Alloy 800H/800HT are two individual solid solution strengthened, iron-nickel-chromium alloys. They are typically offered as one, dual certified alloy, meeting the chemical composition requirements of both alloys. The principle difference between alloys 800H and 800HT is the restricted aluminum and titanium content in 800HT, which results in higher creep and stress rupture properties. Both alloy 800H and 800HT are generally considered to be superior to the base alloy 800 (UNS N08800) because of greater creep and stress rupture properties and a more restrictive C wt% range. Alloy 800H limits the C wt% from just 0.1% max in base alloy 800 to a 0.5% to 0.1% range. Alloy 800HT further controls this by limiting the C wt% to 0.6% to 0.1%. There are also limitations on the grain size for alloy 800 H/HT that are not in place for alloy 800. Limiting chemical composition of all three alloys are given in Table 1.

## Physical Constants and Thermal Properties

Since the compositional range for alloys 800H and 800HT falls within that for alloy 800, the alloys show no significant differences in physical and thermal properties. Values for various properties are given in Tables 2, 3 and 4.

**Table 1 - Limiting Chemical Compositions, %, for INCOLOY alloys 800, 800H, and 800HT**

| General Requirements | | | |
|---|---|---|---|
| **UNS** | N08800 | N08810 | N08811 |
| **INCOLOY** | 800 | 800H | 800HT |
| **Nickel** | 30.0-35.0 | 30.0-35.0 | 30.0-35.0 |
| **Chromium** | 19.0-23.0 | 19.0-23.0 | 19.0-23.0 |
| **Iron** | 39.5 min. | 39.5 min. | 39.5 min. |
| **Carbon** | 0.10 max. | 0.05-0.10 | 0.06-0.10 |
| **Aluminum** | 0.15-0.60 | 0.15-0.60 | 0.25-0.60 |
| **Titanium** | 0.15-0.60 | 0.15-0.60 | 0.25-0.60 |
| **Aluminum + Titanium** | 0.30-1.20 | 0.30-1.20 | 0.85-1.20 |
| **ASTM grain size** | Not specified | 5 or coarser | 5 or coarser |

**Note: These alloys can be specified to more restrictive compositions on a specific order basis.**

**Table 2 - Physical Constants**

| | | |
|---|---|---|
| **Density** | $lb/in^3$ | 0.287 |
| | $g/cm^3$ | 7.94 |
| **Melting Range** | ° F | 2475-2525 |
| | ° C | 1357-1385 |
| **Specific Heat,** | (32-212°F), Btu/lb•°F | 0.11 |
| | (0-100°C), J/kg•°C | 460 |
| Permeability at 70°F (21°C)and 200 oersted (15.9 kA/m) | | |
| **Annealed** | | 1.014 |
| **Hot-Rolled** | | 1.009 |
| **Curie Temperatur e** | ° F | −175 |
| | ° C | −115 |

Table 3 - Modulus of Elasticitya

| Temperature | Tensile Modulu | Shear Modulus | Poisson's Ratiob |
|---|---|---|---|
| °F | $10^3$ ksi | $10^3$ ksi | |
| -310 | 30.55 | 11.45 | 0.334 |
| 75 | 28.50 | 10.64 | 0.339 |
| 200 | 27.82 | 10.37 | 0.341 |
| 400 | 26.81 | 9.91 | 0.353 |
| 600 | 25.71 | 9.47 | 0.357 |
| 800 | 24.64 | 9.04 | 0.363 |
| 1000 | 23.52 | 8.60 | 0.367 |
| 1200 | 22.37 | 8.12 | 0.377 |
| 1400 | 21.06 | 7.58 | 0.389 |
| 1600 | 19.20 | 6.82 | 0.408 |
| °C | Gpa | Gpa | Poisson's Ratiob |
| -190 | 210.6 | 78.9 | 0.334 |
| 20 | 196.5 | 73.4 | 0.339 |
| 100 | 191.3 | 71.2 | 0.343 |
| 200 | 184.8 | 68.5 | 0.349 |
| 300 | 178.3 | 66.1 | 0.357 |
| 400 | 171.6 | 63.0 | 0.362 |
| 500 | 165.0 | 60.3 | 0.367 |
| 600 | 157.7 | 57.4 | 0.373 |
| 700 | 150.1 | 54.3 | 0.381 |
| 800 | 141.3 | 50.7 | 0.394 |

aDetermined by dynamic method.
bCalculated from moduli of elasticity.

