

# NICKEL ALLOY STEEL MATERIAL FLANGES

## USAGE OF NICKEL ALLOY FLANGES

Nickel alloy flanges are chosen for their exceptional properties, including high resistance to corrosion, heat, and pressure, making them ideal for severe and demanding environments.



Here are several scenarios where alloy steel (chrome moly) flanges are the preferred choice:

### 1. Extreme Corrosion Resistance

Nickel alloys, such as Hastelloy®, Inconel®, Monel®, and Alloy 20, offer superior resistance to a wide range of corrosive environments, including acidic, alkaline, and chloride-containing conditions. They are ideal for chemical processing, petrochemical industries, and applications involving exposure to corrosive substances.

### 2. High-Temperature Applications

Nickel alloys maintain their strength and resistance at high temperatures, making nickel alloy flanges suitable for heat-treating equipment, furnaces, and in the aerospace industry where high-temperature strength is crucial.

### 3. Cryogenic Applications

Certain nickel alloys retain their toughness and mechanical properties at extremely low temperatures, making them suitable for liquefied natural gas (LNG) processing, storage, and transportation, as well as other cryogenic applications.

### 4. Marine and Offshore Applications

The excellent corrosion resistance to seawater and marine environments makes nickel alloy flanges a good choice for shipbuilding, offshore oil and gas platforms, and desalination plants.

### 5. Pollution Control

Nickel alloys are used in flue gas desulfurization systems and other pollution control equipment due to their resistance to acidic and corrosive gases.

### 6. Nuclear Power Plants

The ability of certain nickel alloys to withstand nuclear and radioactive environments makes them suitable for use in the construction and maintenance of nuclear reactors, especially in systems that handle radioactive materials or coolants.

Key Considerations:

- **Cost:** Nickel alloy flanges are generally more expensive than carbon steel, stainless steel, or even some duplex/super duplex stainless steel flanges. Their use should be justified by the specific demands of the application that cannot be met by less expensive materials. Their content in terms of Moly, Nickel, and other high grade materials makes the cost per kilogram very high (>50 \$/kg)
- **Fabrication and Welding:** Nickel alloys require specific welding and fabrication techniques to ensure the integrity of the flange connections. Special attention to the selection of filler materials, welding parameters, and post-weld heat treatment is necessary to avoid issues such as cracking or corrosion.
- **Availability:** Some nickel alloys may have limited availability or longer lead times compared to more common materials, which could impact project schedules.

ASTM SPECIFICATIONS FOR NICKEL ALLOY FLANGES

|           |                       |
|-----------|-----------------------|
| ASTM B160 | Nickel 200 Flange     |
| ASTM B166 | Inconel 600 Flange    |
| ASTM B564 | Inconel 625 Flange    |
| ASTM B425 | Incoloy 800 Flange    |
| ASTM B564 | Incoloy 825 Flange    |
| ASTM B564 | Monel K400 Flange     |
| ASTM B564 | Hastelloy C276 Flange |

CHEMICAL COMPOSITION NICKEL-ALLOY FLANGES

| Superalloy Grade | UNS Equivalent | Alloy Composition |      |       |      |       |         |     |      |      |      |
|------------------|----------------|-------------------|------|-------|------|-------|---------|-----|------|------|------|
|                  |                | C                 | Mn   | S     | Si   | Cr    | Ni      | Mo  | Cu   | Ti   | Fe   |
| Nickel 200       | N02200         | 0.08              | 0.18 | 0.005 | 0.18 | ...   | 99.5(a) | ... | 0.13 | ...  | 0.2  |
| Nickel 201       | N02201         | 0.01              | 0.18 | 0.005 | 0.18 | ...   | 99.6(a) | ... | 0.13 | ...  | 0.2  |
| Monel 400        | N04400         | 0.15              | 1    | 0.012 | 0.25 | ...   | 66.5(a) | ... | 31.5 | ...  | 1.25 |
| Monel K-500      | N05500         | 0.13              | 0.75 | 0.005 | 0.25 | ...   | 66.5(a) | ... | 29.5 | 0.6  | 1    |
| Hastelloy B      | N10665         | 0.05 max          | 1    | ...   | 1    | 1     | 61      | 28  | ...  | ...  | 5    |
| Hastelloy D      | –              | 0.12              | 0.9  | ...   | 9.25 | 1     | 82      | ... | 3    | ...  | 2    |
| Inconel 600      | N06600         | 0.08              | 0.5  | 0.008 | 0.25 | 15.5  | 76.0(a) | ... | 0.25 | ...  | 8    |
| Inconel 800      | N08800         | 0.05              | 0.75 | 0.008 | 0.5  | 21    | 32.5    | ... | 0.38 | 0.38 | 46   |
| Hastelloy C-276  | N10276         | 0.01              | 0.5  | 0.02  | 0.03 | 15.5  | 57      | 16  | ...  | ...  | 5.5  |
| Inconel 625      | N06025         | 0.05              | 0.25 | 0.008 | 0.25 | 21.5  | 61.0(a) | 9   | ...  | 0.2  | 2.5  |
| Incoloy 825      | N08825         | 0.03              | 0.5  | 0.015 | 0.25 | 21.5  | 42      | 3   | 2.25 | 0.9  | 30   |
| Hastelloy G      | N06030         | 0.03              | 1.5  | 0.02  | 0.5  | 22.25 | 44      | 6.5 | 2    | ...  | 19.5 |
| 20Cb-3           | N08020         | 0.04              | 1    | 0.02  | 0.5  | 20    | 34      | 2.5 | 3.5  | ...  | ...  |

MECHANICAL PROPERTIES NICKEL-ALLOY FLANGES

| Superalloy grade | UNS Equivalent | Yield Strength (in ksi) | Tensile Strength (in ksi) | Elongation % | Rockwell | Brinell |
|------------------|----------------|-------------------------|---------------------------|--------------|----------|---------|
| Nickel 200       | N02200         | 15                      | 55                        | 35           | –        | 90-120  |
| Nickel 201       | N02201         | 12                      | 50                        | 35           | –        | 90-120  |
| Monel 400        | N04400         | 25                      | 70                        | 35           | –        | 110-149 |
| Monel K-500      | N05500         | 100                     | 140                       | 17           | –        | 265-346 |
| Hastelloy B-2    | N10665         | 51                      | 110                       | 40           | C22      | –       |
| Hastelloy D-205  | –              | 49                      | 114                       | 57           | C30-39   | –       |
| Inconel 600      | N06600         | 30                      | 80                        | 35           | –        | 120-170 |
| Inconel 800      | N08800         | 30                      | 75                        | 30           | –        | 120-184 |
| Hastelloy C-276  | N10276         | 60                      | 115                       | 50           | 184      |         |
| Inconel 625      | N06025         | 39                      | 98                        | 30           | –        | 180     |
| Incoloy 825      | N08825         | 35                      | 85                        | 30           | –        | 120-180 |
| Hastelloy G-30   | N06030         | 51                      | 100                       | 56           | –        | –       |
| 20Cb-3           | N08020         | 35                      | 80                        | 30           | B84-90   | 160     |



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