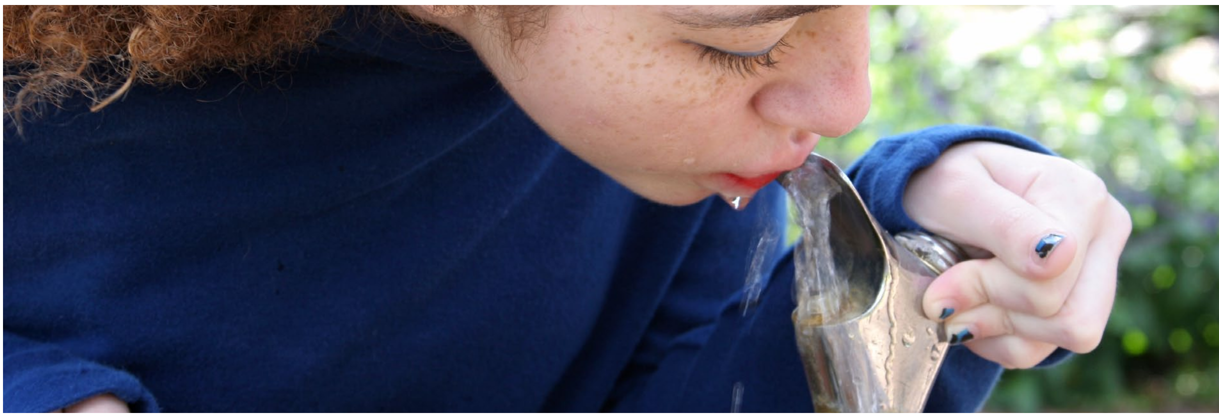
Quality Control and Assurance for Lead-Free Brass

Thermo Scientific Portable XRF Analyzers Enable Rapid Elemental Analysis



Introduction

Lead has no known physiologically relevant role in the human body. Its presence has only been shown to be harmful. This is why, for example, many nations have switched to unleaded gasoline, thus greatly reducing the amount of lead found in the environment. And clearly, lead has no place in our drinking water.

Originally passed in 1974, the United States government amended the Safe Drinking Water Act (SDWA) in 1986 to greatly reduce the amount of lead that could leach out into drinking water. One of the biggest culprits was solder, which until that time could contain up to 50% lead. The amendment reduced the amount of lead allowed in solder to less than 0.2%. At the same time, the allowable amount of lead in brass was reduced to no more than 8%.

In January 2011, Public Law 111-380 was signed, which further amended the Safe Drinking Water Act and, once again, significantly reduced the amount of lead allowed in any new plumbing components that come into contact with drinking water in the United States. With the new allowable level of lead in these brass components lowered to .25% by weight, the government has given manufacturers, distributors, and installers until January 2014, when the new lead-free brass law goes into effect, to prepare for this change.

Removing the lead from these products presents some issues and opportunities for various suppliers and manufacturers. The older 8% brass is typically less expensive and is easier to machine because the lead acts as a lubricant during the machining process. Products made from the new, lead-free brass typically have a price premium of about 25% and are more difficult to machine. Therefore, it might be beneficial to retain both types of brass, keeping the new lead-free alloys for products destined for use inside of the United States, while using the older brass for products shipping outside of the United States. In this scenario, users would need a quick, reliable, nondestructive method to differentiate the two alloys from one another.

Testing and Analysis

NSF International has been at the forefront of the low-lead plumbing products initiative for decades and has been working closely with the U.S. Environmental Protection Agency (EPA) and many of the states to ensure that our drinking water is safe. NSF joined with ANSI to create a standard for measuring the lead content of drinking water system components. This standard, known as NSF/ANSI 372-2011, states:

"Lead content verification testing shall be performed on a representative product, materials, or components using the methodologies in (section) 7."

Thermo Scientific Portable XRF Analyzers Benefits at-a-Glance

- Nondestructive – the x-rays do no harm to a metal sample and the sample requires no preparation
- Simple – the point-and-shoot analyzer performs the analysis in seconds
- Handheld – the analyzer is portable, runs on batteries, and only weighs three pounds
- Traceable – calibrated using NIST traceable standards
- Lead-detection expertise – Thermo Scientific portable XRF analyzers are used by the U.S. Product Safety Commission for testing lead levels in toys and are widely used for lead paint inspection

Section 7 of the standard goes on to explain those measurement techniques that are acceptable for measuring the lead content:

“7.1 XRF (X-Ray Fluorescence), OES (Optical Emission Spectroscopy) Arc/Spark, SEM (Scanning Electron Microscopy)/ EDS (Energy Dispersive Spectrometer) are acceptable methods for screening components, provided the instrument is calibrated to standard reference materials.”

