

**NIMONIC® alloy 901 (UNS N09901/W.Nr. 2.4662) is an age-hardenable Ni-Fe-Cr superalloy with significant additions of molybdenum, titanium and aluminum.** The alloying route for this high-performance material may include combinations of vacuum induction melting, vacuum arc remelting and electroslag remelting, according to the final application and the customer's specification. Typically, the alloy is used for gas turbine engine discs, shafts, rings, casings and seals with a maximum service temperature of around 600°C (1100°F).

**Table 1** - Nominal Chemical Composition, %  
(not for specification purposes)

|                 |           |
|-----------------|-----------|
| Nickel.....     | 42.5      |
| Chromium.....   | 12.5      |
| Molybdenum..... | 5.75      |
| Titanium.....   | 2.9       |
| Cobalt.....     | 1.0 max.  |
| Copper.....     | 0.5 max.  |
| Manganese.....  | 0.5 max.  |
| Silicon.....    | 0.4 max.  |
| Aluminum.....   | 0.35 max. |
| Carbon.....     | 0.1 max.  |
| Sulfur.....     | 0.03 max. |
| Iron.....       | Balance*  |

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

## Heat Treatment

The heat treatment for NIMONIC alloy 901 forged bar is a three-stage process involving a solution treatment followed by two age-hardening stages. The recommended procedure is 3h/1090°C (1994°F)/WQ + 4h/775°C (1427°F)/AC + 24h/705-720°C (1301-1328°F)/AC.

## Physical Properties

Some physical properties for NIMONIC alloy 901 are listed in Tables 2-4. Thermal expansion data in Table 3 were determined on fully heat-treated material. The data are subject to a variation of approximately ±5% according to processing variables. The dynamic modulus data in Table 4 were obtained from fully heat-treated cylindrical specimens vibrated in the flexural mode. The recommended heat treatment is quoted above.

**Table 2** - Physical Properties

|                                    |               |
|------------------------------------|---------------|
| Density, Mg/m <sup>3</sup> .....   | 8.14          |
| lb/in <sup>3</sup> .....           | 0.294         |
| Melting Range, °C.....             | 1280-1345     |
| °F.....                            | 2336-2453     |
| Specific Heat, J/kg•°C.....        | 431 at 20°C   |
| Btu/lb•°F.....                     | 0.103 at 68°F |
| Electrical Resistivity, μΩ•cm..... | 112 at 20°C   |
| ohm/circ•mil•ft.....               | 674 at 68°F   |

**Table 3** - Mean coefficient of linear thermal expansion

| °C     | °F     | μm/m•°C | 10 <sup>-6</sup> in/in•°F |
|--------|--------|---------|---------------------------|
| 20-100 | 70-200 | 13.5    | 7.50                      |
| 200    | 392    | 14.2    | 7.89                      |
| 300    | 572    | 14.3    | 7.94                      |
| 400    | 752    | 14.5    | 8.06                      |
| 500    | 932    | 14.8    | 8.22                      |
| 600    | 1112   | 15.0    | 8.33                      |
| 700    | 1292   | 15.3    | 8.50                      |
| 800    | 1472   | 16.1    | 8.94                      |
| 900    | 1652   | 17.5    | 9.72                      |
| 1000   | 1832   | 19.9    | 11.06                     |

**Table 4** - Dynamic Young's Modulus

| Temperature |      | GPa | 10 <sup>3</sup> ksi |
|-------------|------|-----|---------------------|
| °C          | °F   |     |                     |
| 20          | 68   | 201 | 29.2                |
| 100         | 212  | 198 | 28.7                |
| 200         | 392  | 192 | 27.8                |
| 300         | 572  | 185 | 26.8                |
| 400         | 752  | 179 | 26.0                |
| 500         | 932  | 172 | 24.9                |
| 600         | 1112 | 166 | 24.1                |
| 700         | 1292 | 159 | 23.1                |
| 800         | 1472 | 150 | 21.8                |
| 900         | 1652 | 138 | 20.0                |
| 1000        | 1832 | 126 | 18.3                |

Publication Number SMC-076  
Copyright © Special Metals Corporation, 2004 (Sept 04)

NIMONIC is a trademark of the Special Metals Corporation group of companies.

