

Quality Control of Metal Alloys in the Manufacturing and Metal Fabrication Industries

Thermo Scientific NITON® XL3 Series Handheld Alloy Analyzers – Simply Superior XRF



Introduction and Overview

Metal alloy material verification for Quality Control (QC) and Quality Assurance (QA) has never been more important for safety. From primary metal production, to the metal service center, to component fabrication, to final product assembly, the potential for material mix-ups and the need for traceability are a constant concern at every step. Material verification prior to fabrication or shipping of metal alloy products is critical to ensure that the correct material is sent to the customer and that it is used for the right application. The use of wrong or out-of-specification metal alloys can lead to premature and potentially catastrophic part failures that can be very expensive, damage a business's reputation, and result in loss of life.

Alloy verification using portable x-ray fluorescence (XRF) has become the method of choice for achieving this assurance and peace of mind. Before Total Quality Management (TQM) and Six Sigma methodology raised awareness of the need for better quality control practices, many QC departments relied on less sophisticated and less rigorous inspection methods, or relied solely upon material test reports (MTRs) supplied with their alloy components. The current emphasis on ISO certifications and 100% quality testing, along with the increased regulatory environment, demands total attention to finding and correcting any and all material discrepancies. As alloy testing instruments have become less expensive, easier to use, faster, more accurate and precise, the practice of total reliance on a questionable MTR paper trail is no longer tolerated by many quality managers. When one shipment of mis-marked material or a single wrong fabricated component can mean millions of dollars in returned shipments, lost business, extensive rework, and potential legal ramifications, these quality managers insist on 100% verification of both raw material and finished product.

Modern Technology

Today's QA/QC inspectors and manufacturing engineers have access to powerful testing tools that eliminate reliance on dubious paperwork in favor of empirical test results conducted in their facilities. Thanks to huge advancements in handheld XRF technology pioneered by NITON, now part of Thermo Fisher Scientific, quality control and inspection personnel can test thousands of metal alloy samples per day accurately and nondestructively. In fact, even junior inspectors are capable of turning out large amounts of quality testing data with the highest confidence in the integrity of the results.

Point-and-shoot testing has become a reality with Thermo Scientific NITON XL3 800 Series XRF analyzers. Typical testing times are 1 to 2 seconds to identify and show the alloy grade on the VIP™ tilting color touch-screen display, with lab-quality chemical analysis requiring a few seconds longer to obtain more precise results. Little or no sample preparation is needed for alloy samples with relatively clean surfaces, regardless of shape or size. From a single strand of 1 mm wire to finished weld beads, to rods, bolts, plates, and complete fabricated assemblies – all can be tested by just touching the analyzer to the sample and initiating measurement with a brief trigger pull.

NITON XL3 Benefits At-a-Glance

- Instant positive alloy grade identification
- High-throughput – increased productivity
- Nondestructive – test finished product with confidence
- Reduced scrap and rework – recover lost traceability in seconds
- Laboratory-quality composition analysis
- Real-time, traceable results – not questionable paperwork
- Fast, simple reporting and certificate generation

NITON Analyzers – Anatomy of a Revolution

In 1999, the company led the way to an industry-wide revolution with its introduction of the XL-801S, the first handheld, lab-quality XRF analyzer for metal alloy analysis. Within one year of its introduction, the company had become the leading supplier of handheld XRF analyzers worldwide. The ongoing, rapid growth of alloy testing by portable XRF analysis has been driven by continuous improvement of Thermo Scientific NITON instruments and by the favorable response of metal producers, manufacturers, and others to the smaller size, faster speed, ease of use, and powerful capabilities of the analyzers. Never content to rest on past accomplishments, we continue to work intensively with the metal production and fabrication industries to improve analyzer performance and add new features, enabling our customers to increase productivity, reduce scrap and rework, and reduce costs while improving quality standards.

Rock-Solid Analysis and Grade Identification

One of the keys to success of Thermo Scientific NITON analyzers in alloy analysis has long been the instruments' fast, stable, accurate, and precise fundamental parameters (FP) based factory calibration. The NITON XL3's proprietary FP analysis algorithm includes nearly every element of interest in virtually all types of metal alloys and does not require special calibrations or other user input.

