INCONEL® alloy 617 (UNS N06617/W.Nr. 2.4663a) is a solid-solution, strengthened, nickel-chromium-cobalt-molybdenum alloy with an exceptional combination of high-temperature strength and oxidation resistance. The alloy also has excellent resistance to a wide range of corrosive environments, and it is readily formed and welded by conventional techniques.

The limiting chemical composition of INCONEL alloy 617 is listed in Table 1. The high nickel and chromium contents make the alloy resistant to a variety of both reducing and oxidizing media. The aluminum, in conjunction with the chromium, provides oxidation resistance at high temperatures. Solid-solution strengthening is imparted by the cobalt and molybdenum.

The combination of high strength and oxidation resistance at temperatures over 1800°F (980°C) makes INCONEL alloy 617 an attractive material for such components as ducting, combustion cans, and transition liners in both aircraft and land-based gas turbines. Because of its resistance to high-temperature corrosion, the alloy is used for catalyst-grid supports in the production of nitric acid, for heat-treating baskets, and for reduction boats in the refining of molybdenum. INCONEL alloy 617 also offers attractive properties for components of power-generating plants, both fossil-fueled and nuclear.

Property values are given in both United States customary units and the International System of Units (SI). The SI unit of stress is the pascal (Pa), which is equivalent to newton per square metre. The approximate relationship between the pascal and the pound per square inch (psi) is 1 Pa = 0.000145 psi, or 1 psi = 6895 Pa.

### Physical Constants and Thermal Properties

Melting range and some physical constants at room temperature are shown in Table 2. The alloy’s low density, compared with tungsten-containing alloys of similar strength, is significant in applications such as aircraft gas turbines where high strength-to-weight ratio is desirable.

Thermal properties of alloy 617 at temperatures to 2000°F (1095°C) are given in Table 3. Values for thermal conductivity and specific heat were calculated; other values were measured. Thermal expansion of INCONEL alloy 617 is lower than that of most other austenitic alloys, reducing stresses from differential expansion when the alloy is coupled with carbon steels or low-alloy steels.

Modulus of elasticity of INCONEL alloy 617 is shown along with Poisson’s ratio (calculated from moduli of elasticity) in Table 4. The modulus values were determined by a dynamic method.
Table 3 - Electrical and Thermal Properties

<table>
<thead>
<tr>
<th>Temperature °F</th>
<th>Electrical Resistivity ohm-circ mil/ft</th>
<th>Thermal Conductivity W/m-°C</th>
<th>Coefficient of Expansion µin/in/°F</th>
<th>Specific Heat Btu/in³·°F</th>
<th>Specific Heat Btu/lb·°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>78</td>
<td>736</td>
<td>94</td>
<td>-</td>
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</tr>
<tr>
<td>200</td>
<td>748</td>
<td>101</td>
<td>7.0</td>
<td>0.104</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>757</td>
<td>113</td>
<td>7.2</td>
<td>0.111</td>
<td></td>
</tr>
<tr>
<td>600</td>
<td>764</td>
<td>125</td>
<td>7.4</td>
<td>0.117</td>
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</tr>
<tr>
<td>800</td>
<td>770</td>
<td>137</td>
<td>7.6</td>
<td>0.124</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>779</td>
<td>149</td>
<td>7.7</td>
<td>0.131</td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td>793</td>
<td>161</td>
<td>8.0</td>
<td>0.137</td>
<td></td>
</tr>
<tr>
<td>1400</td>
<td>807</td>
<td>173</td>
<td>8.4</td>
<td>0.144</td>
<td></td>
</tr>
<tr>
<td>1600</td>
<td>803</td>
<td>185</td>
<td>8.7</td>
<td>0.150</td>
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</tr>
<tr>
<td>1800</td>
<td>824</td>
<td>197</td>
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<td>0.157</td>
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</tr>
<tr>
<td>2000</td>
<td>-</td>
<td>209</td>
<td>9.2</td>
<td>0.163</td>
<td></td>
</tr>
</tbody>
</table>

