INCOLOY® alloy 020 (UNS N08020) has excellent corrosion resistance in chemical environments containing sulfuric acid, and useful resistance to environments containing chlorides, nitric acid, and phosphoric acid. Other uses include the production of gasoline, solvents, explosives, inorganic and organic chemicals, pharmaceuticals, and food and synthetic materials. INCOLOY alloy 020 is readily fabricated to produce mixing tanks, heat exchangers, process piping, pickling equipment, pumps, valves, fasteners and fittings. Applications for alloy 020 requiring resistance to aqueous corrosion are essentially the same as those for INCOLOY alloy 825.

### Table 1 - Limiting Chemical Composition, %

<table>
<thead>
<tr>
<th>Element</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel</td>
<td>32.0-38.0</td>
</tr>
<tr>
<td>Chromium</td>
<td>19.0-21.0</td>
</tr>
<tr>
<td>Copper</td>
<td>3.0-4.0</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>2.0-3.0</td>
</tr>
<tr>
<td>Iron</td>
<td>6 x C -1.8</td>
</tr>
<tr>
<td>Carbon</td>
<td>&lt;0.07 max.</td>
</tr>
<tr>
<td>Niobium + Tantalum</td>
<td>8 x C -1.0</td>
</tr>
<tr>
<td>Manganese</td>
<td>2.0 max.</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>&lt;0.045 max.</td>
</tr>
<tr>
<td>Sulfur</td>
<td>&lt;0.035 max.</td>
</tr>
<tr>
<td>Silicon</td>
<td>&lt;1.0 max.</td>
</tr>
</tbody>
</table>

*Reference to the ‘balance’ of a composition does not guarantee this is exclusively of the element mentioned but that it predominates and others are present only in minimal quantities.

### Physical and Mechanical Properties

<table>
<thead>
<tr>
<th>Table 2 - Physical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, lb/in³</td>
</tr>
<tr>
<td>g/cm³</td>
</tr>
<tr>
<td>Shear Modulus, 10⁶ ksi</td>
</tr>
<tr>
<td>GPa</td>
</tr>
<tr>
<td>Young's Modulus, 10³ ksi</td>
</tr>
<tr>
<td>GPa</td>
</tr>
<tr>
<td>Specific Heat, Btu/lb•°F</td>
</tr>
<tr>
<td>J/kg•°C</td>
</tr>
<tr>
<td>Electrical Resistivity, ohm•circ mil/ft</td>
</tr>
<tr>
<td>µΩ•m</td>
</tr>
<tr>
<td>Thermal Conductivity, Btu/in²•°F</td>
</tr>
<tr>
<td>W/m•°C</td>
</tr>
<tr>
<td>Coefficient of Expansion, 77-212°F, 10⁻⁶in/in•°F</td>
</tr>
<tr>
<td>25-100°C, µm/m•°C</td>
</tr>
</tbody>
</table>

### Table 3 - Typical Room Temperature Mechanical Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength, ksi</td>
<td>90</td>
</tr>
<tr>
<td>MPA</td>
<td>620</td>
</tr>
<tr>
<td>Yield Strength (0.2% Offset), ksi</td>
<td>45</td>
</tr>
<tr>
<td>MPA</td>
<td>300</td>
</tr>
<tr>
<td>Elongation, %</td>
<td>40</td>
</tr>
</tbody>
</table>
INCOLOY® alloy 020

Table 4 - Room Temperature Tensile Test Results of Cold Worked INCOLOY alloy 020

<table>
<thead>
<tr>
<th>Cold Reduction (%)</th>
<th>Yield Strength (0.2% Offset) ksi</th>
<th>Tensile Strength ksi</th>
<th>Elongation (%)</th>
<th>Hardness (Rockwell)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>44.4</td>
<td>95.8</td>
<td>38</td>
<td>B83</td>
</tr>
<tr>
<td>20</td>
<td>111.0</td>
<td>119.8</td>
<td>13</td>
<td>C23</td>
</tr>
<tr>
<td>30</td>
<td>124.3</td>
<td>131.5</td>
<td>8</td>
<td>C28</td>
</tr>
<tr>
<td>40</td>
<td>127.5</td>
<td>135.0</td>
<td>7</td>
<td>C27</td>
</tr>
<tr>
<td>50</td>
<td>139.5</td>
<td>147.5</td>
<td>4</td>
<td>C30</td>
</tr>
<tr>
<td>60</td>
<td>139.9</td>
<td>149.3</td>
<td>5</td>
<td>C31</td>
</tr>
</tbody>
</table>

*Stabilize anneal.

Figure 1. High temperature mechanical properties.
— Typical usage range.

Corrosion Resistance

Table 5 - Sulfuric Acid Corrosion Data for Strip*

<table>
<thead>
<tr>
<th>Temperature °C</th>
<th>H₂SO₄ (%)</th>
<th>Corrosion Rate mpy</th>
<th>mm/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>70</td>
<td>2</td>
<td>0.051</td>
</tr>
<tr>
<td>60</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>60</td>
<td>70</td>
<td>3</td>
<td>0.076</td>
</tr>
<tr>
<td>60</td>
<td>90</td>
<td>4</td>
<td>0.102</td>
</tr>
<tr>
<td>75</td>
<td>70</td>
<td>5</td>
<td>0.127</td>
</tr>
<tr>
<td>85</td>
<td>20</td>
<td>18</td>
<td>0.457</td>
</tr>
<tr>
<td>85</td>
<td>70</td>
<td>7</td>
<td>0.178</td>
</tr>
<tr>
<td>85</td>
<td>90</td>
<td>15</td>
<td>0.381</td>
</tr>
<tr>
<td>95</td>
<td>90</td>
<td>27</td>
<td>0.686</td>
</tr>
<tr>
<td>Boiling</td>
<td></td>
<td>20</td>
<td>17</td>
</tr>
</tbody>
</table>

*Test duration - 168 hours.
Fabricating

Information on fabricating is available in the Special Metals publication “Fabricating” or on our website, www.specialmetals.com.

Joining

<table>
<thead>
<tr>
<th>Shielded Metal Arc Welding</th>
<th>Gas Tungsten Arc Welding, Gas Metal Arc Welding</th>
</tr>
</thead>
<tbody>
<tr>
<td>INCONEL welding electrode 112</td>
<td>INCONEL filler metal 625</td>
</tr>
<tr>
<td>INCONEL welding electrode 122</td>
<td>INCONEL filler metal 622</td>
</tr>
<tr>
<td>INCO-WELD welding electrode</td>
<td>INCO-WELD filler metal 686CPT®</td>
</tr>
</tbody>
</table>

Information on joining is available in the Special Metals publication “Joining” on the website, www.specialmetals.com.

Heat Treatments

Hot forming should be in the range 1400-2150°F (760-1175°C). INCOLOY alloy 020 is normally used in the annealed condition. Annealing: 1800-1850°F (982-1010°C) for a time commensurate with section size/AC.

Machining

Information on machining is available in the Special Metals publication “Machining” on the website, www.specialmetals.com.

Available Products and Specifications

INCOLOY alloy 020 is designated as UNS N08020. Standard product forms include pipe, tube, sheet, strip, plate, round bar, flat bar, forging stock, hexagon and wire.


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