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XRF Usage Protocol

PURE EARTH

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Disclaimer

This protocol is designed for use in specific projects and may not be universally applicable. It should be adapted or modified only with the guidance of relevant experts to ensure it meets the unique needs of each project. The creators of this protocol assume no responsibility for its misuse or for any outcomes resulting from its application beyond its intended scope.

Acronyms and Abbreviations

XRF	X-ray Fluorescence
LODs	Limits of Detection
TSIP	Toxic Site Identification Program
PPM	Parts Per Million
PE	Pure Earth
HQ	Headquarters

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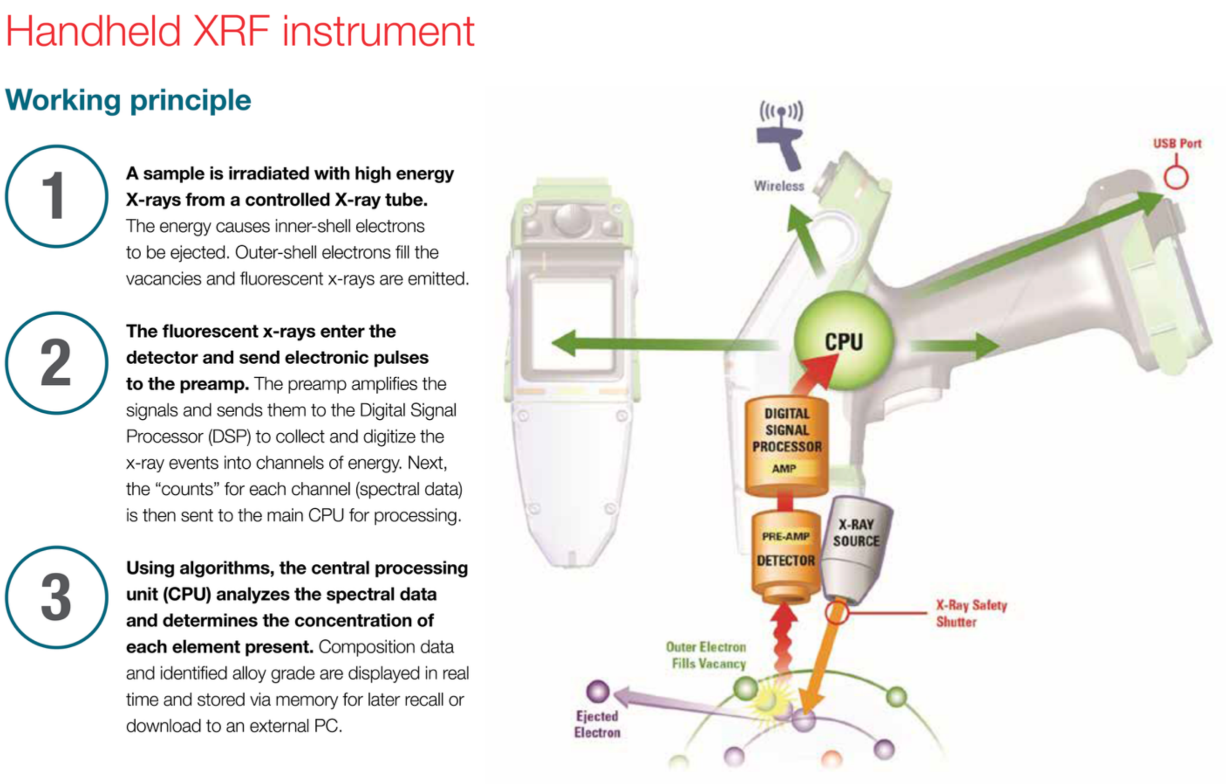
1. Introduction

XRF (X-ray fluorescence) is a non-destructive analytical technique used to determine the elemental composition of materials, including metals of interest like lead and mercury. XRF analyzers determine the chemistry of a sample by measuring the fluorescent (or secondary) X-ray emitted from a sample when it is excited by a primary X-ray source. Each element present in a sample, such as lead or mercury, produces a set of characteristic fluorescent X-rays ("a fingerprint") that is unique for that specific element. If you are interested in reading more about how the XRF works, read ThermoFisher's XRF Technology in the Field, with an excerpt included below, or Evident's XRF Analysis Learning Center.



Handheld XRF instrument

Working principle

1. **A sample is irradiated with high energy X-rays from a controlled X-ray tube.** The energy causes inner-shell electrons to be ejected. Outer-shell electrons fill the vacancies and fluorescent x-rays are emitted.

2. **The fluorescent x-rays enter the detector and send electronic pulses to the preamp.** The preamp amplifies the signals and sends them to the Digital Signal Processor (DSP) to collect and digitize the x-ray events into channels of energy. Next, the "counts" for each channel (spectral data) is then sent to the main CPU for processing.

3. **Using algorithms, the central processing unit (CPU) analyzes the spectral data and determines the concentration of each element present.** Composition data and identified alloy grade are displayed in real time and stored via memory for later recall or download to an external PC.

Pure Earth has used XRFs for many years in applications including the Toxic Site Investigation Program (TSIP), detailed site assessments and monitoring site cleanup activities, and more recently in consumer product testing for items ranging from spices to metallic and ceramic cookware to plastic toys. The portable XRF provides real-time concentration data for metals of interest, which is invaluable for completing site investigations or screening consumer products as contrasted with shipping samples to laboratories and waiting for weeks to get the results.