**NIMONIC® alloy 901**



## NIMONIC® alloy 901

### Mechanical Properties

Tensile properties for forged bar over a range of temperatures are shown in Figure 1. Creep-rupture properties for forged bar are shown by Larson-Miller presentation in Figure 2. Impact properties, at room temperature and at high temperatures, are shown in Tables 5 and 6. For the impact data, the test pieces, taken in circumferential direction, were V-notched.

### Available Products and Specifications

NIMONIC alloy 901 is designated as UNS N09901 and Werkstoff Number 2.4662. Alloy 901 is available as flat or round bar, extruded section and forging billet.

**Rod, Bar, Wire and Forging Stock** - BR HR 55, SAE AMS 5660, SAE AMS 5661, AECMA PrEN2176, AECMA PrEN2177, ISO 9723, ISO 9725

**Others** - AECMA PrEN2178

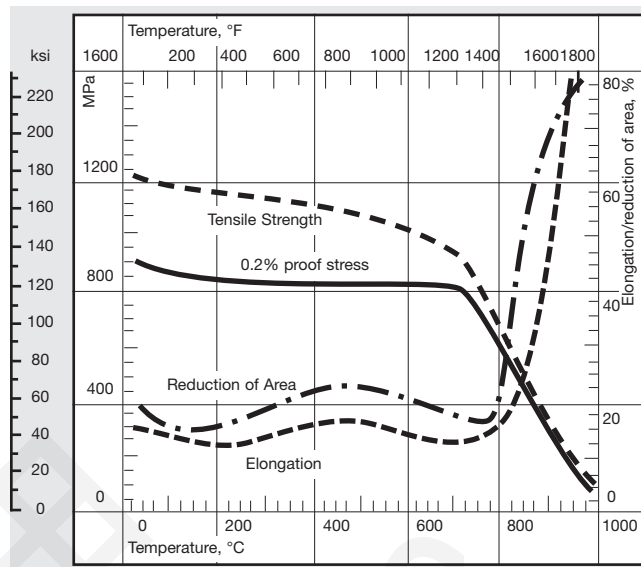


Figure 1. Tensile properties of vacuum refined, extruded and forged bar.

Table 5 - Room-Temperature Impact Properties of NIMONIC alloy 901, J (ft•lbf)

| Soaking time, hours | Soaking Temperature |                |                |                |                |
|---------------------|---------------------|----------------|----------------|----------------|----------------|
|                     | 550°C (1022°F)      | 600°C (1112°F) | 650°C (1202°F) | 700°C (1292°F) | 750°C (1382°F) |
| 30                  | 58 (42.8)           | 44 (32.5)      | 49 (36.2)      | 41 (30.3)      | 50 (36.6)      |
| 100                 | 47 (34.7)           | 50 (36.6)      | 45 (33.2)      | 32 (23.6)      | 27 (19.9)      |
| 300                 | 47 (34.7)           | 57 (42.1)      | 37 (27.3)      | 18 (13.3)      | 14 (10.3)      |
| 1000                | 41 (30.3)           | 38 (28.0)      | 14 (10.3)      | 12 (8.9)       | 5 (3.7)        |
| 3000                | 42 (31.0)           | 47 (34.7)      | 12 (8.9)       | -              | 5 (3.7)        |
| 10,000              | 41 (30.3)           | 15 (11.1)      | 12 (8.9)       | 5 (3.7)        | 5 (3.7)        |

Table 6 - High-Temperature Impact Properties of NIMONIC alloy 901, J (ft•lbf)

| Soaking time, hours | Soaking and Test Temperature |                |                |                |                |
|---------------------|------------------------------|----------------|----------------|----------------|----------------|
|                     | 550°C (1022°F)               | 600°C (1112°F) | 650°C (1202°F) | 700°C (1292°F) | 750°C (1382°F) |
| 0                   | 60 (44.3)                    | 50 (36.9)      | 56 (41.3)      | 42 (31.0)      | 50 (36.6)      |
| 30                  | 49 (36.2)                    | 41 (30.3)      | 37 (27.3)      | 46 (34.0)      | 27 (27.3)      |
| 100                 | 45 (33.2)                    | 41 (30.3)      | 45 (33.2)      | 34 (25.1)      | 42 (31.0)      |
| 300                 | 44 (32.5)                    | 45 (33.2)      | 34 (25.1)      | 41 (30.3)      | 31 (22.9)      |
| 1000                | 73 (53.9)                    | 49 (36.2)      | 26 (19.2)      | 28 (20.7)      | 24 (17.7)      |
| 3000                | 47 (34.7)                    | 41 (30.3)      | 20 (14.8)      | -              | 15 (11.1)      |
| 10,000              | 52 (38.4)                    | 22 (16.2)      | 22 (16.2)      | 12 (8.9)       | 18 (13.3)      |