Optical Emission Spectroscopy

OES works by vaporizing a small amount of the material and analyzing the emitted light spectrum to determine the elements present and their relative concentration. Material that has been tested using this technology exhibits small burn marks on the surface where the test took place.

These systems are bulky, with transportable versions that have a testing “gun” tethered to a rack-based operating system. Burns from spark tests can create significant surface blemishes up to 10 mm in diameter.

Scanning Electron Microscopy with Energy Dispersive X-Ray Spectroscopy

Scanning electron microscopes equipped with EDS detectors can analyze the elemental composition of metal and other substrates.

High-energy electrons striking the sample cause it to emit characteristic x-rays. The detector can identify the elements in the substrate by analyzing the energy spectra of the collected x-rays. Typically, these systems can perform quantitative analysis of elements down to boron. The drawbacks are that it must be performed at high vacuum and sample sizes and shapes are quite limited. Such an analysis can take several minutes per sample and requires a skilled operator.

Handheld X-Ray Fluorescence

Handheld XRF analyzers work on the same general principle as EDS, but they are portable, require no vacuum, and can perform an analysis in seconds. The

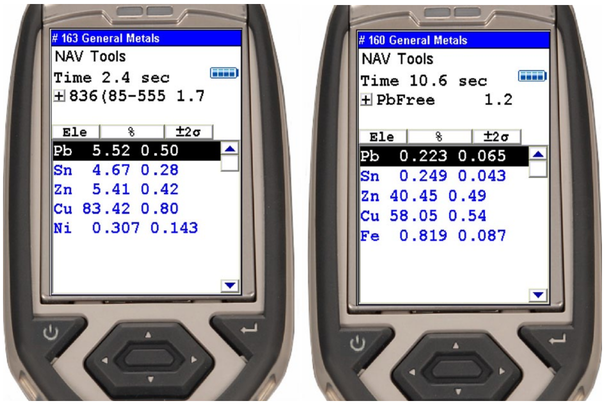
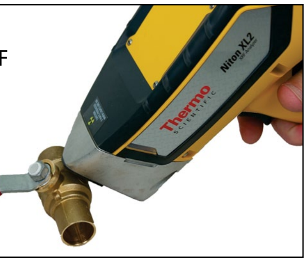


Fig. 1. Comparison of regular 85-5-5-5 brass with new lead-free brass.

Thermo Scientific portable XRF analyzers are ideal for measuring lead in brass components.



analyzer contains a miniature x-ray tube and detector. When the analyzer is held next to the sample and the trigger is pulled, an x-ray beam is emitted from the analyzer. This x-ray beam excites the atoms in the sample, causing electrons to be ejected and then replaced by other electrons. This creates a characteristic x-ray emission, which is then collected and detected. In this way, the analyzer can detect which elements are present in the sample and to what extent.

The image in Figure 1 shows two screen shots from the Thermo Niton XL3t XRF analyzer. The screen shot on the left shows a typical brass alloy, which consists of 85% copper and then approximately 5% each of zinc, tin, and lead with a small amount of nickel. The screen shot on the right shows the composition of one of the new lead-free brass alloys. In this case, the amount of lead has been reduced to <.25% as required by the new regulations.

Many of these new lead-free brass alloys use bismuth as a substitute for lead. Since bismuth costs about ten times more than lead, it should be used judiciously to keep the cost of the alloys down. Thermo Scientific portable XRF analyzers can read bismuth concentration in conjunction with all the other materials commonly used in brass alloys, thus allowing a brass manufacturer to control quality while keeping costs down.

Benefits of X-Ray Fluorescence

XRF is a nondestructive testing technique that can analyze a metal sample in seconds with no need for sample preparation. All of our analyzers are calibrated using NIST traceable standards. Further, they are handheld, portable, and require no vacuum system. This makes XRF the ideal solution for performing incoming inspection on metal alloys from suppliers and for doing final quality assurance and control before shipping finished parts. It is also ideal for tracking and maintaining separate inventories of leaded and non-leaded brass parts.

To discuss your particular applications and performance requirements, or to schedule an on-site demonstration, please contact your local Thermo Scientific portable analyzer representative or contact us directly by email at niton@thermofisher.com, or visit our website at www.thermoscientific.com/niton.

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

Americas
Boston, MA USA
+1 978 670 7460
niton@thermofisher.com

Europe
Munich, Germany
+49 89 3681 380
niton.eur@thermofisher.com

Asia Pacific
New Territories, Hong Kong
+852 2885 4613
niton.asia@thermofisher.com

www.thermoscientific.com/niton

8-319 10/2012

Thermo SCIENTIFIC