The operation of an XRF is a relatively straight-forward point-and-click technology. HOWEVER, correct operation of the XRF is critical for keeping investigators safe and for collecting accurate data. Although there are multiple XRF brands and models available, the following considerations are relevant to the use of all XRFs:

- Health and safety
- Checking system operation and calibration checks for various standards
- Sample type(s) and homogeneity
- Sample thickness
- Special considerations for paint
- Appropriate documentation and data downloads
- XRF detection limits versus reference standards
- Laboratory confirmation of subset of samples tested for each product category

Note that this protocol covers only the general usage of an XRF. Product specific protocols address further considerations for using the XRF on soil versus paint versus cosmetics.

International Travel with XRFs

Caution should be exercised when travelling internationally with an XRF. Appropriate documentation and a letter of introduction should be obtained from Pure Earth prior to international travel with an XRF. An example of such a letter is as follows:

> To Whom It May Concern:
> [NAME] is an employee of the U.S. not-for-profit organization Pure Earth, based in New York City. Pure Earth helps governments identify and reduce public health risks from toxic pollution in the environment and consumer products. [NAME] is carrying a common scientific instrument called an X-ray Fluorescence (XRF) Analyzer that is used for analyzing soil and other materials. The instrument is not dangerous, does not release projectiles or particles, and does not contain radioactive isotopes. The XRF produces and emits low level x-rays only when powered on and activated. The XRF does contain a lithium-ion battery and spare that will be hand carried. The product is the Niton XL3t 700S XRF Analyzer (Serial Number: [XXXX]). [NAME] will use this instrument in relation to a project to reduce public health risks from lead in [NAME OF COUNTRY]. Please allow [NAME] to proceed without delay.

One should carry the entire XRF as a carry-on for the safety and security of the instrument. The battery should be removed from the instrument and stored in the case with the spare. If you are required to check the XRF case, make sure that the case has your contact information on it and remove both the battery and the spare to carry on the plane with you.

Local regulations regarding such devices should also be considered before traveling.

Please be aware that often times this process goes smoothly, and other times not so much with customs agents confiscating XRFs for import taxes, consultation with the country's nuclear regulatory agency and the like.

One can also consider obtaining an ATA Carnet to avoid paying duties and taxes and speed up customs clearance procedures on the XRF (or any a product) that you are temporarily bringing to another country. Note that only certain countries accept the ATA Carnet, so please check first.

2. Health and Safety

All investigators operating the XRF should take an online “Radiation Safety” training before using the XRF. Courses offered by ThermoFisher (the manufacturer of the vast majority of Pure Earth’s Niton XL3s) are available here LINK, with the applicable course for Niton XL3s titled “Radiation Safety for Handheld XRFG – X-Ray Tube”. Similar courses may be available for other brands. This introductory course provides users with the necessary information to safely operate handheld XRF analyzers containing x-ray tubes. Users will learn basic principles of radiation, dose and dosimetry, hazards and relative risk, how to minimize radiation exposure, and safe use principles. Upon finishing the ThermoFisher course, a certificate of completion is available and should be sent to and maintained by Pure Earth’s country and HQ personnel files.

Additional resources can be found in *Chapter 2: Using your analyzer* of Niton XL3 Analyzer User’s Guide and Evident’s XRF Analysis Learning Center. Pure Earth practitioners should be sure to familiarize yourself with the XRF model that you are using.

Primary radiation is radiation that is produced by the analyzer and emitted out through the measurement window. To protect yourself and others:

- Always treat radiation with respect.
- Do not use the XRF if you are or might be pregnant.
- Hold the XRF by the handle during active XRF measurement - there is potential radiation leakage from the area of XRF near the measurement window.
- Never point your analyzer at yourself or anyone else during active XRF measurement.
- Ensure the sample is always in good contact with the measurement window during active XRF measurement when the x-ray tube is on to minimize radiation leakage.
- The sample will absorb most of the primary-beam radiation unless it is smaller than the instrument's measurement window (e.g., like a ring) or of low density and/or thickness (e.g., a thin paint coating). Take caution when analyzing samples that are small, thin, and/or low in density as they may allow much more of the primary beam to escape.

The primary beam (Figure 1) is a directed beam out of the front of the analyzer that can have high dose rates. The secondary beam (Figure 2), or scattered beam, has much lower dose rates. The XRF does not emit radiation unless the instrument is on and the trigger is depressed, with illuminated lights as shown in Figure 3.

