METAL INDUSTRY

APPLICATIONS

# Scrap Metals Recycling	

What types of metal are considered scrap?

The most common metals accepted by scrap yards include copper, steel, aluminum, brass, iron and wires. But your local scrap yard may accept additional metals for recycling and give you cash payouts for your scrap metals.

How can I tell what type of metal I have?

The easiest way to determine what type of metal you're dealing with is to use a magnet. If the magnet sticks to your metal, you have a ferrous metal in your hands, such as steel or iron. Most ferrous metals are not worth much money at scrap yards, but the scrap yard will still accept it and make sure it is recycled properly.

If the magnet doesn't stick, you have a non-ferrous metal, such as copper, aluminum, brass, stainless steel or bronze. These metals are very valuable to recycle and are worth more money at scrap yards.

What metals can I resell?

Non-ferrous metals, such as copper, aluminum, brass, stainless steel and bronze, are worth more money at scrap yards. Ferrous metals, like steel and iron, are not as valuable, but scrap yards will still accept these metals for recycling.

Recycling Processes

The metal recycling industry has an efficient structure with numerous small companies purchasing scrap material and feeding this to highly effective larger international businesses. Non-ferrous metal recycling involves some, or all of the following steps:

Sorting: In order to be recycled appropriately, different types of non-ferrous metals need to be separated from each other, as well as from other recyclables such as paper and plastic.

Baling: Non-ferrous materials are compacted into large blocks to facilitate handling and transportation.

Shearing: Hydraulic machinery capable of exerting enormous pressure is used to cut metals into manageable sizes.

Media separation: Shredders incorporate rotating magnetic drums to separate non-ferrous from ferrous metals. Further separation is achieved using electrical currents, high-pressure air flow and liquid floating systems. Further processing may be needed.

Melting: The recovered materials are melted down in a furnace, poured into casters and shaped into ingots. These ingots are either used in the foundry industry or they can be transformed into flat sheets and other wrought products such as tubing, which are then used to manufacture new products.

The Importance of Electronics Recycling and Precious Metal Recovery

Electronics recycling is critical in diverting solid waste and supporting zero landfill initiatives. Also, highly significant, electronics recycling helps eliminate toxic scrap.

While it constitutes a minority of solid waste, it represents up to 70 percent of toxic waste.

In Europe, approximately 10 million tons of end-of-life and used electronic products are recycled annually. It provides a much richer resource than the extraction of virgin material. In fact, ISRI states that as much gold can be extracted from one metric ton of old computers as can be generated from 17 tons of ore.

This e-waste is a particularly rich source of precious metals – with concentrations 40 to 50 times more abundant than naturally occurring deposits. There are over 320 tons of gold and greater than 7,500 tons of silver used each year to make new electronic products around the world.

Why Is Electronics Recycling Important?

Rich Source of Raw Materials Internationally, only 10-15 percent of the gold in e-waste is successfully recovered while the rest is lost. Ironically, electronic waste contains deposits of precious metal estimated to be between 40 and 50 times richer than ores mined from the earth, according to the United Nations.

Solid Waste Management Because the explosion of growth in the electronics industry, combined with short product life cycle has led to a rapid escalation in the generation of solid waste.

Toxic Materials Because old electronic devices contain toxic substances such as lead, mercury, cadmium and chromium, proper processing is essential to ensure that these materials are not released into the environment. They may also contain other heavy metals and potentially toxic chemical flame retardants.

International Movement of Hazardous Waste The uncontrolled movement of e-waste to countries where cheap labor and primitive approaches to recycling have resulted in health risks to local residents exposed to the release of toxins continues to an issue of concern.

Materials Analysis

In order to analyze the environmental, material, and economic impacts of the recycling of electronic waste, it is important to identify the materials that make up cell phones and tablets. Through analysis, it is possible to identify common elements that can found within a majority of cell phones and tablets. The materials can be broken up into four main categories, precious metals, base metals, hazardous/toxic materials, and all others. The precious metals category included Gold, Silver, Palladium, and Platinum. Base metals included Copper, Aluminum, Nickel, Tin, Zinc, Iron, etc. Lastly, hazardous and toxic materials included Mercury, Beryllium, Indium, Lead, Cadmium, Arsenic, Antimony, etc.

XRF analytical method can be recommended as a qualitative screening method for the analysis of waste loads to verify the content of hazardous substances. Especially the high throughput and the ability to quickly analyze multiple spots makes the XRF technique very attractive as a screening tool for inspecting waste loads at the entrance of waste handling plants. The positive evaluation of the XRF technique convinced the CEN commission to develop a European standard within CEN/TC 292, referred to as prEN 16424 'Characterization of waste –Screening method for the elemental composition by portable X-ray fluorescence instruments', which is currently under approval.

