



Langley Alloys

Nickel  
Alloys

## ALLOY 725

### Specifications:

UNS N07725, ASTM B805, NACE MR0175 / ISO 15156, API 6CRA

Alloy 725 is a Nickel-Chromium alloy with significant additions of Molybdenum, Niobium and Titanium, supplied in the hot worked, annealed and age-hardened condition. It is age-hardened to achieve extremely high strength, approximately twice that of Alloy 625 in the annealed condition, through the precipitation of  $\gamma'$  phase during a controlled heat treatment process. As this high strength is achieved by ageing rather than cold working, it retains excellent ductility and toughness, and this approach is useful for large or non-uniform sections that cannot be strengthened through cold working.

Alloy 725 has very similar corrosion resistance to Alloy 625, and so is utilised in a wide range of very corrosive environments. The high Nickel content ensures resistance to stress corrosion cracking, combined with Molybdenum to strongly resist reducing environments such as sulphuric and phosphoric acids, Chromium to resist oxidising environments such as nitric acid, Titanium to inhibit intergranular corrosion, and overall resistance to pitting and crevice corrosion. The overall combination of alloying elements provides excellent resistance to conditions found in sour oil and gas wells, containing carbon dioxide, chlorides and hydrogen sulphide, and is approved under NACE MR0175 for such applications.

### Key features:

- Suitable for use in highly corrosive sour oil and gas wells, approved under NACE MR0175
- Excellent corrosion resistance in a wide variety of corrosive environments including seawater and industrial acids
- Age hardened for extremely high strength
- Good ductility and toughness
- Excellent resistance to stress corrosion cracking

### Typical applications:

- Downhole equipment for corrosive/sour service
- Oil and gas hangers, connectors,
- Fasteners, especially in marine applications
- Chemical process equipment
- Agitators
- Valve stems

### Physical Properties:

|                                                        |                       |
|--------------------------------------------------------|-----------------------|
| Density (Kg/m <sup>3</sup> )                           | 8310                  |
| Magnetic Permeability (20°C)                           | < 1.001               |
| Young's Modulus (kN/mm <sup>2</sup> )                  | 204                   |
| Poissons Ration                                        | 0.31                  |
| Specific Heat, 20°C (J/(g.K))                          | 0.43                  |
| Electrical Resistivity, 20°C (μΩ-m)                    | 1.144                 |
| Thermal conductivity, 20°C (W/(m.K))                   | 10.6                  |
| Mean coefficient of thermal expansion, 20 - 100°C (/K) | 13 x 10 <sup>-6</sup> |

### Product Forms Available:

|          |          |
|----------|----------|
| Bar      | ✓        |
| Plate    | Enquiry  |
| Tube     | Enquiry  |
| Fittings | Enquiry  |
| Forgings | To order |
| Castings | To order |

### Mechanical Properties:

|                                               | Bars up to 3" (76mm) diameter or section |                            | Bars greater than 10" (254mm) diameter or section |                            | Bars greater than 10" (254mm) diameter or section |                            |
|-----------------------------------------------|------------------------------------------|----------------------------|---------------------------------------------------|----------------------------|---------------------------------------------------|----------------------------|
| 0.2% Proof Stress, min                        | 827 N/mm <sup>2</sup>                    | 120 ksi                    | 827 N/mm <sup>2</sup>                             | 120 ksi                    | 827 N/mm <sup>2</sup>                             | 120 ksi                    |
| Tensile strength, min                         | 1034 N/mm <sup>2</sup>                   | 150 ksi                    | 1034 N/mm <sup>2</sup>                            | 150 ksi                    | 1034 N/mm <sup>2</sup>                            | 150 ksi                    |
| Elongation, 5.65√S0 and 4D                    | 20%                                      |                            | 20%                                               |                            | 20%                                               |                            |
| Reduction of Area                             | 35%                                      |                            | 35%                                               |                            | 35%                                               |                            |
| Hardness (Rockwell C)                         | <43                                      |                            | <43                                               |                            | <43                                               |                            |
| Impact Strength (-60°C) Longitudinal, Typical | 54J av (47J min)                         | 40 ft.lb av (35 ft.lb min) |                                                   |                            |                                                   |                            |
| Impact Strength (-60°C) Transverse, Typical   |                                          |                            | 50J av (43J min)                                  | 37 ft.lb av (32 ft.lb min) | 43J av (37J min)                                  | 32 ft.lb av (27 ft.lb min) |

