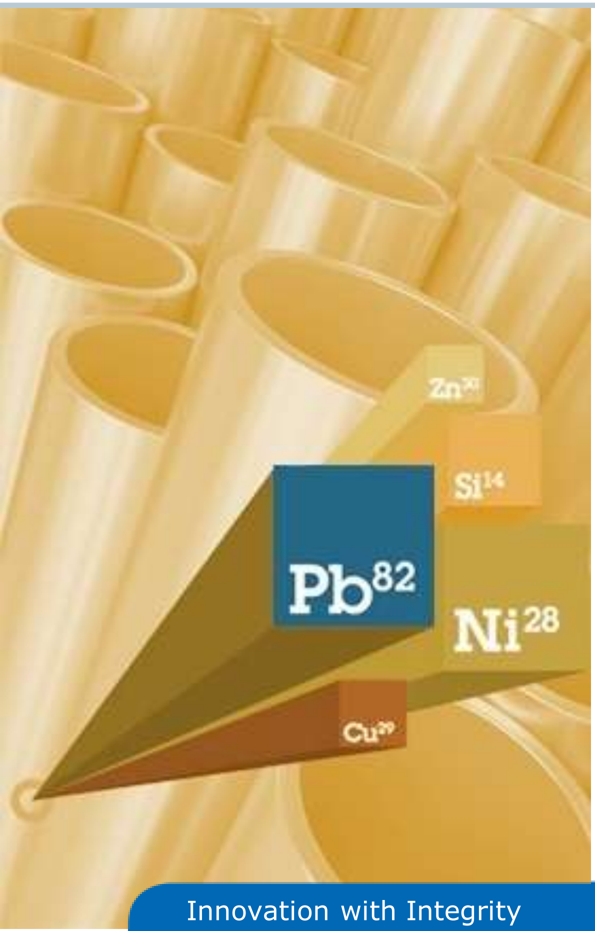
Testing for Compliance with the Safe Drinking Water Act 2014

Screening for Lead (Pb) with Handheld XRF

November 12, 2013



Our Panelists:

Rick Rainville
President
RCR Associates, Inc.

Richard (Rick) Andrew
Director, Global Business Development
Water Systems
NSF International

Alexander Seyfarth
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Bruker Elemental, Kennewick, WA
Lecturer at University of Western Ontario
and PITTCON

Agenda

- Rick Andrew
  - Who is NSF International
  - The Safe Drinking Water Act revision and required testing
  - NSF standards
- Alexander Seyfarth
  - Handheld XRF application solutions
  - How does it work?
  - Hints and tips to avoid pitfalls
- Conclusion and Summary
- Q and A

Disclaimers

- NSF is participating in this webinar to help provide valuable information as part of our public health mission. NSF does not endorse Bruker Elemental products.
- NSF recommends XRF as a valuable tool for assessing and maintaining compliance to lead in drinking water regulations. However, there are some cases in which more exacting analysis involving acid digestion and analysis by ICP-MS are warranted.

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Who is NSF International

- NSF International is a global, independent, public health and safety organization.
- Our mission and focus has always been protecting and improving human health!

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Bringing Industry, Regulators and Consumers Together

Industry
Food, Water, Consumer Goods

Consumers
Media, Educators,
Consumer Groups

Regulators
USDA, EPA, FDA, HC,
State, Local

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Founded in 1944 to Develop Standards, Certify Equipment

- NSF was founded as the National Sanitation Foundation in the University of Michigan's School of Public Health in 1944.

- Today, we are known as *NSF International*, with a corporate headquarters in Ann Arbor, MI, USA, and operations in 120 countries.

NSF Around the Globe

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NSF Water Division

The NSF Water Division develops standards, tests and certifies products that come into contact with drinking water, such as plumbing components, water treatment chemicals and drinking water filters, as well as pool and spa equipment.

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US Safe Drinking Water Act (US-SDWA)

- Currently requires products conveying drinking water to have $\leq$ 8.0% lead content.
- Solder and flux are required to have $\leq$ 0.2% lead content.

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US Safe Drinking Water Act Revision

- New law redefines Lead Free:
  - for products that convey or dispense drinking water
  - a maximum weighted average of 0.25% lead content for pipe, pipe fittings, plumbing fittings or fixtures.
  - 0.2% solders and flux.
- Effective Date January 4, 2014.

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US Safe Drinking Water Act Revision

Redefine “lead free” in SDWA Section 1417(d) to :

- lower the maximum lead content of plumbing products such as pipes and fixtures from 8.0% to 0.25%;
- establish a statutory method for the calculation of lead content; and
- eliminate the requirement that products be in compliance with voluntary standards established in accordance with SDWA 1417(e) for leaching of lead from new plumbing fittings and fixtures.

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US Safe Drinking Water Act Revision

Create exemptions in SDWA Section 1417(a)(4) from the prohibitions on the use or introduction into commerce for:

- "pipes, pipe fittings, plumbing fittings or fixtures, including backflow preventers, that are used exclusively for non-potable services such as manufacturing, industrial processing, irrigation, outdoor watering, or any other uses where the water is not anticipated to be used for human consumption;" (SDWA 1417(a)(4)(A)) or
- Toilets, bidets, urinals, fill valves, flushometer valves, tub fillers, shower valves, service saddles or water distribution main gate valves that are 2 inches in diameter or larger (SDWA 1417(a)(4)(B))