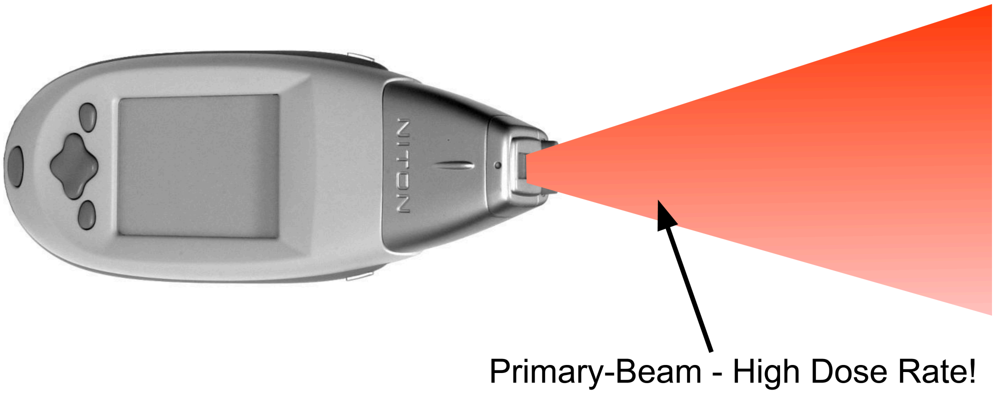


Figure 1. Primary beam

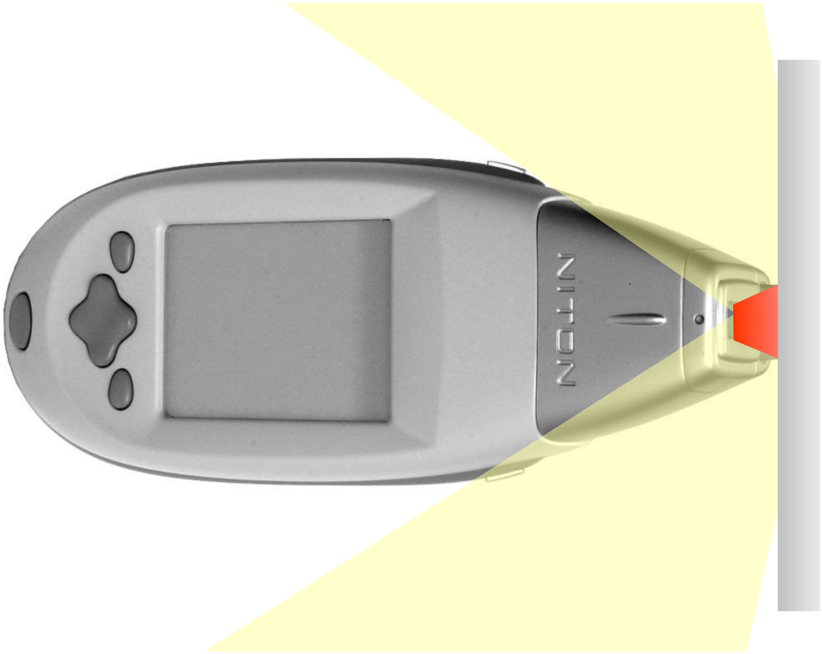


Figure 2. Secondary (scattered) beam

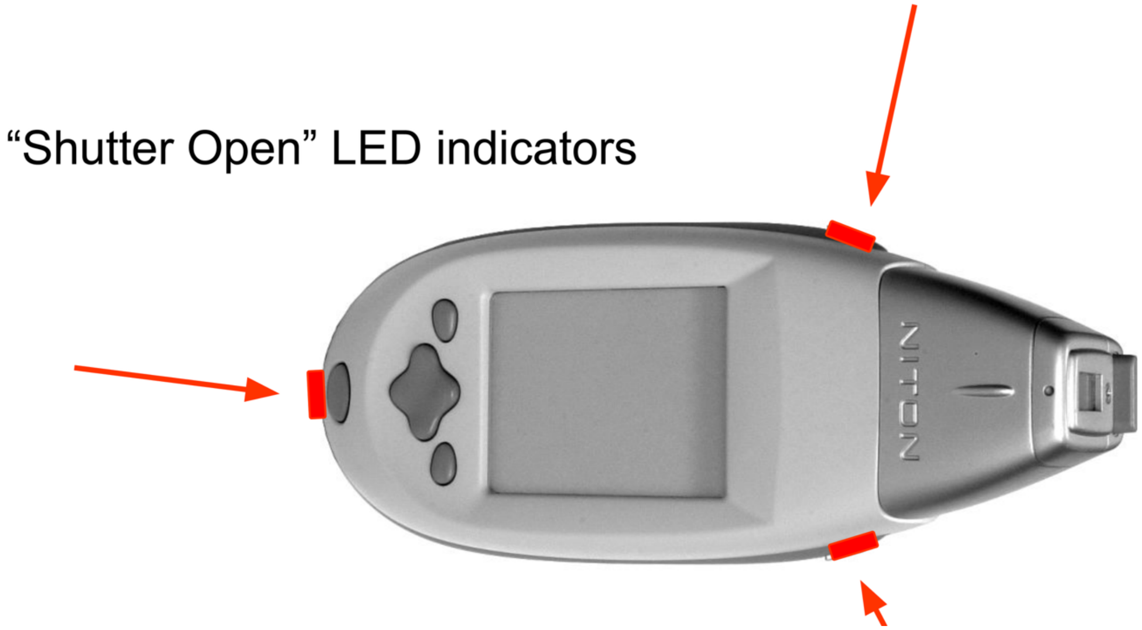


Figure 3. X-ray beam indicator lights indicate that the XRF is emitting radiation.

3. XRF Instrument Preparation

As an example, the key parts of a ThermoFisher Niton XRF are shown in Figures 4 and 5, with more detailed information available in instrument-specific user manuals with which operators should familiarize themselves.