Table 4 - Electrical and Thermal Properties

| Temperature | Electrical Resistivity | Thermal Conductivity | Coefficient of Expansion[a] |
|---|---|---|---|
| °F | ohm•circ | Btu•in/ft$^2$•h°F | $10^{-6}$ in/in/°F |
| 70 | 595 | 80 | - |
| 100 | 600 | 83 | - |
| 200 | 620 | 89 | 7.9 |
| 400 | 657 | 103 | 8.8 |
| 600 | 682 | 115 | 9.0 |
| 800 | 704 | 127 | 9.2 |
| 1000 | 722 | 139 | 9.4 |
| 1200 | 746 | 152 | 9.6 |
| 1400 | 758 | 166 | 9.9 |
| 1600 | 770 | 181 | 10.2 |
| 1800 | 776 | 214 | - |
| 2000 | 788 | - | - |
| °C | μΩ•m | W/m°C | μm/m/°C |
| 20 | 0.989 | 11.5 | - |
| 100 | 1.035 | 13.0 | 14.4 |
| 200 | 1.089 | 14.7 | 15.9 |
| 300 | 1.127 | 16.3 | 16.2 |
| 400 | 1.157 | 17.9 | 16.5 |
| 500 | 1.191 | 19.5 | 16.8 |
| 600 | 1.223 | 21.1 | 17.1 |
| 700 | 1.251 | 22.8 | 17.5 |
| 800 | 1.266 | 24.7 | 18.0 |
| 900 | 1.283 | 27.1 | - |
| 1000 | 1.291 | 31.9 | - |

# Mechanical Properties

The major differences between alloys 800, 800H and 800HT are mechanical properties. The differences stem from the restricted compositions of alloys 800H and 800HT and the high-temperature anneals used for these alloys. In general, alloy 800 has higher mechanical properties at room temperature and during short-time exposure to elevated temperatures, whereas alloys 800H and 800HT have superior creep and rupture strength during extended high- temperature exposure.

# Tensile Properties

Typical tensile properties of INCOLOY alloys 800H and 800HT at temperatures to 2000°F (1095°C) are shown in Figure 1. The data are for annealed extruded tubing of 5-in (127-mm) outside diameter and 0.5-in (12.7-mm) wall.

Tensile properties and hardness of alloys 800H and 800HT at room and elevated temperatures are shown in Table 5. The tests were performed on annealed plate, 0.813 in (20.7 mm) thick.