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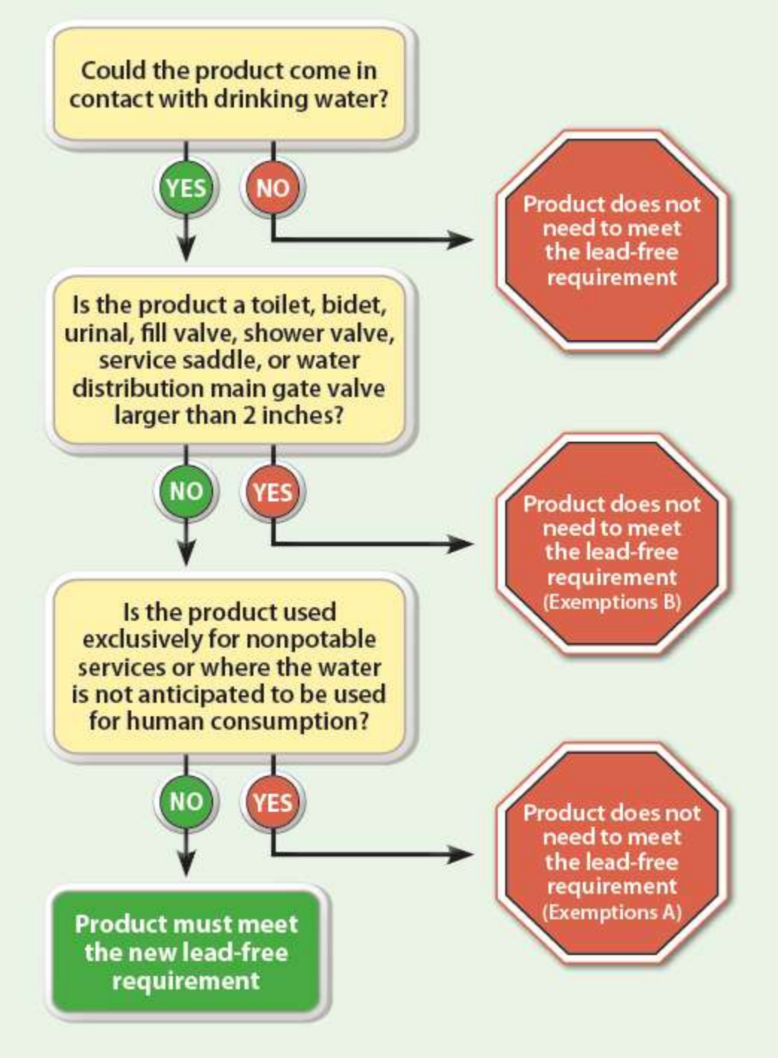
How do I know which products must meet the new lead-free requirement?



US Safe Drinking Water Act Revision

June 2013 the EPA issued a draft FAQ on this website and solicited comments:
http://water.epa.gov/drink/info/lead/upload/epa815p13xxx.pdf

September 2013 EPA created this website:

http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100GRDZ.txt

October 2013 the EPA issued updated FAQs here:

http://water.epa.gov/drink/info/lead/upload/epa815s13001.pdf

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Questions on SDWA

1) Can products purchased before Jan 4, 2014 be installed after that date?

No. Products could be purchased on January 3 2014, but could not be legally installed after January 4.

2) Can coatings be used to meet the lead content requirement?

No. Coatings can be used over metal surfaces, however both the coating and the substrate material should be evaluated for lead content.

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Questions on SDWA

3) Do products temporarily removed for cleaning/calibration like water meters need to be replaced with lead free products?

No. Returning a product into service does not constitute installation or repair so it would not need to be replaced with compliant product.

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Questions on SDWA

4) What if a component is replaced in a water meter, does that component need to meet the lead free requirement?

EPA's October updated FAQs indicate that replacement components must meet the lead free requirement.

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Questions on SDWA

5) Do products designed exclusively for hot water need to comply with the requirement?

EPA's updated October FAQs make it clear that products designed for hot water must comply with the requirements, along with dishwashers and fire hydrants.

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Questions on SDWA

6) Do products need to be third party certified?

The US SDWA does not require third party certification. The US EPA encourages the use of third party certification to standards such as NSF 372.

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Questions on SDWA

7) The US SDWA through 1417 (d) (3) used to require products that dispense drinking water to be in compliance with the lead leaching requirements of the voluntary national standard (meaning NSF 61), but this has been removed, so is this no longer a requirement?

As of January 4, 2014, plumbing fittings and fixtures are no longer required by the SDWA to be in compliance with voluntary standards. However the vast majority of US State or local laws and regulations (e.g., plumbing codes) require certification to NSF 61.

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Rumor

1) After January 4, 2014 water meters will no longer have to comply with NSF 61. They just need to comply with NSF 372.

False.

Water meters were never required by the US SDWA to meet NSF 61. Currently 48 states require (through regulations or policy) that products used in public water supplies comply with NSF 61.

Compliance with NSF 372 is one way to easily demonstrate conformance with the Federal Reduction of Lead in Drinking Water Act – both Federal and State Laws such as California.

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Product Compliance

- NSF published NSF Standard 372 to address the evaluation of weighted average lead content.

- California was first US State to require <u><</u>0.25% weighted average lead content in 2010 via bill AB 1953 → H & S Code 116875

- NSF 61 Standards committee worked to develop NSF 372.

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Product Compliance

- NSF first published the weighted average lead content calculation in Annex G of NSF 61.
- Subsequently the calculation and testing method references were established in a separate Standard NSF 372.
- NSF 61 Annex G now references NSF 372.

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NSF/ANSI 372 Drinking Water System Components- Lead Content

- Scope: Any drinking water system component that conveys or dispenses water for human consumption through drinking or cooking.
- Basic requirements originated from California Health and Safety Code.

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Lead Content Calculation

Core requirement:

Weighted average lead content ≤ 0.25%

Formula:

$$WLC = \sum_{c=1}^{n} \left(LC_c \times \left[\frac{WSA_c}{\sum_{t=1}^{n} WSA_t} \right] \right)$$

where;

WLC	=	weighted average lead content of product
LC	=	percentage lead content of component
WSA	=	wetted surface area of component
n	=	number of wetted components in product

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NSF 372

- NSF 372 provides assurance of compliance with weighted average lead limit of 0.25%.
- However products meeting 0.25% lead content limit can still have small components with high amounts of lead that could leach significant levels of lead.

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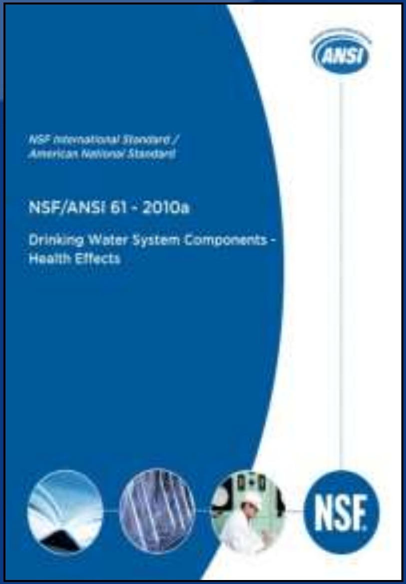
NSF/ANSI Standard 61

Drinking Water System Components – Health Effects



- Covers all products with drinking water contact from source to tap.
- Exposure tests with formulated waters to measure the amount of lead and any other contaminants that can leach from a product.
- Establishes total allowable concentrations of contaminants.