# Using XRF to Sort and Identify Metals Alloys	

In scrap metal, it’s hard to be specific. For instance, copper can come alloyed or unalloyed, insulated or uninsulated, and in any number of different gauges. It can be loose, hydraulically compacted or briquetted. It can be clean or covered in grease and oil. Almost all metals come in an equally wide variety of conditions.

Say you wanted to buy a shipping container of miscellaneous, unalloyed copper scrap having a nominal 92% copper content (minimum 88%) as determined by electrolytic assay, consisting of sheet copper, gutters, downspouts, kettles, boilers, and similar scrap, free of the following: burnt hair wire, copper clad, plating racks, grindings, copper wire from burning, containing insulation, radiators and fire extinguishers, refrigerator units, electrotype shells, screening, excessively leaded, tinned, soldered scrap, brasses and bronzes, excessive oil, iron and non-metallic, and reasonably free of ash. It would be a lot easier if you could just say you wanted to buy a shipping container of Dream, and have it mean all that.

Fortunately, today's advanced portable alloy testing equipment allows scrap yard workers to identify and sort alloy samples faster and more accurately than ever before using portable analyzer. Point-and-shoot is truly a reality with these powerful, versatile and easy to use tools. With just a short measurement on an unknown sample, the alloy grade and chemistry are displayed. With this fast and accurate metal alloy sorting technology, the practice of accepting misidentified material is no longer tolerated. Today such errors result in rejection of entire loads, as well as a loss of confidence and damaged business relationships.

The testing time is often less than five second for routine sorting, and just a few seconds longer to obtain a good quality chemistry. Little or no sample preparation is needed for alloy samples with relatively clean surfaces, regardless of shape or size. From a single strand of 1mm wire to turnings, to massive structures such as reaction vessels, all can be easily tested with a simple trigger pull.

In addition to the high throughput and purity, XRF sorting technology can offer additional advantages compared with many alternative techniques.

The applicability of the XRF technology is multifaceted and not limited to one material class or application. Compared with other technologies, moisture, coloring and surface contamination have no significant negative impact on the detection.

The flexibility of the XRF technique and the sophisticated sorting logic make it possible to respond to changes in the sorting processes as quickly as possible. Furthermore, a great variety of sorting steps can be carried out with the same machine and different preset sorting programs.

Brasses (alloys of copper and zinc) are common utility metals because of their practical combination of corrosion resistance, strength, formability, castability, electrical and thermal conductivity, and nice color at temperatures less than 200º C. They are used as cartridges, electrical contacts, decorative linings, condenser tubing in seawater systems and the petrochemical industry, and cooler materials.

Bronzes (alloys of copper and tin) are also common metals and have good corrosion resistance, castability, and low friction. They are used primarily as valves, bearings, pump parts, container materials, springs, sliding contacts, and gearwheels.

Watch and clock making

Whether a mechanical luxury watch or clock that is sold in only small quantities or a mass-produced quartz movement, the copper alloys can almost always be found in the heart of the movement. The range of alloys offered for this area of application is very broad: Copper-beryllium which, after hardening, exhibits the highest strength of all copper alloys, is often used for the manufacture of various cogwheels, bushings, balance wheels, watch hands, tinsels etc.

Thin brass strips or foil, with or without lead are used for the manufacture of watch hands, dials, cogwheels, tinsel etc.

Alloy testing for alloy grade verification is an essential requirement of many businesses such as consumer electronics, scrap recycling, watch, jewelry, etc. A number of businesses depend on identifying alloys by grade, as well as obtain complete quantitative alloy chemistry.

Classification of copper and its alloys		
Family	**Principal alloying element**	**UNS numbers**
Copper alloys, brass	Zinc (Zn)	C1xxxx–C4xxxx,C66400-C69800
Phosphor bronze	Tin (Sn)	C5xxxx
Aluminum bronzes	Aluminum (Al)	C60600–C64200
Silicon bronzes	Silicon (Si)	C64700–C66100
Copper nickel, nickel silvers	Nickel (Ni)	C7xxxx

COPPER ALLOY ANALYSIS

Copper alloys are valuable to a variety of industries. When copper is mixed with any other element, these materials are known as copper alloys. There are two types of alloys: wrought alloys, which are forged or hammered, and cast alloys, where the materials are molten down and then hardened into the desired shape.

