Nimonic 263, UNS N07263, 2.4650 - High Temperature Alloys Datasheet

Nimonic 263 is a nickel-based superalloy known for its high-temperature strength, excellent corrosion resistance, and good fabricability. It belongs to the Nimonic family of alloys, which are widely used in aerospace, gas turbine, and nuclear industries. Nimonic 263 offers excellent creep and oxidation resistance at elevated temperatures, making it suitable for applications such as gas turbine components, combustion chambers, and high-temperature structural components in aircraft engines. It exhibits good weldability and can be readily formed and machined using standard techniques. Overall, Nimonic 263 is valued for its combination of high-temperature performance and mechanical properties, making it a versatile material for demanding engineering applications.

Chemical Composition

The chemical composition of Nimonic 263 typically includes the following elements:

- Nickel (Ni): Approximately 51%

- Chromium (Cr): Around 20%

- Cobalt (Co): Typically 20%

- Molybdenum (Mo): Generally 6%

- Titanium (Ti): Typically 2%

- Aluminum (Al): Usually 0.7%

- Iron (Fe): Generally 2%

- Other trace elements: Including small amounts of manganese, silicon, sulfur, and boron.

Please note that the exact composition may vary slightly depending on the specific manufacturing process and the desired properties of the alloy. Nimonic 263 is known for its high-temperature strength, oxidation resistance, and corrosion resistance, making it suitable for use in aerospace, gas turbine engines, and other high-temperature applications.

Mechanical Properties

The mechanical properties of Nimonic 263 typically include:

1. **Tensile Strength**: Nimonic 263 exhibits high tensile strength, typically ranging from 850 MPa to 1100 MPa (123,000 psi to 160,000 psi). This property enables it to withstand high loads and stresses in demanding applications.

2. **Yield Strength**: The yield strength of Nimonic 263 is typically in the range of 550 MPa to 900 MPa (80,000 psi to 130,000 psi), indicating its ability to resist deformation under load before permanent deformation occurs.

3. **Elongation**: Nimonic 263 typically has a moderate elongation at break, ranging from 20% to 35%. This property indicates its ability to deform plastically before fracture occurs.

4. **Hardness**: Nimonic 263 exhibits high hardness levels, typically ranging from 30 HRC to 40 HRC (Rockwell C scale).

This hardness contributes to its wear resistance and ability to maintain dimensional stability under high-stress conditions.

5. **Impact Toughness**: Nimonic 263 demonstrates good impact toughness, making it resistant to fracture or failure under sudden loading conditions. This property is particularly important in applications subjected to dynamic loading or shock.

6. **Fatigue Strength**: Nimonic 263 has good fatigue strength, allowing it to withstand repeated cyclic loading without failure. This property is crucial for components subjected to fluctuating stresses over time.

7. **Creep Resistance**: Nimonic 263 exhibits excellent creep resistance at elevated temperatures, making it suitable for use in high-temperature applications such as gas turbine engines.

8. **Corrosion Resistance**: Nimonic 263 has good corrosion resistance, particularly in high-temperature and oxidizing environments. This property helps to prolong the service life of components exposed to corrosive conditions.

These mechanical properties make Nimonic 263 a highly desirable material for a wide range of high-temperature applications, including aerospace, gas turbine engines, nuclear reactors, and industrial processes, where strength, toughness, and corrosion resistance are critical requirements.

Physical Properties

The physical properties of Nimonic 263 typically include:

1. **Density**: Nimonic 263 has a density of approximately 8.35 g/cm³ (0.302 lb/in³), which is relatively high compared to other engineering materials.

2. **Melting Point**: The melting point of Nimonic 263 is around 1300°C to 1360°C (2372°F to 2480°F), depending on the specific composition and processing conditions.

3. **Thermal Conductivity**: Nimonic 263 exhibits moderate thermal conductivity, typically around 11.5 W/(m·K) to 14 W/(m·K) at room temperature. This property influences its ability to conduct heat and dissipate thermal energy.

4. **Coefficient of Thermal Expansion**: The coefficient of thermal expansion of Nimonic 263 is relatively low, typically around 11.5 µm/m·K to 12.5 µm/m·K at room temperature. This indicates its ability to maintain dimensional stability over a range of temperatures.

5. **Electrical Conductivity**: Nimonic 263 is not typically used for its electrical conductivity, but it generally exhibits low electrical conductivity due to its metallic composition.

6. **Magnetic Properties**: Nimonic 263 is usually non-magnetic in the annealed condition, but it can become slightly magnetic after cold working or heat treatment. This property may be important in certain applications where magnetic interference must be minimized.

7. **Corrosion Resistance**: Nimonic 263 exhibits good corrosion resistance, particularly in high-temperature and oxidizing environments. However, it may be susceptible to certain types of corrosion, depending on the specific operating conditions and environment.

These physical properties contribute to the overall performance and suitability of Nimonic 263 for various engineering applications, where factors such as dimensional stability, thermal conductivity, and corrosion resistance are important considerations.

Heat Treatment

The heat treatment process for Nimonic 263 typically involves the following steps:</br>

1. **Solution Treatment**: Nimonic 263 is first solution treated by heating the material to a specific temperature range, typically around 1090°C to 1175°C (1994°F to 2147°F). The alloy is held at this temperature for a certain duration to dissolve any precipitates and achieve a homogeneous austenitic microstructure.