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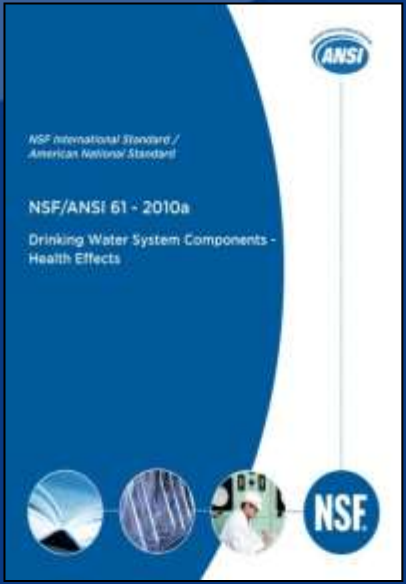
NSF/ANSI Standard 61

Drinking Water System Components – Health Effects



- NSF 61 tests for any contaminant that may migrate from a material into drinking water.
  - Metals
  - Non-metals

NSF/ANSI Standard 61

Drinking Water System Components – Health Effects

- For lead NSF 61 limits the maximum amount of lead that can be contributed to water to 5.0 ppb.

Can products pass NSF 372 and fail NSF 61?

- Yes
  - Products could pass NSF 372 (lead content)
  - but fail NSF 61 (lead leaching test)

Lead Leaching versus Lead Content

- In a study NSF tested products meeting $\leq$0.25% weighted average of lead to NSF 61:
  - 25 solid brass fittings,
  - 65 valves and water meters.

- Nine (9) products (10%) did not meet the NSF 61 lead leaching limit of 5 ppb.

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Lead Content versus Lead Leaching

- 100% of the low lead brass fittings passed the 5 ppb NSF 61 leach test.

- However 9 of 65 low lead brass valves and meters failed to meet the 5 ppb requirement .

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Lead Content versus Lead Leaching

- Valves and meters may have small components with higher leaded materials that cause lead leaching failures but still meet the weighted average lead content.
- Contamination of parts is another possibility.
- So products could met 0.25% weighted average lead requirement but fail lead leaching test.
- Important that products meet both requirements.

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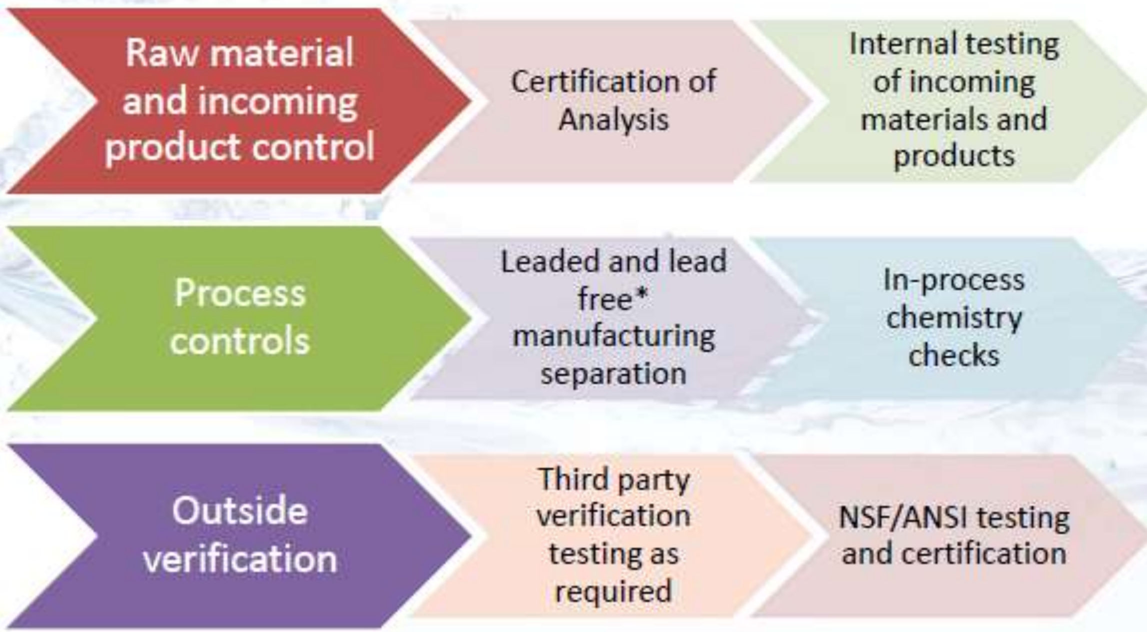
Lead-Free* Product Compliance



* Lead free refers to <0.25% weighted average lead content in relation to wetted surface of pipe, fittings, and fixtures in systems delivering water for human consumption.

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Who are the ANSI Accredited Third-Party Certification Bodies?

- CSA Group
- ICC Evaluation Service (ICC-ES), LLC
- International Association of Plumbing and Mechanical Officials Research & Testing (IAPMO R&T)
- Intertek Testing Services NA, Inc.
- NSF International (NSF)
- Truesdail Laboratories, Inc.
- Underwriters Laboratories (UL), LLC
- Water Quality Association (WQA)