There are approximately a bit more than 400 different types of copper alloys, and they are grouped into various classes. These classes are categorized based on the principal alloying element that is merged with the copper, whether it is zinc, tin, aluminum, silicon or nickel. The most common copper alloys are brasses and bronzes.

Sample preparation

The sample surface is generally prepared by using a lathe or a milling machine. Grinding is not possible because of risk of contamination.

Sample analysis time

The analysis time taken between the start of the analysis and the display of its result is in average 15 seconds.

Performance guarantee

The precision expresses the closeness of the concentration values of the individual runs of an analysis. The lowest the precision value, the smallest the number of runs needed for high confidence in the average result. The DL is the smallest concentration that can be distinguished from a blank value with a given probability. It is defined as three times the standard deviation of the background expressed in concentration units.

Accuracy and factory calibration

The accuracy is the most important figure of merit of a spectrometer. It expresses the agreement between the result and the reference value. It depends on the quality of the reference materials used for calibration, on some instrumental attributes and parameters.

Calibration

The following qualities for calibrations are in use:

- Low alloy copper
- Brass
- Bronze
- Cu-Al / Cu-Ni / Cu-Z
- Gunmetal
- Cu-Co-Be-Ag
- General Sorting alloys

Aluminum Metal Sorting with LIBS

The planet's resources are exhaustible, making it more and more important to use secondary raw materials. By using secondary raw materials in the production of aluminum, the energy-intensive electrolysis process is eliminated, thereby reducing the total energy costs to approximately 10 percent of primary production's energy price.

The sorting process produces high-purity metal fractions that can be sold directly and profitably. Assuming the current revenue for the recovered metals for the sorting of zorba, the payback of the machine—including labor and operating costs—can be reached in less than a year.

LIBS Analyzer is a breakthrough in light metals identification. Designed for rugged environments like yours, it delivers precise readings of light metals and alloys you couldn't identify before, to help you upgrade more loads and make more profit.

SORT MORE LOADS, SCORE MORE PROFITS.
The LIBS Analyzer will revolutionize your light metals identification process, empowering your team to make more advance light metal chemistry readings of in-demand light base metals like [Al, Mg, and Ti] and alloying elements with point-and-shoot convenience in just seconds.

Easily Sort Light Metal and Alloys
Again, choose a LIBS Analyzer for fast identification of a broader range of hard-to-measure light metals and alloys, including aluminum, magnesium, copper, lithium, etc. and make it easier to upgrade scrap loads and verify metal chemistry.

Eye-safe Laser Technology: No X-rays, No Regulations
The LIBS Analyzer utilizes a 3b laser that operates in Class 1 conditions and eliminates x-ray radiation safety hazards - and cuts out paperwork, compliance checks, user training, user restrictions, and annual fees.

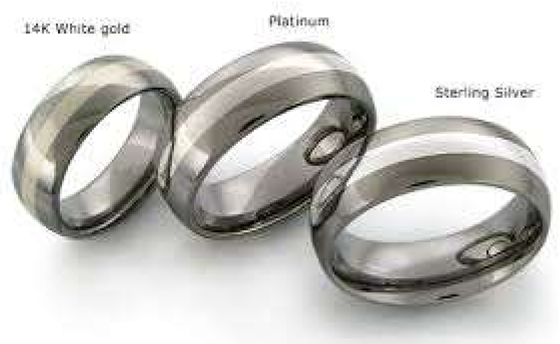
Maximize Team Productivity
The laser cuts through grime and debris, minimizing sample cleaning and grinding, and streamlining your measurement process. Plus, an intuitive interface enables any user to take accurate readings, while an ergonomic handle greatly

Built Tough to Keep Your Business Going
Ditch fragile x-ray units and pick up the device designed to handle rugged scrapyard like yours. A shock- and moisture-resistant frame, solid-state components and two rechargeable batteries provide your crew with long-lasting, durable performance and virtually eliminate downtime and service costs.

Determination of Gold and Other Precious Metal Content with XRF

Precious metals are the basis for jewelry production, however, they are also often used in high-tech industries such as electronics and medicine. The product cycle for precious metals ranges from the extraction of raw materials in mines via specific and at times very complex processing techniques all the way to recycling. Highest purity of the base metals, precise alloying and control of trace and minor elements is the basis of all precious metal products.

For assayers and refiners of precious metals, material analysis instruments must fulfil exacting requirements. Just determining the precise gold content is not enough: It is important to ascertain the complete composition of the alloy, including elements like platinum or silver.
Fire assaying (cupellation) is the traditional method for determining gold content, whether for gold bars, coins or valuable jewelry.