Yet, providing accurate alloy chemistry is only part of the equation. Using our extensive experience with the metals industry, we have incorporated an alloy grade library that simultaneously provides users with the common trade name of the alloy on the instrument display. By incorporating a hybrid approach, which combines the SAE Unified Numbering System (UNS) alloy grade specifications with knowledge of the "as produced" chemistries of these alloys, the NITON XL3 provides unmatched accuracy in grade identification.



Test finished products with confidence
Photo courtesy DCI Inc, St Cloud, MN



Lab quality analysis at your fingertips.

Thermo Scientific NITON XL3 Series Analyzers – Simply Superior Alloy Analysis

Thermo Scientific XRF analyzers continue to lead the handheld alloy analysis field with technology that responds directly to the needs and requests of the metal production, fabrication, and distribution industries. The NITON XL3 800 Series brings the metals and manufacturing industries the latest in a series of cutting-edge, rugged, dependable tools with improved ergonomics, speed and performance, while still retaining the point-and-shoot simplicity that has been a hallmark of NITON analyzers.

Available in x-ray tube source (NITON XL3t) and radioisotope source (NITON XL3p) configurations, the NITON XL3 800 Series is the only handheld XRF analyzer that allows customers to select the x-ray source that best suits their business needs.

By combining advanced electronics and materials technology with the most powerful x-ray tubes ever used in handheld XRF instruments (up to 50 kV), the NITON XL3t is in a class by itself. With multiple primary filters for optimal sample excitation and a helium-purge option to target light elements from magnesium (12) to sulfur (16), the NITON XL3t provides an analytical range, speed, and precision that is unmatched in any other handheld XRF instrument.

Meanwhile, the groundbreaking NITON XL3p features our patented Infiniton™ technology, which consistently provides fast, reliable, nondestructive alloy ID with accuracy that compares favorably to lab XRF instrumentation, in a rugged, dependable Infiniton radioisotope configuration that is virtually maintenance-free.

No matter which configuration you choose, a host of new features directly benefits the customer. From the integrated tilting color touch-screen display to the customizable menus for ease of use, the ergonomic NITON XL3 Series analyzers are both the lightest weight and most ruggedly constructed instruments ever made, making them appropriate for use under all environmental conditions, both indoors and out. Couple these features with integrated Bluetooth™, USB, and serial communications, and cumbersome download procedures of PDA synchronization become a thing of the past. In addition, all Thermo Scientific NITON analyzers use third-generation lithium-ion batteries, providing the longest usage cycle of any handheld XRF analyzer.

NITON XL3 Series Performance

Thermo Scientific NITON XL3 800 Series analyzers provide alloying chemistry for up to 30 of the most common elements in tens of thousands of alloy grades, with additional elements available on request. Families of alloys that can be accurately identified and analyzed with a standard system include:

- Stainless Steels
- 12 Cr Steels
- Chromium-Molybdenum (Cr-Mo) Steels including V stabilized versions
- Low alloy Steels such as 4140, 4340, etc.
- Nickel (Ni) alloys such as Hastelloy® and Inconel®
- Monel® alloys
- Tool Steels
- Copper (Cu) alloys
- Titanium (Ti) alloys
- Wrought Aluminum (Al) alloys

Additional grades that can be accurately sorted with the addition of the Helium (He) Purge Light Element Analysis Package include:

- Zecor® SS alloys containing 5-6 % Si
- Ti alloys including direct measurement of Al content
- Al and Silicon (Si) Bronzes
- Aluminums for Si and Mg content

Evaluating Performance

When potential users are evaluating the performance of analytical instrumentation, they are generally concerned with two criteria: speed and accuracy. What many do not understand is that there are two distinct factors to consider when asking “How accurate is it?”:

- Precision – This is a measure of repeatability, or the degree of agreement between individual measurements of a set of measurements, all of the same quantity.
- Accuracy – This is a measure of reliability, and is the difference between the *true value* of a measured quantity and the *measured value*.

