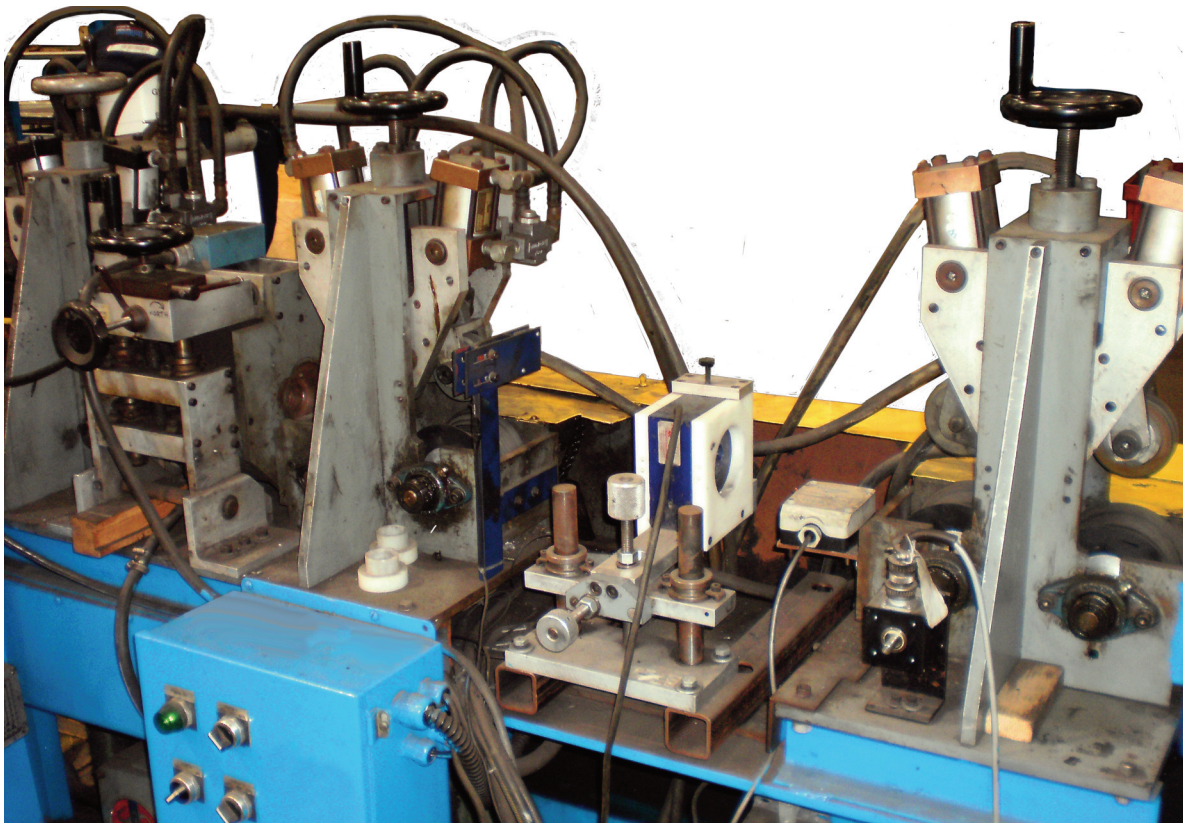


# Detecting Sigma Phase

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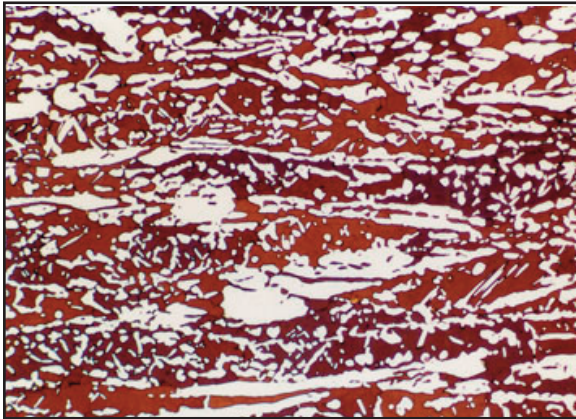
Using MultiMac® Eddy Current Equipment



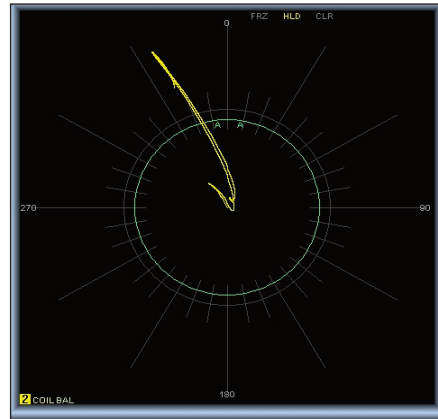
# Sigma Phase Description

Sigma Phase is a brittle, nonmagnetic phase of tetragonal structure occurring in many transition metal alloys; frequently encountered in high chromium stainless steels. It results from a transformation of Delta ferrite in the alloy, creating carbides at the grain boundaries, which reduce the carbon and chromium content that normally provides strength and corrosion resistance in the metal matrix. Because the condition has significant length and is not a single point type defect, the standard, which is provided by the customer, is measured as a percent of the cross section of the tube wall or bar, using micrographic techniques.

Sigma Phase is generally thought to occur as a result of improper or extensive heat treatment, such as can occur with a malfunctioning high temperature furnace. Some metallurgists believe this is most likely to occur at temperatures between 600°C and 900°C. For the 2507 grade of duplex stainless steel, sigma phase may be resolved at temperatures above 1050°C through a corresponding annealing.



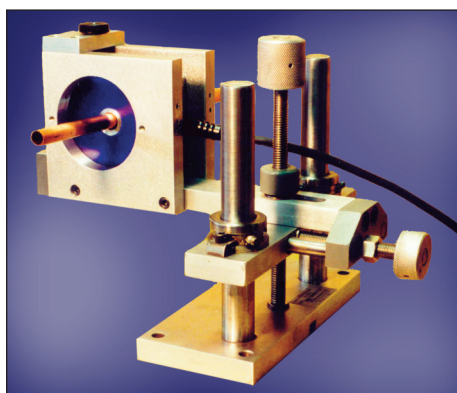
Microscopic images of Sigma Phase



Sigma Phase signal, as displayed on the MultiMac® eddy current test screen.

## Test System

- ☑ Detects Sigma Phase as Small as 2.6% of Tube Wall Cross Section
- ☑ Inspects 2507 Duplex Stainless Steel Tube
- ☑ 80 FT Cut Lengths
- ☑ 3/4" OD with .083" Wall Thickness
- ☑ 2 Channel MultiMac® Eddy Current Tester Off-line
- ☑ 2 Varimac® Comparator Coils



CP 30 Eddy Current Coil Platform

The test consists of a two channel MultiMac® eddy current tester. One channel is used for the detection of typical defects, while the other absolute channel is used for finding Sigma Phase.

The MultiMac's absolute channel test uses two Varimac® eddy current comparator coils. One coil is balanced on air and used to calibrate the equipment with a reference standard. The other is the actual test coil, mounted on a CP 30 Coil Platform, shown at left.

The complete system is mounted on a Dual Pinch Stand test bench and includes a CP 352 for the defect detection, followed by the CP 30 for Sigma Phase. The system operates offline on cut length 2507 duplex stainless steel tubes up to 80 feet in length, 3/4" OD, with a wall thickness of 0.083".

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