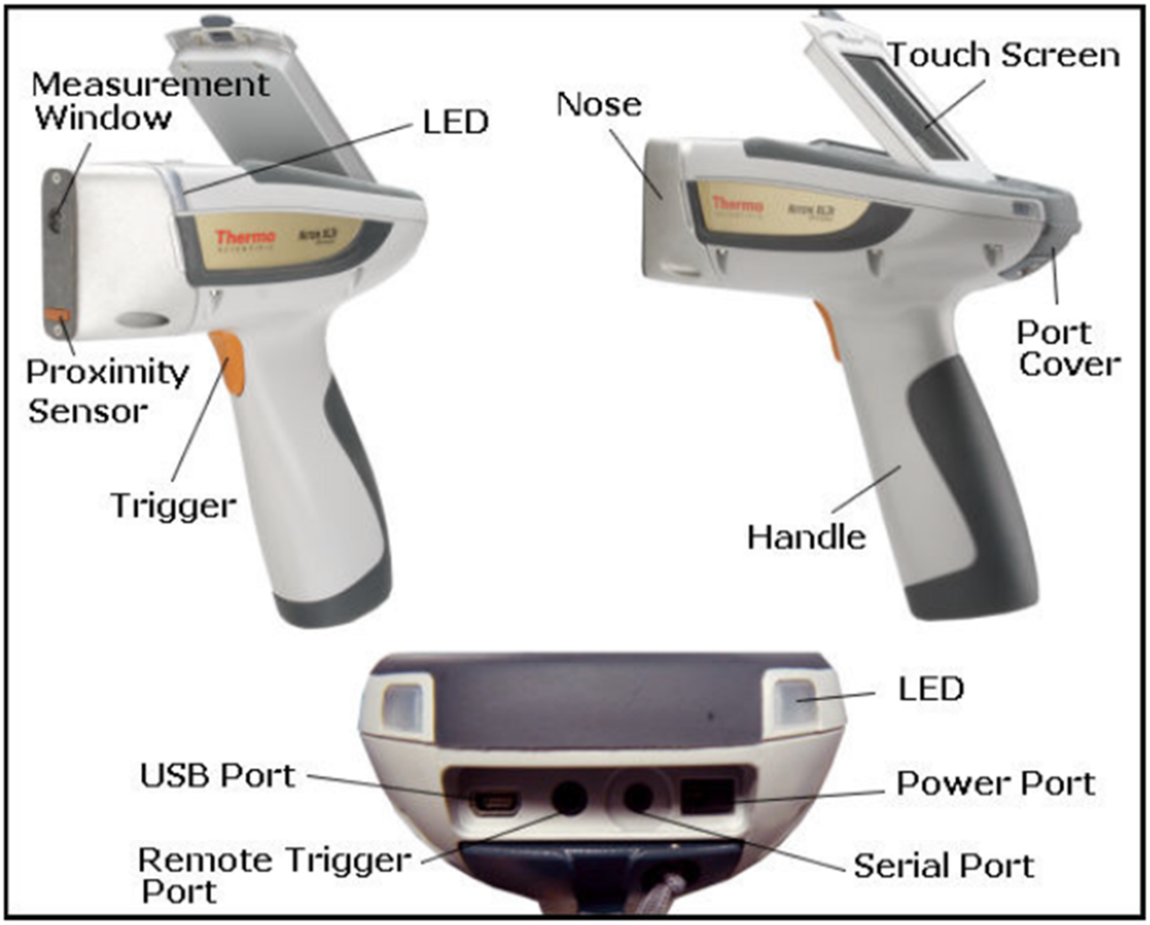


Figure 4. Niton XRF pieces and parts.

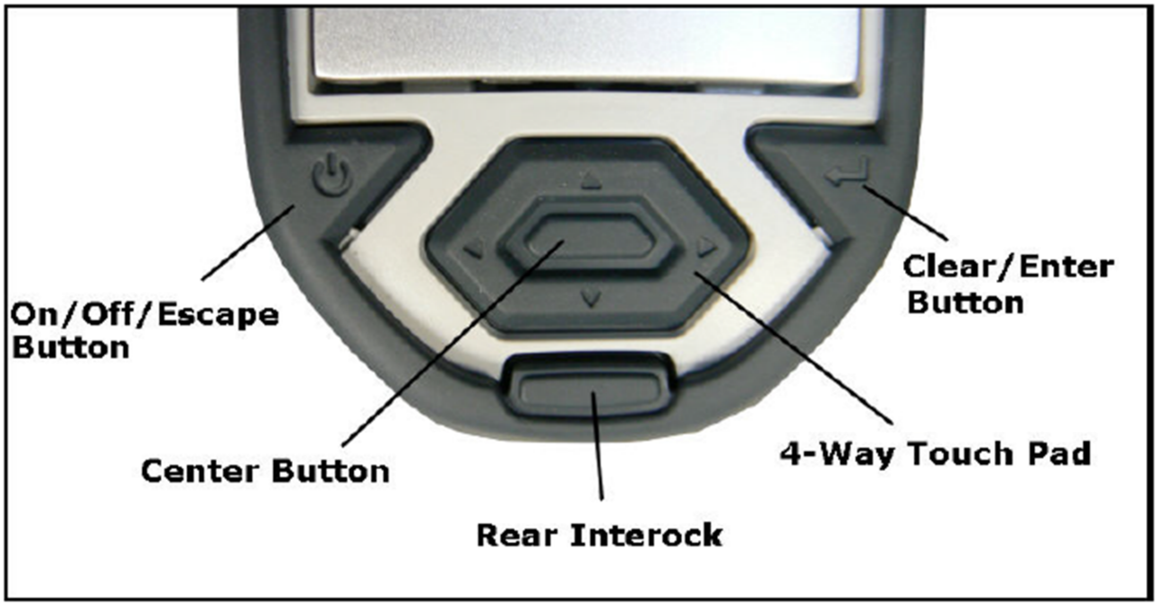


Figure 5. Niton XRF user interface.

