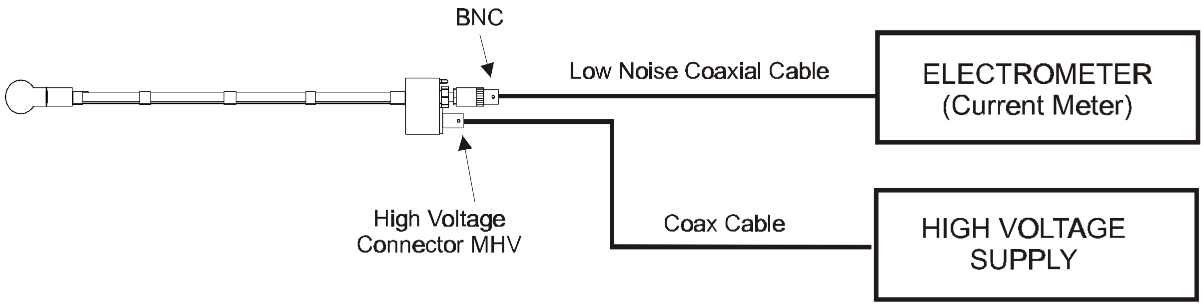

Figure 1 Ionization Chamber Electrical Connection