Compared to PIN or SD detectors, the proportional counter tube has the largest active detector area with a slightly curved window.

Application Note # 94

XRF Analysis with Proportional Counter Tube – These are the Advantages

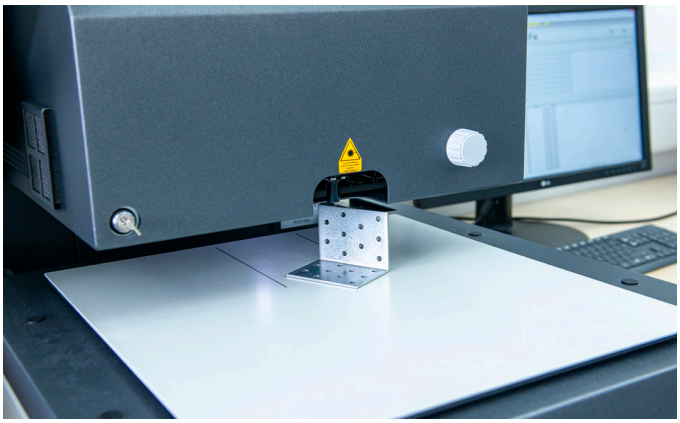
The detector takes on a crucial function in X-ray fluorescence (XRF) analysis. A detector can detect if the atoms in the sample to be measured are excited by an X-ray beam to emit fluorescence radiation. The measurement software then evaluates the detected radiation. Only at Fischer users can choose from the three most crucial detector types. In addition to the silicon PIN diode (Si-PIN diode) and the silicon drift detector (SDD), the proportional counter tube is indispensable in the portfolio of a measurement technology specialist as an inexpensive yet powerful alternative.

Since the early 1980s, XRF measurement technology has been used to measure the thickness of metallic coatings. Today, XRF is firmly established in the everyday industry and the laboratory. The thinnest layers on connectors, printed circuit boards, fasteners, and much more can be measured quickly, precisely, reliably and non-destructively.
A detector is necessary to determine the fluorescence radiation generated by the layers' excitation by X-rays. The information from the detector is passed to the evaluation software and converted into the corresponding layer thickness.

The first detector on the market was the proportional counter tube. This is a counter tube filled with gas. The fluorescence radiation is detected by passing through the window and interacting with the gas.
Over time, other types of detectors were added: the Si-PIN diode and the SDD. These have a higher energy resolution, which is why they are predestined for the measurement of very thin single and multiple layer systems as well as for the analysis of complex metal alloys.

Nevertheless, there are applications where the use of the proportional counter tube offers the optimal solution. It is the cost-effective entry point when it comes to routine measurements of known coating systems or alloys. Precise results are obtained for coating thickness measurements in the range of 0.1 – 50 µm (depending on the coating system). If elements are not too close together, as with ZnNi and AuAgCu coatings, material analysis can also be conducted without any problems. In

The proportional counter tube is typically used to measure hard coatings on steel or hard metal, chrome coatings on fittings and machine components, silver coatings in the energy supply sector, electroless nickel coatings on structural components, and zinc or nickel coatings on fasteners and fittings.



If a measuring distance of more than 20 mm is required for measurements on complex shaped test parts, the proportional counter tube shows its strengths.

contrast, closely spaced peaks such as gold and platinum can be analyzed with high separation accuracy using the Si PIN diode and the SDD.

In terms of its design, the proportional counter tube has the following advantages: the active detector area is typically 10 to 100 times larger than that of a semiconductor detector. In addition, it has a slightly curved window. This allows a much larger solid angle to be covered by the detector, much more fluorescence radiation to be detected, and a high count rate to be achieved. Thus, this type of detector is less sensitive to the test part alignment to the detector, the measurement distance setting and the sample geometry.

The Advantage when Large Measuring Distance is Needed:
This brings particular advantages for measurements of complex-shaped samples and recesses when a measuring distance of more than 20 mm is required. If the thickness of the zinc layer is measured at an angle of approximately 6 cm, the strengths of the proportional counter tube come to bear significantly. With a measured mean value of 21.4 µm, the standard deviation is only 0.2 µm, the coefficient of variation 0.9 %. To achieve the same measurement result using a Si PIN diode, the measurement time would have to be increased twelvefold (see table).

Table

DETECTOR TYPE	MEASUREMENT TIME	STANDARD DEVIATION	VARIATION COEFFICIENT
Proportional Counter Tube (0.2 mm Aperture)	10 s	0.2 µm	0.9 %
Silicon PIN Diode	10 s	1.1 µm	5.3 %
	120 s	0.2 µm	1.0 %

Measuring task: Zn/Fe, measuring distance: 60 mm, number of measurements: 25 each

The Advantage when a Small Measuring Spot is Needed:
If the layer thickness and composition of simpler layer systems on smaller samples such as plug contacts needs to be determined, correspondingly small measuring spots of approx. 0.1 mm are required. The proportional counter tube is also the optimum detector choice in many cases of this kind. For example, compared to the other detector types, the proportional counter tube achieves the same precision with a shorter measurement time when measuring the thickness of the gold layer on a plug contact.

Advantage of Measuring with Fischer Measurement Technology:
The Fischer measurement software features the in-house developed drift compensation as standard to achieve consistently reliable measurement results. This gives the proportional counter tube unique stability. The software automatically corrects a possibly occurring drift of the peak position in the spectrum and thus prevents falsification of the results, especially with critical peak overlays.

Conclusion:
The proportional counter tube is the cost-effective entry for coating thickness measurements in the range of 0.1 – 50 µm (depending on the coating system), as well as analysis of elements that are spaced apart. If a large measuring distance of more than 20 mm has to be handled, the proportional counter tube shows its strengths. Due to the very large active detector area as well as the slight curvature of the window, a high count rate is achieved even in such cases since a large amount of fluorescence radiation is detected by the detector. The drift compensation developed by Fischer ensures that consistently reliable measurement results are obtained.