Most analytical instrumentation reports statistical precision along with the quantitative measurement results. Precision is a function of the statistical analysis of the raw data, whereas accuracy must be determined by testing samples with known values, and comparing the measured results to the known values.

However since even the best laboratory methods used to provide these values have statistical limitations in both precision and accuracy, *true value* is never really known, even in a “certified standard.”

Regarding XRF instrumentation, increases in measurement time relate directly to improvement in precision. With XRF analysis, each fourfold increase in measurement time improves the precision for each element by a factor of two.

NITON Analyzers Measure Up

NITON XRF instruments report a two-sigma precision along with the result for each analyte. The two sigma precision represents a 95 percent confidence interval for the data. Note that the precision, or +/- error band, is not an indication of accuracy, but a measurement of repeatability around a *most probable value*. Accuracy must be assessed by comparing the measured result and precision to known values from a reference standard.

Unparalleled Accuracy

In our performance testing, each alloy sampled was measured under the same conditions multiple times using ten individual production instruments. While the performance data below can be considered typical, performance of individual instruments of this configuration under varying conditions may differ slightly from those shown here.

Table 1 and Table 2 illustrate both the outstanding accuracy and the precision of the NITON XL3t 800 Series alloy analyzer against the values of certified reference materials* for Stainless Steel 321 and Hastelloy C-276. The indicated times are the seconds of measurement per filter.

SS 321	BNRM-85C				
	Cert	5 Sec	+/-	20 Sec	+/-
Grade ID		321		321	
Cr	17.68	17.90	0.31	17.85	0.14
Ni	10.01	9.97	0.46	9.99	0.22
Mn	1.63	1.65	0.30	1.66	0.14
Ti	0.45	0.41	0.09	0.40	0.04
Cu	0.30	0.30	0.13	0.32	0.06
Mo	0.33	0.34	0.03	0.35	0.01

Table 1: Performance data for Stainless Steel 321

Hast C-276	BS H2B				
	Cert	5 Sec	+/-	20 Sec	+/-
Grade ID		C-276		C-276	
Cr	15.43	15.03	0.36	15.07	0.17
Mo	15.54	15.99	0.33	16.01	0.16
Fe	6.52	6.50	0.40	6.58	0.21
W	4.13	4.42	0.47	4.47	0.23
Mn	0.57	0.63	0.34	0.66	0.17
Co	0.39	0.39	0.23	0.40	0.11
Ni	56.75	56.49	0.64	56.33	0.32

Table 2: Performance data for Hastelloy C-276

*Note that the certified values of each standard are those provided by the supplier(s) of the individual reference materials. Neither Thermo Fisher Scientific nor its subsidiaries make any guarantee, expressed or implied, as to the accuracy of the certification data of the materials used in this configuration.

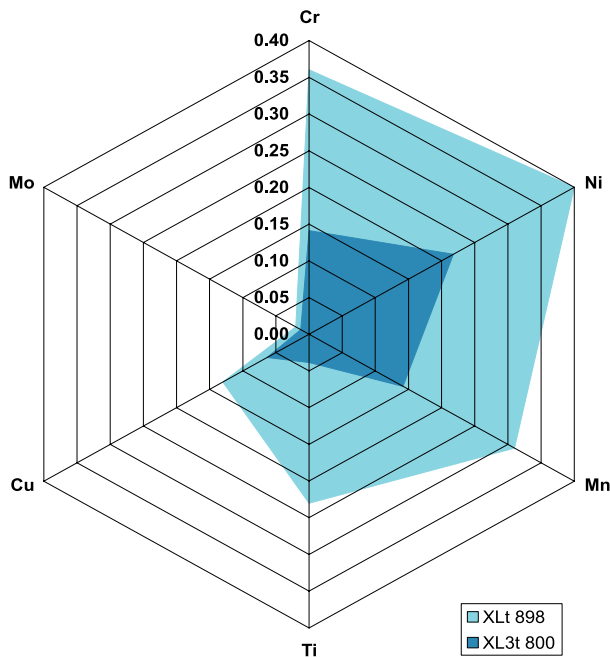


Figure 1: Instrument error comparison for Stainless Steel 321. Note especially the improvement for Ti, as the fraction of a percentage of Ti is the only difference that separates SS 321 from SS 304.

