Examination Method for Quality Assurance of Electronic and Electromechanical Components

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Abstract: Supplier's quality assurance is an important part of operation of quality managements systems that were built out at companies that utilize electronic components, within the frames of which the examination of built-in components according to environmental aspect is performed.
This study overviews the tasks of quality assurance and deals with a possible method of heavy metal examination in details.

1 Introduction

In our days, in an acute market competition situation, companies must not only produce products with perfect quality but must satisfy quality environmental requirements, too. Consideration of the directive no. 53 of European Union in case of electronic and electromechanical components is especially important, it prohibits application of heavy metals that can be recuperated with difficulty and strongly pollute the environment in the components and systems built from them.

2 Quality Assurance of the Incoming Product

At a company that produces electronic units, supplier quality assurance is provided at a department that deals with the examination of incoming products before they get into the stock or production. The department generally consists of several groups, and due to their harmonised work, only faultless components of good quality are built in. Incoming components are divided basically into three groups.

- Electronic and electromechanical components,

- Metal components,

- Plastic components and packing materials.

Incoming components according to examinations are divided into several groups [1], [2]*:*

- 100% inspection, when the whole lot is examined.
- Components that undergo checking by *sampling*: from a given lot a determined number of samples is taken, checked, then conclusion is made about the quality of the lot.
- Components *not inspected*: *NI* – materials (non-inspected), these can be let to stock without checking.

Route of inspection of incoming components can be followed using figure 1.

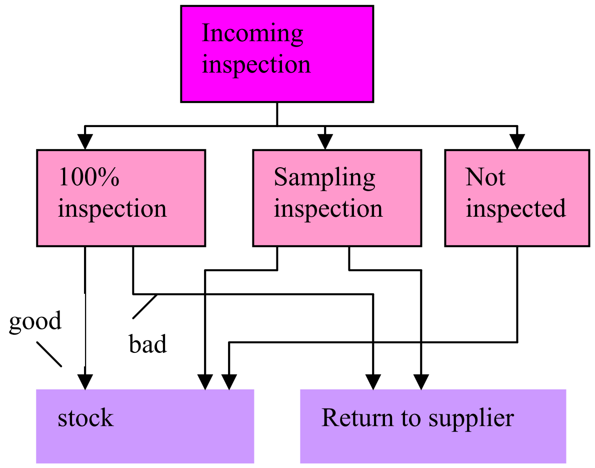

Figure 1
Route of inspection of incoming components

At the department, special measurements are performed in a laboratory that was specially developed for this purpose. Such measurements are the examination of solderability of individual electronic components, testing of pick-ups, dimensional measurement using projector or 3D measuring machine. The most special measurement is X-ray material testing that concerns individual electronic, electromechanical or metallic components.

3 Take-over Inspection of Electronic Components

Inspector of incoming products, based on the invoice belonging to the consignment, inspects the identification label as well as suitability of the components to the drawing. Parameters of capacitors and resistors must be checked on each coil. This means that data on the drawing, on the supplier's identification and on the own label must coincide. If this is done then from each lot a coil must be selected randomly, and from them a component must be measured using the RCL meter that is found in the laboratory. RCL meter is a special measuring machine that helps to determine the values of resistors, capacitors and inductances. In case of ICs, crystals or other components that cannot be measured using the available tools, the titles on them must be verified with the titles specified by the label or technical drawing. If the inspection cannot be performed without opening of the original ESD packing of the piece then the inspection must be omitted. On figure 2 the tasks to be performed after identification of the material can be tracked.