## Chemical Composition:

|     | Cr   | Ni   | Mo  | Co | Nb<br>(+Ta) | Ti   | W | Cu | C    | Mn   | N | Si   | P     | S     | Fe  | Al   |
|-----|------|------|-----|----|-------------|------|---|----|------|------|---|------|-------|-------|-----|------|
| Min | 19.0 | 55.0 | 7.0 |    | 2.75        | 1.00 |   |    |      |      |   |      |       |       |     |      |
| Max | 22.5 | 59.0 | 9.5 |    | 4.00        | 1.70 |   |    | 0.03 | 0.35 |   | 0.20 | 0.015 | 0.010 | Bal | 0.35 |

## Product Comparison:

| Alloy Comparisons                                     | N07725 | N06625 | N04400 | N05500 | N07718<br>(aged) |
|-------------------------------------------------------|--------|--------|--------|--------|------------------|
| 0.2% Proof Strength (N/mm2)                           | 827    | 415    | 170    | 690    | 827              |
| Corrosion Rate (mm/year) - Seawater                   | 0.01   | 0.01   | 0.25   | 0.18   | <0.01            |
| Corrosion Rate (mm/year) - 10% sulphuric acid at 80°C | 0.15   | 0.15   | 0.06   | 0.1    | 0.15             |
| Corrosion Rate (mm/year) - Boiling 50% nitric acid    | 1.8    | 1.8    | 1.1    | <2     | 1.5              |

## Machining Advice:

| Operation                  | Cutting Speed m/min<br>(ft/min)                                                                            | Feed Rate mm/rev (in/rev)                    | Depth of cut mm (in)     |
|----------------------------|------------------------------------------------------------------------------------------------------------|----------------------------------------------|--------------------------|
| Milling                    | 11 - 14 (35 - 45)                                                                                          | 0.1 - 0.2 mm/tooth<br>0.004 - 0.008 in/tooth | 0.2 - 3.0 (0.007 - 0.12) |
| Drilling 6.4mm (1/4") dia  | 9 - 12 (29 - 38)                                                                                           | 0.05 (0.002)                                 |                          |
| Drilling 12.7mm (1/2") dia | 9 - 12 (29 - 38)                                                                                           | 0.13 (0.005)                                 |                          |
| Drilling 25.4mm (1") dia   | 9 - 12 (29 - 38)                                                                                           | 0.25 (0.01)                                  |                          |
| Turning - Roughing         | 9 - 12 (29 - 38)                                                                                           | 0.25 ( 0.01)                                 | 6.4 (0.25)               |
| Turning - Finishing        | 12 - 15 (38 - 50)                                                                                          | 0.20 ( 0.008 )                               | 1.3 (0.05)               |
| Tooling                    | Milling/Turning: Carbide (SANDVIK GC 235, SECO T25M)<br>Drilling: HSS, point angle 118°, chisel angle 120° |                                              |                          |

## Production Route:

Alloy 725 is produced through high-quality melting processes to ensure cleanliness and consistency.

- Melting can be undertaken by Electric Arc Furnace (EAF), followed by Argon Oxygen Decarburisation (AOD) or Vacuum Oxygen Decarbonisation (VOD) and then Vacuum Arc Remelting (VAR)
- Alternatively, melting by Vacuum Induction Melting (VIM) followed by further refinement by Vacuum Arc Remelting (VAR)
- Or, melting by Vacuum Induction Melting (VIM), followed by Electro Slag Refining (ESR) and Vacuum Arc Remelting (VAR)
- Annealing shall be carried out at a temperature above 1040°C, allowing sufficient time for full annealing to take place
- The material should be cooled rapidly, air cooling is preferred

f) Ageing is undertaken at 730°C for 8 hours, followed by furnace cooling to 620°C, holding for 8 hours, then air cooling

g) Bars are supplied with a standard peeled surface

h) Each complete batch of material is ultrasonically tested, and all bars visually inspected

## Further Processing:

- Order processing and stock control is facilitated by a fully-integrated computer system which links to item production and inspection
- Automated band saws are available for accurate stock cutting up to a section size of 650mm (25")
- First-stage processing, including water jet cutting, turning, boring and grinding can be undertaken to help manage your overall supply chain
- Additional documentation and certification can be supplied as required

## Unique metals for your demanding applications

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