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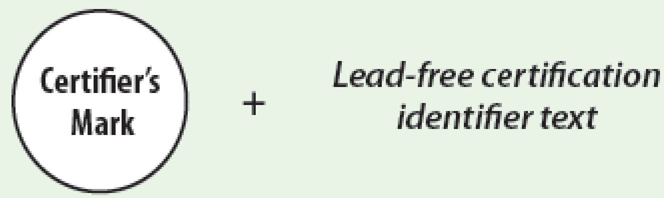
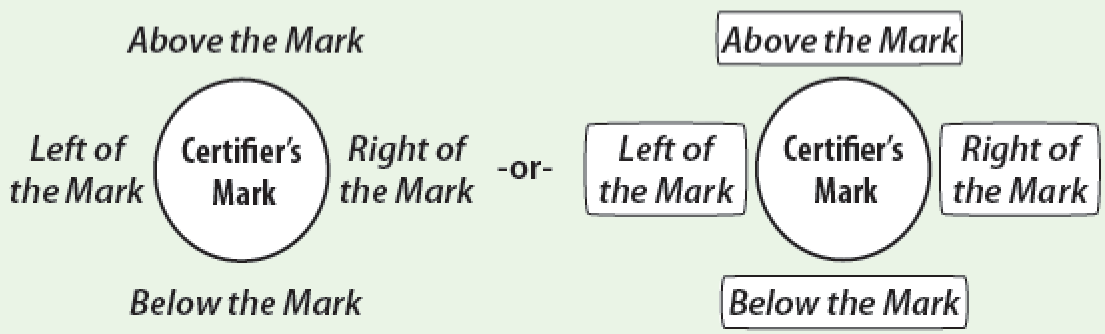
Where are the Lead-Free Certification Marks Located?

1. The certifier's marks will typically be located on the front or back of the packaging or engraved on the product itself. If required, text for the lead-free certification identifier will also be included:



2. Next to the certifier's mark, the lead-free certification identifier text can stand alone or can be enclosed in a box:



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Certification Marks for:

CSA Group	LLC; Low Lead Content; NSF/ANSI 372; Drinking Water NSF/ANSI 61-G
ICC Evaluation Services (ICC-ES), LLC	ICC ES PMG LOW LEAD
International Association of Plumbing and Mechanical Officials Research & Testing (IAPMO R&T)	UPC®; IAPMO R&T™; UPC®

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Certification Marks for:

Intertek Testing Services NA, Inc.	Intertek Intertek
NSF International (NSF)	NSF® NSF®-61-G NSF®-372 NSF® pw-G
Truesdail Laboratories, LLC	

Certification Marks for:

Underwriters Laboratories (UL), LLC	UL CERTIFIED HEALTH EFFECTS US-CA File No.	UL	UND. LAB. CLASSIFIED UND. LAB. CLFD
Water Quality Association (WQA)	TESTED AND CERTIFIED Water Quality UNDER INDUSTRY STANDARDS	TESTED & CERTIFIED WQA INDEPENDENTLY	NSF/ANSI 372 by WQA

Summary

To ensure that products will not contribute lead as well as other contaminants to drinking water, they should comply with both:

- **NSF/ANSI Standard 372 -** verifies compliance with lead content but not lead and other contaminant leaching.
- **NSF /ANSI Standard 61 -** verifies compliance for leaching of lead and other metallic and non-metallic contaminants.

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Audience Poll

Please use your mouse to answer the question in the poll window on your screen.

On a scale of 1 to 10, what is your readiness for the new US Safe Drinking Water Act Revision?

1 = totally unprepared, 10 = completely ready

a. 1
b. 2
c. 3
d. 4
e. 5
f. 6
g. 7
h. 8
i. 9
j. 10

Stay tuned - we'll share the poll results at the end of the presentation.

Ensuring Compliance to the Safe Drinking Water Act

El	PASS	%	FAIL	+/- [*3]
Pb	0.230	2.142	0.270	0.108
Fe	0.000	0.263	0.000	0.031
Cu	0.000	64.136	0.000	0.754
Zn	0.000	33.280	0.000	0.181
As	0.000	0.050	0.000	0.034
Sn	0.000	0.115	0.000	0.057
Cr	0.000	< LOD	0.000	0.024
Mn	0.000	< LOD	0.000	0.024
Co	0.000	< LOD	0.000	0.013

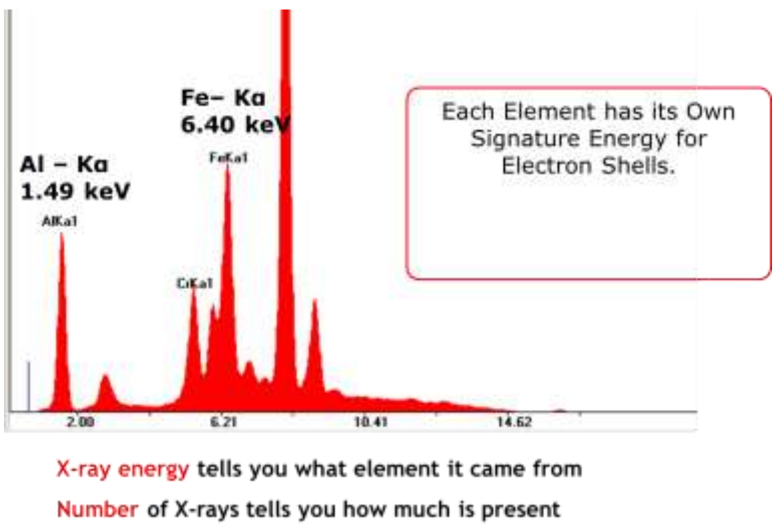
Finding Lead!
Instrumentation for Pb detection

- Bruker Corporation (Nasdaq: BRKR), Billerica ,MA produces and services scientific equipment with production sites in the US, Germany, France, Switzerland, Japan and Australia.
- For low lead detection Bruker offers all the tools from the service lab to the regulatory compliance screening:
  - ICP-MS (AURORA) from ppt to ppm (liquid or digested sample) (e.g. for leached solutions)
  - S-OES (Q-Series) ppm to weight % in metals only with remaining arc spot on sample in the lab or shop floor
  - XRF (S8 Series) nondestructive sub ppm to weight % in the lab
  - HH XRF (TITAN) Hand held non destructive screening tool from ppm to weight % with factory Low Pb in Cu and Restricted Materials app. Made in Kennewick, WA.




HH XRF… the easy way to screen for Pb!

