

Introduction

Cromgard C20-3 is a molybdenum-enhanced grade of stainless steel. The Chromium (Cr), Nickel (Ni), Molybdenum (Mo) and Nitrogen (N) are controlled to give a phase balance similar to that of the 2205 duplex grade of stainless steel while reducing costs. Cromgard C20-3 fills a gap between Type 316L and DSS 2205 in terms of corrosion resistance, while possessing the higher mechanical characteristics of a duplex stainless steel. Cromgard C20-3 can be an economic alternative to Type 316L stainless steel providing enhanced strength and corrosion resistance.

When heat treated properly, Cromgard C20-3 has a microstructure of nearly equal proportions of austenite and ferrite. This microstructure and composition ensures that Cromgard C20-3 is much more resistant to stress corrosion cracking (SCC) than austenitic stainless steels such as Type 316 or Type 317.

The yield strength of Cromgard C20-3 is more than double that of austenitic stainless steels such as grades 304L and 316L. This often allows down gauging in the design, depending on Young's Modulus and buckling limitations.

Cromgard C20-3 has a ductile to brittle transition temperature of about -40°C or lower. This grade can also become embrittled when exposed to temperatures between 300°C and 550°C. (475°C embrittlement) and 550°C and 1,000°C (sigma (σ) and chi (χ) phase formation). Thus, application temperatures are generally limited from -50°C to 300°C.

Applications

Cromgard C20-3 has similar general and pitting corrosion resistance that fills the gap between Type 316L austenitic stainless steel and DSS grade 2205. Its excellent strength, toughness, corrosion resistance and resistance to stress corrosion cracking (SCC) make Cromgard C20-3 suitable for applications such as:

- Subsea Flow Lines
- Bridge Decking
- Desalinization
- Water Heaters
- Pipes & Tubes
- Water Treatment
- Potable Water Systems
- Power Generation
- Chemical Processing
- Transport Tanks
- Home Appliances
- Heat Exchangers
- Pressure Vessels
- Architectural Structures
- Pulp & Paper Production

Specifications Coverage

Cromgard C20-3 is covered in ASTM specifications A240 (plate, sheet and strip), A270 (sanitary tube), A480, A789 (tube), A790 (pipe), and A928 (pipe welded with filler). Cromgard C20-3 is approved for ASME Boiler and Pressure Vessel Code use under Code Case 2503-1 for Section VIII Division I use. Cromgard C20-3 is certified as an acceptable material for use in drinking water treatment and distribution systems by NSF International in Appendix C of NSF/ANSI Standard 61:2005.

Cromgard C20-3 is included in Appendix X of API Standard 650, Welded Steel Tanks for Oil Storage.

Corrosion Resistance

Cromgard C20-3 resistant to dilute reducing acids and moderate concentrations of oxidizing acids. The alloy is also resistant to low concentrations of organic acids.

Plain and welded samples of Cromgard C20-3 were exposed for over 1000 hours in a salt fog cabinet per ASTM B117. No signs of rust or pitting were observed.

Pitting Corrosion Resistance

A relative ranking of the resistance to chloride-ion pitting corrosion can be made by following ASTM Standard G150 and increasing the test temperature until the onset of pitting is observed. The temperature at which attack is first observed is called the critical pitting temperature (CPT) and can be used as a relative measure of pitting corrosion resistance. The CPT criterion is useful in ranking alloys, but does not necessarily indicate an absolute limiting temperature for the use of a particular alloy in chloride bearing solutions. Test data shows that Cromgard C20-3 has a CPT of 95°F (35°C), which is slightly better than that of Type 317L.

The CPT was determined for as-welded Cromgard C20-3 material in an acidified ferric chloride solution in accordance with ASTM G48, Practice C. Results after 72 hours showed that the as-welded samples of Cromgard C20-3 passed the test at 41°F (5°C) and failed the test at 50°F (10°C). In comparison Type 316L would fail in this test at approximately 32°F (0°C).

Where pitting corrosion is anticipated, steel with high pitting resistance equivalents (PRE), such as Cromgard C20-3, should be considered. The PRE number for Cromgard C20-3 is 30.

Atmospheric Corrosion

The atmospheric corrosion resistance of Cromgard C20-3 is very good. Cromgard C20-3 more than sufficient in urban and industrial environments and is normally well suited for most marine environments .

Welding

Cromgard C20-3 can be welded by most methods used to weld stainless steels. Autogenous welding will increase the amount of ferrite present in the weldment and adjacent areas of the base metal. If Cromgard C20-3 is autogenously welded, the fabrication should be solution annealed to restore the desirable microstructure and hence the toughness. A nitrogen addition is recommended to preserve corrosion resistance and strength.

Commercially available overmatched filler metals are suggested for welding Cromgard C20-3. Such filler metals, like AWS E2209, contain more nickel than the base metal in order to produce a phase balance within the weld that is approximately the same as the base metal.

When Cromgard C20-3 is welded to different metals, a filler metal should be chosen that contains a quantity of austenite forming elements that is sufficient to produce a fully austenitic weld. Non-Filler metal welds should be heat treated for optimum corrosion resistance and formability.

ASME Code Case 2503-1 states that for welding performance qualifications, Cromgard C20-3 shall be considered P-No. 10H, Group 1.

Chemical Composition

| Element | Range |
|------------|---------------|
| Carbon | 0.030 max |
| Silicon | 1.000 max |
| Manganese | 2.000 max |
| Phosphorus | 0.030 max |
| Sulfur | 0.020 max |
| Chromium | 19.50 - 22.50 |
| Nickel | 3.000 - 4.000 |
| Nitrogen | 0.140 - 0.200 |
| Molybdenum | 1.500 - 2.000 |
| Iron | Balance |

Per ASTM A240

Mechanical Properties

| Property | Value |
|---------------------------------------------------|-------|
| Tensile Strength (ksi) \leq 4.76mm Thickness | 100 |
| Tensile Strength (ksi) $>$ 4.76mm Thickness | 95 |
| 0.2% Proof Strength (ksi) \leq 4.76mm Thickness | 70 |
| 0.2% Proof Strength (ksi) $>$ 4.76mm Thickness | 65 |
| Elongation* | 25% |

Per ASTM A240

Values are minimum unless stated

* Elongation over a length of 50.8mm

Physical Properties



| Property | | Value |
|----------------------------------|----------------|-------|
| Density (lb/in ³) | | 0.28 |
| Modulus of Elasticity | Tension (GPa) | 210 |
| Specific Heat Capacity (J/ kg K) | | 510 |
| Thermal Conductivity | 100°C (W/ m K) | 17.0 |
| Magnetic | | Yes |

Per ASTM A240 & EN 10088-2



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Note: This data sheet is intended as a source of information, and as an ongoing service for the benefit of Cromgard C20-3 users and specifiers. However, Crompion International cannot be held responsible either for the suitability of the steel in question for any particular purpose, or for the performance or selection of the steel, on the basis of the information contained herein or otherwise; unless Crompion International has specifically authorized the purpose or selection. Crompion International shall not be liable in the event of a breakdown or malfunction occurring due to faulty design, material or workmanship of the steel, whether based on the information contained herein or not, and shall not under any circumstances be liable for any damages, either direct or indirect, particularly consequential damages, including but not limited to damages for loss of profits arising from the installation and use of such steel.

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