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2016

THE LEROY LAKE PROPERTY

A Sampling and Geochemistry Report

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Geophysical Instrument User Guide

A Sampling and Geochemistry Report on the Leroy Lake Property

DATE:

July 22nd, 2016

SUBMITTED BY:

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Introduction

The Leroy Lake Property is located in Nicol Township of the Larder Lake Mining Division. It consists of two unpatented mining claims, 4275564 and 4275574, currently owned by Clayton Larche. On April 23rd and 24th, 2016 a sampling program was commenced in efforts to understand the geochemical constituents of the local rocks. Samples were analyzed with the utilization of a portable x-ray fluorescence device in order to determine mineral elements.

Location and Access

The Leroy Lake Property is located in Nicol Township of the Larder Lake Mining Division approximately 6 kilometers east of Gowganda, Ontario (see appendix A). The property straddles the shores of Leroy Lake; claim 4275564 is situated on the western shore and claim 4275574 is situated on the eastern shore. Both areas of the property can be directly accessed via trails stemming north off Highway 560. Trails bisect both claims, providing good access throughout the property. Highway 560 runs roughly parallel to the southern boundary of the property while a hydro power line runs roughly parallel to the northern boundary of the property.

Background and Description

The Leroy Lake Property was staked on June 1st, 2014 consisting of four units within two blocks encompassing approximately 200 acres/80 hectares (see appendix B):

- Claim 4275564 (1 unit)
- Claim 4275574 (3 units)

The property displays varying topography from low lying swamps to distinctive outcrops. As such, the vegetation is mixed ranging in species from jack pine, spruce, balsam, birch, poplar as well as some cedar. The major water source in the area is the centrally located Leroy Lake which is associated with several tributaries and smaller water bodies in the vicinity.

Evidence of recent logging and associated activities in the area is quite prevalent, most notably on claim 4275574. At the time of staking it is estimated that the northwestern and eastern sides of Leroy Lake were likely logged the year prior. Subsequent slash and burn activity was also observed. This accounts for the good access and maintained roads with the exception of a couple culverts that were removed by the ministry.

Regional Geology

The Leroy Lake Property is situated within the Cobalt-Gowganda Silver Camp, one of the most prolific silver mining areas in the world, having produced over 600 million ounces of silver since the early 1900's (Joyce et al, 2012). Silver deposits within this camp occur along the northern and eastern margins of the Southern Province in an area referred to as the Cobalt Embayment, which is bounded on the north and east by Archean basement rocks and to the southeast by the Grenville Front (Joyce et al, 2012). The area is underlain by Early Proterozoic rocks of the

Huronian-Superior group resting on Archean granitic, metavolcanic and metasedimentary rocks of the Superior Province (Joyce et al, 2012).

Archean basement rocks are exposed within the Cobalt Embayment and both the sediments and basement rocks have been intruded by sills and dikes known as the Nipissing diabase (Joyce et al, 2012). All of the deposits occur at or near the Archean-Huronian unconformity. They are spatially associated with Nipissing diabase either with or within 600 feet of its upper and lower contacts. Many of the mineralized veins occur on the upward projection of Archean supracrustal rocks and many are found near volcanogenic base metal sulfide deposits in the Archean basement (Andrews et al, 1986).

Silver ore veins vary in width and length and can occur in a variety of rock types including the Huronian sediments, Nipissing diabase, and Archean metavolcanics and metasediments (Joyce et al, 2012). Mineralization is typically discontinuous with veins occurring in local shear zones, along faults and zones of dilation mainly as discrete and narrow fissure fillings (Joyce et al, 2012). Veins are predominantly composed of carbonates (calcite and/or dolomite) with arsenides and sulpharsenides of cobalt, nickel, and iron with native silver and bismuth (Joyce et al, 2012). The veins are typically zoned; the carbonates make up the central part of the vein while silicates occur as thin layers immediately adjacent to vein walls (Joyce et al, 2012). The silver-bearing assemblages occur at or near the interface between the silicates and carbonates (Joyce et al, 2012).

Property Geology

The Leroy Lake Property is associated with the Gowganda Silver Area which is underlain by a complex of volcanic rocks of Keewatin age made up of basic and intermediate lavas and tuffs with slightly metamorphosed volcanics to chlorite, mica and hornblende schists (Benjelloun, 1968). The Matachewan diabase as well as the Nipissing diabase intrude this formation, which largely defines the contact in which silver veins occur (McIlwaine, 1966).

The Leroy Lake Property hosts the historic Silver Bullion Mine (1920-1926) and Coleroy Mine (1921-1927) as well as the Chapelle Prospect (see appendix C). The Silver Bullion Mine is described as an outcropping of Keewatin greenstone with a quartz-calcite vein carrying native silver, native bismuth and smaltite and niccolite (Burrows, 1926). It was eventually comprised of a 300-foot shaft made up four vertical levels with the construction of a 100 horse power boiler, a 6-drill compressor and a 6- by 8-inch hoist (Burrows, 1926).

The Coleroy Mine is described as Keewatin greenstones and tuffs intruded by a Matachewan diabase dike with the presence of several veins consisting of calcite, quartz, copper pyrites, iron pyrites, cobalt, nickel and native silver (Burrows, 1926). It was eventually comprised of a 660-foot shaft with five vertical levels with the construction of a winch (Burrows, 1926). The Ministry of Northern Development and Mines reports a 12-meter long vein containing native silver as well as silver values up to 2500 grams per ton over 0.15 meters (Guindon, 2005).

Figure 1. Silver Bullion Mine - depicting infrastructure, shaft and lateral workings (Burrows, 1926).

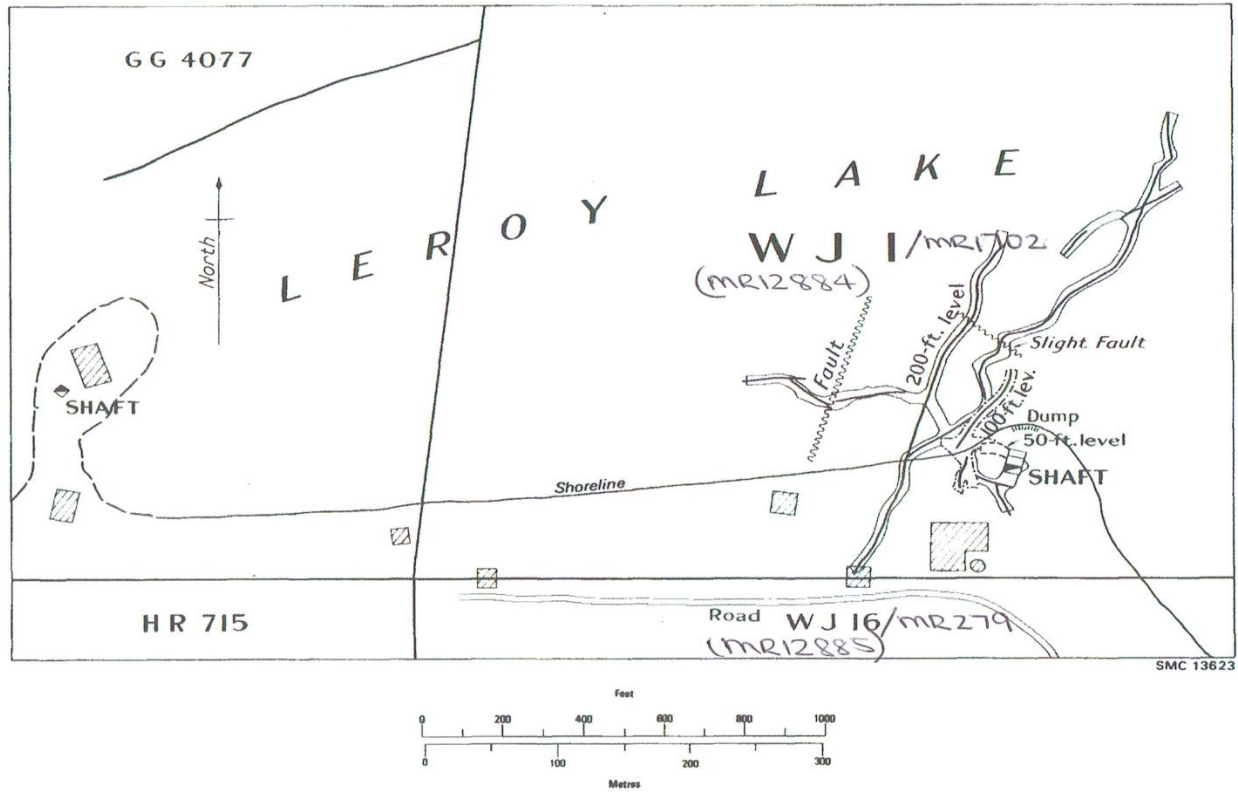
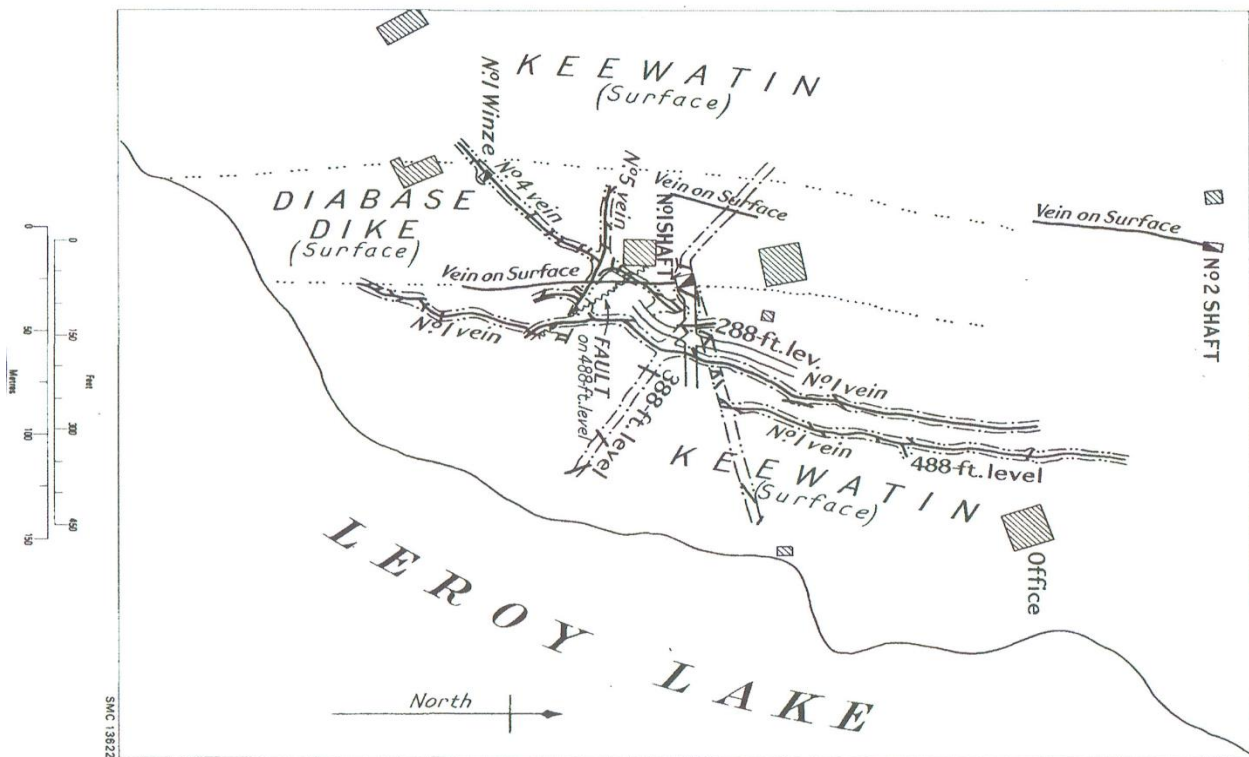


