Fabrication of components in 2205 is not difficult but it does require some modification of the practices commonly used for Type 316L. 2205 has high strength, which may require changes of technique in cold forming. Welding can be done with little risk of hot cracking, but the welder should be aware that a high cooling rate, weld spatter, strike scars, damp electrodes, and high interpass temperatures can lead to embrittlement and reduced corrosion resistance.

To obtain welded joints with corrosion resistance and mechanical properties equivalent to those of the base metal, the welders and inspectors should be informed in advance of the special aspects of forming and welding 2205. Preparing written welding procedures and having welders perform trial welds are sensible precautions prior to beginning production.

Because 2205 is often selected for critical components in highly corrosive environments, welded joints must be inspected carefully. Incomplete fusion, incomplete penetration, a poorly cleaned root side, spatter, and strike scars must be remedied. Suitable nondestructive testing methods are X-ray inspection, liquid penetrant inspection, hydrostatic testing, leak detection, and ferrite measurement. Destructive testing methods include bend tests, impact tests, and metallographic examination. A corrosion test such as that in ASTM A 923, Method C, may also be useful.

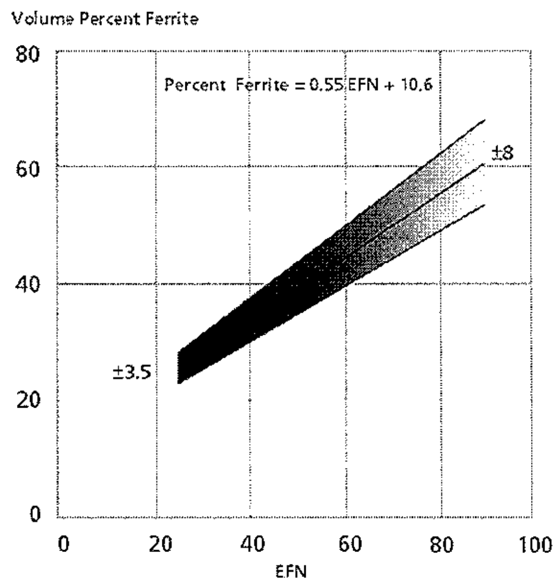
Ferrite Measurement

2205 Code Plus Two is controlled to have an austenitic-ferrite balance with 30–55% ferrite, typically about 45% ferrite. Substantial deviations of the austenite-ferrite ratio from this range can adversely affect the mechanical properties and corrosion resistance of the welded joint. Excessively low ferrite content (<25%) can result in reduced strength and a risk of stress corrosion cracking. Excessively high ferrite content (>75%) can lead to reduced corrosion resistance and impact toughness.

Metallographic measurement of ferrite is a destructive test and very time consuming, requiring a well-equipped laboratory. A less precise but non-destructive test method is determination of ferrite number by a Magnegage equipped with a counterweight. The Magnegage determines the magnetic capacity of a metal by measuring the force exerted in lifting a small permanent magnet from the test surface. This force is converted to a Ferrite Number (FN). Because the original instrument went only to 28FN, a counterweight is used to extend the range to higher ferrite numbers expressed as Extended Ferrite Number (EFN). Outokumpu has used this method on a large number of unannealed weld metals and determined the relationship of EFN to the volume fraction of ferrite measured metallographically. This relationship is shown in Figure 2 and may be expressed as: Volume Percent Ferrite = 0.55 EFN + 10.6

Figure 2

Relationship Between Volume Percent Ferrite and EFN in Unannealed Duplex Weld Metals



Magnetic measurements of ferrite in duplex stainless welds are best made using metallographically measured reference samples of similar weld geometry. Electronic instruments based on magnetic response, e.g., the Fischer Feritscope, also may be useful for quality control when adequately calibrated.

Dissimilar Metal Welds

For dissimilar welds such as 2205 to carbon or low alloy steels, appropriate filler metals may be Avesta