GLOBE UNITED FZE

Positive Material Identification (PMI): XRF vs. OES

A decision guide for stainless steels, duplex grades and nickel alloys

2026

PMI turns specification into evidence.

The wrong alloy can look identical while creating a serious corrosion or containment risk in sour, chloride-rich, or high-temperature hydrocarbon service.

PMI verifies the alloy on the actual component—not only on its certificate.

The practical question is not “Do we test?” but “Which technique answers the specification?”

Two tools. Two distinct answers.

XRF

Which alloy family is this?

Fast, non-destructive screening.

Excellent for major alloying elements.

OES

Does this grade meet its defining chemistry?

Full-spectrum chemistry including carbon.

Essential when carbon or nitrogen drives acceptance.

Core message: XRF identifies the family. OES distinguishes carbon-defined grades.

XRF: fast confidence at the point of inspection

A handheld analyzer reads key heavier elements such as Cr, Ni, Mo, Nb, Ti, Cu and W.

Typical grade identification takes seconds; quantified chemistry takes less than a minute.

Its portable, non-destructive format suits receiving inspection, installed assets, and 100% PMI programmes.

BOUNDARY

It cannot measure carbon.

PRIMARY XRF SIGNATURES

Cr CHROMIUM	Ni NICKEL	Mo MOLYBDENUM
Nb NIOBIUM	Ti TITANIUM	Cu COPPER

OES: when the defining element is invisible to XRF

Spark OES measures the full analytical suite, including carbon; suitably equipped instruments also measure nitrogen, sulfur, phosphorus and boron.

It requires a bright-metal surface, controlled preparation, calibration, and an argon-shielded spark.

The test leaves a small burn mark, trading convenience for more complete grade confirmation.

GUIDANCE

Use OES when light-element chemistry drives acceptance.

CRITICAL LIGHT ELEMENTS

C CARBON	N NITROGEN
S SULFUR	P PHOSPHORUS

For 316L, carbon changes the decision.

XRF easily separates major austenitic families, including **304 versus 316** by molybdenum content.

It cannot distinguish 304 from 304L or 316 from 316L because the **defining difference is carbon**.

Where **L-grade weldability** or **H-grade creep strength** is specified, OES is required for positive identification.

Dual certification remains legitimate only when the component’s **measured carbon** supports the claimed grade.

For duplex, measured nitrogen makes PREN defensible.

XRF identifies duplex tiers—and Cu/W variants—through Cr–Ni–Mo signatures.

Super duplex verification depends on **measured nitrogen** when PREN is part of the specification.

$$PREN = \%Cr + 3.3 \times \%Mo + 16 \times \%N$$

On duplex welds, OES chemistry and ferrite verification are **complementary controls—not substitutes**.

For nickel alloys, XRF is the frontline control.

Distinct Ni–Cr–Mo–Nb–W–Cu signatures make XRF highly effective for confirming common nickel-alloy families.

It quickly distinguishes high-value substitutions such as Alloy 625 versus C-276, or Alloy 825 versus Alloy 20.

Escalate to OES for carbon-critical grades, weld consumables, or full-spectrum certification support.

RESULT

Fast, non-destructive protection against costly alloy substitutions.

KEY XRF SIGNATURES

Alloy 625	Ni-Cr-Mo-Nb
C-276	Ni-Cr-Mo-W
Alloy 825	Ni-Cr-Mo-Cu-Ti
Alloy 20	Ni-Cr-Cu-Nb

Choose the method by the acceptance criterion.

DECISION CRITERION	HANDHELD XRF	MOBILE SPARK OES
Cr, Ni, Mo, Nb, Ti, Cu, W	**Excellent**	**Excellent**
Carbon	*Not possible*	Down to approximately 0.01% with argon shielding
Nitrogen for duplex PREN	*Not possible*	On N-capable instruments
Surface impact	None	Small spark mark; may need dressing
Typical role	Receiving PMI, field sorting, installed-asset surveys	L-grade confirmation, weld verification, PREN support

Screen. Escalate. Document.

1 Screen with XRF

Identify the alloy family and catch major substitutions quickly.

2 Escalate to OES

Use when carbon, nitrogen, sulfur, phosphorus, or related light-element chemistry defines the requirement.

3 Verify welds as a package

Combine OES with ferrite or hardness testing as applicable to the alloy and specification.

4 Document the result

Record instrument ID, calibration/CRM check, test location, acceptance basis, and disposition.

The most avoidable PMI failures are procedural.

AVOID THIS	DO THIS INSTEAD
Testing through paint, oxide, or contamination	**Test on cleaned base metal**
Accepting “316/316L” without a carbon check	**Use OES when L-grade weldability is specified**
Assuming nitrogen from Cr/Mo readings	**Measure nitrogen where PREN must be demonstrated**
Testing the flange but not the weld	**Verify the weld when it is the likely non-conformance point**
Treating repair work as unchanged	**Re-verify after repair or component replacement**

How Globe United applies PMI

100% Receiving XRF

For pressure-retaining and wetted alloy material, reconciled with EN 10204 3.1/3.2 certificates.

OES Confirmation

For carbon-defined grades, applicable duplex components, C-276 wetted parts, and production welds where client ITPs designate PMI hold points.

Duplex Weld Packages

Combining OES chemistry, ferrite measurement, and hardness testing in line with the stated quality approach.

Traceable Records

Aligning PMI results, certificates, and weld maps for seamless vendor-document review.

Make the material evidence as strong as the specification.

Discuss material verification requirements with Globe United’s applications engineering team.

CORPORATE CONTACT

W www.globeunitedae.com

E info@globeunitedae.com

T +971 50 330 1384