Figure 2. Coleroy Mine - depicting infrastructure, shafts and lateral workings (Burrows, 1926).



Exploration History

Exploration in the area has been ongoing since the early 1900's due to the construction of the railway from North Bay to Haileybury and New Liskeard. The Cobalt Silver Camp was discovered in 1903 and exploration expanded outward in all directions. This area came to be known as the birthplace of Canadian hard rock mining due to its accessible mineral-rich veins occurring at surface. By 1911, silver production was at its peak with 31,000,000 ounces of silver shipped (Dumaresq, 2009). Production continued at a high level until the mid- to late-1920's when the price of silver collapsed.

During that peak time both the Silver Bullion Mine and Coleroy Mine were discovered on the Leroy Lake Property. The mines closed in the mid-1920's due to the collapse of silver commodity prices and the property has remained patented and lightly explored since. In June of 2014, the mineral rights of the Leroy Lake Property opened to the crown and became available for staking, at which point, Clayton Larche acquired them.

Sampling Program and Results

On April 23rd and 24th, 2016 a sampling program commenced on the Leroy Lake Property by three personnel; Clayton Larche, Sara Wigelsworth, and Scott Woolhead. Due to the high volume of snow still present, it took some time to clear an area in order to collect a sample. As a result, samples were only accessible for collection on claim 4275564 where there was more snow melt due to the higher topography, as opposed to claim 4275574, where there was less snow melt due to the low lying topography. It was also more difficult to determine the location of the waste rock pile on claim 4275574 due to the snow.

Therefore, sampling was concentrated on the waste rock pile of the historic Coleroy Mine, currently staked as claim 4275564. In total, 20 grab samples were collected to be further tested by geochemical analysis. The objective of this sampling program was to understand the mineral elements of waste rocks left at surface of the Coleroy Mine. Analysis was completed with a portable x-ray fluorescence device (pXRF) which produced a geochemical composition of the samples collected (see appendix D). Two x-ray beams are projected onto a sample to detect the possible presence of 36 different elements in parts per million (ppm). For this particular pXRF device, it was calibrated to detect the following 36 elements:

Magnesium (Mg)	Chromium (Ch)	Rubidium (Rb)	Antimony (Sb)
Aluminum (Al)	Manganese (Mn)	Strontium (Sr)	Tantalum (T)
Silica (Si)	Iron (Fe)	Yttrium (Y)	Tungsten (W)
Phosphorus (P)	Cobalt (Co)	Zirconium (Zr)	Mercury (Hg)
Sulphur (S)	Nickel (Ni)	Niobium (Nb)	Thallium (Tl)
Potassium (K)	Copper (Cu)	Molybdenum (Mo)	Lead (Pb)
Calcium (Ca)	Zinc (Zn)	Silver (Ag)	Bismuth (Bi)
Titanium (Ti)	Arsenic (As)	Cadmium (Cd)	Thorium (Th)
Vanadium (V)	Selenium (Se)	Tin (Sn)	Uranium (U)

For this program, a total of 212 scans were completed including the insertion of quality assurance and quality control (QAQC) tests. The QAQC tests were represented as either a

duplicate (of the sample prior), a standard (of a known elemental make-up and quantity) or a blank (silica). These were performed after every twenty scans and a re-calibration of the machine was performed after approximately 50 scans.

The pXRF detected anywhere from 0 ppm to over 400,000 ppm for these particular samples based on the elements listed above. The most prevalent elements detected were silica, calcium and iron, being present in almost every sample. The least prevalent elements detected were cobalt, selenium, cadmium, tin, antimony, tungsten and thallium. Of the top ten percent of elements detected were magnesium, aluminum, silica, sulphur, potassium, calcium, titanium, iron, copper, zinc, lead and silver. These observations can be viewed in figure 3 below.

The pXRF machine detected many elevated elements for the different samples scanned, however, of most economic interest was the content for silver, copper, nickel, zinc, iron and lead. The highest silver content detected was 19,557 ppm, which is just under 2% Ag. The highest copper content detected was sample #13 at 359,632 ppm (~36% Cu). The highest nickel content detected was sample #2 at 717 ppm (0.07% Ni). The highest zinc content was sample #1 at 199,521 ppm (~20% Zn). The highest iron content was sample #6 at 323,334 ppm (~32% Fe). The highest lead content detected was sample #11 at 98368 ppm (~9% Pb). These observations can be viewed in figure 4-10 below.

The sampling program that took place on the Leroy Lake Property generated a comprehensive representation of the minerals present. It is likely that surface samples with higher grade values have been over-picked throughout the last several decades as the mine has remained dormant. Therefore, based on this research and the historic significance of the property, it would be interesting to collect and analyze samples at a greater depth within the waste rock pile. Comparing both samples at surface as well as at depth may yield higher-grade results as the depth increases.