**Figure 1. High-temperature strength tensile properties of alloys 800H and 800HT.**

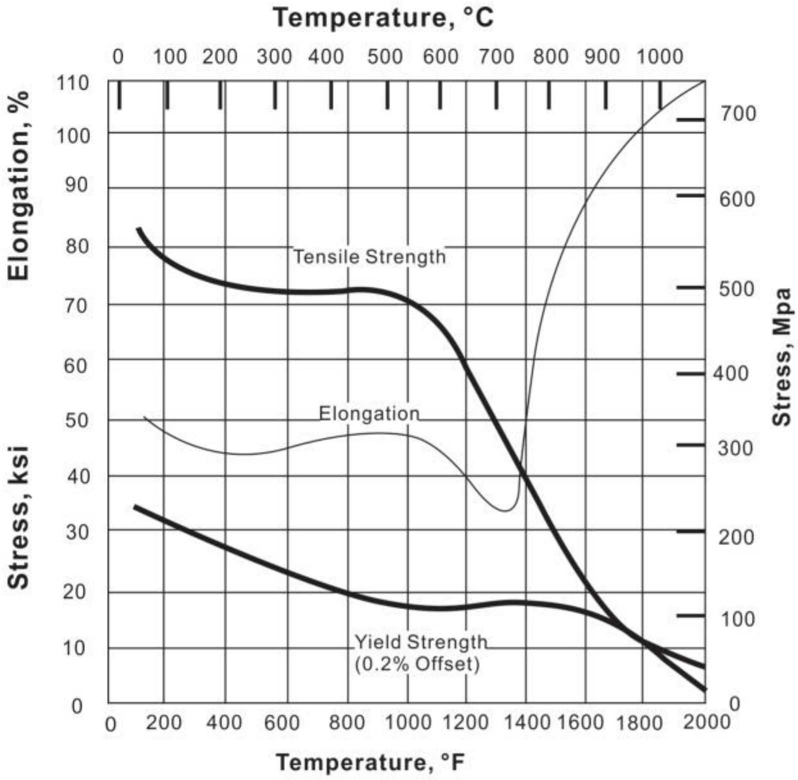


**Table 5 - Tensile properties and hardness of alloys 800H/800HT at high temperatures**

| Temperature | | Hardness BHN | Tensile Strength | | Yield Strength (0.2% Offset) | |
|---|---|---|---|---|---|---|
| °F | °C | | ksi | Mpa | ksi | Mpa |
| 80 | 27 | 126 | 77.8 | 536 | 21. 7 | 150 |
| 800 | 425 | – | 67.5 | 465 | 18. 8 | 130 |
| 1000 | 540 | 90 | 62.7 | 432 | 13.0 | 90 |
| 1200 | 650 | 84 | 54.8 | 378 | 13.5 | 93 |
| 1300 | 705 | 82 | 47.7 | 329 | 15.8 | 109 |
| 1400 | 760 | 74 | 34.2 | 236 | 13.1 | 90 |

**Table 6 - Room-temperature properties of cold-rolled (20%) alloys 800H and 800HT after high-temperature exposure**

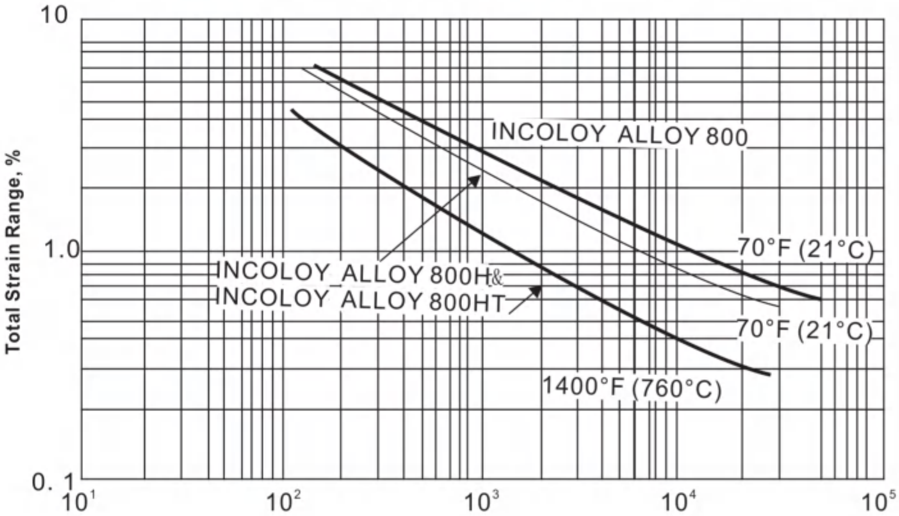