Table 4 - Modulus of Elasticity

<table>
<thead>
<tr>
<th>Temperature °F</th>
<th>Tensile Modulus 10⁶ ksl</th>
<th>Shear Modulus 10⁶ ksl</th>
<th>Poisson's Ratio b</th>
</tr>
</thead>
<tbody>
<tr>
<td>74</td>
<td>30.6</td>
<td>11.8</td>
<td>0.30</td>
</tr>
<tr>
<td>200</td>
<td>30.0</td>
<td>11.6</td>
<td>0.30</td>
</tr>
<tr>
<td>400</td>
<td>29.0</td>
<td>11.2</td>
<td>0.30</td>
</tr>
<tr>
<td>600</td>
<td>28.0</td>
<td>10.8</td>
<td>0.30</td>
</tr>
<tr>
<td>800</td>
<td>26.9</td>
<td>10.4</td>
<td>0.30</td>
</tr>
<tr>
<td>1000</td>
<td>25.8</td>
<td>9.9</td>
<td>0.30</td>
</tr>
<tr>
<td>1200</td>
<td>24.6</td>
<td>9.5</td>
<td>0.30</td>
</tr>
<tr>
<td>1400</td>
<td>23.3</td>
<td>9.0</td>
<td>0.30</td>
</tr>
<tr>
<td>1600</td>
<td>21.9</td>
<td>8.4</td>
<td>0.30</td>
</tr>
<tr>
<td>1800</td>
<td>20.5</td>
<td>7.8</td>
<td>0.31</td>
</tr>
<tr>
<td>2000</td>
<td>18.8</td>
<td>7.1</td>
<td>0.32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature °C</th>
<th>Tensile Modulus GPa</th>
<th>Shear Modulus GPa</th>
<th>Poisson's Ratio b</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>211</td>
<td>81</td>
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<tr>
<td>100</td>
<td>206</td>
<td>80</td>
<td>0.30</td>
</tr>
<tr>
<td>200</td>
<td>201</td>
<td>77</td>
<td>0.30</td>
</tr>
<tr>
<td>300</td>
<td>194</td>
<td>75</td>
<td>0.30</td>
</tr>
<tr>
<td>400</td>
<td>188</td>
<td>72</td>
<td>0.30</td>
</tr>
<tr>
<td>500</td>
<td>181</td>
<td>70</td>
<td>0.30</td>
</tr>
<tr>
<td>600</td>
<td>173</td>
<td>66</td>
<td>0.30</td>
</tr>
<tr>
<td>700</td>
<td>166</td>
<td>64</td>
<td>0.30</td>
</tr>
<tr>
<td>800</td>
<td>157</td>
<td>61</td>
<td>0.30</td>
</tr>
<tr>
<td>900</td>
<td>149</td>
<td>57</td>
<td>0.30</td>
</tr>
<tr>
<td>1000</td>
<td>139</td>
<td>53</td>
<td>0.31</td>
</tr>
<tr>
<td>1100</td>
<td>129</td>
<td>49</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Mechanical Properties

INCONEL alloy 617 has high mechanical properties over a broad range of temperatures. One of the alloy’s outstanding characteristics is the strength level it maintains at elevated temperatures. The resistance of the alloy to high-temperature corrosion enhances the usefulness of its strength.

aCalculated from electrical resistivity.
bMean coefficient of linear expansion between 78°F (26°C) and temperature shown.
cCalculated values.

aDetermined by dynamic method.
bCalculated from moduli of elasticity.
**Tensile Properties**

Typical room-temperature tensile properties of various product forms are listed in Table 5. All values are for material in the solution-annealed condition. Properties shown for sheet, strip, and plate are for the transverse direction.

Tensile properties at high temperatures of solution-annealed, hot-rolled rod are shown in Figure 1. The test specimens were from rod of 0.50-in (13-mm) or 0.62-in (16-mm) diameter. High-temperature tensile properties of solution-annealed, cold-rolled sheet are presented in Figure 2. The tests were performed in the transverse direction on sheet of 0.187-in. (4.75-mm) thickness.