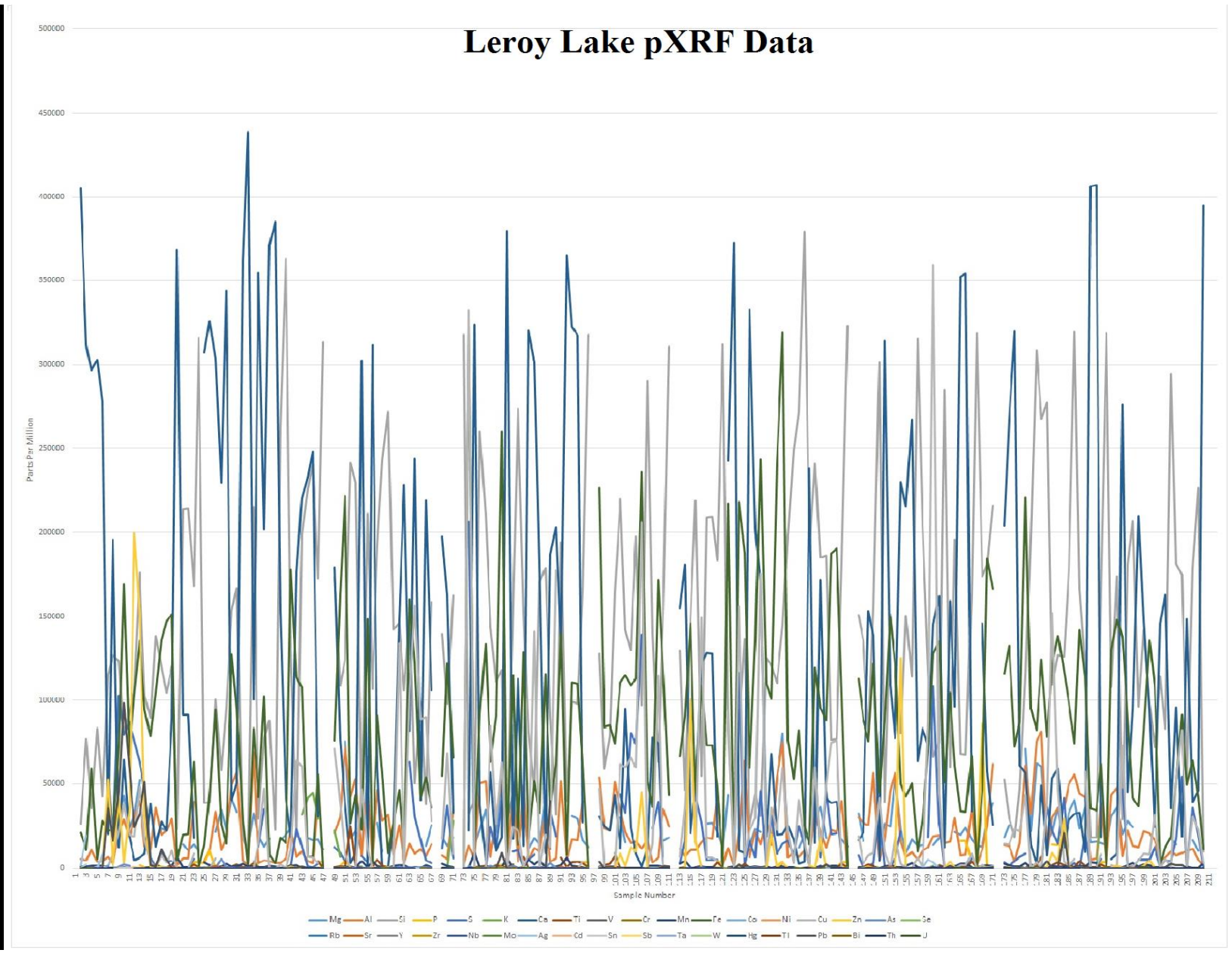


Figure 3. Leroy Lake pXRF Data - depicting ppm levels of all elements detected.

Leroy Lake pXRF Data (Economic Elements)

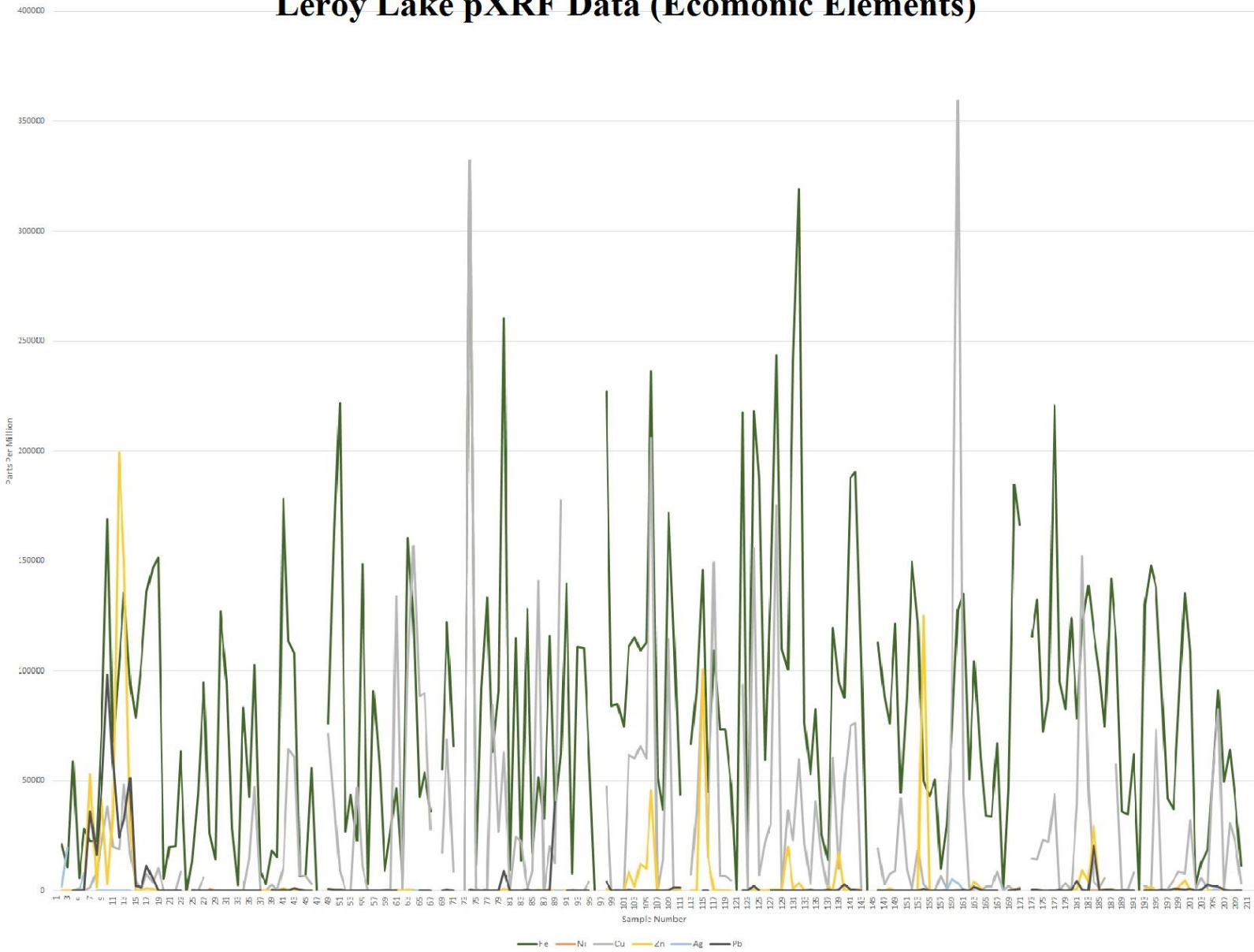


Figure 4. Leroy Lake pXRF Data - depicting ppm levels of elements of economic interest.

Figure 5. Leroy Lake pXRF Data – depicting ppm levels detected for silver element.