2. **Quenching**: After solution treatment, the alloy is rapidly quenched, usually in water or oil, to "freeze" the microstructure in its high-temperature state. Quenching helps to lock in the desired properties, such as high strength and hardness, achieved during solution treatment.

3. **Age Hardening**: The quenched Nimonic 263 is then aged at a lower temperature, typically around 720°C to 780°C (1328°F to 1436°F), for several hours. During aging, fine intermetallic precipitates form within the microstructure, resulting in a significant increase in strength and hardness.

4. **Multiple Aging Steps**: Depending on the specific properties desired, Nimonic 263 may undergo multiple aging steps, where the material is reheated and aged multiple times to achieve the desired combination of strength, hardness, and toughness.

5. **Cooling**: After aging, the Nimonic 263 is cooled naturally or air-cooled to room temperature. This completes the heat treatment process and stabilizes the microstructure of the alloy.

The precise parameters of the heat treatment process, including temperatures, durations, and cooling rates, may vary depending on the specific requirements of the application and the desired properties of the final product. It's essential to carefully control the heat treatment process to ensure that Nimonic 263 achieves the desired combination of mechanical properties, such as strength, hardness, and toughness, for its intended use.

Welding Properties

Welding Nimonic 263 requires careful consideration of its unique properties to ensure successful and durable welds. Here are some key points to consider when welding Nimonic 263: 1. **Preparation**: Thoroughly clean the surfaces to be welded to remove any contaminants, such as oil, grease, or oxides, which can negatively affect the quality of the weld. 2. **Welding Method**: Gas tungsten arc welding (GTAW or TIG) is commonly used for welding Nimonic 263 due to its precision and control. Gas metal arc welding (GMAW or MIG) can also be used, but it may require additional precautions. 3. **Filler Material**: Select a filler material that matches the composition of Nimonic 263 and provides suitable mechanical properties for the intended application. Nimonic 263 filler wire or rod is often used for welding Nimonic 263. 4. **Preheat**: Preheating the base metal can help reduce the risk of cracking and improve the weldability of Nimonic 263. Preheat temperatures typically range from 200°C to 400°C (392°F to 752°F), depending on the thickness of the material and the welding process. 5. **Welding Parameters**: Adjust welding parameters such as current, voltage, and travel speed to achieve optimal penetration and fusion while minimizing the heat input. Nimonic 263 is sensitive to overheating, so it's important to avoid excessive temperatures during welding. 6. **Shielding Gas**: Use a high-purity inert gas, such as argon or helium, as a shielding gas to protect the weld pool from atmospheric contamination and oxidation. 7. **Post-Weld Heat Treatment (PWHT)**: Depending on the specific requirements of the application, a post-weld heat treatment may be necessary to relieve residual stresses and improve the mechanical properties of the weld. 8. **Welding Position and Joint Design**: Consider the welding position and joint design when planning the welding process. Ensure proper fit-up and accessibility to facilitate welding and achieve high-quality welds. 9. **Cooling Rate**: Control the cooling rate of the weldment to minimize the risk of cracking and distortion. Slow cooling or post-weld annealing may be necessary for thicker sections or complex geometries. By following these guidelines and best practices, it is possible to achieve high-quality welds when welding Nimonic 263, ensuring the integrity and performance of the welded components in demanding applications.

Machining Properties

Machining Nimonic 263 requires careful consideration of its properties to ensure efficient and precise machining operations. Here are some key points to consider when machining Nimonic 263: 1. **Tool Selection**: Use carbide or high-speed steel (HSS) cutting tools with sharp cutting edges and coatings designed for high-temperature alloys. These tools provide good wear resistance and cutting performance. 2. **Cutting Speed**: Use moderate to low cutting speeds to minimize tool wear and heat generation. Start with conservative cutting speeds and adjust as needed based on tool performance and workpiece conditions. 3. **Feed Rate**: Adjust the feed rate to achieve optimal chip formation and evacuation. Use higher feed rates for roughing operations and lower feed rates for finishing operations to achieve desired surface quality and dimensional accuracy. 4. **Depth of Cut**: Use shallow depths of cut to minimize tool wear and ensure consistent cutting performance. Avoid aggressive cuts that may lead to excessive tool pressure and heat generation. 5. **Coolant Use**: Use ample coolant or cutting fluid during machining to dissipate heat and lubricate the cutting tool-workpiece interface. Flood coolant or through-tool coolant delivery systems are effective in cooling and lubricating the cutting zone. 6. **Tool Geometry**: Select cutting tools with appropriate geometry, including rake angle, clearance angle, and cutting edge geometry, to optimize chip formation and evacuation. Sharp cutting edges and positive rake angles are generally preferred for machining Nimonic 263. 7. **Workpiece Fixturing**: Secure the workpiece firmly to minimize vibrations and ensure stability during machining operations. Use proper clamping devices or fixtures to hold the workpiece securely in place. 8. **Tool Wear Monitoring**: Regularly inspect cutting tools for signs of wear and damage, such as flank wear, chipping, or built-up edge. Replace worn or damaged tools promptly to maintain machining accuracy and productivity. 9. **Chip Control**: Manage chip formation and evacuation to prevent chip recutting and tool damage. Use appropriate chip breakers, tool coatings, or chip evacuation systems to control chip flow and improve machining efficiency. By following these guidelines and best practices, you can achieve efficient and accurate machining of Nimonic 263, meeting the requirements of various industrial applications while extending tool life and minimizing production costs.

Similar or Equivalents Steel Grade

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