**Fatigue Strength**

High-cycle fatigue strength of INCONEL alloy 617 at room temperature and 1600°F (870°C) is indicated by the curves in Figure 3. The data are from rotating-beam tests on coarse-grain, solution-annealed, hot-rolled rod of 0.56-in. (14-mm) diameter.

The results of low-cycle fatigue tests on coarse-grain, solution-annealed plate are shown in Figure 4. Included for comparison are test results for welded joints. The specimens were from joints welded by the gas-metal-arc process using matching-composition filler metal.

![Graph 1: High-temperature tensile properties of solution-annealed, hot-rolled rod.](image1)

![Graph 2: High-temperature tensile properties of solution-annealed, cold-rolled sheet.](image2)

**Table 5 - Typical Room-Temperature Mechanical Properties of Solution-Annealed Material**

<table>
<thead>
<tr>
<th>Product Form</th>
<th>Production Method</th>
<th>Yield Strength (0.2% Offset)</th>
<th>Tensile Strength</th>
<th>Elongation, %</th>
<th>Reduction of Area, %</th>
<th>Hardness BHN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>kai</td>
<td>MPa</td>
<td>kai</td>
<td>MPa</td>
<td></td>
</tr>
<tr>
<td>Plate</td>
<td>Hot Rolling</td>
<td>46.7</td>
<td>322</td>
<td>106.5</td>
<td>734</td>
<td>62</td>
</tr>
<tr>
<td>Bar</td>
<td>Hot Rolling</td>
<td>46.1</td>
<td>318</td>
<td>111.5</td>
<td>769</td>
<td>56</td>
</tr>
<tr>
<td>Tubing</td>
<td>Cold Drawing</td>
<td>55.6</td>
<td>383</td>
<td>110.0</td>
<td>758</td>
<td>56</td>
</tr>
<tr>
<td>Sheet or Strip</td>
<td>Cold Rolling</td>
<td>50.9</td>
<td>351</td>
<td>109.5</td>
<td>755</td>
<td>58</td>
</tr>
</tbody>
</table>
INCONEL® alloy 617

**Figure 3.** Rotating-beam fatigue strength of solution-annealed INCONEL alloy 617.

**Figure 4.** Low-cycle fatigue strength of solution-annealed plate and as-welded joints. Welds were made with INCONEL Filler Metal 617 and the gas-metal-arc process.

**LCF Considerations**

The development of alloy 617 centered on the desire for maximum creep strength at elevated temperatures. Solution annealing temperatures were selected to provide the coarse grains necessary for the best high temperature creep resistance. In recent years, designers of turbine hot gas path structures have realized the need for optimization of both low cycle fatigue (LCF) strength as well as creep. A development program was initiated to achieve this optimization. The results of the program are detailed in Reference 1.

Tension-tension axial load controlled LCF test data acquired at 1100°F (593°C) and 1400°F (760°C) are shown in Figure 5 and Table 6. The improvement in LCF performance with ASTM grain sizes of 4 and 5 is significant. After extensive thermomechanical processing experimentation, a controlled practice was developed which restricts the grain size of production plate to ASTM 3 to 6. Slight alloy composition modifications permit better grain size control and improved stress rupture properties. The combination of alloy composition optimization and closely controlled thermomechanical processing results in an alloy which demonstrates much improved LCF performance with little or no loss of creep resistance in comparison with coarse grain material. The improved LCF performance extends to higher temperatures as well, as shown in Figure 6.

**Figure 5.** Effect of grain size on the tension-tension axial stress controlled LCF properties of alloy 617 (R=0.1).

**Figure 6.** Effect of temperature on the tension-tension axial stress controlled fatigue strength of alloy 617 (R=0.1).
INCONEL® alloy 617

INCONEL alloy 617 displays exceptionally high levels of creep-rupture strength, even at temperatures of 1800°F (980°C) and above. That characteristic, combined with good resistance to oxidizing and carburizing atmospheres, makes the alloy especially suitable for long-term, high-stress use at elevated temperatures.

Figure 7 shows the creep strength of solution-annealed alloy 617 at temperatures to 2000°F (1095°C). Rupture strength of solution-annealed material over the same temperature range is shown in Figure 8. The tests were performed on bar, tubing, and sheet specimens.