The measurement accuracy coupled with the NITON XL3's unparalleled testing speed means high throughput with real-time traceable results you can depend on.

Four Times Faster – Twice as Precise

For comparison testing against another instrument, we measured ourselves against the best – the previous generation Thermo Scientific NITON XLt 898. The graphical comparisons in Figures 1 and 2 compare the error bands of the older XLt 898 instrument to the NITON XL3t 800. Note that the area of uncertainty (or average statistical precision) of the NITON XL3t 800, represented in the darker blue, shows a two-fold improvement or better for most elements over that of the older generation XLt 898, represented in light blue. Since measurement time relates directly to precision, the NITON XL3t 800 is literally four times faster, or twice as precise when compared to the XLt 898.

Service and Support

Thermo Scientific NITON XL3 Series analyzers have been designed to be the most dependable portable XRF analyzers ever made. From the rugged Lexan® EXL housing to the precision semiconductor x-ray detector, each individual component has been engineered to be dependable as well as easily serviceable. When routine service is required, Thermo Fisher Scientific has more than 30 NITON Analyzers service centers on six continents.

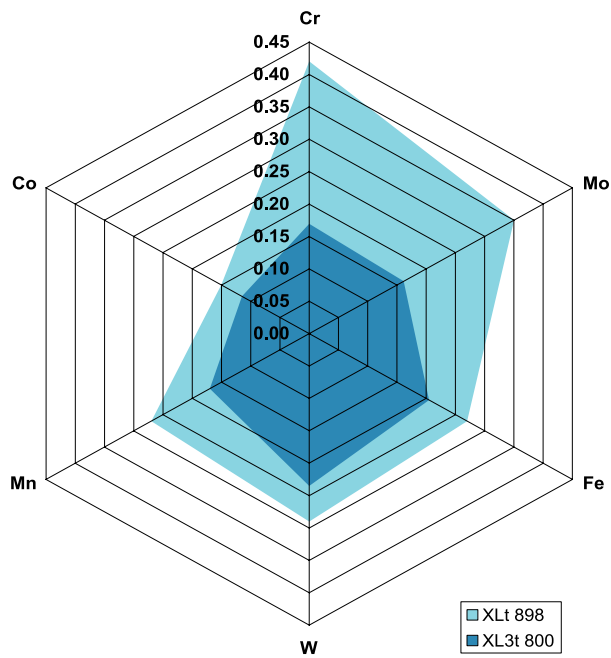


Figure 2: Instrument error comparison for Nickel-based alloy Hastelloy C-276. Note the greatly improved precision for both Cr and Mo.

Configurations and Accessories

Providing the right XRF analysis tool for almost any organization's analytical and budgetary requirements, Thermo Scientific NITON analyzers offer a wide range of options in models and accessories.

With the choice of the most powerful x-ray tubes ever offered in a handheld XRF instrument or the new second generation Infiniton with dramatically higher performance, these powerful tools will again revolutionize material inspection.

All NITON XRF analyzers come with a shielded, waterproof carrying case, shielded belt holster, and PC-compatible NITON Data Transfer (NDT™) software for remote operation, file transfer, data management, and advanced data analysis. Optional items include test stands, welding masks, hot surface adaptors and extension handles.

NITON XL3 800 Series – The Choice Is Clear

Thermo Scientific NITON XL3 800 Series analyzers offer the most versatility, the greatest number of options, and the highest performance of any handheld XRF analyzer. With many users performing more than 1000 readings in a single 8-hour shift, the ruggedness, ease of use, speed, accuracy, and precision of our latest generation of handheld alloy analyzers set new benchmarks for the industry.

The result is maximum productivity, minimum downtime, and expert training and support when you need it, anywhere in the world.

In addition to these offices, Thermo Fisher Scientific maintains a network of representative organizations throughout the world.

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Specifications, terms and pricing are subject to change. Not all products are available in all countries. Please consult your local sales representative for details.

All competitive references are based on an internal direct comparison of commercially available handheld XRF analyzers, July 2007.

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