Why Resistance-thermometer Bridges can serve you

Use of a modified Wheatstone bridge for temperature measurements provides several characteristics of value in a variety of laboratory procedures.

One characteristic, of course, is ability to reach highest precision; here the equipment is unique and becomes a "must". However, other characteristics give the scientist options in other connections. Perhaps the sometimes higher cost, the larger size of resistance-thermometer units as compared with thermocouples and the relative slowness as compared with 20-gauge or finer thermocouples, have obscured such advantages as the following:

Wide Range. A temperature bridge with appropriate thermometers can cover as much as or as little as you wish of the temperature range from -258 to +660 C . . . that is, from below the hydrogen point to above the antimony point. Furthermore, the instrument measures actual temperature . . . not temperature difference as a thermocouple does. This combination of values indicates usefulness for routine work as well as for secondary and primary standards.

Readability. The reading device for a bridge measurement moves several times further per degree C than is the case with other instruments. For example, with a Mueller Bridge the galvanometer spot moves 2 mm per 0.001° C; whereas with a thermocouple and a White or Wenner potentiometer the spot moves 0.7 mm, and a Beckmann differential thermometer's mercury column moves only 0.1 mm per 0.001° C. Other instruments of the three classes may show larger motions, but differences will be of the same order. Thus, the bridge method has outstanding advantages in readability.

"Average" Readings Supplied. The sensitive portion of a resistance thermometer is about as large as a mercury thermometer's bulb, whereas the sensitive area of a thermocouple is perhaps 1 or 2 mm sq. The resistance unit thus averages the temperature of an appreciable area, reducing the effect of non-uniformity in ambient fluid.

Sturdiness. Industrial-type resistance thermometers (Thermohms) are as sturdy as thermocouples and are installed in the same way. Among laboratory-type equipments, the most fragile resistance unit stands up quite definitely better than mercury bulbs under the small shocks and impacts which even the most careful user will impose. Furthermore, a broken or damaged resistance unit's case can often be replaced or repaired. These very practical advantages lead many scientists and test engineers to use the bridge method.

Remote Reading. Bridge instruments are inherently remote-reading; there is no need to consider accessibility, lighting, etc., of the primary element. This advantage is a real one, even when making small set-ups of equipment. On large or intricate set-ups, where vessels may be at various levels, and protection from light, body heat, etc., are possible additional factors, bridge measurements are often the only practical method.

### Principal Characteristics of L&N Temperature Bridges

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Arrangement of Ratio Arms &amp; Rheostat</th>
<th>Limit of Error</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type G-2 Mueller Bridge (Extreme high precision)</strong></td>
<td>Two ratio arms, 1,000 Ω ea., adjustable to equality. Rheostat range 0 to 111,111 Ω in 0.001 steps.</td>
<td>±0.003% or a few ten thousands of an ohm whichever is greater.</td>
</tr>
<tr>
<td>Accessory needed: Precision Resistance Thermometer; H S galvanometer</td>
<td>Three shunted decades giving steps of 0.0001, 0.001 and 0.01 Ω; three decades of 0.1, 1 and 10 Ω resistors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Principal shunted and decade resistors thermostat controlled to 0.01 Ω.</td>
<td></td>
</tr>
<tr>
<td><strong>Type G-1 Mueller Bridge (Excellent Precision)</strong></td>
<td>Two ratio arms, 560 Ω each, adjustable to equality. Rheostat range 0 to 81,111 Ω in 0.001 steps.</td>
<td>±0.005 Ω up to 10 Ω ±0.03% above 10 Ω.</td>
</tr>
<tr>
<td>Accessory needed: Same as for Mueller Type G-2</td>
<td>Three shunted decades giving steps of 0.0001, 0.001, 0.01 Ω; two decades at end of ratio arms of 0.1 and 1 Ω resistors.</td>
<td></td>
</tr>
<tr>
<td><strong>Resistance-Thermometer Bridge (Moderate Precision)</strong></td>
<td>Two ratio arms, 130 Ω nominal. Rheostat range 0 to 200.1 Ω. Two decades at end of rheostat for connection of 0, 10, 20, 25, 25.5, 30, 40, 50, 60 or 70-Ω resistors.</td>
<td></td>
</tr>
<tr>
<td>Accessory needed: Thermohm Resistance Thermometer; Galvanometer</td>
<td>Two decades at end of rheostat for connection of 0, 10, 20, 25, 25.5, 30, 40, 50, 60 or 70-Ω resistors.</td>
<td></td>
</tr>
<tr>
<td><strong>Portable Temperature Bridge</strong></td>
<td>Two ratio arms, 130 Ω nominal. Rheostat range 0 to 200.1 Ω. Two decades at end of rheostat for connection of 0, 10, 20, 25, 25.5, 30, 40, 50, 60 or 70-Ω resistors.</td>
<td>±0.005 Ω up to 10 Ω ±0.03% above 10 Ω.</td>
</tr>
<tr>
<td>Accessory needed: Thermohm Resistance Thermometer</td>
<td>Two decades at end of rheostat for connection of 0, 10, 20, 25, 25.5, 30, 40, 50, 60 or 70-Ω resistors.</td>
<td></td>
</tr>
<tr>
<td><strong>Portable Temp. Indicator Accessory needed:</strong></td>
<td>Two ratio arms, 130 Ω nominal. Rheostat range 0 to 200.1 Ω. Two decades at end of rheostat for connection of 0, 10, 20, 25, 25.5, 30, 40, 50, 60 or 70-Ω resistors.</td>
<td></td>
</tr>
<tr>
<td><strong>Thermohm Resistance Thermometer</strong></td>
<td>Two decades at end of rheostat for connection of 0, 10, 20, 25, 25.5, 30, 40, 50, 60 or 70-Ω resistors.</td>
<td></td>
</tr>
<tr>
<td><strong>Portable Temp-Difference Indicator Accessory needed:</strong></td>
<td>Two ratio arms, 130 Ω nominal. Rheostat range 0 to 200.1 Ω. Two decades at end of rheostat for connection of 0, 10, 20, 25, 25.5, 30, 40, 50, 60 or 70-Ω resistors.</td>
<td></td>
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</tbody>
</table>