### Stability of Properties

Alloy 617 exhibits good metallurgical stability for an alloy of its strength level. Table 7 shows changes in tensile and impact properties after exposures extending to 12,000 h at elevated temperatures. All samples were in the solution-annealed condition before exposure. The strengthening is attributable to carbide formation and, at exposure temperatures of 1200°F (650°C) to 1400°F (760°C), to precipitation of gamma prime phase.

**Table 6** - Effect of grain size on the tension-tension axial stress controlled LCF properties of alloy 617 at 760°C (1400°F)

<table>
<thead>
<tr>
<th>Alloy 617 Heat Number</th>
<th>ASTM G. S. Size No.</th>
<th>Tension-Tension Axial Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>XX0023UK</td>
<td>2.5</td>
<td>500</td>
</tr>
<tr>
<td>XX0015UK</td>
<td>5.0</td>
<td>64,391</td>
</tr>
<tr>
<td>XX0005UK</td>
<td>9.5</td>
<td>93,440</td>
</tr>
</tbody>
</table>

### Creep and Rupture Properties

INCONEL alloy 617 displays exceptionally high levels of creep-rupture strength, even at temperatures of 1800°F (980°C) and above. That characteristic, combined with good resistance to oxidizing and carburizing atmospheres, makes the alloy especially suitable for long-term, high-stress use at elevated temperatures.

Figure 7 shows the creep strength of solution-annealed alloy 617 at temperatures to 2000°F (1095°C). Rupture strength of solution-annealed material over the same temperature range is shown in Figure 8. The tests were performed on bar, tubing, and sheet specimens.

**Table 7** - Mechanical Properties After Exposure to Elevated Temperatures

<table>
<thead>
<tr>
<th>Exposure Temperature</th>
<th>Exposure Time, h</th>
<th>Yield Strength (0.2% Offset)</th>
<th>Tensile Strength</th>
<th>Elongation, %</th>
<th>Impact Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>°F</td>
<td>°C</td>
<td>kcal</td>
<td>MPa</td>
<td>kcal</td>
<td>MPa</td>
</tr>
<tr>
<td>No exposure</td>
<td></td>
<td>46.3</td>
<td>319</td>
<td>111.5</td>
<td>769</td>
</tr>
<tr>
<td>1100 595</td>
<td>100</td>
<td>46.5</td>
<td>321</td>
<td>111.5</td>
<td>769</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>51.8</td>
<td>357</td>
<td>116.5</td>
<td>803</td>
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<tr>
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<td>4000</td>
<td>55.7</td>
<td>384</td>
<td>117.5</td>
<td>810</td>
</tr>
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<td>838</td>
</tr>
<tr>
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<td>67.6</td>
<td>466</td>
<td>132.0</td>
<td>910</td>
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<tr>
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<td>357</td>
<td>114.5</td>
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<td>66.6</td>
<td>459</td>
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<td>58.7</td>
<td>405</td>
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<td>872</td>
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<td>70.5</td>
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<td>138.0</td>
<td>952</td>
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<td>4000</td>
<td>70.6</td>
<td>487</td>
<td>138.0</td>
<td>952</td>
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<td>100</td>
<td>58.3</td>
<td>402</td>
<td>126.5</td>
<td>872</td>
</tr>
<tr>
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<td>100</td>
<td>56.3</td>
<td>388</td>
<td>128.0</td>
<td>879</td>
</tr>
<tr>
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<td>130.0</td>
<td>896</td>
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<td>12000</td>
<td>56.4</td>
<td>389</td>
<td>129.5</td>
<td>893</td>
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</tbody>
</table>
Figure 7. Creep strength of solution-annealed INCONEL alloy 617.

Figure 8. Rupture strength of solution-annealed INCONEL alloy 617. Arrows denote tests discontinued before fracture.
Figure 9. Resistance to cyclic oxidation at 2000°F (1095°C). Cycles consisted of 15 minutes heating and 5 minutes cooling in air.

Figure 10. Resistance to cyclic oxidation at 2100°F (1150°C). Samples were exposed to temperature in 50-h cycles.