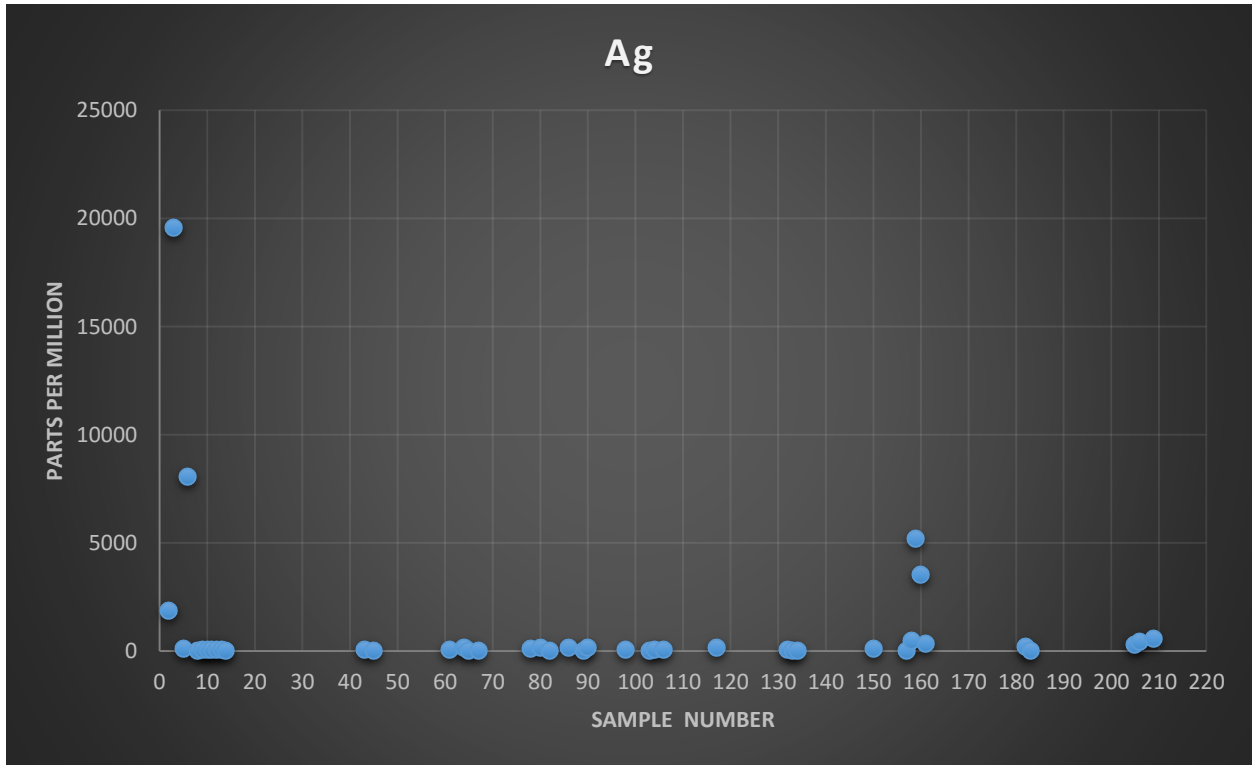


Figure 6. Leroy Lake pXRF Data – depicting ppm levels detected for copper element.

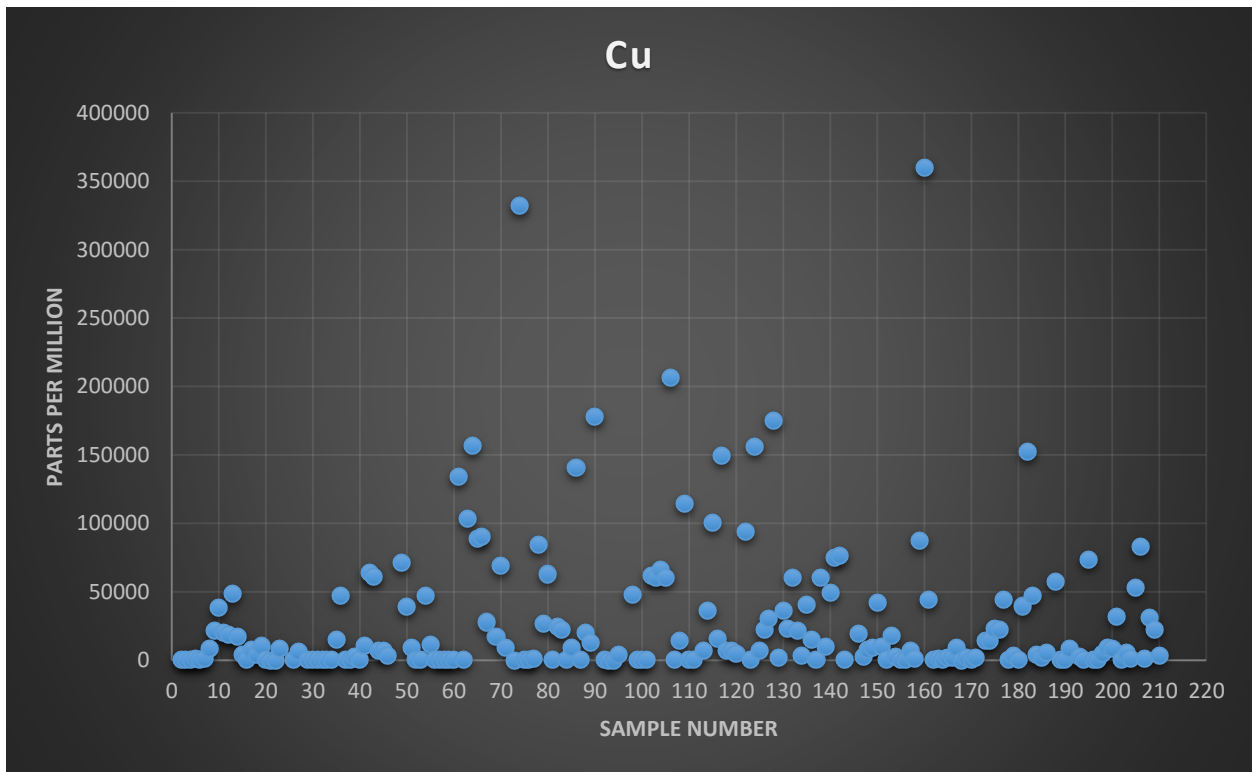


Figure 7. Leroy Lake pXRF Data - depicting ppm levels detected for nickel element.

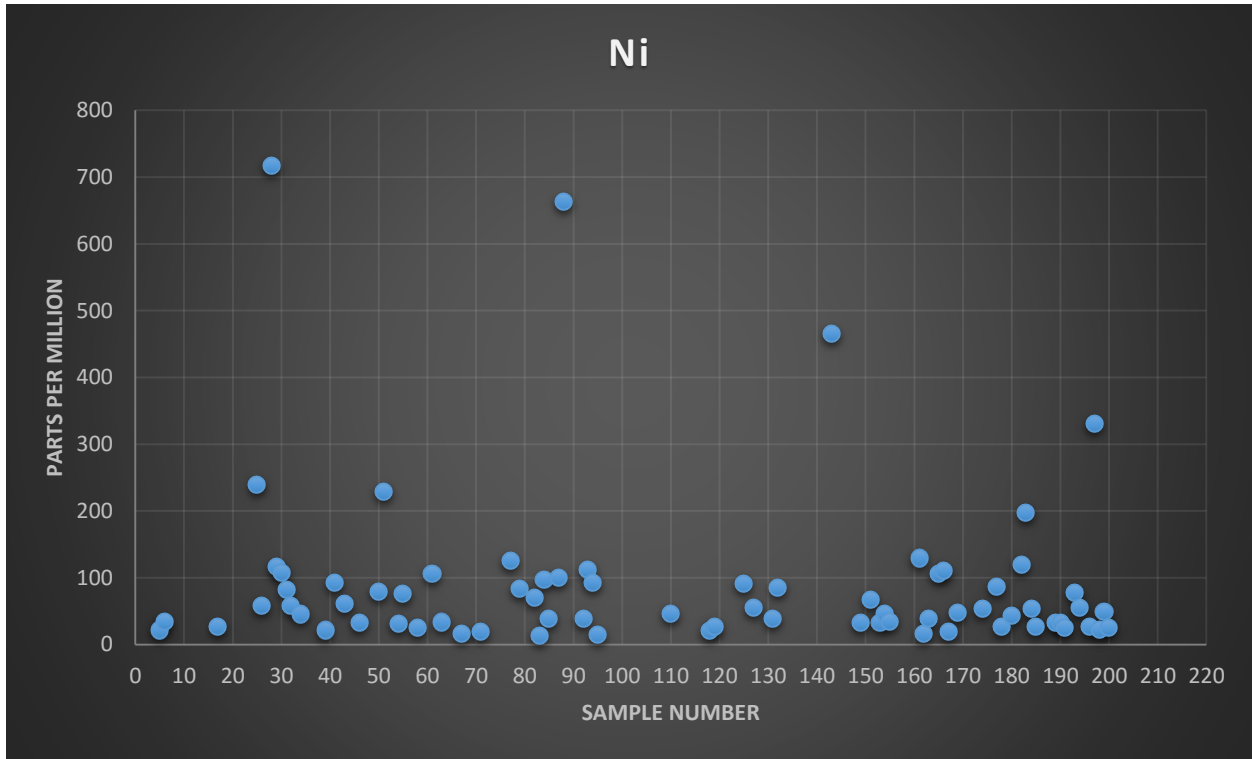


Figure 8. Leroy Lake pXRF Data - depicting ppm levels detected for zinc element.

