I. INTRODUCTION

The AMI liquid helium level sensor uses a small Niobium-Titanium (NbTi) wire as the detector element. A heater creates and helps maintain a normal zone in that portion of the wire above the liquid helium level while that portion of the wire below the liquid helium level remains superconducting. The output voltage of the sensor varies linearly with a change in liquid level.

The AMI liquid helium level sensor is designed to operate with an AMI liquid helium level meter. Each meter is calibrated for a specific sensor length and if sensors of different lengths are interchanged the level meter will require recalibration. Operation of the sensor with other level meters or operation of different length sensor with a meter calibrated for a specific length may void the sensor warranty.

II. SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>1/4&quot;</td>
</tr>
<tr>
<td>Active lengths</td>
<td>1 to 60 inches</td>
</tr>
<tr>
<td>Overall length</td>
<td>usually 1 inch longer than active length</td>
</tr>
<tr>
<td></td>
<td>(1/2 inch at top and bottom)</td>
</tr>
<tr>
<td>Sensor current</td>
<td>70 milliamperes (nominal)</td>
</tr>
<tr>
<td>Sensor voltage</td>
<td>0-60 V dc depending on sensor length.</td>
</tr>
<tr>
<td>Nominal sensor resistance</td>
<td>4.5 ohms/cm (11.6 ohms/in) at 10K</td>
</tr>
<tr>
<td></td>
<td>5.4 ohms/cm (13.7 ohms/in) at 300K</td>
</tr>
<tr>
<td>Maximum magnetic field</td>
<td>10 Tesla</td>
</tr>
</tbody>
</table>

III. INSTALLATION

1. Carefully remove the sensor from the shipping tube and remove all packaging material.

2. The sensor must be mounted with the electrical leads coming out of the top.
3. For minimum losses, mount the liquid helium sensor so that warm helium gas rising from the sensor can pass directly out of the dewar without contacting surfaces at 4.2K. Do not mount the sensor in restricted areas (tubes, etc.) where the liquid level around the sensor might be depressed by pressure differences in the gas. Do not cover the holes in the sensor.

4. The sensor may be mounted by taping or clipping it to an appropriate support structure. Do not exert excess pressure on the sensor with the mounting device to avoid crushing the tube. Avoid constraining both ends of the sensor and allow for contraction of the sensor during cooldown.

5. Avoid bending the sensor or lead wires when cold to avoid the possibility of cracking or breaking the sensor or wire insulation.

6. Do not operate the sensor in a vacuum. Operating the sensor in a vacuum may cause thermal damage and/or destruction of the superconducting filament sensor. Do not inadvertently turn the instrument on with the sensor in an evacuated chamber. Operation in pumped liquid helium environments is acceptable to 1K as long as liquid helium is present.

7. Avoid installing in a location where icing (frozen water or gas) may occur since ice formations may cause erratic operation. Ice formation on the NbTi filament may stop the propagation of the normal (resistive) zone before it actually reaches the liquid/gas interface. This will give an indication of a higher helium level than actually exists.

8. Ensure the level meter is de-energized (unplugged) and connect the sensor to the terminal strip on the rear of the level meter panel. The liquid helium level sensor leads are color coded. Red - positive current, black - negative current, blue - positive voltage, yellow - negative voltage. Connect the sensor to the four terminals at the back of the instrument being careful to match the sensor colors to those indicated on the instrument.

9. If the sensor is energized while it is warm the meter will peg on the low end of the scale due to the fact that NbTi is about 15% more resistive at room temperature than in the normal state at 10K.

IV. OPERATION

1. The liquid helium level sensor is designed to work with all AMI liquid helium level instruments. The level meter will be calibrated for a specific length level sensor (calibrated length will be marked on the rear panel of the level instrument). The level meter is calibrated in percent of active probe length.
[Note that all sensors have a nominal one-half inch non-active portion at the top and bottom of the sensor.]

Further information on the helium level instrument is contained in the Installation, Operations and Maintenance Instructions for the particular model instrument you have purchased.

2. Helium consumption is a function of the power input to the sensor and will vary with the current, temperature (resistance) and the length of the sensor. AMI has, under ideal laboratory conditions, measured the helium consumption for a typical sensor to be as low as 20 milliliters per hour. This was measured in an open dewar when the hot gas did not contact the dewar walls. However, in typical installations the helium consumption will be somewhat higher. The maximum helium consumption (at 70 milliamperes and 4.5 ohms/cm) would be 30 ml/hr/cm of active length. To minimize helium consumption it is recommended that the sensor be installed in accordance with the installation instructions in section III and the power to the sensor turned off at the level instrument between measurements. AMI offers a sample and hold helium level measurement instrument that automatically energizes the sensor long enough to establish a level reading and then automatically shuts off until the next preselected sample interval.

V. MAINTENANCE

The helium level sensor will provide years of useful service and require no maintenance if installed and operated in accordance with these instructions. The sensor is a sealed unit and internal repair or service is not feasible.

VI. TROUBLESHOOTING

1. No level reading:
   a. Ensure level meter is plugged in.
   b. Ensure the leads are connected to the proper instrument terminals.
   c. Ensure all lead wires are secure and are not broken.
   d. Ensure the vessel is cold and capable of collecting helium.

2. Erratic or erroneous level reading:
   a. Ensure there is no ice formations around sensor.
   b. Ensure sensor is not installed in a restricted area.
NOTE: Anomalous behavior of the sensor may be seen, under some conditions, at the lambda point of helium.

If the cause of the problem cannot be located please call an AMI representative at (615) 482-1056.