- XRF as an analytical technology has been around since the 1960's but only in the last 10 years been available in a Handheld package
- The light weight (< 1.4 kg, 3 pounds) instruments of today have performance previously known only to "big" units
- Like all XRF the X-ray gun shoots X-rays to the sample, which excite X-rays from the sample and detects them and quantifies the signal

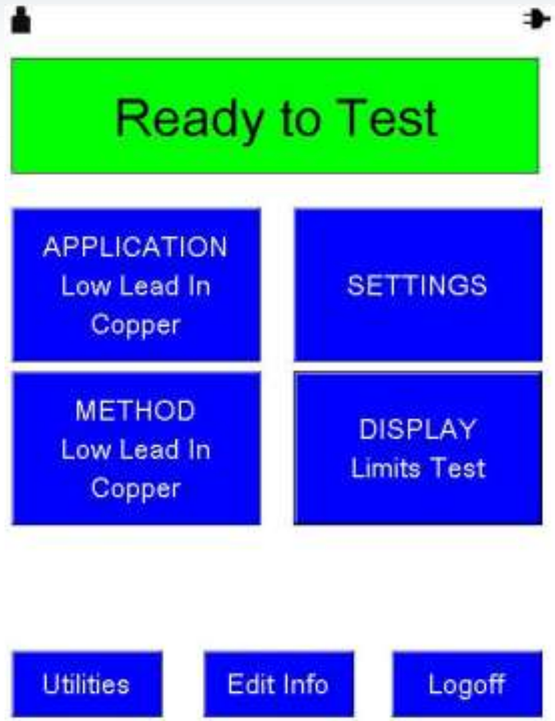


XRF Benefits

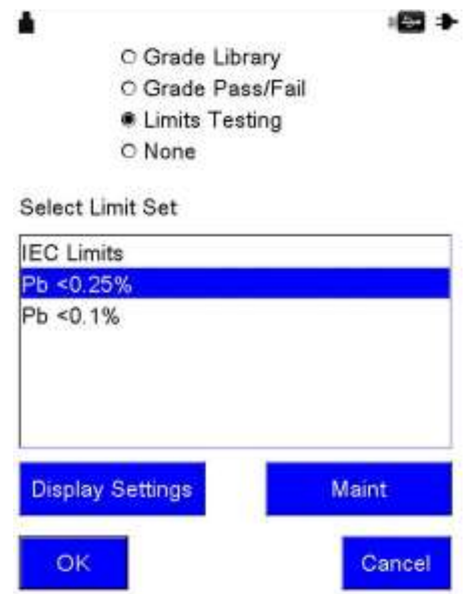
- Non destructive for the sample
- Not just alloy but ALL wetted surfaces
- Nearly no sample preparation needed*
- 15 sec for decision! Point, shoot, know!
- Light weight! 8h battery!
- Easy to use, rugged housing
- Cost efficient: No calibration maintenance
- Full Alloy id and restricted materials analysis (plastics, etc.) applications available
- Camera option for aiming and documentation

* Surface needs to be clean and suitable to make a measurement

How to start

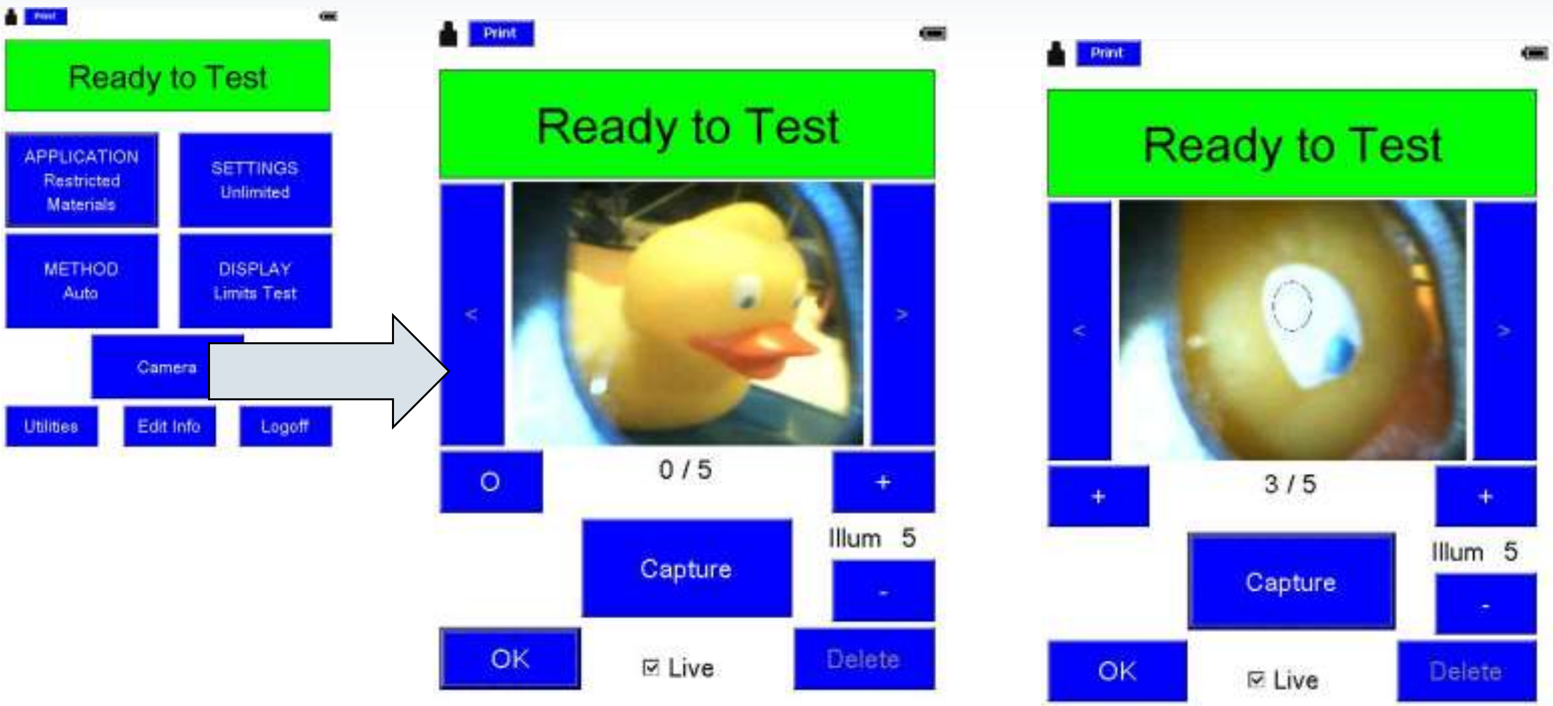


Ready to Test
APPLICATION
Low Lead In
Copper
SETTINGS
METHOD
Low Lead In
Copper
DISPLAY
Limits Test
Utilities
Edit Info
Logoff