Figure 11. Resistance to oxidation of heat-resistant alloys at 1832°F (1000°C). Samples were exposed in air with 20% water. Cycle period was once per week.

Figure 12. Carburization resistance of heat-resistant alloys at 1832°F (1000°C). Samples were exposed to H₂-5.5% CO₂-4.5% CH₄.
The resistance of INCONEL alloy 617 to cyclic oxidation at 2000°F (1095°C) is shown in Figure 9. The tests were performed on specimens of thin strip and consisted of cycles of exposure to temperature for 15 minutes followed by cooling in still air for 5 minutes. The results demonstrate the ability of the alloy to form and retain a protective surface oxide under conditions of extremely severe thermal cycling. The results of a similar test at 2100°F (1150°C) are shown in Figure 10. The specimens of thin strip were exposed to the test temperature in 50-hour cycles with weight loss determined after each cycle. The resistance of alloy 617 and other high strength, heat-resistant alloys to static oxidation in moist air at 1832°F (1000°C) is shown in Figure 11.

The composition of INCONEL alloy 617 includes substantial amounts of nickel, chromium, and aluminum for a high degree of resistance to oxidation and carburization at high temperatures. Those elements, along with the molybdenum content, also enable the alloy to withstand many wet corrosive environments.

### Design Considerations

 Allowable design stresses for INCONEL alloy 617 products are found in Table 1B of Section II, Part D of the ASME Boiler and Pressure Vessel Code. Alloy 617 is one of the few materials covered by the ASME Code with design stresses up to 1800°F. Allowable design stresses from the 2005 edition for the common temperatures of application are compared with those for UNS N06230 in Table 8. It is seen that alloy 617 permits increasingly higher design stresses over UNS N06230 as temperature increases in the range where these alloys are typically employed.

### Corrosion Resistance

The resistance of INCONEL alloy 617 to aqueous corrosion by many media, the alloy is normally only used at high temperatures. For information about the resistance of alloy 617 in specific wet environments, visit the website, www.specialmetals.com.

### Oxidation and Carburization

The resistance of INCONEL alloy 617 to cyclic oxidation at 2000°F (1095°C) is shown in Figure 9. The tests were performed on specimens of thin strip and consisted of cycles of exposure to temperature for 15 minutes followed by cooling in still air for 5 minutes. The results demonstrate the ability of the alloy to form and retain a protective surface oxide under conditions of extremely severe thermal cycling. The results of a similar test at 2100°F (1150°C) are shown in Figure 10. The specimens of thin strip were exposed to the test temperature in 50-hour cycles with weight loss determined after each cycle. The resistance of alloy 617 and other high strength, heat-resistant alloys to static oxidation in moist air at 1832°F (1000°C) is shown in Figure 11.

The excellent resistance of alloy 617 to oxidation results from the alloy’s chromium and aluminum contents. At elevated temperatures, those elements cause the formation of a thin, subsurface zone of oxide particles. The zone forms rapidly upon exposure to high temperatures until it reaches a thickness of 0.001 to 0.002 in. (0.025 to 0.05 mm). The oxide zone provides the proper diffusion conditions for the formation of a protective chromium oxide layer on the surface of the metal. It also helps to prevent spalling of the protective layer.

INCONEL alloy 617 has excellent resistance to carburization. Table 9 compares alloy 617 and some other carburization-resistant alloys in a gaseous carburizing environment at 2000°F (1095°C). The weight-gain measurements indicate the amount of carbon absorbed during the test period. Table 10 shows the superiority of alloy 617 over alloys of similar strength in a gas-carburization test at 1800°F (980°C).

### Aqueous Corrosion

While alloy 617 exhibits excellent resistance to aqueous corrosion by many media, the alloy is normally only used at high temperatures. For information about the resistance of alloy 617 in specific wet environments, visit the website, www.specialmetals.com.
INCONEL alloy 617

**Fabrication**

INCONEL alloy 617 has good fabricability. Forming, machining, and welding are carried out by standard procedures for nickel alloys. Techniques and equipment for some operations may be influenced by the alloy’s strength and work-hardening rate. Information on fabricating is available in the Special Metals publication “Fabricating” on the website, www.specialmetals.com.

