



Application Note # 1009

Precious Metal Analysis with Bruker Handheld XRF Analyzers

From earrings and necklaces to wedding rings, ornamental gold is found everywhere, easily making it the most popular alloy used in jewelry. In 2007 alone, 2,425 tons of gold alloy jewelry was produced worldwide at an estimated cost of US\$ 54.2 billion. As gold reaches record prices, knowing the precise gold assay is more important than ever. Whether buying, selling, or recycling, it is important to ensure gold content with a reliable analysis method, bypassing stamped hallmarks or certificates that can't always be trusted.

Within seconds Bruker S1 Handheld XRF analyzers can identify the exact gold content in jewelry, coins, and other valuable products with excellent accuracy. The Bruker S1 handheld XRF devices are an ideal tool for the jewelry industry, cash-for-gold operations, pawn shops, coin collectors and gold scrap recycling.

Bruker S1 Handheld XRF analyzers provide a rapid, completely non-destructive test of not only gold, but also platinum, silver, palladium, and other precious metals. In addition to precious metal content, the Bruker S1 can also precisely determine the concentration of other trace alloying elements and dangerous heavy elements such as lead.



The Bruker S1 precious metal alloys calibration includes the following elements: Au, Ag, Cd, Co, Cr, Cu, Fe, In, Ir, Mn, Ni, Pb, Pd, Pt, Rh, Ru, Sb, Sn, Ti, Zn

Since the gold content of an alloy is measured in karats, with 24 karats being pure gold, the relationship between weight-percent composition and the karat is easily translatable, with 1.0 Karat = 4.1666% Au. The Bruker S1 reports percentage of gold and other alloying elements, as well as Karat grade.

Screenshot of Gold measurement, with KARAT Grade ID

| Precious Metals 12:43 | | | | | |
|----------------------------|-------|-------|-------|------|--|
| 10 karat Gold | | | | | |
| 8 Time 60.1 Match Qual 9.4 | | | | | |
| 11-23-2010 18:31 | | | | | |
| El | Min | % | Max | +/- | |
| Au | 41.00 | 41.30 | 43.00 | 0.14 | |
| Cu | 30.00 | 34.50 | 50.00 | 0.06 | |
| Zn | 0.00 | 7.78 | 18.00 | 0.03 | |
| Ag | 0.00 | 7.67 | 12.00 | 0.05 | |
| Ni | 0.00 | 7.64 | 18.00 | 0.03 | |

The Instruments of Choice

S1 SORTER

The Bruker S1 SORTER analyzer offers high performance and point-and-shoot simplicity in an economical package. The optional precious metal calibration enables accurate and reliable analysis of all precious metals and alloying elements. Automatic sample size compensation ensures accurate analysis results for jewelry of all shapes and sizes.

S1 TURBO

When the highest possible performance is required, the S1 TURBO^{SD} is the right choice. The S1 TURBO^{SD} incorporates the latest in X-ray detection technology: the silicon drift detector (SDD). The Bruker XFlash SDD detector provides excellent resolution and high count rates, both essential for quick and accurate analysis of gold and other jewelry alloys. In precious metal analysis, the S1 TURBO^{SD}'s most significant advantage is speed of analysis, which enables high throughput.



Use of the optional desktop-top stand with the S1 TURBO enables precise sample positioning

Test Results

Accuracy of gold analysis was demonstrated using the S1 TURBO^{SD} by measuring multiple certified gold standards ranging from 8.4 Karat to 24 Karat (35 - 99.99%). Gold accuracy results are presented in Figure 1. Based on the test results, the average gold analysis accuracy in the 35% - 100% gold range was better than ± 0.4 wt% (± 0.1 Karat). Based on similar tests, the average accuracy of the S1 SORTER was better than ± 0.7 wt% (± 0.16 Karat). The accuracy of gold analysis can be further improved by applying type standardization for the specific gold sample type.

The precision of S1 TURBO^{SD} and S1 SORTER gold analysis is demonstrated in Table 1. Precision of the analysis can be improved by extending the measurement time; generally, the standard deviation of the measurement can be halved by using four times the standard measurement time.

