# Analysis of Stainless Steel Testing

## Using the Niton Apollo Handheld LIBS Analyzer

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### Introduction

Stainless steels are ubiquitous in society today. They are produced as sheets, plates, bars, wires, and tubing to be fabricated into every imaginable type of material and equipment. This includes use in chemical and petrochemical industries, power generation, food production, architecture, transportation, and much more. With over 100 distinct grades of stainless steel, all looking similar, how can one be sure that the right grade is used for the intended purpose?

*The Niton Apollo in use, validating a Mill Test Report (MTR) prior to fabrication.*

### The Need for Testing

Quality Control (QC) and Positive Material Identification (PMI) instruments have become indispensable tools for robust material verification programs. These tools help ensure that the correct grade of stainless steel is used in the right place at the right time. The wrong grade can have consequences as simple as economic loss, or as crucial as loss of life. Explosions in chemical and petrochemical plants are vivid reminders of the dangers of using incorrect alloys. Therefore, most industries strive to ensure product quality by verifying raw materials used during the production process.

Among other material verification methods, the Mill Test Report (MTR) is sometimes utilized to validate goods. In certain cases, the MTR can be unreliable or incorrect due to a mix up in the labeling process. It is best practice to perform a second validation of the MTR to verify goods. Catching the issue at the forefront of inspection – using elemental analysis – avoids the costly problem of determining goods have been developed out of specification after adding value during the fabrication process. Oftentimes, the resulting occurrence must be scrapped entirely.

Material verification doesn't stop at incoming inspection. Supervisors and QC managers must ensure that the correct materials are used throughout the production process. Once again, best practice requires elemental analysis – often for regulatory compliance. Testing may follow the part, assembly, or equipment right through to a final validation before shipping. When received by the customer, an incoming inspection is generally performed again. And so, it goes, continuing to be inspected along the path to the final use.

Most especially in critical processes, inspection will continue right up to the point of installation. For installations that predate the inspection process (e.g., thirty-year-old refineries), the process may even require the shut-down of an operating refinery in order to test in-process materials that may not have had adequate testing when installed.

## Test Equipment Challenges

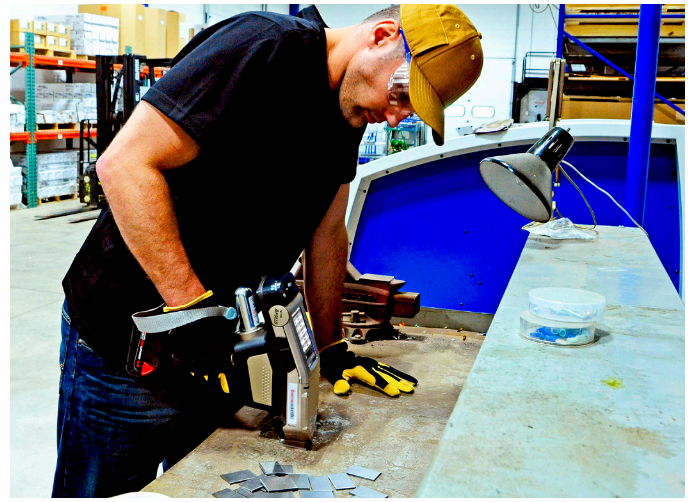
Both XRF (x-ray fluorescence) and OES (optical emission spectroscopy) have performed material verification in the past. In the early days of testing, only labs were equipped with the expansive instrumentation required to validate materials. However, with the miniaturization of lab technologies, in-process and in-field testing has now become a reality.

Carbon (C), an important alloying element, is added to stainless steels to help increase its hardness and strength. To date, analyzing carbon has been a challenge. The most popular material verification method, handheld x-ray fluorescence (XRF), has been incapable of detecting carbon content. Optical Emission Spectroscopy (OES) can detect carbon, but is only available in large, bulky carts, making it difficult to apply in awkward field environments (ladders, catwalks, ditches, tight spaces, etc.).

Depending on the grade of stainless steel, carbon content can be between 0.005% to 1.2%. In certain stainless steels, a high carbon content is undesirable, especially for welding due to the threat of carbide precipitation. For these reasons, the determination of carbon is essential for a comprehensive verification of grade and safe operation over time.

## Niton Apollo Handheld LIBS Analyzer

Now there's a new tool available to professionals performing material analysis. The Thermo Scientific™ Niton™ Apollo™ handheld LIBS analyzer utilizes Laser Induced Breakdown Spectroscopy (LIBS) to perform inspection of materials during the fabrication process. Weighing just 6.4 lbs. (2.9 kg.), the Niton Apollo specializes in measuring carbon content in a convenient, portable form factor – eliminating the need for bulky Optical Emission Spectroscopy (OES) carts in many situations. Featuring an effective laser and high purity argon purge, the Niton Apollo can confirm or replace inaccurate MTRs, eliminate risks associated with welding incompatible alloys, and even differentiate between similar alloys grades.



Designed to provide superior results, the Niton Apollo can measure low levels of carbon in L grade stainless steel of around 100-300 ppm (parts per million). This sensitivity enables the Niton Apollo to differentiate the levels of carbon in 304L with ~300 ppm or ~0.03% carbon, from the ~0.06% level in a 304 grade (for example). Other examples of the need to test for carbon include 316 vs. 316L/ 316H and 317 vs. 317L. Until recently, only large, bulky OES analyzers have been capable of quantifying low levels of carbon in stainless steel in the field.

## Conclusion

The Niton Apollo handheld LIBS analyzer can be used to determine carbon concentration for quality control (QC) in the fabrication industry. Its handheld form factor enables users to easily and safely perform material verification directly in the field with lab-quality precision and results. The key benefit of this advanced design comes from its superior accuracy, repeatability, and long-term stability, making the Niton Apollo an indispensable tool for stainless steel material verification.

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