- Make sure that the battery and spare are fully charged before beginning measurements. (Note that the XRF can be used while connected to an appropriate power source, which is not likely pertinent to field settings.) Do NOT leave batteries on charge for extended periods of time.
- Avoid usage in extreme conditions, including heat, cold and wet environments. Care should be taken particularly in hot conditions to operate in the shade so the XRF does not overheat – it will take significant time to return to operating conditions.
- Prior to each use, inspect the measurement window circled in red in Figure 6 for damage (rips) or dirt/debris. The window should be replaced when damaged, at the start of a new project, or after every 2 months of regular use. Several replacement windows are provided with the instrument, and window replacement is relatively straight-forward (Figure 7). An instructive video of this process is in this LINK. Consult the user manual for window replacement instructions and contact PE HQ as necessary.

Alternatively, clear tape can be used in the place of the provided replacement windows according to representatives at ThermoFisher. The adhesive tape can be applied directly to the area over the measurement window after removing the provided window and replacing the metal cover on the nose. The tape can be easily replaced subsequent by removing and affixing a new piece. Note that the user should ensure that the tape is not adversely influencing measurement by checking the verification standards. An example tape source is provided here: LINK

Figure 6. XRF window for inspection. This window is also the source of primary radiation when XRF is activated.

Figure 7. XRF window replacement.

Note: always place a thin plastic bag between the XRF window and your sample to protect the window from mechanical damage and contamination like dust or sampled materials – both will impact all future measurements without the knowledge of the user until the next calibration check! Different portions of the thin plastic bag can be used, but avoid using dirty, dusty, and/or contaminated bags by replacing several times over the course of a day (Figure 8).

Figure 8. Use of the plastic bag in measurement with XRF.

- A system check should be performed daily. This allows the instrument to run an internal check – no further interaction is required by the operator. No radiation is emitted by the instrument during a system check.

Perform the XRF system check by navigating through the main menu. Select SYSTEM CHECK, then select YES. If the system check is performed adequately, the message “System Ok” will be displayed. Select CLOSE to exit. If you receive a failure error, perform a second “SYSTEM CHECK”. If you still receive an error, contact PE HQ.

- At the beginning of the day or anytime the instrument has been off for 30 minutes, conduct a calibration verification. This is not an actual calibration – it is checking XRF readings versus known standards to verify the degree of accuracy of the instrument for each type of material (e.g., plastic, metal, soil).

Select the appropriate standard for the sample type(s) or matrix you will be analyzing. Always include the calibration "Blank" to make sure the XRF is not yielding false positive results.

Note that this is a very important step in being able to qualify the data from the XRF. If significant errors are occurring with known standards, then the data that you will be collecting will not be accurate! XRF reading of known standards also allows for potential adjustment of XRF readings for uniformity compared to XRF readings made on different days and/or with other instruments. See Calibration Verification Standards section below.

The table below lists appropriate standards for each sample type (or matrix). Please note that this list provides examples of commonly provided reference standards, although many more exist for various purposes.

Matrix	Expected Pb conc (ppm)	Lower acceptable range (-25%)	Upper acceptable range (+25%)
Blank			
SiO2 180-647 (BLANK)	0	ND	10
SiO2 180-428 (BLANK)	0	ND	10
Soil			
SdAR-L2 Soil 180-649A	183	137	229
CRM - 180-649 - NIST 2709a	17.3	13	21.6
RCRA 180-661	500	375	625
SdAR-M2 180-706	808	606	1010
NIST 2711a	1400	1050	1750
NIST 2702	133	100	166
Plastic			
PLPE-8ED-31	152	114	190
PN 180-619 Multi-element Reference Sample	150	113	188
Paint			
AIS Standards pbBlock-1	1 mg/cm2	0.75 mg/cm2	1.25 mg/cm2
PbPEFIC	2.31 ug/cm2	1.73 ug/cm2	2.89 ug/cm2
Metal			
MBH-16611X SAC305R “Tin Check”	1000	750	1250
MBH Check Sample R 180-696	1200	900	1500

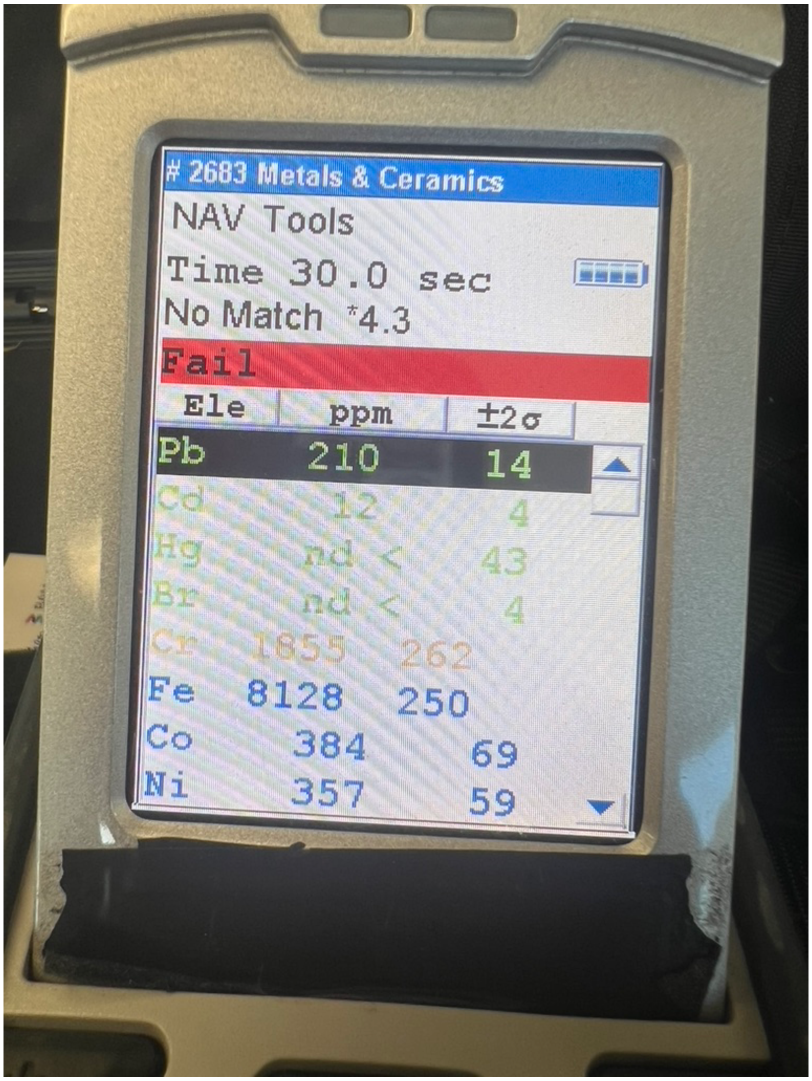
- Record the Pb concentration reading for each calibration verification standard used in the format included in the XRF Field Datasheet (LINK) or the XRF General Datasheet (LINK). Note that both datasheets provides several of the above commonly provided reference materials, but others should be added to the datasheet as appropriate.
    - If readings are outside of acceptable range, restart XRF and try again. If still outside range for one or more sample types, contact HQ prior to collecting additional measurements for that mode. Additionally, replacing the XRF window may help.
- The calibration verification should also be repeated and recorded at the end of the session.

