Globe United

TECHNICAL INSIGHT
OIL & GAS SECTOR

01

MATERIALS INTEGRITY & ASSURANCE

Intergranular *Corrosion* Testing

A quality-assurance guide for critical level instrumentation.

The Risk Is Often *Invisible*

Intergranular corrosion can advance along grain boundaries while the visible metal surface appears largely intact. It is a material-integrity risk, not a cosmetic defect.

A failure mode below the *surface.*

PREFERENTIAL ATTACK

Corrosion follows susceptible grain-boundary regions rather than exposing a broad, obvious surface defect.

CRITICAL CONSEQUENCE

Welded, wetted and pressure-retaining components can lose integrity from within.

CONTROL POINT

The fabricated microstructure matters as much as the alloy designation on the certificate.

Three Alloy Families. *Three Mechanisms.*

Select the test for the degradation mechanism — not simply the material label.

Austenitic stainless steel

304 / 316 / 321 / 347

Chromium-carbide sensitization

Carbides can reduce chromium next to grain boundaries, undermining local passivity and enabling intergranular attack.

TESTING QUESTION

Are grain-boundary regions chromium-depleted?

Duplex stainless steel

2205 / 2507 / LEAN DUPLEX

Detrimental intermetallic phase

Sigma, chi and related precipitates can reduce toughness and local corrosion resistance after harmful thermal exposure.

TESTING QUESTION

Are detrimental intermetallic phases present?

Nickel-rich alloys

625 / C-276 / 825 / ALLOY 20

Grain-boundary precipitates

Improper heat treatment or welding can create carbides and intermetallic phases at grain boundaries in severe-service alloys.

TESTING QUESTION

Are chromium/molybdenum-depleting precipitates present at grain boundaries?

Fabrication History Changes *Corrosion Resistance*

SENSITIZATION RANGE

425–815 °C

Carbide Precipitation

For austenitic stainless steels, time in the approximate 425–815 °C sensitization range can cause carbide precipitation at grain boundaries.

Invisible Local Conditions

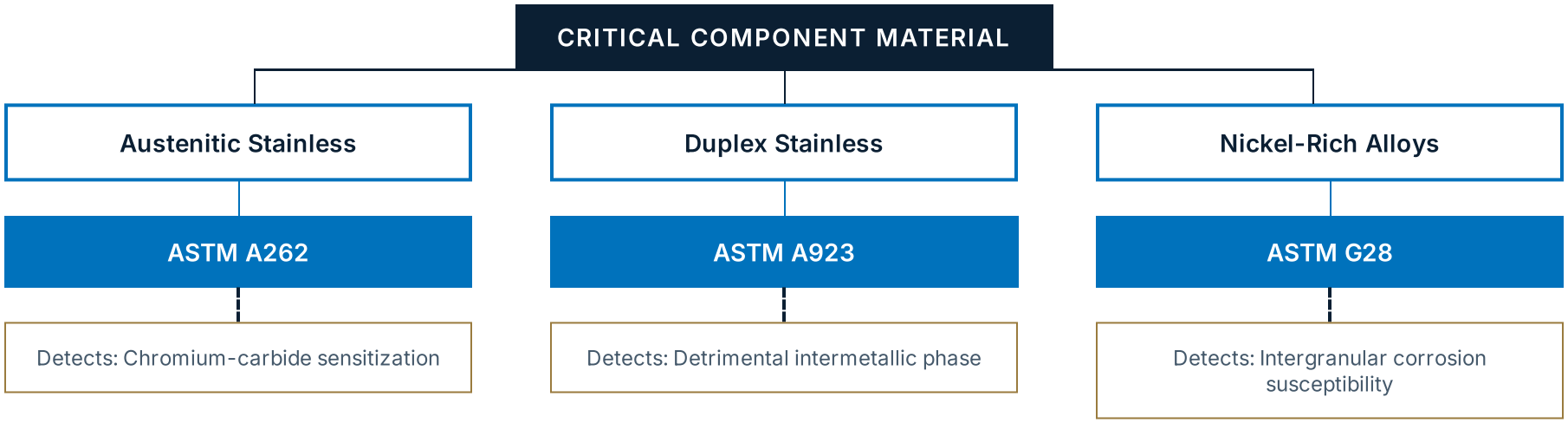
Welding, hot forming, stress relief and other thermal cycles can create a local condition that is not visible through routine visual inspection.