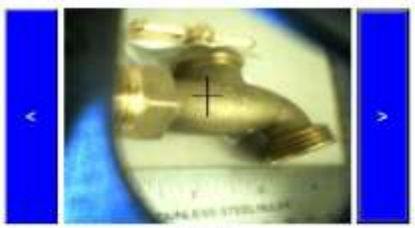


Grade Library
Grade Pass/Fail
Limits Testing
None
Select Limit Set
IEC Limits
Pb <0.25%
Pb <0.1%
Display Settings
Maint
OK
Cancel

Documentation of measurements
Point and "picture"



Measuring samples



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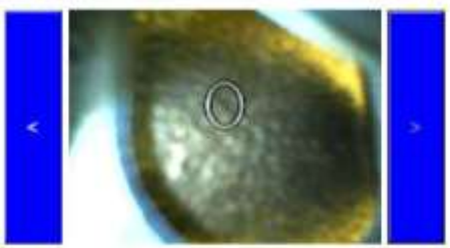

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El	Min	%	Max	+/- [*2]
Cu	58.000	57.956	64.000	0.474
Zn	32.000	37.788	40.000	0.127
Pb	0.800	2.573	1.500	0.076
Sn	0.500	0.714	1.500	0.060
Fe	0.000	0.704	0.700	0.027
Ni	0.000	0.256	1.000	0.018
Cr		< LOD		0.018
Mn		< LOD		0.019
Co		< LOD		0.010

- Most sample sizes and shapes can be analyzed.
- Think of the measurement window as the "eye" of the analyzer. Whatever you put in front of it, that is what it will see.
- Because lead in the body of an alloy can become smeared on the face of a copper part, inconsistent readings can occur when measuring the same part in multiple places.
- Careful cleaning of the part with a clean rag and alcohol will minimize this problem and is recommended whenever measuring metallic parts for lead.
- Apply the nose of the analyzer to the sample, ensuring that the proximity sensor is covered.
- Pull the trigger to begin the analysis. Results will begin to display in less than two seconds.

Interpreting the results

302 Pb025 PASS
Time 15.0

El	PASS	%	FAIL	+/- [*3]
Pb	0.230	0.111	0.270	0.029
Fe	0.000	0.022	0.000	0.016
Ni	0.000	0.336	0.000	0.028
Cu	0.000	86.956	0.000	0.813
Zn	0.000	4.590	0.000	0.069
Zr	0.000	0.007	0.000	0.006
Sn	0.000	7.975	0.000	0.232
Cr	0.000	< LOD	0.000	0.016
Mn	0.000	< LOD	0.000	0.026

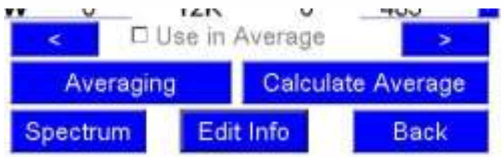
310 Pb025 PASS
Time 15.0

El	PASS	%	FAIL	+/- [*3]
Pb	0.230	< LOD	0.270	0.029
Fe	0.000	0.057	0.000	0.019
Cu	0.000	99.926	0.000	0.973
As	0.000	0.008	0.000	0.007
Cr	0.000	< LOD	0.000	0.018
Mn	0.000	< LOD	0.000	0.020
Co	0.000	< LOD	0.000	0.006
Ni	0.000	< LOD	0.000	0.031
Zn	0.000	< LOD	0.000	0.032

- The Low Pb in Cu method is optimized for measuring less than 1% lead in copper based alloys.
- Good results may be characterized by those that are within +/- 0.02% of the actual value when at the cutoff of 0.25%.
- Those results plus the +/- value that are less than 0.23% are considered acceptable and will PASS inspection.
- Those results minus the +/- value that are greater than 0.27% will FAIL inspection.
- Those results between the thresholds are borderlined. The inspection is inconclusive; additional testing will be required.

Averaging readings from the same sample

last (n) will be averaged when you press Calculate Average



Examples of Pass, Inconclusive, and Fail

34 Pb <0.25% PASS
Time 15.0

El	PASS	%	FAIL	+/- [*3]
Pb	0.230	0.111	0.270	0.037
Cr	0.000	0.010	0.000	0.010
Fe	0.000	0.032	0.000	0.014
Ni	0.000	0.420	0.000	0.030
Cu	0.000	86.902	0.000	0.927
Zn	0.000	4.613	0.000	0.078
As	0.000	0.011	0.000	0.010
Sn	0.000	7.901	0.000	0.251

< ☐ Use in Average >
Averaging Calculate Average
Spectrum Edit Info Back

33 Pb <0.25% INCONCLUSIVE
Time 8.0

El	PASS	%	FAIL	+/- [*3]
Pb	0.230	0.167	0.270	0.063
Fe	0.000	0.040	0.000	0.022
Ni	0.000	0.437	0.000	0.046
Cu	0.000	86.808	0.000	1.443
Zn	0.000	4.440	0.000	0.122
Sn	0.000	8.095	0.000	0.400

< ☐ Use in Average >
Averaging Calculate Average
Spectrum Edit Info Back

35 Pb <0.25% FAIL
Time 15.0

El	PASS	%	FAIL	+/- [*3]
Pb	0.230	0.665	0.270	0.071
Cr	0.000	0.025	0.000	0.015
Fe	0.000	0.336	0.000	0.028
Ni	0.000	0.104	0.000	0.019
Cu	0.000	60.329	0.000	0.798
Zn	0.000	38.092	0.000	0.204
Sn	0.000	0.439	0.000	0.086

< ☐ Use in Average >
Averaging Calculate Average
Spectrum Edit Info Back

Interpreting measurement uncertainty

24 Pb <0.25% PASS
Time 15.0

El	PASS	%	FAIL	+/- [*3]
Pb	0.230	0.110	0.270	0.037
Cu	0.000	86.838	0.000	0.925
Sn	0.000	8.000	0.000	0.252
Zn	0.000	4.593	0.000	0.078
Ni	0.000	0.406	0.000	0.030
Fe	0.000	0.036	0.000	0.014
Cr	0.000	0.011	0.000	0.010