Jewelry and recycling precious metals

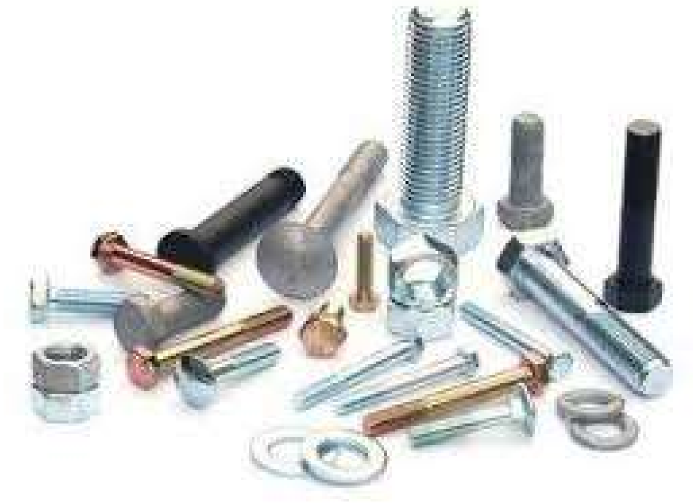
XRF analysis encompasses a wide variety of instrument types based on the end-user's needs and application types.

Where laboratory XRF analyzers can offer a large analytical flexibility, a portable XRF analyzer is quite powerful in its own respect. Pre-installed calibrations can determine a wide range of precious metal and gold alloys accurately and much more precise than an acid test. Portable XRF analyzers are easy to handle and require less skills to operate than a laboratory XRF system and provide the portability often needed to conclude commercial transactions in a speedy and reliable manner in these types of environments.

Fastener Quality Control

Using handheld spectrometer for the analysis of alloy chemistry and identification of alloy grade assures users that the composition of the metal they purchase, fabricate, verify or install is the grade that they specified.

Metal fasteners, such as screws, nuts, bolts, and clamps, are universal components of many machines and assemblies. Metal fasteners may also use to join materials such as wood, metal, plastic, or even fabrics together. Fasteners are made from steel, brass, aluminum, or other metals, depending on the design specifications of the application for which they are being used.



In critical applications, such as aerospace manufacturing, fasteners made with the wrong alloy can result in costly or even catastrophic consequences.
Following several high-profile counterfeiting cases in the 1980s regarding Army tanks, Navy ships, and interstate highway bridges, the National Institute of Standards and Technologies created the Fastener Quality Act (FQA) to ensure that industrial fasteners are manufactured according to specification.

XRF and LIBS equipment are considered as nondestructive testing techniques, that can analyze a metal sample in seconds with little to no need for sample preparation. These analyzers are portable and require no vacuum.

Positive Material Identification - PMI Testing on Metals

Why PMI?

With Positive Material Identification (PMI), the alloy composition, and thus, the identity of materials can be determined. If a material certificate is missing or/and you need to be certain about the type of material used, PMI as an NDT method is the best solution. Positive Material Identification is particularly used for high quality metals like stainless steel and high alloy metals.

PMI is needed when:

- working with a part that is part of an assembly
- A sample cannot be cut for routine testing
- A mixed lot is suspected
- Material identification/documentation has been misplaced
- There are questions about samples too costly to destroy

Two types of PMI

Because specifications for materials used in industry are increasingly more specific, the need for PMI testing has been steadily increasing. XRF and LIBS types of PMI are available, and both analysis techniques offer advantages and disadvantages.

X-ray Fluorescence (XRF) instruments work by exposing a sample to be measured to a beam of X-rays. XRF analyzers are easy to use, the units are light and small in size, and the sample to be measured does not require much preparation. But, there are limitations on the number of elements that XRF units can measure

In the Laser Breakdown Spectroscopy (LIBS) technique, atoms also are excited; however, the excitation energy comes from a laser spark. In this case, the energy of the spark causes the electrons in the sample to emit light, which is converted into a spectral pattern. By measuring the intensity of the peaks in this spectrum, the LIBS analyzer can produce qualitative and quantitative analysis of the material composition. Although LIBS is considered a nondestructive testing method, the Laser spark does leave a tiny little burn on the sample surface.

One of the key reasons LIBS technology is chosen instead of XRF is LIBS's superiority in the measurement of light elements in metals. The technology also is employed in the measurement of aluminum in aluminum alloys. LIBS measurements can be attained without an argon atmosphere, but will suffer from degraded accuracy and precision or repeatability.

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