4. Sample Preparation and Measurement Considerations

XRFs can be used to determine metals concentrations in a wide variety of materials, including metals, soil, cosmetics, plastics, paints. There are many considerations when using an XRF for different purposes and for different product categories. General considerations are included below. Pure Earth is in the process of developing product-specific protocols for items such as paint, plastics, spices etc. that will provide additional information for sampling, testing and XRF screening. This document will be updated as those product-specific protocols are completed.

Detection Limits

XRFs have Limits of Detection (LODs) for each element. These LODs are variable and depend on the substrate being tested, concentrations of other elements in the sample, the length of time of the measurement, and change with every sample measurement. These are often reported as an LOD or "ND" for Not Detected. It is important to record the corresponding 2σ or 3σ adjacent to the LOD or ND, as shown in Figure 9. This reflects the level of the LOD or ND for that reading, i.e., ND<# which becomes important with respect to comparing to various reference standards and whether or not the XRF is able to measure a concentration below a given standard. Notably, typical non detects for lead can be on the order of ND<3 to 5 ppm, although it can certainly be higher in given circumstances, e.g., ND<10 or 20 ppm. The importance of this is highlighted below in Reference Standards.



```
# 2683 Metals & Ceramics
NAV Tools
Time 30.0 sec
No Match *4.3
Fail
Ele    ppm    ±2σ
Pb     210     14
Cd      12      4
Hg    nd <     43
Br    nd <      4
Cr    1855    262
Fe    8128    250
Co     384     69
Ni     357     59
```

Figure 9. XRF results for XRF Reading No. 2863 indicating lead (Pb) at 210 ppm (+/- 14 ppm) and mercury (Hg) not detected above 43 ppm. Note that the Fail indication in red indicates that one or more readings are above a default or user-defined limit and does not indicate an XRF-related failure.

<u>Calibration Verification Standards</u>

It is important to select the appropriate calibration verification standards and representative concentration ranges when possible. XRFs typically come with verification standards that include known concentrations of selected metals in various substrates like plastic, metal, and soil or they can be obtained separately. An XRF will interpret the reflected signal from a hard metal versus soft plastic differently. Ideally, it would be best to have several verification standards with a range of concentrations that will be representative of the concentration range that you will be measuring to assess the linearity of the calibration. Unfortunately, this is often not the case, and you will have a 2-point calibration check – the Blank and one known concentration in a given substrate.

Paint

Paint and paint calibration verification standards deserve special consideration. Paint modes on XRFs typically read in in ug/cm^2 or mg/cm^2 for comparison to dried paint standards on walls (e.g., 0.5 or 1.0 mg/cm^2). However, it may also be desirable to have a mass-based concentration (ppm) for comparison to a manufacturing standard of 90 ppm (dry weight basis) or other regulations limiting lead content of painted products such as toys.

When using the XRF to measure lead in dried paint, e.g., for an assessment in a home, one should use either Paint Mode or Painted Products Mode and the Plastics Mode for each sampling location when using a Niton XRF:

- Use Paint Mode or Painted Products Mode to measure lead in mg/cm^2 or ug/cm^2, respectively. The Painted Products made uses lower internal calibration standards and is better suited for paint with lower levels of lead like toys, hence ug/cm^2. The Paint Mode uses higher internal calibration standards like paint on walls and is better suited for higher levels of lead in paint, hence mg/cm^2.
  - Do NOT use the Painted Product Mode to measure in ppm.
  - Paint Mode does not have a ppm option, only mg/cm^2.
- Use the Plastics Mode to measure paint in ppm in the same location as above.
  - The Plastics mode assumes an infinite thickness of the sample, which is often an issue for applied paints. Readings in this manner should take this potential dilution of the actual lead concentration in the paint into consideration.
  - Alternatively, paint may be scraped (using appropriate health and safety measures) and placed in a plastic bag for the XRF measurement, noting that a thickness of at least 1/2 inches or 1.2 cm thick is recommended.
- Record and report the readings and associated modes with the correct concentration units (mg/cm^2, ug/cm^2 or ppm).
- Record and report the readings for the provided paint standards (e.g., PbPEFIC) using the Painted Products Mode, AIS Standards pbBlock-1 for Paint Mode, and the provided plastic standards (e.g., PLPE-8ED-31) using the Plastics Mode at the beginning and end of each field day to verify the calibration of the XRF.