**Hot and Cold Forming**

Alloy 617 has good hot formability, but it requires relatively high forces because of its inherent strength at elevated temperatures. In general, the hot-forming characteristics of alloy 617 are similar to those of INCONEL alloy 625. The temperature range for heavy forming or forging is 1850 to 2200°F (1010 to 1205°C). Light working can be done at temperatures down to 1700°F (925°C).

INCONEL alloy 617 is readily cold formed by conventional procedures although its work-hardening rate, shown in Figure 13, is high. For best results, the alloy should be cold formed in the fine-grain condition, and frequent intermediate anneals should be used. Annealing for cold forming should be done at 1900°F (1040°C).

Further information on general hot-forming and cold-forming can be obtained from Special Metals.

**Heat Treatment**

INCONEL alloy 617 is normally used in the solution-annealed condition. That condition provides a coarse grain structure for the best creep-rupture strength. It also provides the best bend ductility at room temperature. Solution annealing is performed at a temperature of 2150°F (1175°C) for a time commensurate with section size. Cooling should be by water quenching or rapid air cooling.

**Machining**

Information on machining of alloy 617 can be obtained from Special Metals. Cutting tools should be sharp and have positive rake angles to minimize work hardening of the material. Cutting feed and depth of cut must be sufficient to prevent burnishing of the workpiece surface. Additional information on machining is available in the Special Metals publication ‘Machining’ on the company website, www.specialmetals.com.

**Joining**

INCONEL alloy 617 has excellent weldability. INCONEL Filler Metal 617 is used for gas-tungsten-arc and gas-metal-arc welding while INCONEL Welding Electrode 117 is used for shielded metal-arc welding. The composition of the filler metal matches that of the base metal, and deposited weld metal is comparable to the wrought alloy in strength and corrosion resistance. Tensile properties at high temperatures of all-weld-metal specimens are shown in Figure 14. As indicated by Figure 15, rupture strength of the weld metal is equivalent to that of the wrought alloy. Low-cycle fatigue strength of welded joints is shown in Figure 4. Additional information on joining is available in the Special Metals publication “Joining” on the company website, www.specialmetals.com.
It has been shown that small residual amounts of cold work, such as that which results from even mild forming operations, can have a pronounced effect on the creep or rupture performance of superalloys, including alloy 617. While re-solution annealing at 2150°F (1177°C) followed by water quenching would remove the effects of cold work and restore creep properties, laboratory and production data show that a re-anneal at this temperature would result in grain coarsening and thereby reduce LCF performance. Lower annealing temperatures were investigated on samples cold worked 10 and 20%. Samples of as solution annealed material were included in the investigation, as some areas of complex shapes receive essentially no cold work in the part forming process. The data (Figure 16) show that a re-solution anneal of 2050°F (1121°C) followed by air cooling is optimum for achieving recrystallization of the cold worked structure while not promoting grain growth in areas that received little or no cold work. Subsequent tests on production components have confirmed the appropriateness of this re-solution annealing treatment.

Based on these considerations the following recommendations are suggested: beginning with mill solution annealed material (2150°F [1177°C], water quench), cold form, weld and re-solution anneal at 2050°F (1121°C) followed by air-cooling. An acceptable alternative procedure, if the fabrication is too large to re-anneal as an assembly, would be to re-solution anneal the individual pieces after forming but before assembly (welding).
INCONEL® alloy 617

Available Products and Specifications

INCONEL alloy 617 is designated as UNS N06617 and Werkstoff Nr. 2.4663.a. Allowable design stresses for ASME Boiler and Pressure Vessel Code construction are defined in ASME Code Cases 1956 and 1982.

