RoHS: Screening and Analysis of Electrical Instruments and Components

XRF and ICP spectrometers for determination of regulated substances in electrical and electronic products according to the European Directive RoHS
With the SPECTRO XEPOS, SPECTRO MIDEX and SPECTRO MIDEX M X-ray fluorescence spectrometers and the SPECTRO ARCOS and SPECTRO GENESIS ICP spectrometers, SPECTRO offers efficient solutions for the analytical requirements for the determination of regulated substances in electrical and electronic equipment. The total amount of chromium and bromine together with the elements cadmium, mercury and lead can be very exactly determined with these instruments. If the tolerance values for the former are exceeded, the exact fraction of hexavalent chromium or PBB and PBDE can be determined with different analytical techniques.

Since July 2006, electrical and electronic instruments and components marketed in the European Union are forbidden to contain the hazardous metals cadmium, lead and mercury. This has been established in the European directive for the Restriction of Hazardous Substances in Electrical and Electronic Equipment (RoHS) that also forbids the use of hexavalent chromium and the brominated flame retardants containing PBB and PBDE. The tolerance limits are 100 mg/kg for cadmium and 1000 mg/kg each for the other elements and bonds. The WEEE directive simultaneously regulates the minimum quotas for the recycling and reuse of electrical and electronic waste, for which products containing low levels of harmful substances are an important prerequisite.

If manufacturers and suppliers want to prove their conformity with the directives, functional analytical procedures are urgently required. X-ray fluorescence analysis and optical emission spectrometry with ICP, along with other technologies, are recommended in the IEC 111/24/CD from the International Electrotechnical Commission.

The scope of the RoHS directive includes, for example:

- Small and large household appliances
- IT and telecommunications equipment
- Consumer equipment
- Lighting equipment
- Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
- Toys, leisure and sports equipment
- Automatic dispensers

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In the IEC 111/24/CD with recommendations for suitable analytical procedures within the framework of the RoHS directive, the International Electrotechnical Commission describes X-ray fluorescence analysis, with its minimal requirements for sample preparation, as being suited for fast quantitative screening.

ICP emission spectrometry, with its more complex but standardized sample preparation procedures, is indicated as being an appropriate tool for quantitative elemental analysis.

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X-ray fluorescence spectrometry is more suited to fast limiting value control for the elements cadmium, mercury, lead, chromium and bromine than any other analytical method. It requires little or no sample preparation and is non-destructive. Even samples of polymer granulates, insulation and housing materials can be directly analyzed if necessary. If disturbances due to particle size, thickness or matrix effects that are too high occur, then it is possible to conduct a quick sample preparation using a hot press or pulverization. All of the other elements from Na to U can be simultaneously determined in addition to the elements required in the RoHS.

The SPECTRO XEPOS is a particularly powerful XRF analyzer with exceptional multifaceted capabilities. Compared to conventional bench top instruments, it achieves decidedly better detection limits. A very low powered X-ray tube with a power of only 50 W serves as the radiation source. The extreme sensitivity is obtained with an extended polarization system by which the primary tube radiation is bundled in a luminously intense polarization and secondary target optics. With this technique, it is not necessary to utilize radiation filters that lead to heavy losses in sensitivity.

With its versatility and flexibility, the SPECTRO XEPOS is supremely suited to limiting value determination in accordance with the regulations. Solid, powder and liquid samples can be analyzed. The analyses can be easily automated using an integrated autosampler and cuvettes. The instrument analyzes largely matrix independent as the software corrects for this type of influence as well as for those due to sample thickness. This and many additional instrument and software characteristics make operation simple and safe.
The SPECTRO MIDEX and SPECTRO MIDEX M are used for the analysis of very small surfaces and samples. Both are multifaceted X-ray fluorescence microanalysis systems with focal point excitation and a high-resolution detection system that are also capable of conducting quick overview analyses. All 80 elements from aluminum to uranium can be determined within less than two minutes.

The SPECTRO MIDEX, with its roomy sample chamber, has an adjustable sample stand. The exact measuring position can be exactly determined using the built-in video camera with 20 times zoom. Operation of the instrument is conducted with the computer included in the scope of delivery and is very easy due to the special software. The diameter of the measuring point is small, down to 0.7 or 2 mm.

The measuring spot is much smaller, down to 0.2 mm, with the SPECTRO MIDEX M, which utilizes a motor driven xyz-table line scanner that allows mapping of sample surfaces larger than 10 x10”.

A double video system with different magnification is integrated for the setting of measuring positions. It is possible to define lines or surface areas for measurement on the samples to be analyzed. The software makes it possible to evaluate individual measuring points and to graphically display the distribution of the elements within a pre-defined sample area.
SPECTRO supplies the SPECTRO ARCOS ICP spectrometer as an upscale analytical instrument with extreme exactness for a wide range of wavelengths. Because of its higher cost and, compared to XRF, more complicated sample preparation, it is usually used for control measurements on samples that could not be clearly judged with XRF. To do this, the SPECTRO ARCOS utilizes superior technology.

With its unique, analytically superior optical system and the UV-Plus concept for highest performance in the UV range, the SPECTRO ARCOS captures the entire relevant spectrum from 130 to 770 nm simultaneously. The new high-speed read-out system is not only the basis for quick measurement and evaluation, but also permits the detectors a dynamic operating range of new dimensions. The free-running, robust 27.12-MHz generator enables stable excitation conditions even under extreme loading, and requires no external water cooling.

The SMART ANALYZER VISION software platform is easy and intuitive to operate. It offers a wide range of functions, which perfectly support the innovative instrument design and make it simple to use. A special strength lies in the deliberate automation module, which can easily realize both standard tasks and also very complex analytical requirements.
The SPECTRO GENESIS is the first and only ICP-OES spectrometer available with factory calibrated methods - truly “plug & analyze” without needing to first develop a method. The methods are delivered ready for use straight out of the box with an application package that includes the sample introduction system, sample preparation instructions and method.

The SPECTRO GENESIS offers a real economic alternative to sequential ICP and Atomic Absorption spectrometers, enabling those who are unfamiliar with ICP to profit from the advantages of leading CCD ICP technology and to use a powerful, low cost and user friendly analytical system.

An extensive package of accessories is available for the SPECTRO GENESIS to further expand its application range. This includes, but is not limited to, a wide range of sample introduction systems, autosamplers, an autodilutor, an ultrasonic nebulizer and a hydride generator.

The SPECTRO GENESIS is equipped with powerful automation functions for the safe unattended analysis of a large number of samples. With an optional autosampler, several hundred samples can be processed without operator intervention. If the relevant methods are available, simply import or define a sample list.

**SPECTRO GENESIS**

- A powerful alternative to conventional sequential ICP and Atomic Absorption spectrometers
- High speed analyses using simultaneous measurement of the complete spectrum
- Factory calibrated, norm-conforming methods for environmental and industrial applications
- Minimal installation and training requirements
- Compact design enables seamless integration into the laboratory
- Excellent price-performance ratio