When using the XRF to measure lead in new, wet paint samples (e.g., obtained during an assessment of paints in a marketplace), one should follow this abbreviated protocol:

- Paint several layers of paint on a paper or cardboard surface until the dried paint is at least 1/2 inches or 1.2 cm thick. The paint should be dry and the thickness matters to not dilute the readings.
- Use the Plastics Mode to measure paint in ppm. Do NOT use the Painted Product Mode to measure in ppm. Note ppm option is not available in Paint Mode.

- Collect measurements of the paper used for the paint coating and the surface you are measuring on to ensure no interferences.
- Record and report the readings and associated mode in ppm.

Record and report the readings for the provided plastic standards (e.g., PLPE-8ED-31) using the Plastics Mode at the beginning and end of each field day to verify the calibration of the XRF.

It is important to note that the difference between a mass per area reading and a ppm (mass of lead/per mass of paint) reading lies primarily in the XRFs interpretation depending on a user specified test mode (e.g., Painted Product Mode or Plastic Mode for most Niton XRFs). Regardless of the test mode, the XRF beam will penetrate a certain thickness into the paint, and possibly the underlying substrate, and will calculate a total mass of lead based on the signal it receives back. The XRF will then distribute the calculated mass of lead over the diameter of the measurement window to calculate a mass per area concentration in a Paint Mode or Painted Products Mode or by assuming an infinitive thickness to calculate a mass per mass (e.g., ppm) in most other modes (e.g., Plastics Mode). Regardless of the mode and the reported concentration units, the XRF does not know the thickness of penetration, the thickness of the paint, or variations in lead concentrations over the penetration thickness (e.g., in different layers of paint, in the underlying substrates, etc.). The XRF simply calculates a total mass over the penetration thickness and interprets it based on user defined setting(s) or assumptions of infinite thickness. Two examples of these limitations, which have important ramifications for comparison to regulatory standards as well as potential exposure assessments:

- For thin coatings of paint, the XRF will likely penetrate some thickness into the substrate with the effect of diluting the readings if the substrate does not contain lead or creating a false positive if the substrate contains lead (e.g., painted metals surfaces).
- Painted surfaces may contain multiple layers of paint, in which case the XRF reading may yield something of an average. Similarly, if there are many layers of paint on a surface (e.g., an old building), the XRF may not penetrate the full thickness and may miss the presence of underlying coats of lead paint.

Please note the following for reference and to highlight the issue and source of confusion for mass-based concentrations obtained in Painted Products mode. One can convert paint measurements from ppm obtained in Painted Products mode to mass per area and vice-versa, as follows. HOWEVER, you need to know or approximate the density and thickness of the paint.

Concentration (ug/cm^2) = Concentration (mg/kg) * Density (g/cm^3) * Thickness (um) / 10,000

The following example shows the relation between two paint measurements of the same paint made in Painted Products mode. One measurement was 90,000 ppm and one was 0.27 mg/cm^2. While these two measurements are seemingly very different, the difference is related to the default settings in most XRFs for paint density (1 g/cm^3) and thickness (30 microns). Conversion between the two are shown below using the default settings (a) and using potentially more representative values for thickness and density of dried paint (b).

$$a).\quad \frac{90{,}000\,\frac{mg}{kg} * 1\,\frac{g}{cm^3} * 30um}{10{,}000} = 270\,\frac{ug}{cm^2} = 0.27\,mg/cm^2$$

$$b).\quad \frac{6300\,\frac{mg}{kg} * 1.5\,\frac{g}{cm^3} * 300um}{10{,}000} = 283\,\frac{ug}{cm^2} = 0.28\,mg/cm^2$$

Homogeneity

Loose samples (e.g., spices, powders) should be well mixed in a sample-dedicated plastic bag prior to taking an XRF measurement in that same bag. Soil samples may also be measured in a bag or in situ for site investigations. Multiple XRF measurements of hard samples such as metallic cookware or plastic toys are typically necessary to represent the heterogeneity within a seemingly uniform aluminum pot or to represent different colors of a plastic toy or ceramic bowl for example. Food contact surfaces e.g., the inside of a bowl or pot may be of greater interest than the outside. Please refer to individual product-specific protocols (e.g., for metallic cookware, spices, etc.) for additional guidance.

For toys, make sure that there are no metallic parts interior to the toy (e.g., batteries, wires, lights, gear boxes, screws) prior to XRF use. These metallic parts will give false positive readings that are not representative of potential lead exposure to the exterior plastic portions of the toy.

Moisture Content

XRFs work best with dry samples, with moisture content or wetness absorbing the XRF signal. For soil samples, it is best to complete in situ (in place) XRF measurements when the ground is dry. One option is to collect and dry wet samples prior to analysis. However, this creates additional timing and logistical issues.

Sample Thickness

The x-rays from an XRF penetrate to varying thicknesses depending on the strength of the XRF, but also on type and density of the sample. Penetration thicknesses can range from a few microns in a metal sample to several millimeters in softer samples like paint, soil and spices.