**Rod, Bar, Wire, and Forging Stock** - ASTM B 166/ASME SB 166 (Rod, Bar and Wire), ASTM B 564/ASME SB 564 (Forgings), SAE AMS 5887 (Bars, Forgings and Rings), VdTÜV 485 (Sheet, Plate, Bar and Tubing), ISO 9724 (Wire), DIN 17752 (Rod and Bar), DIN 17753 (Wire), DIN 17754 (Forgings)

**Plate, Sheet, and Strip** - ASTM B 168/ASME SB 168 (Plate, Sheet and Strip), SAE AMS 5888 (Plate), SAE AMS 5889 (Sheet and Strip), VdTÜV 485 (Sheet, Plate, Bar and Tubing), ISO 6208 (Plate, Sheet and Strip), DIN 17750 (Plate, Sheet and Strip)

**Pipe and Tube** - VdTÜV 485 (Sheet, Plate, Bar, and Tubing), ISO 6207 (Tubing), ASTM B 546/ASME SB 546 (Pipe), DIN 17751 (Pipe and Tube)

**Composition** - DIN 17744

**Welding Products** - INCONEL Filler Metal 617 - AWS A5.14/ERNiCrCoMo-1; INCONEL Welding Electrode 117 - AWS A5.11 / E NiCrCoMo-1

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**Figure 16.** Effect of cold work and subsequent annealing temperature (annealed for 1 hour and air cooled) on the yield strength and grain size of alloy 617.

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**References**


U.S.A.
Special Metals Corporation
Billet, rod & bar, flat & tubular products
3200 Riverside Drive
Huntington, WV 25705-1771
Phone +1 (304) 526-5100 +1 (800) 334-4626
Fax +1 (304) 526-5643

France
Special Metals Services SA
17 Rue des Frères Lumière
69680 Chassieu (Lyon)
Phone +33 (0) 4 72 47 46 46
Fax +33 (0) 4 72 47 46 59

Germany
Special Metals Deutschland Ltd.
Postfach 20 04 09
40102 Düsseldorf
Phone +49 (0) 211 38 63 40
Fax +49 (0) 211 37 98 64

Hong Kong
Special Metals Pacific Pte. Ltd.
Unit A, 17th Floor, On Hing Bldg 1 On Hing Terrace
Central, Hong Kong
Phone +852 2439 9336
Fax +852 2530 4511

India
Special Metals Services Ltd.
No. 60, First Main Road, First Block
Vasantha Vallabha Nagar
Subramanyapura Post
Bangalore 560 061
Phone +91 (0) 80 2666 9159
Fax +91 (0) 80 2666 8918

Italy
Special Metals Services SpA
Via Assunta 59
20054 Nova Milanese (MI)
Phone +39 362 4942 24
Fax +39 362 4942 224

The Netherlands
Special Metals Service BV
Postbus 8681
3009 AR Rotterdam
Phone +31 (0) 10 451 44 55
Fax +31 (0) 10 450 05 39

Singapore
Special Metals Pacific Pte. Ltd.
Room 910, Ke Lun Mansion
12A Guanghua Road
Chao Yang District
Beijing 100020
Phone +86 10 6581 8396
Fax +86 10 6581 8381

Affiliated Companies
Special Metals Welding Products
1401 Burris Road
Newton, NC 28658, U.S.A.
Phone +1 (828) 465-0352
Fax +1 (800) 624-3411

Canada House
Bidavon Industrial Estate
Waterloo Road
Biddford-On-Avon
Warwickshire B50 4JN, U.K.
Phone +44 (0) 1789 491780
Fax +44 (0) 1789 463-6614

Controlled Products Group
590 Seaman Street, Stoney Creek
Ontario L8E 4H1, Canada
Phone +1 (905) 643-6555
Fax +1 (905) 643-6614

A-1 Wire Tech, Inc.
A Special Metals Company
4550 Kishwaukee Street
Rockford, IL 61109, U.S.A.
Phone +1 (815) 226-0477
Fax +1 (815) 226-0537

Rescal SA
A Special Metals Company
200 Rue de la Couronne des Prés
78681 Epône Cédex, France
Phone +33 (0) 1 30 90 04 00
Fax +33 (0) 1 30 90 02 11

DAIDO-SPECIAL METALS Ltd.
A Joint Venture Company
Daido Shingawawa Building
6-35, Kohnan 1-chome
Minato-ku, Tokyo 108-0057, Japan
Phone +81 (0) 3 5495 7237
Fax +81 (0) 3 5495 1853