The Limits of "L" Grades

Low-carbon “L” grades reduce susceptibility, but do not replace controlled fabrication or verification where the project specification requires it.

Match the Standard to the Alloy

MATERIAL FAMILY	CORRECT TESTING BASIS	WHAT THE TEST ADDRESSES
Austenitic stainless steel	ASTM A262	Chromium-carbide sensitization / intergranular attack
Duplex stainless steel	ASTM A923	Detrimental intermetallic phase
Nickel-rich, chromium-bearing alloy	ASTM G28	Susceptibility to intergranular corrosion



A cross-citation between alloy family and test basis should be resolved through the project technical-query process.

ASTM A262: *Screen Fast.* Accept Correctly.

Understanding the role of screening and acceptance practices for austenitic stainless steels.

Practice A

An oxalic-acid microstructural screening method. A dual or ditch structure requires the applicable hot-acid practice to govern.

Practice E

Commonly specified for welded austenitic components: 24-hour copper–copper sulfate testing followed by 180° bend evaluation.

Practices B, C and F

Use weight-loss corrosion testing for the appropriate grade and service context; their acceptance limits come from the requisition or governing product standard.

ASTM A923: *Duplex Requires Its Own Answer.*

ASTM A923 is the appropriate basis for 2205 and related duplex grades; ASTM A262 was not designed to detect duplex intermetallic phases.

METHOD C VS. ASTM G48

A923 Method C and ASTM G48 use related chemistry but address different questions: intermetallic phase screening versus pitting and crevice resistance.

Method A

Provides an electrolytic etch screen to classify the microstructure.

Method B

Evaluates impact toughness, which is highly sensitive to intermetallic phases.

Method C

Measures ferric-chloride corrosion response to detect localized depletion.

ASTM G28: *Select the Method.*

ASTM G28 extends IGC testing to wrought, nickel-rich, chromium-bearing alloys used in severe service. The selected method must align with the alloy family.

GENERAL NICKEL-ALLOY BASIS

Method A

Uses ferric sulfate–sulfuric acid for a broad roster of nickel alloy families and evaluates general susceptibility to intergranular attack.

SELECTION FOCUS

Appropriate for the applicable listed alloy family and specified delivery condition.

C-FAMILY ALLOY BASIS

Method B

A 24-hour mixed-acid method developed primarily for C-family alloys. Its severity makes correct alloy scope essential to a meaningful result.

SELECTION FOCUS

Use only for alloys within the intended method scope.

ACCEPTANCE CRITERION

For weight-loss methods, the purchaser specification or product standard defines the acceptance corrosion-rate limit.

Testing Is a Quality Chain, *Not a Laboratory Event.*

01

REQUISITION

State the correct standard, practice or method, specimen condition and acceptance criterion.

02

TRACEABILITY

Link the tested specimen to the installed heat through positive material identification and heat-number control.

03

FABRICATION

Where production welds are tested, the coupon should replicate the production welding procedure, including any PWHT.

04

VERIFICATION

Report the result through the appropriate certificate with a complete, reconciled documentation trail.

An Auditable Certificate Tells the *Whole Story.*

COMPLETE CERTIFICATE CONTENT

A complete IGC certificate identifies the governing standard and practice or method, specimen condition, test duration and solution, evaluation method, acceptance criterion, result and heat-number traceability.

OES VS. XRF DISTINCTION

For carbon-sensitive sensitization resistance, OES can verify carbon content; XRF alone cannot read carbon.

COMMON AVOIDABLE ISSUES

Common avoidable issues include withdrawn practices, screening methods treated as final acceptance, missing specimen condition and corrosion-rate results without a stated limit.

Quality Assurance for *Critical Level Instrumentation.*

INTEGRATED QA REGIME

At Globe United FZE, IGC testing forms part of the quality-assurance regime for level gauges, magnetic level indicators, chambers, stilling wells and associated instrumentation.

APPLICATION ENGINEERING SUPPORT

Our application engineering team can advise on a suitable IGC test regime for the service conditions and specification basis.

AUDIT-READY DOCUMENTATION

Our documentation packages are prepared to support third-party and operator vendor audits.

Protect the Integrity That *Cannot Be Seen.*

01
Material selection.

02
Correct test regime.

03
Traceable certification.

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Project-specific requirements are governed by the applicable purchase order, material requisition and referenced standard editions.