| Exposure Temperature | | Exposure Time | Impact Strengtha | | Yield Strength (0.2% Offset) | | Tensile Strength | | Elongation | Reduction of Area |
|---|---|---|---|---|---|---|---|---|---|---|
| °F | °C | h | ft•lbf | J | ksi | Mpa | ksi | Mpa | % | Mpa |
| No exposure | | - | 112 | 152 | 113. 0 | 779 | 114.0 | 786 | 15.5 | 58.0 |
| 1000 | 540 | 1,000 | 63 | 85 | 114. 5 | 789 | 127.5 | 879 | 18.5 | 50.5 |
| | | 4,000 | 78 | 106 | 112. 5 | 776 | 125.5 | 865 | 20.0 | 52.5 |
| | | 8,000 | 61 | 83 | 113. 5 | 783 | 128.5 | 886 | 20.0 | 47.0 |
| | | 12,000 | 61 | 83 | 113. 5 | 783 | 128.5 | 886 | 20.0 | 52.0 |
| 1200 | 650 | 1,000 | 87 | 118 | 90.5 | 624 | 109.0 | 752 | 23.0 | 46.5 |
| | | 4,000 | 65 | 88 | 79.4 | 547 | 107.0 | 738 | 21.5 | 43.0 |
| | | 8,000 | 62 | 84 | 81.4 | 561 | 106.5 | 734 | 25.5 | 52.5 |
| | | 12,000 | 63 | 85 | 78.9 | 544 | 105.0 | 724 | 24.0 | 50.0 |