VII. WARRANTY

All products manufactured by AMI are warranted to be free of defects in materials and workmanship and to perform as specified for a period of one year from date of shipment. In the event of a failure occurring during normal use, AMI, at its option, will repair or replace all products or components that fail under warranty, and such repair or replacement shall constitute a fulfillment of all AMI liabilities with respect to its products. All warranty repairs are F.O.B. Oak Ridge, Tennessee.

VIII. RETURN AUTHORIZATION

Items to be returned to AMI for repair (warranty or otherwise) require a return authorization number to ensure your order will receive the proper attention. Please call an AMI representative at (615) 482-1056 for a return authorization before shipping any item back to us.
I. INTRODUCTION

The AMI Model 110A liquid helium level meter is designed to be used with an AMI liquid helium level sensor. The Model 110A provides a simple and reliable method of measuring liquid helium in a dewar. The instrument is calibrated to indicate 0-100% of active length. The active length of sensors can be from one to sixty inches. The sensor length for which your instrument is calibrated is marked on the rear panel of the instrument. The Model 110A furnishes a constant current to the AMI liquid helium level sensor and measures the resulting voltage. This voltage is scaled, inverted and offset so that the liquid helium level is indicated on a 0% to 100% front panel meter (see figure 1). The liquid helium level is also available as a 0-100 mV recorder output on the rear panel. Your Model 110A may have been delivered as a stand alone unit or panel mounted to fit into a standard 19" instrument rack. These installation, operations and maintenance instructions apply to either configuration.

II. SPECIFICATIONS

Input power ------------------------ 115 or 230 V ac, 50-60 Hz
Linearity -------------------------- 2%
Absolute calibration -------------- 2% of full scale
Sensor current --------------------- 70 milliamperes
Sensor voltage -------------------- 0-60 V dc depending on sensor length
External recorder signal ---------- 0.1 volts full scale regardless of sensor length.
                                          \[ R_{red} = 1.0 \]
                                          \[ R_{yellow} = 5.7 \]

III. INSTALLATION

1. Carefully remove the instrument from the shipping carton and remove all packaging material.

2. Ensure the meter is de-energized (unplugged) and connect the liquid helium level sensor to the terminal strip on the rear panel (see figure 2). The liquid helium level sensor leads are color coded. Red - positive current, Black - negative current, Blue - positive voltage, Yellow - negative voltage. Connect the sensor to the four terminals at the back of the instrument being careful to match the sensor wire colors to those indicated on the instrument.

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3. Consult the "Installation, Operation and Maintenance Instructions for the AMI Liquid Helium Level Sensor" for the installation instructions for the level sensor.

NOTE: Operation of the AMI Model 110A liquid helium level meter with a device other than an AMI liquid helium level sensor may void the instrument warranty.

IV. OPERATION

After the sensor is properly installed and cooled, operation is achieved by simply energizing the instrument and turning the power switch to the "power" position. The instrument is pre-calibrated. The helium level is read directly from the large panel meter or by the recorder from the 0-100 mv output terminal on the rear panel.

It is recommended that the power switch be turned off between readings to reduce helium consumption.

V. MAINTENANCE

The helium level meter will provide years of reliable service and require no maintenance if installed and operated in accordance with these instructions.

The instrument was calibrated for a specific sensor length before shipping and should never need adjustment. However, the calibration procedure is included for you information. Calibration is most simply accomplished with the aid of an appropriate resistor. All sensors have a resistance of 4.55 ohms/cm (active length) when in the normal state and maintained just above the transition temperature of 10K. Thus, if you are using a 50 cm sensor, you will need a 50 x 4.55 = 227.5 ohm resistor for calibration purposes (use a variable wire wound resistor capable of handling 70 mA).

NOTE: The active length of a sensor is usually 1" less than its overall length.
Consult figure 3 when using the following procedure:

1. Connect the calibration resistor between the rear panel red and black terminal points. Connect one shorting wire between the yellow and black terminals and another between the red and blue terminals. Turn on the power switch.
2. With the cover removed from the chassis, adjust the 5K potentiometer (zero) until the panel meter needle reads zero.
3. Use a clip lead to short out the calibrating resistor. Adjust the span potentiometer to read full scale.
4. Repeat steps 2 and 3. The instrument is now calibrated.
5. With the calibrating resistor shorted adjust the 5K (recorder output) potentiometer for 100 millivolts.

If the instrument is to be recalibrated for a different length sensor, one end of the small wire jumper on the circuit board might need to be shifted. The approximate sensor lengths for the jumper position are:

- Position A - 4 to 10 inches
- Position B - 9 to 24 inches
- Position C - 20 to 60 inches

VI. TROUBLESHOOTING

1. No level reading:
   a. Ensure level meter is plugged in.
   b. Ensure the leads are connected to the proper terminals.
   c. Ensure all lead wires are secure and are not broken.
   d. Ensure the helium vessel is cold and capable of collecting helium.

   NOTE: A warm sensor will cause the meter to peg on the low end of the scale.

2. Erratic or erroneous level reading:
   a. Ensure there is no ice formations around the sensor.
   b. Ensure the sensor is not installed in a restricted area.
   c. Ensure the sensor is installed with lead wires at the top.

   If the cause of the problem cannot be located please call an AMI representative at (615) 482-1056.
VII. WARRANTY

All products manufactured by AMI are warranted to be free of defects in materials and workmanship and to perform as specified for a period of one year from date of shipment. In the event of a failure occurring during normal use, AMI, at its option, will repair or replace all products or components that fail under warranty, and such repair or replacement shall constitute a fulfillment of all AMI liabilities with respect to its products. All warranty repairs are F.O.B. Oak Ridge, Tennessee.

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LIQUID HELIUM LEVEL METER
MODEL 110A

Figure 1 Front View

Figure 2 Rear View

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