PRINCETON GAMMA-TECH

Product Information

PGT WELL DETECTORS

THE THROUGH-HOLE ADVANTAGE

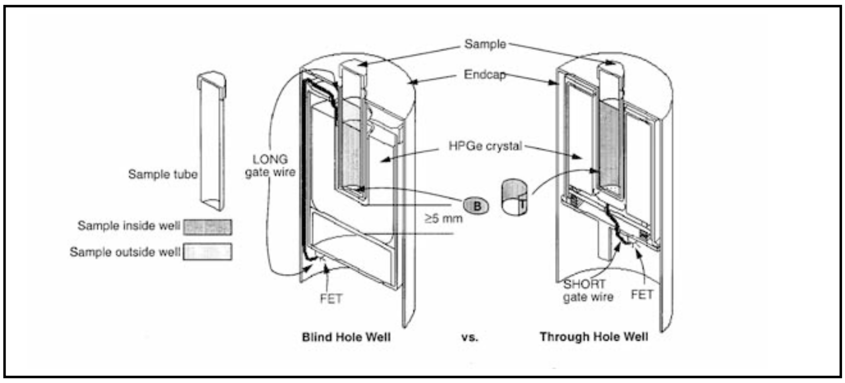

Figure 1: Cross-Section of the PGT Well Detector vs. blind hole well detector

PGT well detectors are ideal for efficiently analyzing small, low-activity samples. Spectra acquired with a through-hole PGT well detector exhibit better energy resolution and improved minimum detectable activity values. This improved performance is a direct result of the PGT “through-hole” design.

Much has been written about the supposed superiority of blind hole detectors because of their nearly 4-pi geometry. However, this is significant only for a point source or very small samples. The blind hole was the original configuration used by PGT to manufacture its first Ge(Li) well detectors circa 1968. But just as the Ge(Li) crystal has been replaced by the superior HPGe crystal, so too has the blind hole design been supplanted by the through hole design. There are a number of reasons why this is a better design, but what proves it to be better is detector performance.

Through-Hole Efficiency

Consider two equal sized crystals as shown in figure 1. The detector on the left is fabricated as a blind-hole well and the detector on the right as a through-hole well. Two factors affecting efficiency in a well detector are the sample size and the surface area of the crystal to which the sample is exposed. In figure 1 above, compare the crystal area at the bottom of the blind-hole (B) with the additional surface area (T) of the through-hole well. The blind-hole well detector will have a minimum of 5mm of solid crystal below the well. Thus there is at least an additional 5 mm of well length in the through-hole design.

For 10 mm diameter hole, area B = 78.5, while T = 157; for a 15mm hole, B = 176.6 and T = 235.5. At 20mm diameter, a size that is standard with PGT (but special order for blind-well detectors), the areas are equal. That assumes, of course, that the blind hole still has just 5 mm left below the hole! And not only is there a gain in detector surface area, but for the same diameter a larger sample volume can be analyzed. A larger sample means that counting time can be reduced for greater laboratory efficiency.

In addition, the through hole design lets the customer decide where the bottom of the well insert is to be located within the crystal hole, based on the type of sample to be analyzed, its shape and volume. The sample can be centered within the crystal, and there will still be a gain in surface area exposed to the sample. With a given sample volume, the photons from the top of the sample in the blind hole detector are lost. When that same volume is centered in a PGT well detector, the entire sample length is exposed to the sides of the well. Think of a light in the center of a tunnel that shines on all the walls of the tunnel with only a small fraction of the light lost out of the entrances.

The through hole design thus increases the number of processed counts and improves statistical accuracy.

Resolution

The second factor affecting well detectors - resolution - is directly related to electronic noise. As shown in figure 1, the gate wire by which the detector signals are conducted to the FET is much longer for a blind well. The contact to the center electrode must be made at the front of the detector in the small space between the sample hole and the center contact, and the lead must go around the crystal to the FET at the back. Any movement in this lead due to external vibrations, however small, will cause a capacitance change at the FET input, which then appears as a microphonic signal at its output, resulting in peak broadening, poor peak detectability and therefore longer counting times.

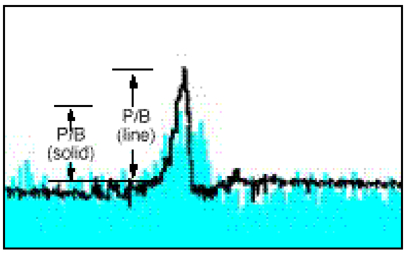

Figure 2: The resolution advantage

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PGT Well Detectors for Efficient Analysis

Crystal type	P-type HPGE with vapor-deposited gold inner contact for improved low-energy sensitivity	**Cryostat (standard)**	Aluminum endcap and well insert 30-liter dipstick Dewar
Usable energy range	< 10 keV - 10 MeV	**Preamplifiers**	RG-11 resistive feedback (standard) Low-Power and transistor reset (optional)
Well diameter	10, 14, 16, 20mm (standard) 33mm or more (custom)	**Well options**	Beryllium and low-Z organic well inserts for low-energy ranges Ultra-low-background Al also available
Active Volumes	50- 170 cc (standard) >170cc available		
Resolution 122 keV	1.20- 1.40 eV	**Cryostat options**	JT Cool mechanical cooler for laboratory or field work Low-background NPR cryostat Quiet-One™ anti-microphonic crystal mounting
Resolution 1.33 MeV	2.1- 2.3 keV		

In contrast, the center contact of the PGT well detector extends the entire length of the crystal. Only a very short gate wire is required to reach the FET. Because it is so much shorter, and also because it does not need to be threaded between the crystal and the endcap, there is much less possibility of microphonic noise. And for the extremely noisy environments or field deployment, PGT offers its proprietary Quiet-One™ ultra-low microphonics mounting system.

The significance for resolution is shown graphically in figure 2. The line spectrum has better resolution. Its narrower peak has as many net counts as the shorter, broader peak, with a resultant better peak-to –background ratio.

Minimum Detectable Activity

The MDA represents the “bottom line” for an analysis. A lower MDA translates to greater confidence that weak signature lines or trace elements will be detected. Any improvement in MDA from a nominally greater efficiency is more than offset by the effects of poorer resolution and the corresponding larger background under the peak.

Applications:

- Bio-Assay
- Sediment studies
- Pb-210
- Low activity environmental counting
- Nuclear medicine applications

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