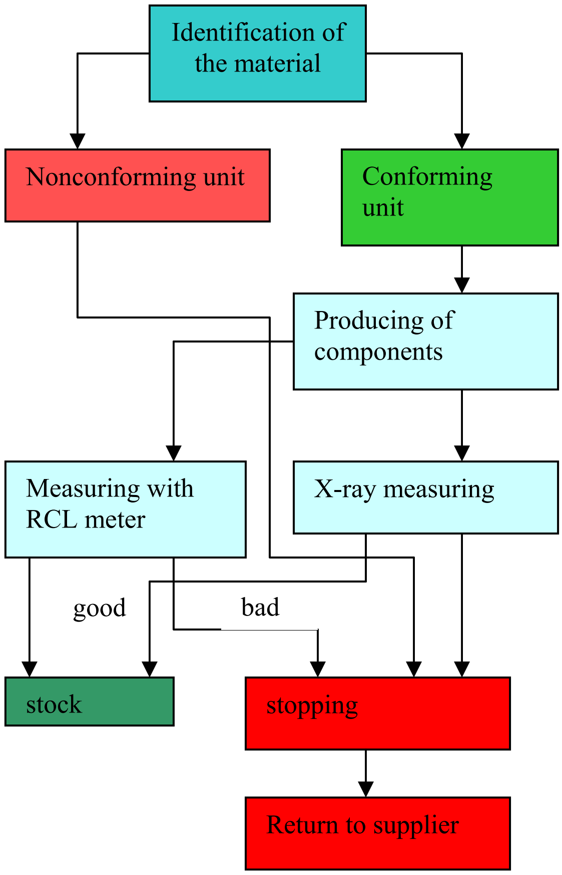

Figure 2

ESD packing serves for protection of the component against high humidity, because at soldering the material of the component can crack because of sudden change of humidity. However, the packing itself cannot protect against vapour during sea transport – although vacuum packing is used – therefore silicone balls are used to drain humidity. Protection against static electricity is provided by this ESD packing. If everything is OK, after quality control the stock may place the components on the position. There are cases when the component arrives in a damaged packing. In this case a lockup is required everyhow, because it must be checked if the material is damaged. The inspection requires 100% examination.

4 Inspection on Heavy Metals of Electronic Components

Heavy metal examination has an important role in electronic industry, as heavy metal content is bound by strict regulations, just therefore its checking has a highlighted role [3]. Its checking is performed by a material testing machine that has several types: In one thing, however, they coincide: each type is suitable for determination of lead, cadmium, chrome and mercury contents. When testing, a sample is taken from the material using x-ray, a measuring program on a computer compares the measured values with those fixed during calibration, then evaluates it. Measurement results are continuously registered by a computer, about which a protocol is taken, and after the measurements the evaluation may begin.

X-ray material testing machines, based on their operating principles can be the following:

1. Essence of operation of wavelength-deflecting XRF spectrometers is that in the diffraction space a crystal distributes the x-ray lines of different length emitted by the sample. The recipient can receive only one wavelength at a time, therefore the crystal and the recipient alternate the angle of inclination at the same time. Structure of a wavelength-deflecting spectrometer can be followed on figure 3.

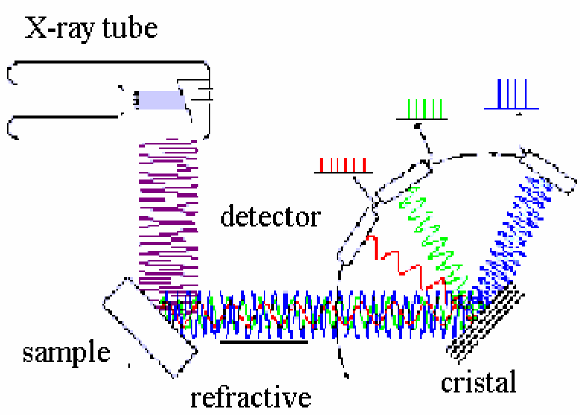

Figure 3

Structure of a wavelength-deflecting spectrometer

2 Schematic diagram of an *energy-controlling XRF spectrometer* is shown on figure 4. In energy-controlling systems, the primary x-ray evokes several spectrum lines in the wavelength system. Every wavelength immediately starts the receiver (generally not exactly in the same moment). The receiver detects an electronic pulse that is proportional to energy of the photon.