aCharpy V-Notch tests.

## Fatigue Strength

Low-cycle fatigue strength of alloys 800, 800H and 800HT at room temperature and 1400°F (760°C) is shown in Figure 2. Low-cycle fatigue data for alloys 800, 800H and 800HT are compared at 1000°F (538°C) and 1200°F (649°C) in Figures 3 and 4.

**Figure 2. Low-cycle fatigue strength of alloys 800, 800H and 800HT.**
**Bending strain was used for alloy 800; axial strain was used for alloys 800H and 800HT.**



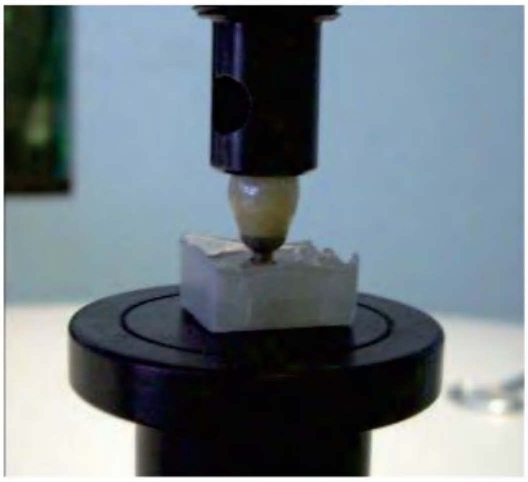



**Figure 3. Low-cycle fatigue strength of alloys 800, 800H and 800HT at 1000°F (540°C).**

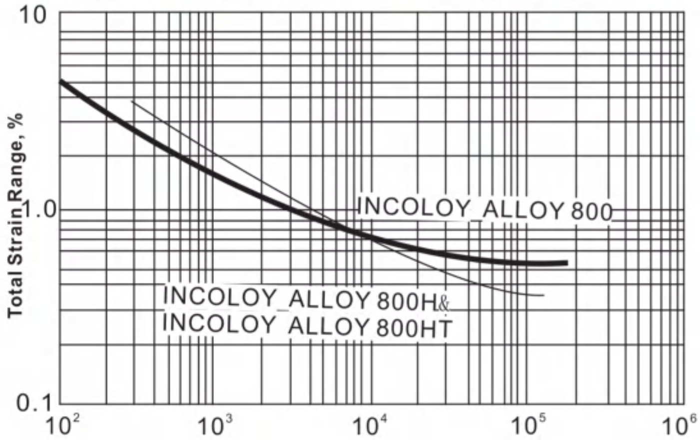
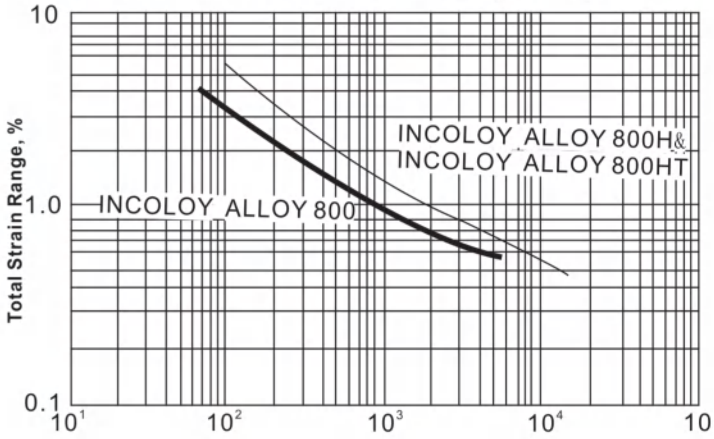



**Figure 4. Low-cycle fatigue strength of alloys 800, 800H and 800HT at 1200°F (650°C).**




## Creep and Rupture Properties

The outstanding characteristics of both alloys 800H and 800HT are their high creep and rupture strengths. The controlled chemistries and solution annealing treatment are designed to produce optimum creep-rupture properties. Figure 5 shows creep strength of alloys 800H and 800HT at various temperatures.

Rupture strength of these alloys is shown by the data plotted in Figure 6.

The excellent creep-rupture strength of alloy 800HT (UNS N08811) is illustrated by the Larson-Miller parameter plot in Figure 7.