25 Pb <0.25% PASS
Time 30.0

El	PASS	%	FAIL	+/- [*3]
Pb	0.230	0.105	0.270	0.026
Cr	0.000	0.011	0.000	0.007
Fe	0.000	0.034	0.000	0.010
Ni	0.000	0.416	0.000	0.021
Cu	0.000	86.899	0.000	0.655
Zn	0.000	4.570	0.000	0.055
Sn	0.000	7.961	0.000	0.178

- The +/- value in the right-most column of the results is a good approximation of confidence in the measured amount.
- A 15-second reading yields an approximate 0.025% uncertainty in the Pb result near the cutoff.*
- A 30-second reading yields an approximate 0.020% uncertainty in the Pb result near the cutoff.*
- Confidence can be improved by increasing the measurement time (up to 60 seconds) or by taking multiple readings.
- This +/- value becomes important whenever the result is close to the 0.25% cutoff.

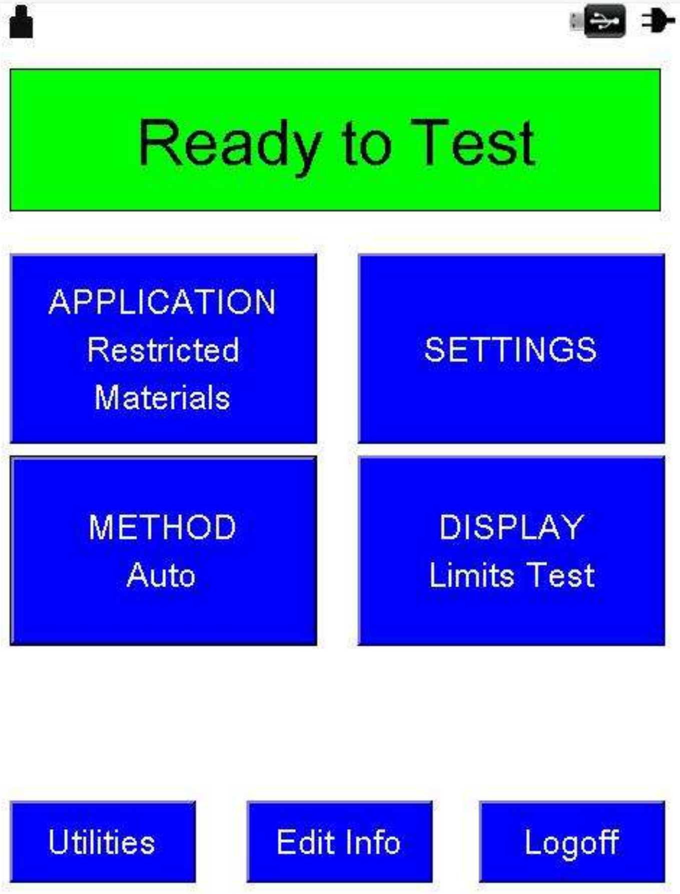
* The actual +/- value depends upon other factors besides measurement time, such as: sample matrix (other elements in the sample besides Pb), surface condition, etc., but it is a useful estimate.

Pitfalls in Screening for Pb
Surface Pb enrichment

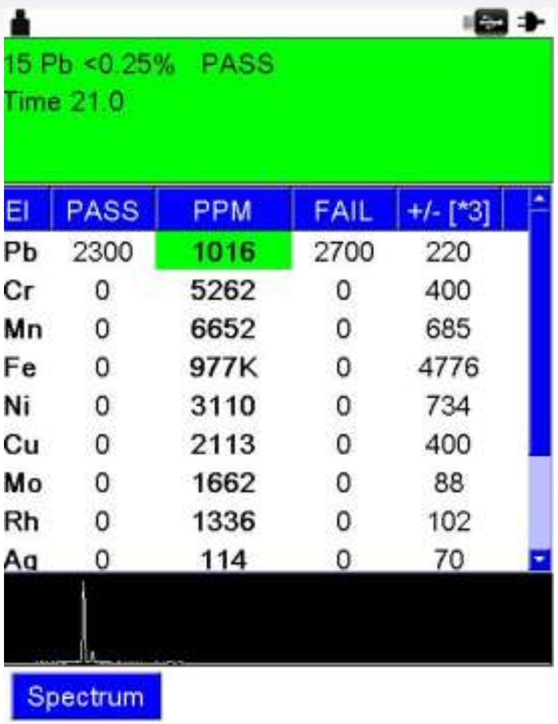
- Pb in the copper alloys can smear and create a layer of "high" Pb on the surface. This happens if the sample was ground and not lathed or cut.
- Pb can be enriched in the surface close to the cast form
- Always measure different spots of the sample
  - If you notice above limit high lead values on some areas but below limit on others, then IF it is the same material you have Pb smearing, otherwise there are 2 or more components from different material
  - Refer to NSF/ANSI 372 for compliance calculation
- In case of doubt, "cut" the sample with a fast and cooled cutting tool or lathe off the surface of an ingot

Other wetted surfaces

- How to test other alloys and plastics for compliance?
  - Restricted Materials application
  - Auto mode
- Any metal, any plastic or composite material



Regardless if steel, fittings, etc.