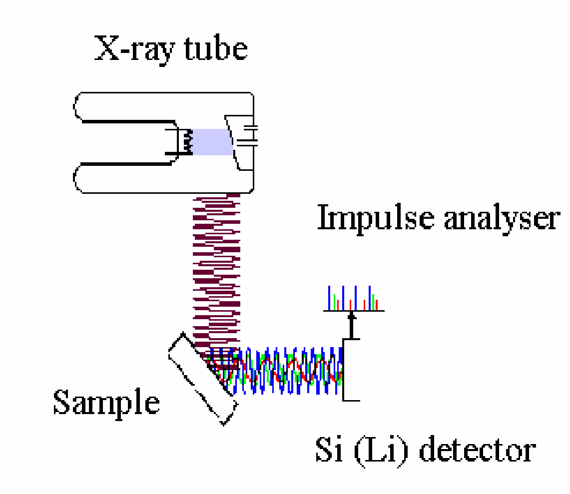

Figure 4
Energy-controlling XRF sprectometer

Comparing the two system: Both the energy controlling system and the wavelength-deflecting system have several advantages. At the energy-controlling system, the measuring instrument is capable of simultaneous accumulation of the entire spectrum, its quick analysis, and it is flexible in respects of the evoking and primary ray conditions. Beside its numerous outstanding technical parameters, it is not necessary that using them, operating costs can be lower. The wavelength-deflecting system has not so favourable parameters as the energy controlling system, however, in the practice it has approved the expectations about it, because a higher top value intensity can be reached during measuring, in case of longer wavelengths the resolution was improved and is more sensible to weaker lines.

Operation of the EDX 700 type measuring machine is shown on figure 5. [4]. You can see that the ray, starting from the x-ray source, through the source filter and light paralleling penetrates to the given depth then it is reflected from there and gets into the x-ray receiver. Data are compared from the receiver. Data registered during calibration constitute a basis for comparison.

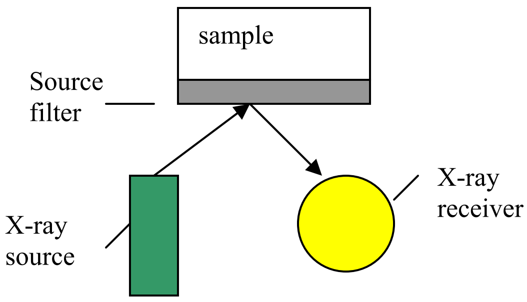

Figure 5
EDX 700 type measuring machine

X-ray source

The x-ray tube operates with a high-voltage force support with a 5-50 kV output. Head of the vacuum tube consists of a target station made of rhodium (anode). As the accelerating electrons reach the target station, it emits x-rays. The tube forms the x-rays into a beam through a beryllium window. The process is illustrated by figure 6.

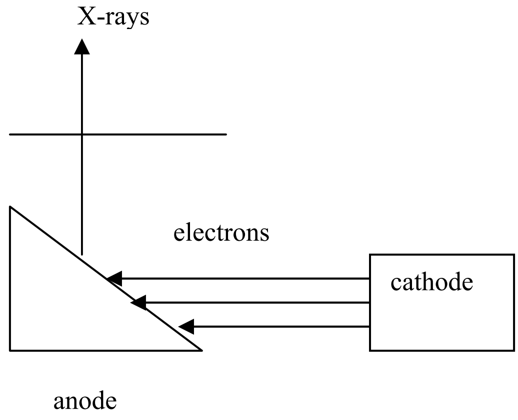

Figure 6

Primary x-ray filters and light paralleling improve the quality of the spectrum due to continuity of the dissipated x-ray tube with a background decrease evoked in the spectrum. The filters can be reached by Ti, Al, Zr, Ni and the polymers. Light paralleling decreases the analyzed area of the sample. These light paralleling tools can be selected according to 4 kinds of settings that can be the following. 10 mm; 5 mm; 3 mm és 1 mm. Using smaller light paralleling tools, the spectrum and the resulting intensity can be decreased and the collection time can be increased.

X-ray receiver:

EDX 700 is a lithium spin solid state receiver. If the x-ray enters the receiver, it evokes a photoelectron of so high energy that finally diffuses its energy in a multiple interaction that supports valence electrons into the leading group, leaving the resource into the valence group. The electron resource pairs are collected by the bias voltage of the 1000 V receiver, increasing the given high current strength for each x-ray that enters the receiver. Value of the pulse is proportional to x-ray energy.

Conclusions

The above system, based on industrial experiences, according to the corresponding work instructions is suitable to meet quality and environmental requirements to the product. Using the examination method, the costs for faults and cycle times can be significantly decreased, or indexes of effectiveness can be improved.

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