For further particulars of any of the above equipments address our nearest office or 4926 Stenton Ave., Philadelphia 44, Pa.
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DL leucyl-glycine
L leucyl-glycine
DL leucyl-glycyl-glycine
L leucyl-glycyl-glycine
D leucyl-L-tyrosine
L leucyl-L-tyrosine
DL-lysine Hydrochloride
L-lysine Hydrochloride
D-methionine
DL-methionine
L-methionine
DL-norleucine
DL-norvaline
DL-ornithine Hydrochloride
L ornithine dihydrochloride
D-phenylalanine
DL-phenylalanine
L-phenylalanine
L-proline
succine
D-serine
DL-serine
L-serine
Sodium glutamate
taurine
DL-threonine
L-threonine
DL-thyroxine
D-tryptophane
DL-tryptophane
L-tryptophane
DL-tyrosine
L-tyrosine
DL-valine
L-valine

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- 16 oz. bottle with 4 oz. filter

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Size</th>
<th>Ex. Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>54459A</td>
<td>6 oz</td>
<td>1.75</td>
</tr>
<tr>
<td>54459B</td>
<td>8 oz</td>
<td>2.25</td>
</tr>
<tr>
<td>54459C</td>
<td>16 oz</td>
<td>3.00</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Extra filters Supplied 2 to a box</th>
</tr>
</thead>
<tbody>
<tr>
<td>54459D</td>
<td>2 oz Filter only 2.50 per box</td>
</tr>
<tr>
<td>54459E</td>
<td>3 oz Filter only 3.50 per box</td>
</tr>
<tr>
<td>54459F</td>
<td>4 oz Filter only 4.50 per box</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Cat. #94550</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIMENSIONS</td>
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<tr>
<td>Ex.</td>
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<tr>
<td>-------------</td>
</tr>
<tr>
<td>Size</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Length overall</td>
</tr>
<tr>
<td>Diam. large loop</td>
</tr>
<tr>
<td>Diam. small loop</td>
</tr>
<tr>
<td>Chain length</td>
</tr>
</tbody>
</table>

MEASUREMENTS ARE GIVEN IN MM.

<table>
<thead>
<tr>
<th>Size</th>
<th>Ex.</th>
<th>1%</th>
<th>5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra</td>
<td>1.35</td>
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<td></td>
</tr>
<tr>
<td>Small</td>
<td>1.45</td>
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<td></td>
</tr>
<tr>
<td>Medium</td>
<td>1.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large</td>
<td>1.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extra</td>
<td>2.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assorted</td>
<td>1.80</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Size</th>
<th>Each</th>
</tr>
</thead>
<tbody>
<tr>
<td>24435A</td>
<td>5 oz. (150 cc)</td>
<td>1.90</td>
</tr>
<tr>
<td>24435B</td>
<td>8 oz. (250 cc)</td>
<td>2.10</td>
</tr>
<tr>
<td>24435C</td>
<td>16 oz. (500 cc)*</td>
<td>3.10</td>
</tr>
<tr>
<td>24435D</td>
<td>24 oz. (750 cc)*</td>
<td>4.10</td>
</tr>
<tr>
<td>24435E</td>
<td>32 oz. (1000 cc)*</td>
<td>4.50</td>
</tr>
<tr>
<td></td>
<td>Available with or without handle-specify when ordering</td>
<td></td>
</tr>
</tbody>
</table>

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- Methionine Sulfone
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