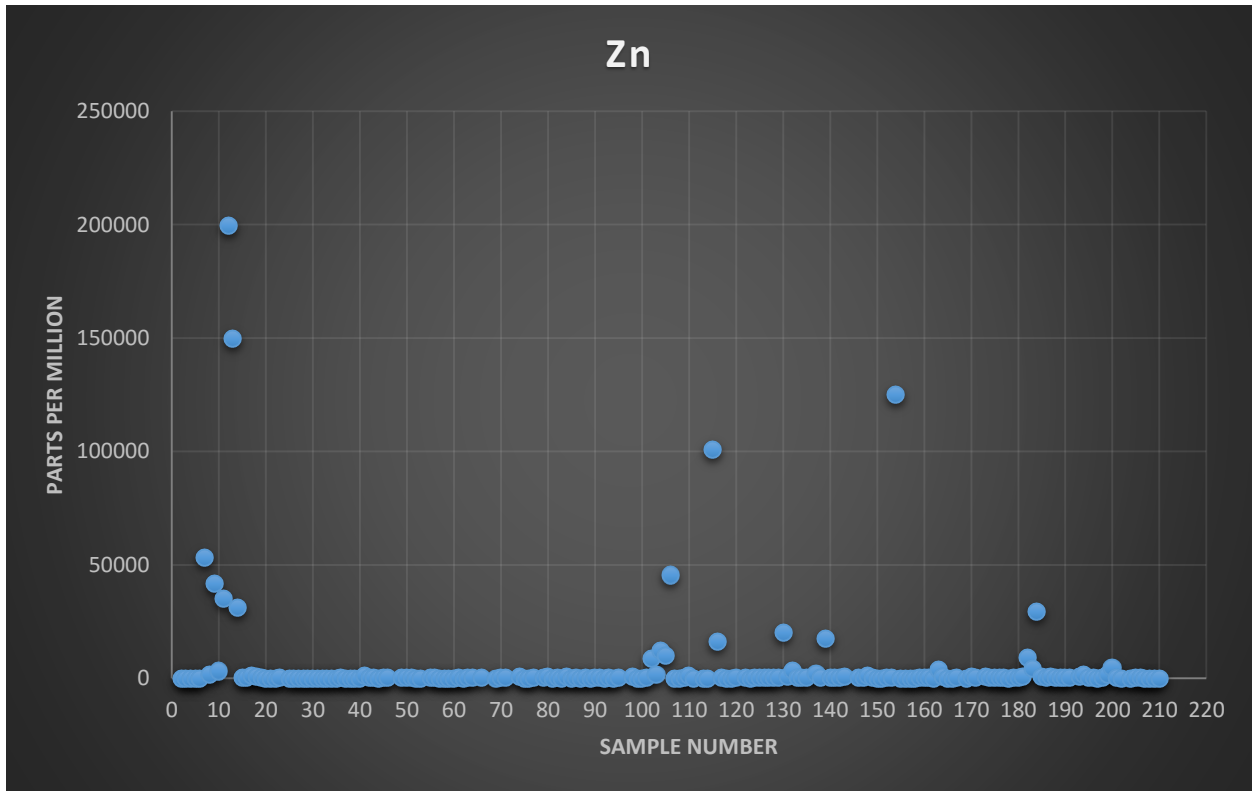


Figure 9. Leroy Lake pXRF Data - depicting ppm levels detected for iron element.

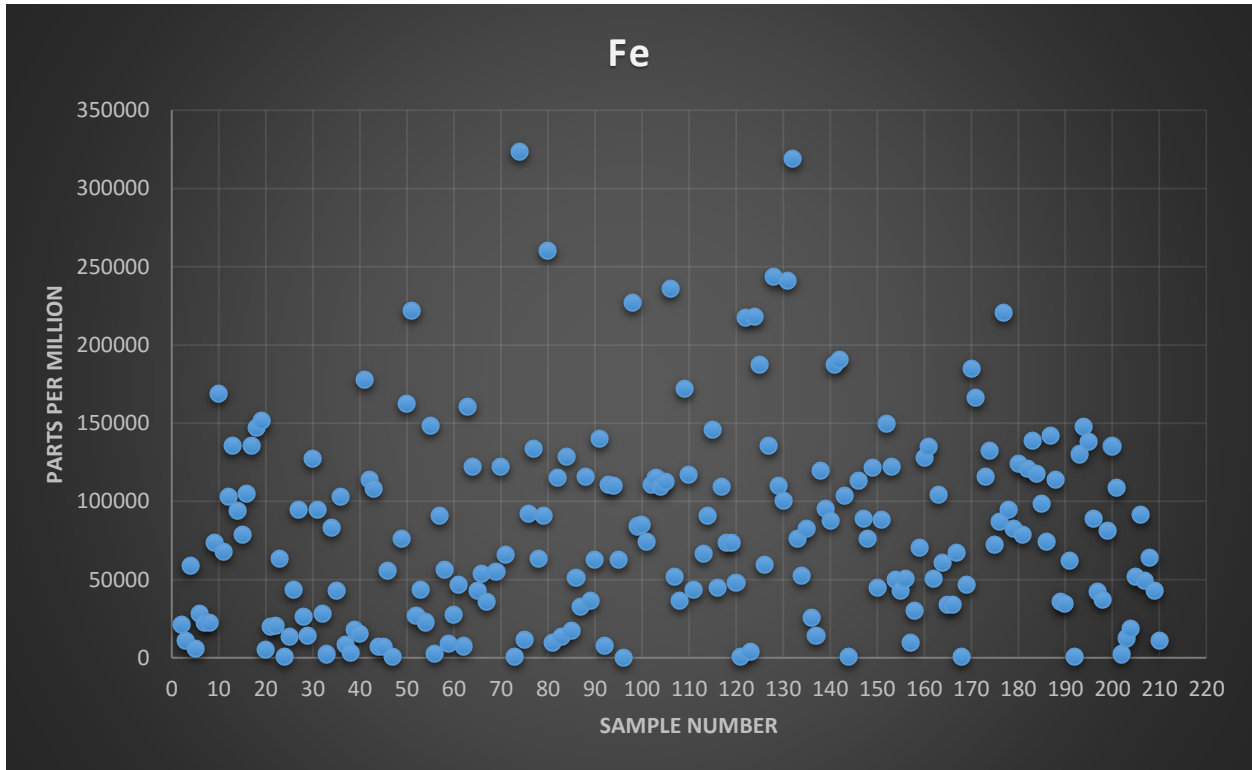
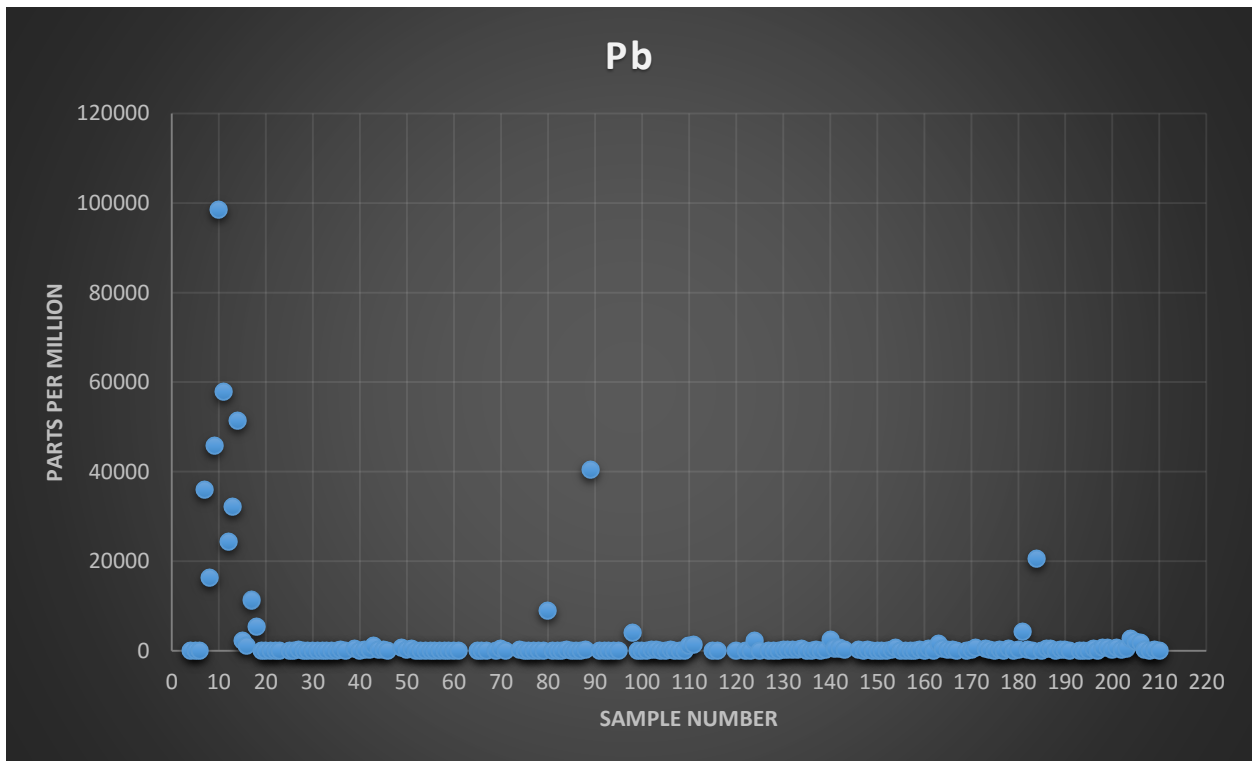


Figure 10. Leroy Lake pXRF Data - depicting ppm levels detected for lead element.