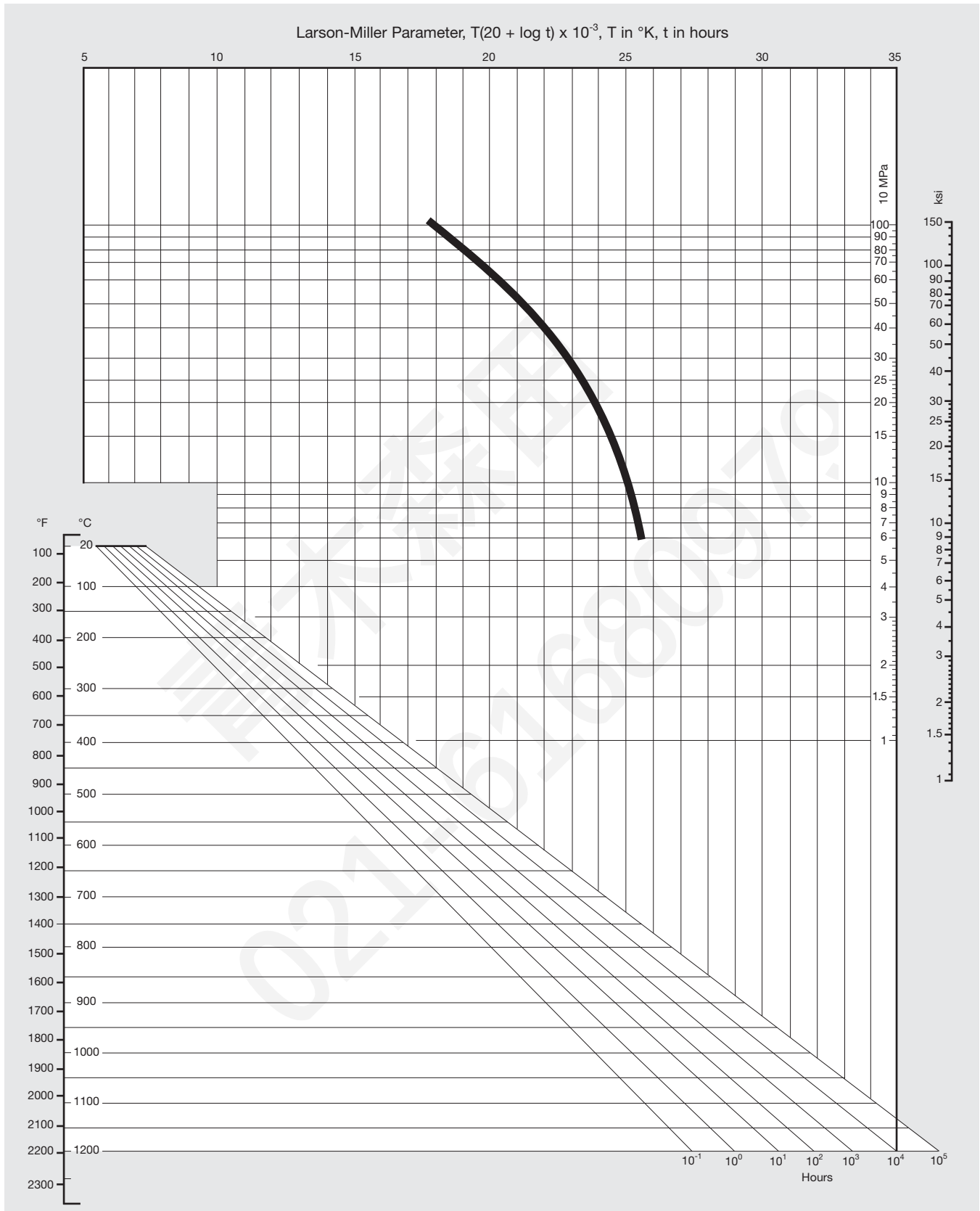


Figure 2. Creep-rupture properties of NIMONIC alloy 901 forged bars.