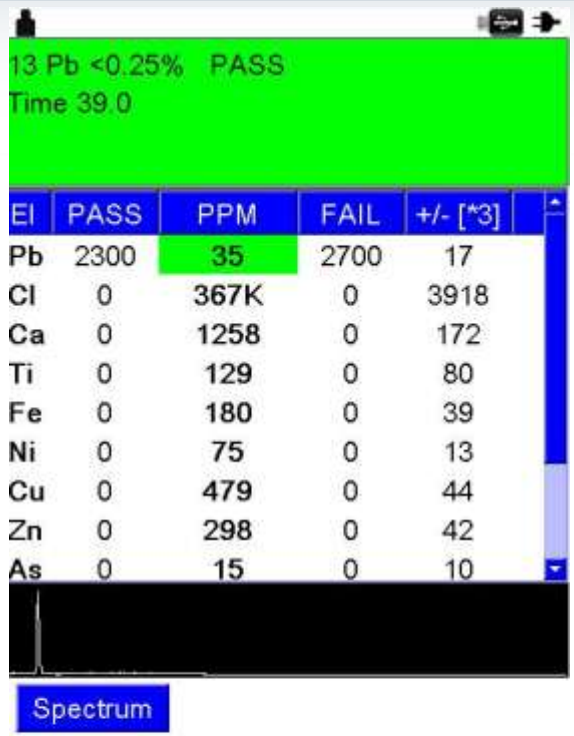


15 Pb <0.25% PASS
Time 21.0

El	PASS	PPM	FAIL	+/- [*3]
Pb	2300	1016	2700	220
Cr	0	5262	0	400
Mn	0	6652	0	685
Fe	0	977K	0	4776
Ni	0	3110	0	734
Cu	0	2113	0	400
Mo	0	1662	0	88
Rh	0	1336	0	102
Ag	0	114	0	70

Spectrum

Steel/Metal

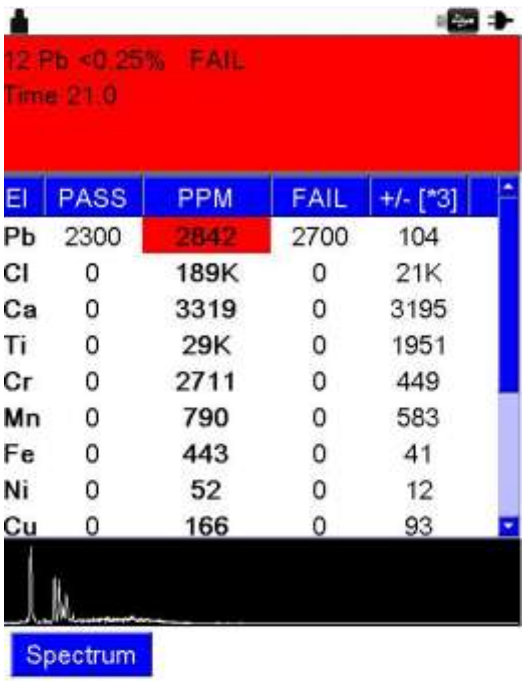


13 Pb <0.25% PASS
Time 39.0

El	PASS	PPM	FAIL	+/- [*3]
Pb	2300	35	2700	17
Cl	0	367K	0	3918
Ca	0	1258	0	172
Ti	0	129	0	80
Fe	0	180	0	39
Ni	0	75	0	13
Cu	0	479	0	44
Zn	0	298	0	42
As	0	15	0	10

Spectrum

PVC



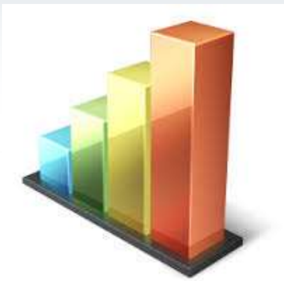
12 Pb <0.25% FAIL
Time 21.0

El	PASS	PPM	FAIL	+/- [*3]
Pb	2300	2842	2700	104
Cl	0	189K	0	21K
Ca	0	3319	0	3195
Ti	0	29K	0	1951
Cr	0	2711	0	449
Mn	0	790	0	583
Fe	0	443	0	41
Ni	0	52	0	12
Cu	0	166	0	93

Spectrum

PVC

Conclusion: How to master SDWA 2014



Poll results – How ready are you for SDWA 2014?

A three-pronged strategy is recommended for compliance with the new US Safe Drinking Water Act Revision

1) Assure that incoming materials comply with the law
   - Work with suppliers to assure they understand the law, and obtain certificates of conformance from them
   - Check incoming materials for compliance
     - XRF is a great tool for this! Instrumentation has become more capable, much LIGHTER and easier to use : screening according to NSF 372 can be done readily in the warehouse, store, and production location

2) Use careful process controls and separate leaded and lead free manufacturing

3) Obtain third party certification

Q & A

Any questions?

Please type any questions
you may have for our speakers
in the Q&A panel and
click Send.

How did we do?

When you exit the webinar, please fill
out our evaluation survey to let us
know. We appreciate your feedback.

Thank you!

Take the Next Step

Request a demo:

> https://www.bruker.com/products/x-ray-diffraction-and-elemental-analysis/handheld-xrf/forms/handheld-xrf-request-form.html

Learn more about Handheld XRF and screening techniques:

PITTCON 2014 SHORT COURSES

- 154 *Screening for Restricted Materials (ROHS II) Using HH XRF* – March 6, 2014 (Thursday), ½ day course
- 150 *Basic User and Safety Training for Hand Held XRF (PXRF) in the Workplace* – March 4, 2014 (Tuesday), ½ day course
- 153 *Practical Handheld (HH) XRF or Portable XRF in the Workplace – March 5, 2014* (Wednesday), ½ day course

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Show	Dates	Location
International Pool Spa Patio Expo	November 12 – 14, 2013	Las Vegas, NV, USA
World Plumbing Congress	November 14 – 15, 2013	Delhi, India
China International Kitchen and Bath Show	November 26 – 28, 2013	Shanghai, China
Kitchen and Decoration Taipei 2013	December 12 – 15, 2013	Taipei, Taiwan
Plastivision	December 12 – 16, 2013	Mumbai, India

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Webinar	Content	Webinar	Content
Nov 20, 2012 **TXRF for Trace Element Analysis of Air, Land and Water**	This one-hour live webinar demonstrates the capabilities of TXRF for trace element analysis of air (aerosol and filters), land (soils and sediments), and water (fresh and effluents). Learn about level of detection, ease-of-use, regulated analysis, and advantages of TXRF in various, everyday environmental applications. Register now	Dec 13, 2010 **Trace Element Analysis of Industrial Wastewater and Sewage with TXRF and ICP-MS**	Join Mike Beauchaine and Andrew Toms as they present the capabilities of TXRF and ICP-MS for trace element analysis of wastewater. Learn about the combined advantages of the two techniques for routine, industrial and mobile lab testing. View recording Download slides

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