**Figure 5. Typical creep strength of alloys 800H and 800HT.**

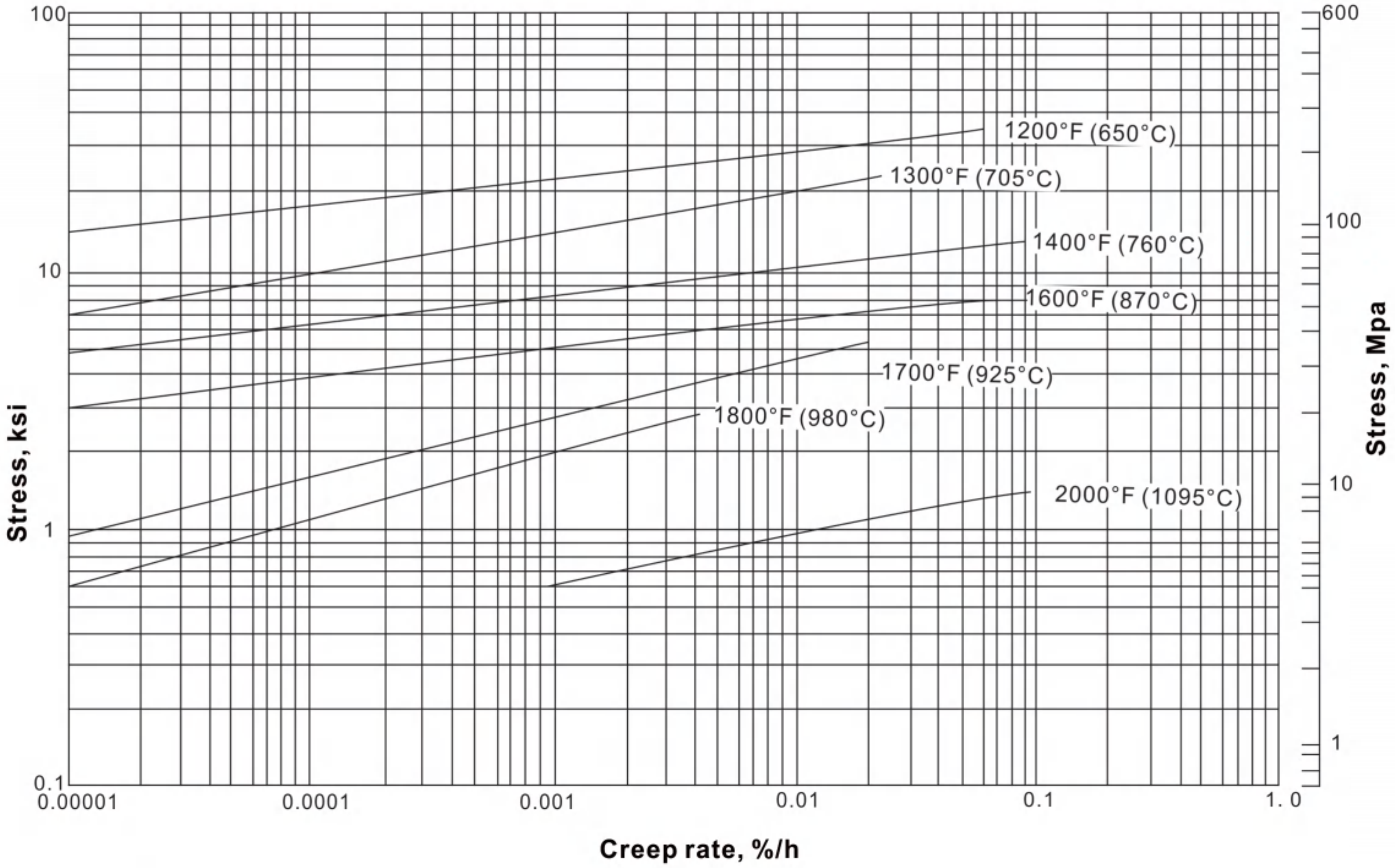



**Figure 6. Typical