Qualifications

I, Sara Wigelsworth, of 56 Fraser Street in the town of Connaught, Ontario, do hereby certify that:

1. I am a prospector/claim staker and have been practicing my profession for six years.
2. I am a graduate of the University of Saskatchewan having received a B.Sc. Hon. in Archaeology in 2009.
3. My knowledge of the property described herein was obtained by my fieldwork and documentation.
4. I do not have or expect to receive any interest in the property that forms the basis of this report.

Respectfully submitted,

Sara Wigelsworth

References

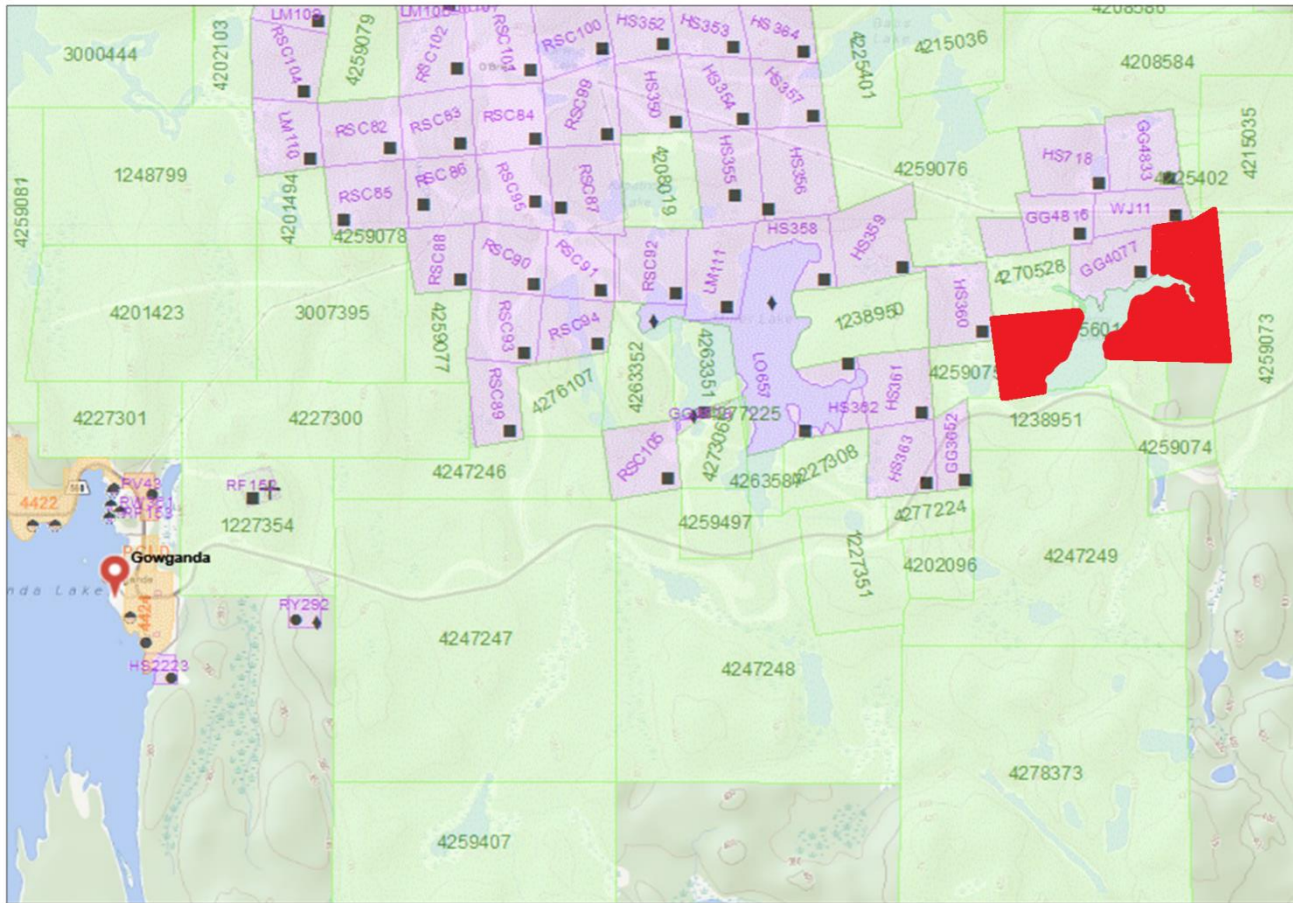
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MINISTRY OF NORTHERN DEVELOPMENT AND MINES
CLAIMaps

Leroy Lake Property

Notes:
Claims
4275564
4275574



Legend

- Administration Boundaries**
 - Mining Divisions
 - Resident Geologist District
 - Townships and Areas
 - UTM Grid
 - Geographic Lot Fabric
 - Other Federal Land
- Mineral Tenure Grid**
 - OMTG Tenure Grid
- Alienations**
 - Withdrawal
 - Notice
- Unpatented Claim**
 - Active
 - Recon'd
 - Pending
- Disposition**
 - Disposition
- Disposition Symbols**
 - Camp
 - Disposition Unknown/Pending
 - Freehold Patent Mining Rights Only
 - Freehold Patent Surface Rights Only
 - Freehold Patent Surface and Mining Rights
 - Land Use Permit
 - Leasehold Patent Mining Rights Only
 - Leasehold Patent Surface Rights Only
 - Leasehold Patent Surface and Mining Rights
 - License of Occupation Mining Use Only
 - License of Occupation Surface Use Only
 - License of Occupation Surface and Mining Rights
 - License of Occupation Uses Not Specified
 - Order in Council
 - Tower
 - WPLA
- Geology Layers**
 - AMIS Sites
 - AMIS Features
 - Drill Holes
 - Mineral Occurrences

0 1.7 km

Projection: Web Mercator



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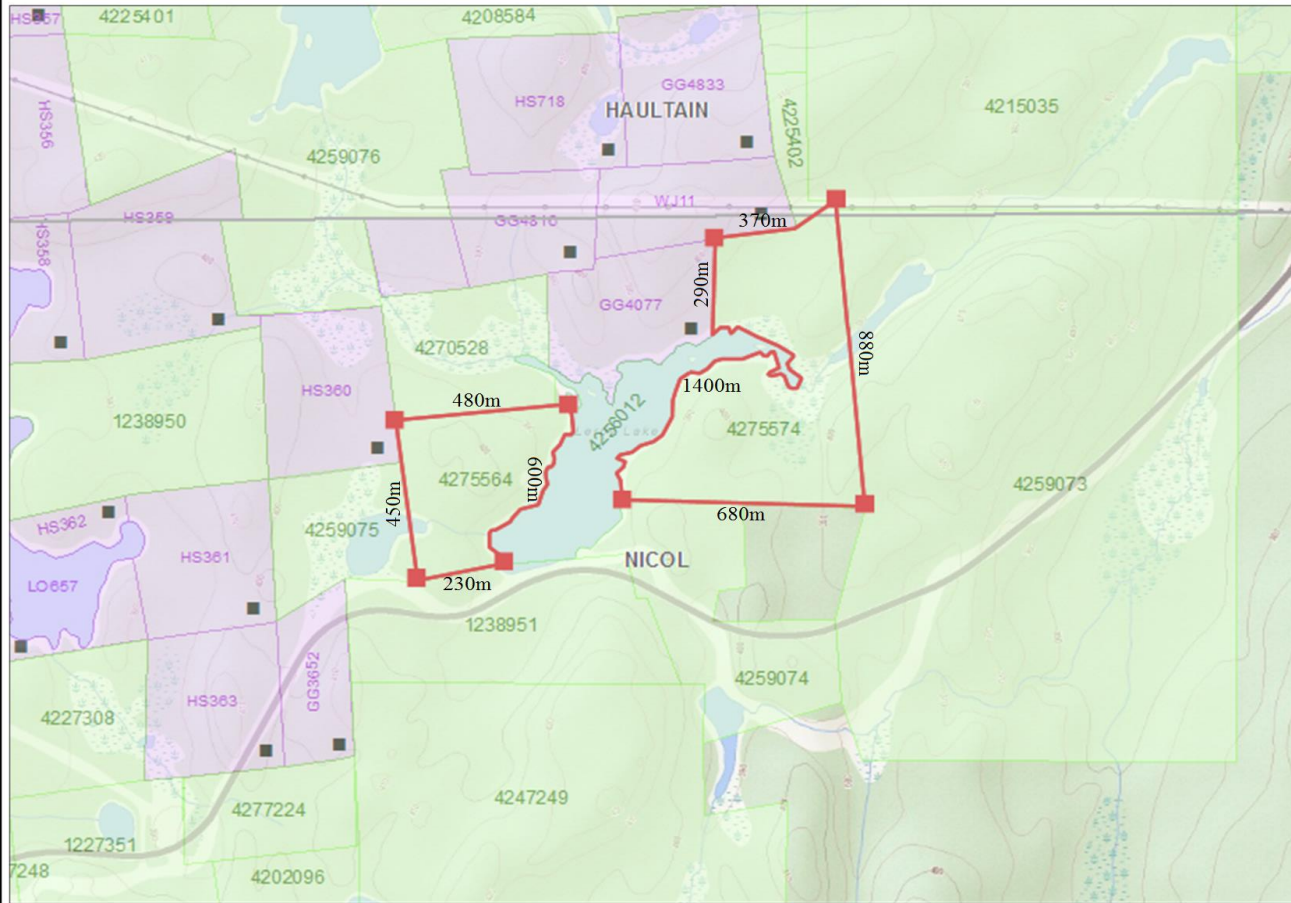




