

MATERIALS INTEGRITY / TECHNICAL BRIEF

Ferrite Testing

Why the right microstructure matters in austenitic, duplex and nickel alloys.

A practical guide to weld integrity, material control and defensible documentation.



One small parameter. A major service-life decision.

Material certificates confirm only part of the story. In stainless steels and nickel alloys intended for sour, cryogenic or chloride-laden service, ferrite content is a critical microstructural control that can influence integrity in service.

“The right amount of ferrite is completely different for each alloy family.”

01

Weldability

The required phase balance is set before a weld is deposited.

02

Service performance

Corrosion resistance, toughness and cracking risk depend on getting the balance right.

03

Acceptance

Ferrite measurement becomes a hold point in many welding and NDE specifications.

Three alloy families. Three different answers.

The correct control point is defined by alloy family and intended duty—not by a single magnetic reading.

ALLOY FAMILY	TYPICAL FERRITE TARGET	WHY IT MATTERS
Austenitic stainless welds 304L / 316L / 321	~3–10 FN	Helps prevent hot cracking without sacrificing corrosion resistance or toughness.
Duplex / super duplex 2205 / 2507	~30–70% Project specifications often 35–65%	Phase balance supports the alloy’s strength and pitting resistance.
Nickel alloys Alloy 625 / Alloy 825 / Alloy C-276	Essentially zero	Ferrite is metallurgically foreign; a magnetic response needs investigation.

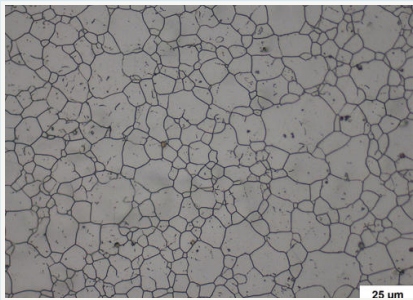
KEY INSIGHT

Ferrite measurement matters because the consequence of getting it wrong is alloy-specific.

A small amount of ferrite is engineered into the weld.

~3–10

FERRITE NUMBER (FN) — TYPICAL RANGE FOR
STANDARD AUSTENITIC STAINLESS WELD FILLERS



Representative micrograph — illustrative only

Fully austenitic weld metal is susceptible to solidification cracking. A limited delta-ferrite fraction helps control sulphur and phosphorus effects, creates more crack-resistant ferrite/austenite boundaries, and accommodates shrinkage strain.

Why not more?

Preferential attack in oxidising acids

Corrosion risk

Sigma-phase formation at 550–900 °C

Embrittlement and loss of impact toughness

BCC phase transformation at low temperature

Reduced cryogenic toughness

The engineering task is a window—not a maximum.

Performance lives in the balance.

Ferrite supports yield strength and chloride stress-corrosion-cracking resistance. **Austenite** supports toughness and general corrosion resistance. Together they enable demanding pitting performance.

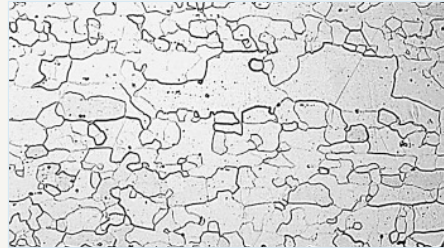
PROCESS CONTROL — Control heat input and interpass temperature to prevent intermetallic precipitation.

If ferrite is too high

Impact toughness can collapse, especially at low temperatures.

Hydrogen-induced stress cracking (HISC) susceptibility rises sharply.

Pitting resistance falls as chromium nitrides precipitate.



Representative micrograph — illustrative only

50 / 50

APPROXIMATE FERRITE / AUSTENITE DESIGN BALANCE

If ferrite is too low

Strength falls below the design basis.

Resistance to chloride stress corrosion cracking degrades.

In nickel alloys, ferrite is not a target. It is a signal.



Nickel-based alloys are fully austenitic by design. A non-zero magnetic response on a component or weld overlay should trigger investigation—not an assumption.

Dilution — ferritic substrate influence in weld overlays

Cross-contamination — grinding debris, iron smearing or shared tooling

Wrong / mixed material — mis-issued ferritic or duplex material in a nickel alloy assembly

Essentially zero ferrite by design in Alloy 625, Alloy 825 and Alloy C-276

Screen fast. Confirm chemistry. Make the conclusion defensible.

Fast production control. Referee-level qualification.

DESIGN

WRC-1992 predictive diagram

Estimates weld ferrite from chemistry before welding; prediction does not replace measurement.

QUALIFY

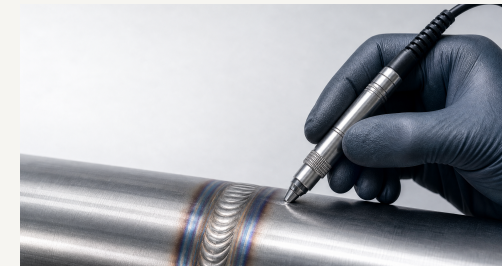
Metallographic point counting — ASTM E562

Measures actual sectioned volume fraction; the reference method for duplex phase balance.

PRODUCE

Magnetic induction — Feritscope

Fast, non-destructive readings in FN or %Fe; suitable for finished welds and in-situ control.



Audit-Ready Practice Calibrate against certified standards, take multiple readings per location, apply correction factors where required, and record measurement location, instrument serial number and calibration status.

Note: FN and %Fe should not be treated as interchangeable for acceptance reporting.

The reading matters. The framework makes it meaningful.

Ferrite measurement becomes valuable when linked to material traceability, procedure discipline and complete documentation.

01

Material certification

EN 10204 3.1 traceability

02

PMI

OES / XRF as appropriate

03

Welding qualification

WPS / PQR acceptance criteria

04

Production NDE

RT, hardness and impact-test cross-checks as specified

05

Documentation

A coherent, review-ready dossier

REFERENCE For duplex weld procedure qualification, properly etched metallographic sections and ASTM E562 manual point counting remain the reference condition described in the guide.

Ferrite control is procedural, not reactive.

“Measured, recorded and defensible.”

Design stage

Filler selection and dilution planning against WRC-1992 predictions; ferrite acceptance criteria built into duplex and controlled-ferrite WPS.

Qualification

Duplex procedures qualified with ASTM E562 point counting across weld, HAZ and parent metal, alongside impact and corrosion testing where specified.

Production

Calibrated magnetic ferrite surveillance on production welds with traceable calibration records and multi-point reporting.

Segregation & cleanliness

Dedicated tooling and handling disciplines that keep ferritic contamination away from nickel alloy and stainless fabrication.

Documentation

Ferrite reports integrated with EN 10204 certification, PMI, NDE and hardness records for vendor-document review.

Globe United FZE designs and manufactures magnetic level gauges, level instrumentation and associated fabrications from SAIF Zone, Sharjah, UAE—supporting ADNOC, Aramco, Petrofac and EPC contractors across the GCC.



START THE CONVERSATION

Specify it. Measure it. Document it.

Talk to Globe United about material selection, ferrite acceptance criteria and documentation requirements for your next project.

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