If you do not have sufficient thickness, the XRF reading will be affected by what is underneath your sample, most often diluting the sample and underestimating the actual lead concentration (although the opposite can also occur if the is lead in what lies beneath your sample). Conversely, if there are many layers of paint on a surface, the XRF may not penetrate the full thickness and may miss the presence of underlying coats of lead paint.

Please make sure your sample is at least 1/2 inches or 1.2 cm thick or more to avoid this issue. Smudges of lipstick on paper or single layers of paint are insufficiently thick to yield accurate results. Note that denser samples like ceramics or metallic cookware do not need to be as thick.

Sample Shape

XRFs interpret the reflected beam. If the sample does not cover the XRF window (e.g., a thin ring) or is curved outward (convex), portions of the signal may be lost and reduce the accuracy of the XRF. Choose a flat area for sample measurement when possible. The user should NOT hold samples for measurement.

Sample Location

It is important to record the location of the XRF measurements, particularly when collecting soil measurements at a contaminated site for subsequent mapping of concentration data or to record the location of a home or marketplace that is being assessed.

GPS coordinates (latitude and longitude) can be obtained from your phone, however, these are generally based on cell towers (not satellites) and lack the degree of accuracy for many items, especially for soil samples at a site. Thus, use of cell phones is not recommended for this purpose. Some of Pure Earth's existing and the new XRFs have a GPS receiver working off satellites. This function must be activated on the XRF, and the GPS location readings should be verified using a hand-held GPS device (e.g., Garmin eTrex 10) before relying on the data from the XRF. Latitude and longitude should be recorded as decimals, not degrees (e.g. 18.418789, not 18°41'87).

XRF Measurements and Laboratory Confirmation

It is often desirable to submit a subset of samples for laboratory confirmation of the lead or other metals concentrations. It is important to have accurate XRF readings of precisely what you will be submitting to a laboratory, e.g., making sure you are comparing exactly what you are XRFing with what you are submitting to the laboratory (e.g., comparing apples to apples). This is relatively straightforward for homogeneous samples like spices or cosmetics. However, soil samples with XRF measurements at ground surface will not compare well to a sample that is subsequently dug up and put in a bag. For lab confirmation for soil samples, collect soil samples into a plastic bag and mix the sample thoroughly. Take ~5 measurements using the

XRF and submit the sample for laboratory confirmation. It is best to do this over the range of measured concentrations, weighted to those closer to a given cleanup standard. This should yield the best results.

5. XRF Operation and Measurements

- Measurements should be made on a hard surface – never in your hand or on your leg.
- Collect "blank" measurement of the empty plastic bags you are using and the underlying surface where you will be doing measurements to ensure lead is below detectable levels. If lead is detected, find a new surface. Record these measurements on the XRF Field Datasheet (LINK).
- Avoid taking measurements in sample containers like plastics or glass as these may contain lead. Place samples in plastic bags whenever possible.
- Ensure the XRF is in the appropriate mode for the sample type. Each XRF make and model has different modes available. Most Pure Earth Niton XRFs contain the following modes:
  - Plastics
  - Soil
  - Metals and Electronics
  - Consumer Goods (Toys, Painted Products etc.)
  - Paint
  - Test All

The user should select the mode that best represents the material that they are testing. This informs the XRF on how it should be interpreting the reflected beam it receives. For softer items like spices and cosmetics, the Soil mode should be selected. The Test All mode lets the instrument decide which is best and may be helpful when testing multiple product types in a home-based assessment for example. Note that the modes under Consumer Goods (e.g., Toys, Painted Product) will also determine a Pass or Fail determination in addition to reporting the concentrations of metals, as shown in Figure 9. The Pass or Fail determination is simply whether or not the reading is above or below a threshold set as a default or input by the user – it is not a failure of the instrument.

- The XRF tests a sample by pressing and holding the trigger. The longer you test a sample, the more accurate and lower the limits of detection are. Most XRFs have a default of 30 seconds, but slightly shorter times may be sufficient depending on the data quality objectives. When in question, use 30 seconds.
- If lead is below the detection limit, record the detection limit for that reading as displayed on the instrument.
- Retain all samples (properly labelled and secured) for possible additional screening or laboratory testing. This will likely be dependent on project specifics.

Data Management

- All data should be recorded either on the XRF Field Datasheet LINK (e.g., for multiple readings during a site investigation) or the XRF General Datasheet LINK (e.g., for an assessment of a home or marketplace). At the end of each day when XRF readings are taken, download and retain raw data file as .csv or .xls. These data files only contain consecutive XRF reading numbers and do not contain the associated sample ID unless one was mechanically entered – see next bullet.
- Make sure that each XRF reading in the data file is correlated with a unique sample ID, so the reader can connect any XRF reading in the file with a sample, otherwise the datafile is useless. These sample IDs should have been recorded along with the XRF reading number on the Field Datasheet, for each product sample, calibration readings, working surface, blanks, duplicates etc.).
- File name should be written with the Country Code and the date that the samples were analyzed as DD-MM-YYYY.
    - Most XRFs store thousands of data points so it is not typically necessary to erase the stored data, although this might be desired under certain circumstances. In addition, you can typically select which data you'd like to download.
- Contact PE HQ for assistance with installing and operating the Niton software which allows for downloading the raw XRF data to a PC (Windows only).

6. Additional Information

- Soil and Dust Samples using Cup LINK
- XRF General Datasheet file LINK
- XRF Field Datasheet LINK
- Lead in Products and Using Camera in small items LINK
- Niton XRF - Download database from XRF LINK
- Vanta: Trust but Verify - Quality assurance & control in handheld XRF LINK