MINISTRY OF NORTHERN DEVELOPMENT AND MINES
CLAIM Maps

Leroy Lake Property

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 - Freehold Patent Mining Rights Only
 - Freehold Patent Surface Rights Only
 - Freehold Patent Surface and Mining Rights
 - Land Use Permit
 - Leasehold Patent Mining Rights Only
 - Leasehold Patent Surface Rights Only
 - Leasehold Patent Surface and Mining Rights
 - License of Occupation Mining Use Only
 - License of Occupation Surface Use Only
 - License of Occupation Surface and Mining Rights
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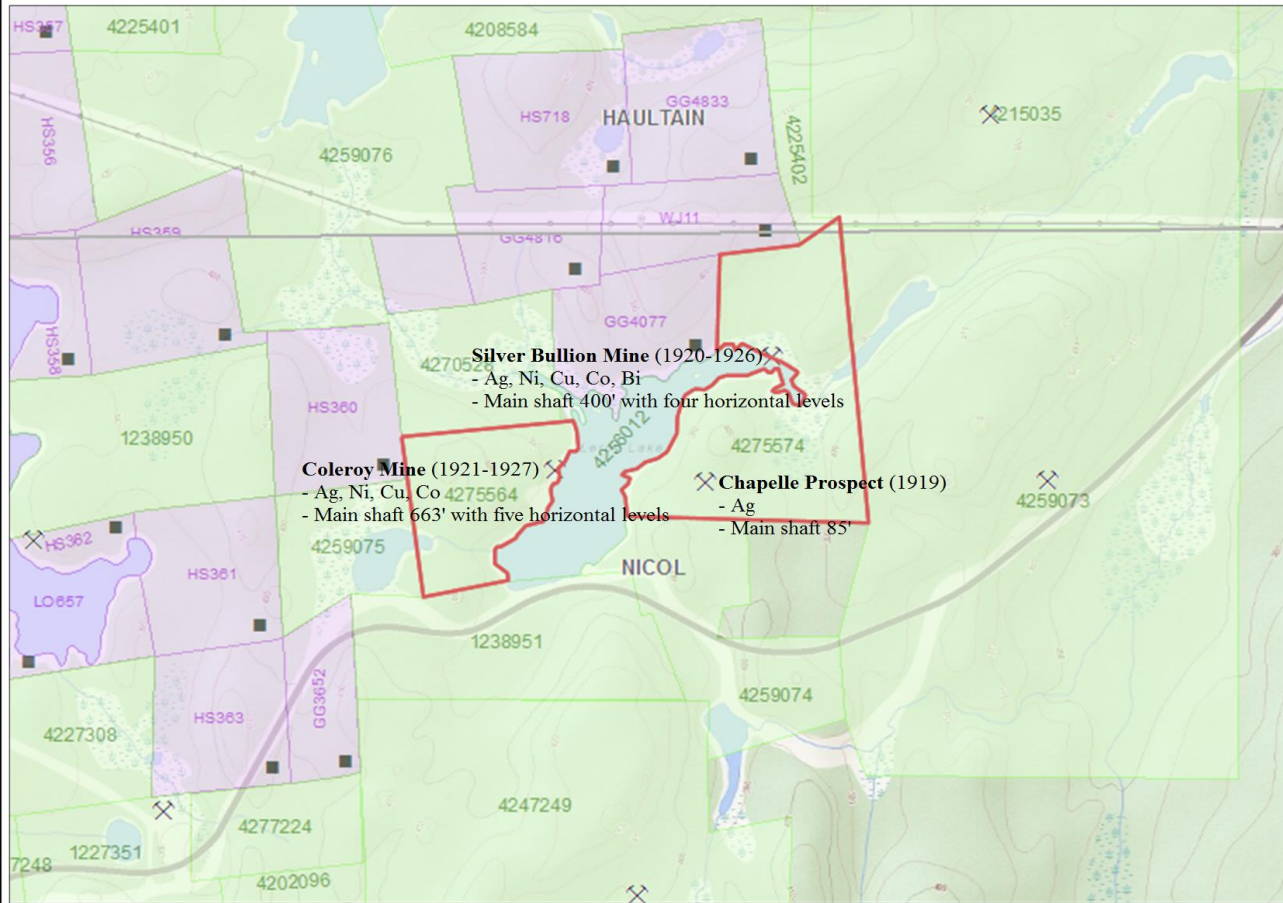




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 - Leasehold Patent Mining Rights Only
 - Leasehold Patent Surface Rights Only
 - Leasehold Patent Surface and Mining Rights
 - License of Occupation Mining Use Only
 - License of Occupation Surface Use Only
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User Manual

Delta™ Family: Handheld XRF Analyzers



Introduction

Includes a:

- Description of the Innov-X *Delta*™ family of handheld XRF analyzers.
- Visual tour of the instrument(s) noting all the major features, and accessories.

Description of *Delta* System

What Is It?

The *Delta* is a handheld energy dispersive X-Ray fluorescence spectrometer, generally referred to as an XRF analyzer. A complete *Delta* package consists of:

- Handheld analyzer using an integrated group of instrument components that are sealed in an ergonomically designed, light-weight body. They include --
- Controller
- Color touchscreen (ergonomically mounted interactive display)
- Membrane navigation keys
- Choice of detectors (**PiN or SDD**) to meet wide-ranging application goals

Coordinated with these robust characteristics, the instrument's **key feature** is Innov-X's proprietary control, data acquisition, and analysis software with customer configured options.

Additional accessories (standard and optional) include:

- Li-Ion batteries (2) - {Standard}
- Delta Docking Station (DDS) Dedicated charging and calibration unit - {Standard}
- Rugged waterproof carry case - {Standard}
- Portable test stand to create a Delta workstation (A-020-D) {Optional}
- Soil foot (A-035) (Optional)
- Soil extension pole (990055) (Optional)
- Trimble Xplorer Package (Optional)

What Does It Do?

The expanded *Delta* family of handheld XRF instruments delivers fast and precise identification and analysis for elements from magnesium to uranium (Mg to U) depending on the selected model. A weatherproof/dustproof ultra rugged design including an **integral heat sink** permits users to conduct diverse analysis testing under severe operating conditions. An added convenience feature for field use is battery **"Hot Swapping."**

Applications

The analyzer gives accurate chemical analysis for commercial or industrial areas, such as:

- Positive Material Identification
- Mining and Exploration
- Consumer Safety
- Scrap Processing
- Environmental Testing
- Light Element & Aluminum Analysis

