# X-Ray Fluorescence Analysis

## XRF

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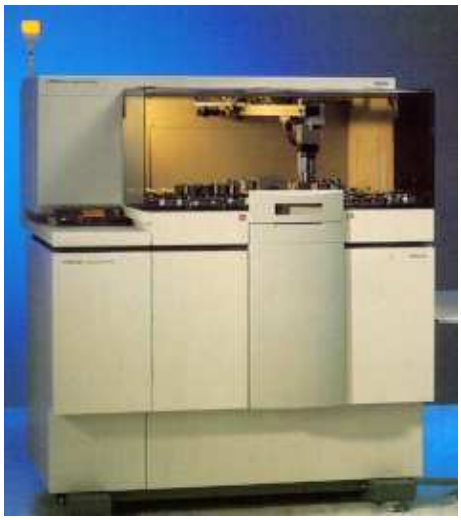

## Methods

X-ray fluorescence analysis (XRF) is an analytical method for the qualitative and quantitative determination of elements beginning roughly at sodium all the way up to uranium. The method is normally non-destructive; therefore, sample preparation is either simple or not even necessary. A major application of XFR is the measurement of metals and metal alloys. There are various types of x-ray fluorescence analysis (XRF) equipment based on different physical parameters:

**1. Energy dispersive x-ray fluorescence analysis (ED-XRF)** is normally used for routine tests because the equipment is less sophisticated and therefore cheaper. The disadvantages are lower sensitivity and selectivity (resolution).

**2. Wavelength dispersive x-ray fluorescence analysis (WD-XRF)** requires a higher level of sophistication of the equipment and thus higher costs, however, it offers higher sensitivity and the detection level is in the range of several µg/g (ppm).

The PHILIPS PW2404 sequence x-ray spectrometer used by **revierlabor** is a WD-XRF and it is equipped with a ceramic x-ray tube (4kW) with Rh anode, 6 analyzer crystals (LiF220, LiF200, Ge111, PE002, PX-1 and PX-4) enabling detection of the elements F to U as well as 3 detectors (flow rate and scintillation meters and a xenon proportional counter). It has an automatic sample changer for 144 samples. SuperQ-Software is used for quantitative analysis and SemIQ-Software for screening.

## Our Services (Analysis)

Analysis of the following metals and non-metals is possible:

- **Al, As, Au, Ba, Bi, Ca, Ce, Co, Cr, Cu, Fe, Hg, K, La, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Pt, Sb, Sc, Se, Si, Sn, Te, Ti, Tl, U, V, W, Zn and Zr.**

The device is mainly used for quantitative analysis of major, minor and trace elements in metal samples. Powder samples are usually measured by producing fused beads (0.5 g sample + 15 g sodium borate) for quantitative analysis or pressed powder pellets (0.5 g sample + 5 g Movital) for semi-quantitative analyses (screening). XRF is particularly suited for the determination of chemical composition, material inspection and material determination.

## Sample Requirements

Metal samples with a diameter ranging from 6 mm to a max. of 30 mm as well as chips and powder. Sample quantity of the latter is a minimum of 1000 mg enabling a repeat determination.
Chips and powder are prepared wet chemically (borate bead).

## Applications

- **Steels**
- **Nickel based alloys**
- **Non-ferrous metals and special alloys**
- **Titanium and titanium alloys, light metals**
- **Ores, minerals, carbons, ashes**
- **Dental and implant alloys**
- **Analysis of coatings**
- **Ceramics, oxides and mixed oxides**
- **Hard metals, cobalt and tungsten alloys**

## Process Characteristics

By means of XRF elements can be identified and quantitatively measured. Starting with sodium all elements can be determined in a concentration range from approx. 10 µg/g (ppm) to 100 % by weight. Specific detection limits depend on the atomic number of the element, the sample matrix, the method of sample preparation and the technical sophistication of the spectrometer.

## Standards Excerpt

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| DIN 51001 | General Guidelines for XRF |
| DIN 51418 | General Terminology and Basics of XRF |
| DIN EN ISO 12677 | Chemical Analysis of Refractory Products by X-Ray Fluorescence Fused Cast Bead Method |
| DIN 51729-10 | Testing of Solid Fuels – Determination of the Chemical Composition of Ash<br>Part 10: X-Ray Fluorescence Analysis (XRF) |
| DIN ISO 12980 | Analysis of Carbonaceous Materials – Green Coke and Calcined Coke |
| DIN ISO 4503 | Hard metals: Determination of the Contents of Metallic Elements by X-Ray Fluorescence – fusion method |
| ISO 9516 | Iron Ores – Determination of Various Elements by X-Ray Fluorescence Spectroscopy |
| ASTM B 890 | Standard Test Method for Determination of Metallic Constituents of Tungsten Alloys and Tungsten Hard metals by X-Ray Fluorescence Spectrometry |
| ASTM D 4326 | Standard Test Method for Major and Minor Elements in Coal and Coke Ash By X-Ray Fluorescence |
| ASTM E 322 | Standard Test Method for X-Ray Emission Spectrometric Analysis of Low-Alloy Steels and Cast Irons |
| ASTM E 539 | Standard Test Method for X-Ray Emission Spectrometric Analysis of 6Al-4V Titanium Alloy |
| ASTM E 572a | Standard Test Method for Analysis of Stainless and Alloy Steels by X-ray Fluorescence Spectrometrie |
| ASTM E 1085 | Standard Test Method for X-Ray Emission Spectrometric Analysis of Metals |
| ASTM E 1085 | Cobalt and Cobalt Alloy |
| ASTM E 1085 | Nickel and Nickel Alloy |
| ASTM E 1085 | Copper and Copper Alloy |
| ASTM E 1085 | Aluminum and Aluminum Alloy |


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