rupture strength of alloys 800H and 800HT**

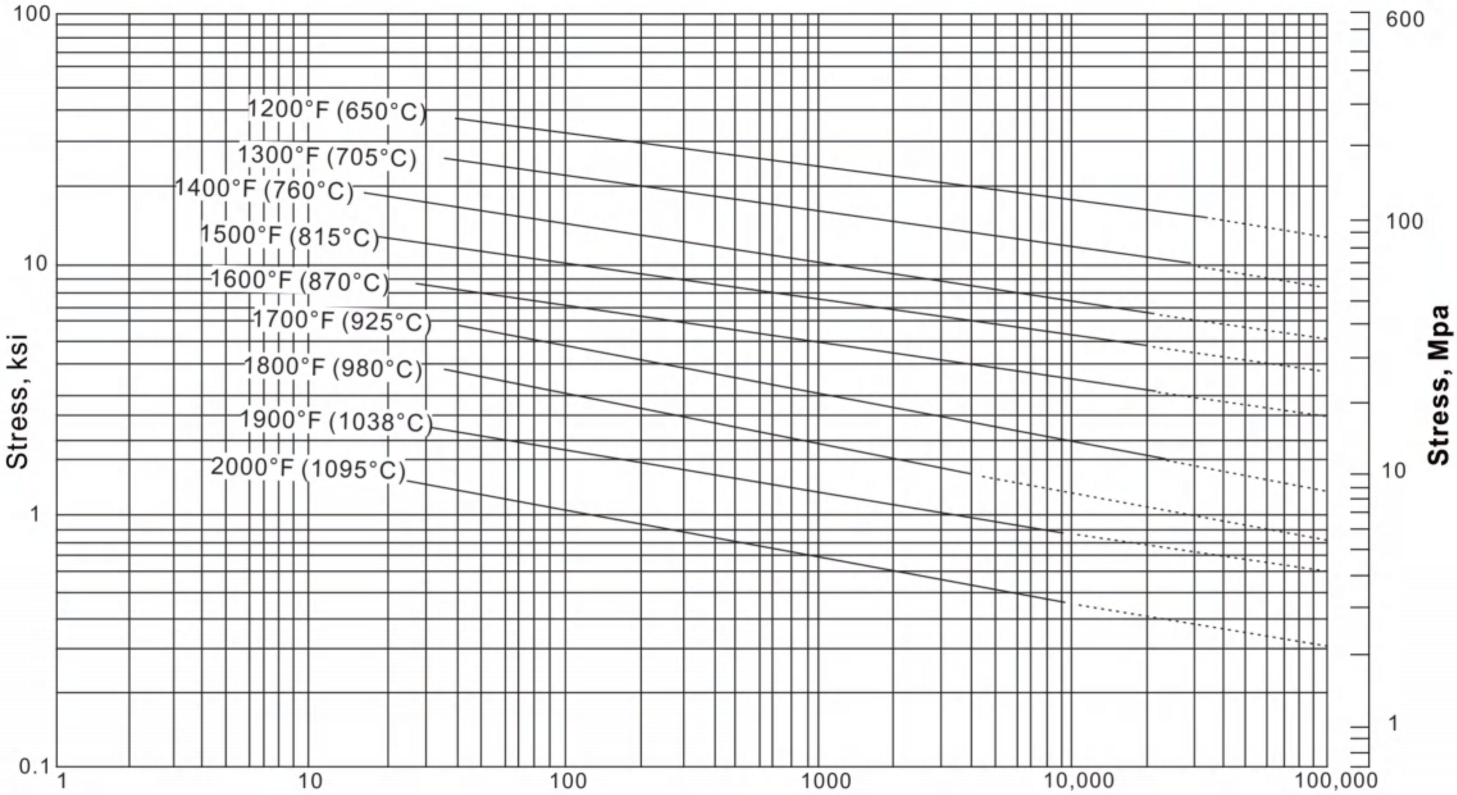
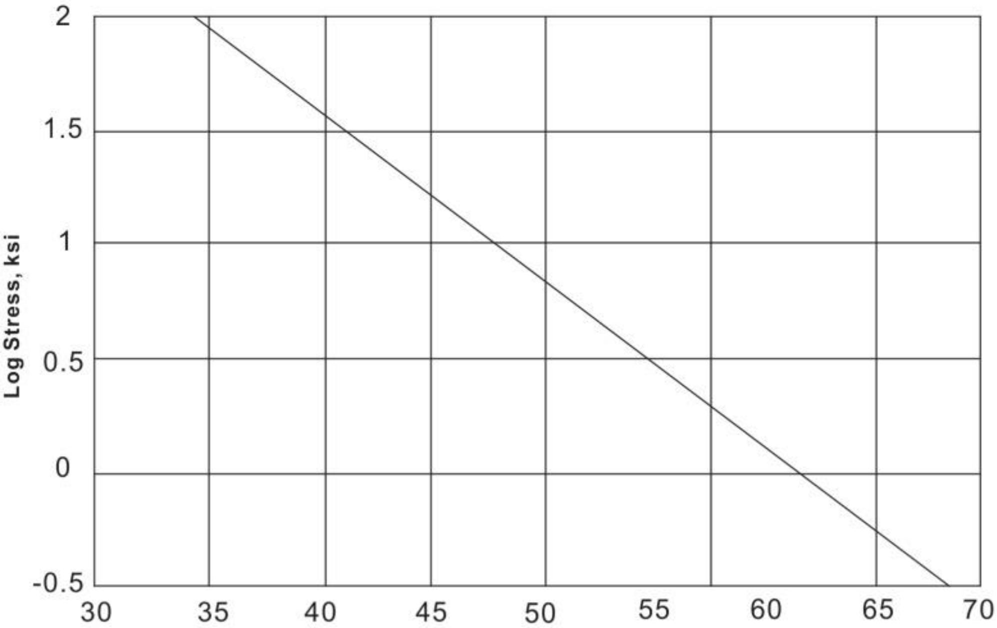