Table 1: Precision Data for a 22 Karat Gold Alloy

S1 SORTER repeatability - 30s measurement time

| Meas | Au | Ag | Zn |
|------------|-------|-------|-------|
| 1 | 91.3 | 3.49 | 1.13 |
| 2 | 91.5 | 3.41 | 1.08 |
| 3 | 91.3 | 3.37 | 1.07 |
| 4 | 91.6 | 3.34 | 1.06 |
| 5 | 91.4 | 3.41 | 1.04 |
| 6 | 91.4 | 3.41 | 0.98 |
| 7 | 91.3 | 3.59 | 1.14 |
| 8 | 91.3 | 3.51 | 1.09 |
| 9 | 91 | 3.5 | 1.04 |
| 10 | 91.2 | 3.59 | 1.05 |
| AVG result | 91.33 | 3.46 | 1.07 |
| STD DEV | 0.164 | 0.087 | 0.047 |
| Cert value | 91.69 | 3.31 | 1.02 |

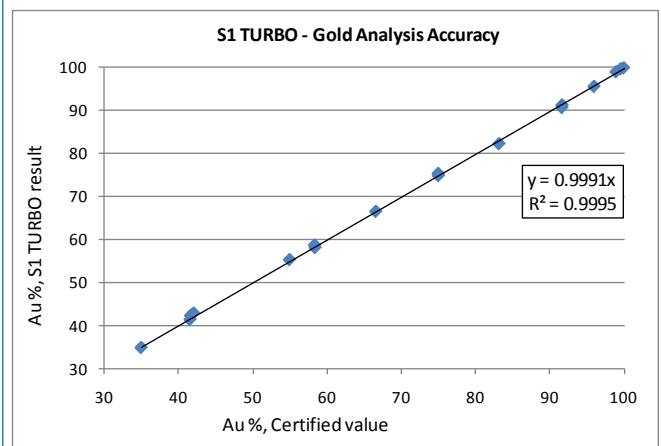
S1 TURBO^{SD} repeatability - 30s measurement time

| Meas | Au | Ag | Zn |
|------------|-------|-------|-------|
| 1 | 91.8 | 3.24 | 0.96 |
| 2 | 91.8 | 3.22 | 0.96 |
| 3 | 91.9 | 3.23 | 0.96 |
| 4 | 91.8 | 3.28 | 0.97 |
| 5 | 91.9 | 3.24 | 0.96 |
| 6 | 91.9 | 3.22 | 0.96 |
| 7 | 91.8 | 3.24 | 0.95 |
| 8 | 91.9 | 3.23 | 0.95 |
| 9 | 91.8 | 3.32 | 0.95 |
| 10 | 91.8 | 3.26 | 0.96 |
| AVG result | 91.84 | 3.25 | 0.96 |
| STD DEV | 0.052 | 0.031 | 0.008 |
| Cert value | 91.69 | 3.31 | 1.02 |

Summary

The Bruker S1 SORTER and S1 TURBO^{SD} handheld XRF analyzers provide an accurate and reliable solution for analysis of gold and other precious metal samples. Both analyzers can easily measure jewelry samples of all shapes and sizes. Bruker S1 Handheld XRF analyzers are true point-and-shoot tools for simple and completely non-destructive analysis of gold and other precious metals.

Figure 1: S1 TURBO - Gold Analysis Accuracy



Bruker Elemental is continually improving its products and reserves the right to change specifications without notice. © GJS 01-2011 P/N: 040.0060.01.0

www.handheldxrf.com ●

Americas

Sales
 Billerica, MA · USA
 Tel. +1 (978) 663-3660 x1463
 hhsales@bruker-elemental.net

Service/Manufacturing
 Kennewick, WA · USA
 Tel. +1 (509) 783-9850
 hhinfo@bruker-elemental.net

Europe / Middle East / Africa

Sales/Service
 Bruker Nano GmbH
 Berlin · Germany
 Tel. +49 (0)30 670 990-0
 info-hh@bruker-elemental.com