**Table 7 - Representative Rupture-Strength Values for alloys 800H/800HT**

| Temperature | | 10000h | | 100000h | | 10000h | | 100000h | |
|---|---|---|---|---|---|---|---|---|---|
| ° F | ° C | Ksi | Mpa | Ksi | MPa | Ksi | Mpa | Ksi | Mpa |
| 1200 | 650 | 17.5 | 121 | 15.0 | 103 | 14. 0 | 97 | 13. 0 | 90 |
| 1300 | 705 | 11.0 | 76 | 9.5 | 66 | 8. 8 | 61 | 8. 0 | 55 |
| 1400 | 760 | 7.3 | 50 | 6.3 | 43 | 5. 8 | 40 | 5. 3 | 37 |
| 1500 | 815 | 5.2 | 36 | 4. 4 | 30 | 4. 1 | 28 | 3.7 | 26 |
| 1600 | 870 | 3.5 | 24 | 3. 0 | 21 | 2. 8 | 19 | 2. 5 | 17 |
| 1700 | 925 | 1.9 | 13 | 1. 6 | 11 | 1. 4 | 10 | 1. 2 | 8. 3 |
| 1800 | 980 | 1.2 | 8.3 | 1. 0 | 6. 9 | 0. 9 | 6. 2 | 0. 8 | 5.5 |

**Figure 7. Creep-rupture strength of alloy 800HT (UNS N08811)**




Larson-Miller Parameter = (T + 460)*(22.93 + log t)*10-3
where T = temperature in °F and t = rupture life in hours

**Size Ranges**

## BILLET AND BAR PRODUCTS

**Billet and Bar**
Diameters 0.5 in. to 15 in. (12.7 mm to 381 mm) and weights up to ca. 22,000 lb. (10,000 kg)

**Round Cornered Squares**
4 in. to 14 in. (102 mm to 356 mm) across flats and weights up to approx. 20,000 lb. (9,000 kg)

**Hot Rolled Rod**
Diameters 0.5 in. to 2.36 in. (13 mm to 60 mm) and lengths up to ca. 20 ft. (6 m). Longer lengths on application

**Hot Rolled Wire Rod**
Diameters 0.217 in. to 0.59 in. (5.51 mm to 15 mm) in coil form

**Cold Drawn Rounds**
Diameters 0.5 in. to 4 in. (13 mm to 102 mm) and lengths up to approx. 32 ft. (10 m)

**Cold Drawn Hexagons**
0.5 in. to 4 in. (13 mm to 101.6 mm) across flats and lengths up to ca. 20 ft. (6 m)

**Cold Drawn Wire**
Diameters from 0.004 in. to 0.2 in. (0.2 mm to 5 mm) available in coil, on reels and in “pay-off packs”

**Ingot**
Diameter up to 44 in.

## TUBULAR PRODUCTS

**Cold Worked Seamless Pipe and Tube**
0.75 in. to 26 in. (19.1 mm to 660 mm) O.D. range
Hot Worked (Extruded) Seamless Pipe and Tube
3.5 in. to 8.625 in. (88.9 mm to 219.1 mm) O.D. range

## FLAT PRODUCTS

**Hot Rolled Plate**
Thickness from 0.187 in. to 4 in. (4.76 mm to 102 mm) and widths from 48 in. to 98 in.(1,220 mm to 2,500 mm)

**Cold Rolled Sheet**
Thickness from 0.008 in. to 0.25 in. (0.20 mm to 6.4 mm) and widths to 48 in. (1,219 mm)

**Cold Rolled Strip**
Thickness from 0.008 in. to 0.125 in. (0.20 mm to 3.2 mm) and widths down to 12.6 in. (320 mm)

**Minimum Mill Quantities**
Small batch quantities, 300 or 500 kg, can be offered for most bar & tube sizes, for flat products, the minimum order quantity is 2 metric tons.

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