Delta Family: Types, Models, and Calibrations



Delta Types and Models

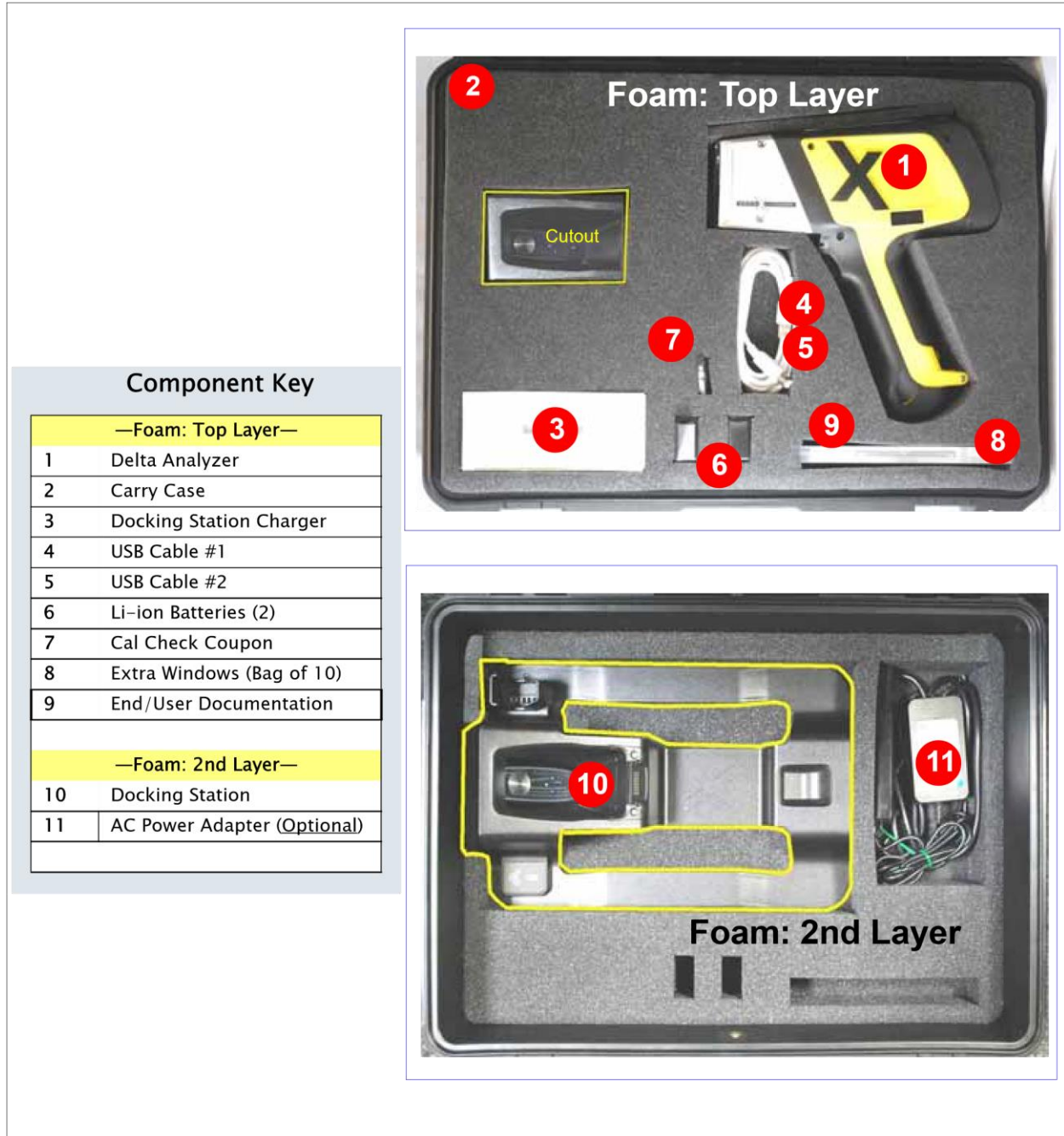
Type	Modes	Models
Premium	Alloy	DP-2000
	Environmental	DP-4000
	Mining	DP-6000
	RoHS	DP-6500
Standard	Alloy	DS-2000
	Environmental	DS-4000
	Mining	DS-6000
	RoHS	DS-6500
Classic	Alloy	DC-2000
	Environmental	DC-4000
	Mining	DC-6000
	RoHS	DC-6500

Modes and Calibrations

ALLOY Analysis	Alloy Alloy Plus FastID & Pass/Fail Precious Metals	MINING	Mining Mode 2 Beam Mining Car Catalyst	LEAD PAINT	Lead in Paint (HUD) Lead in Paint (Industrial)
SOIL Analysis	Environmental Exploration	CONSUMER GOODS	RoHS Consumer Products	THIN	Filter Analysis Dust Wipe

Tour of the *Delta* Package

The figure below depicts *Delta's* major components as initially shipped to a customer. Note that the protective foam in the Carry Case has **TWO** LAYERS.



Tour of Instrument

1. Handheld Analyzer

Component Key

Delta - All Models

1	Delta Analyzer (Premium Model Shown)
2	Probe
3	Measurement Window (Prolene Film)
4	Hinged Window Plate
5	Docking Station Connector
6	Trigger
7	Handle - Non-Slip Rubber Grip
8	Battery Boot
9	Data Port w/ Rubber Cover
10	Heat Sink
11	I/O (Power) Switch w/ LED Indicator
12	X-ray Warning Light Array
13	Touchscreen for User Interface
14	Navigation Buttons



- 11 I/O Power Switch w/LED Indicator
- 12 X-ray Warning Light Array

2. Delta Docking Station (DDS)

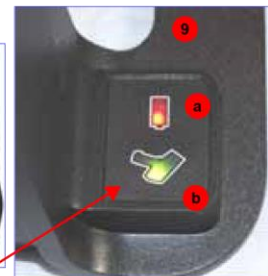
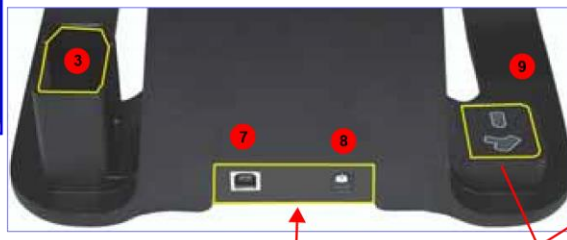


Component Key

Delta - All Model	
1	Delta Docking Station (Empty)
2	Analyzer Signal/Control Connector
3	Spare Battery Charge Socket
4	CalCheck Test Cup (316 stainless steel coupon)
5	Docking Station (Loaded)
6	Second Battery in Socket
7	Data Port(s): — Docking Station ->Rear — Analyzer -> Left Side
8	Input Power (12 VDC)
9	Indicator Lights
a	Second Battery Charging
b	Analyzer Engaged



See C4/Pages 44-45 for more information



3. Accessories- List the Standard and Optional Accessories

Standard

- Batteries
- Delta Docking Station (DDS)
- DDS Power Adapter
- USB Cables 1 - USB mini to USB A
- USB Cable 2 - two part powered data cable
- Windows- Bags of Kapton and Prolene films
- Cal Check (Standardization) Coupon

Optional

- AC Power Adapter (Battery Replacement)
- A-020-D TestStand/Workstation for Delta

STANDARD Accessories

Batteries

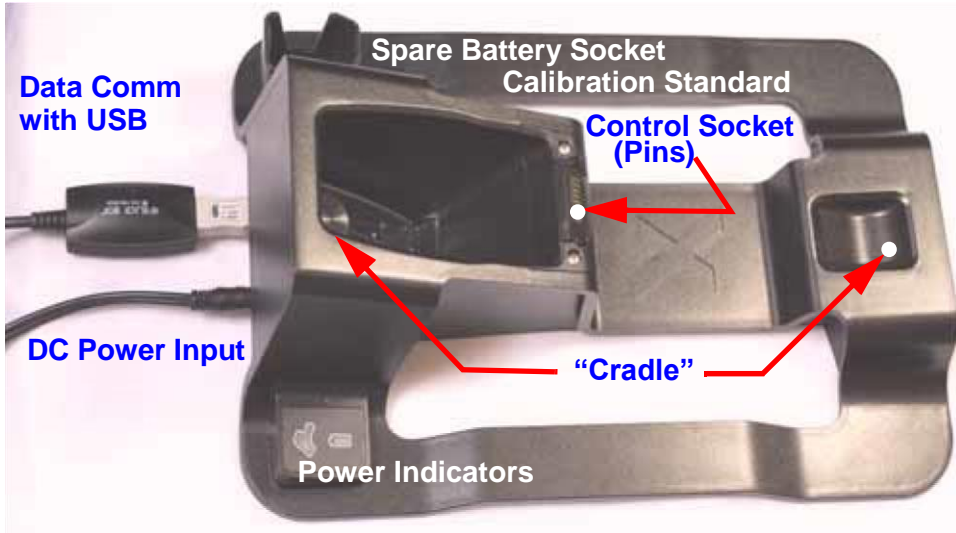
Two removable Li-ion batteries are standard accessories for the Delta.



Delta Docking Station (DDS)

This is key accessory. It provides **three** functions:

- Cal Check by one of two means - “On Demand” or Automatically
- Charge internal battery in handle
- Charge additional battery in auxiliary socket



Power Adapter for DDS



I/O Cables

PN 101310: This *standard accessory* provides a means to transfer information into or out of the sealed analyzer. It is good practice to export the current day's testing results to your PC.

PN 101310
 USB Data Cable
 Mini USB B Connector
 USB A Connector



PN 103209 and 103210: This is a two part assembly that supports communication between the Delta Docking Station and a PC.

PN 103209

USB Repeater Cable USB A
Female Connector
USB A Male Connector

Part One **Data Cable Assembly**



Part Two

PN 103210

USB Adaptor Male to Male USB Connector USB B Connector

Cal Check (Standardization) Coupon

This part is used as a reference sample to provide a test standard for a Cal Check procedure if the Docking Stations is not available. The instrument indicates when a Cal_Check is necessary.



Measurement Window Films

A bag of 10 window films are a standard accessory. The composition of the film is model and application dependent

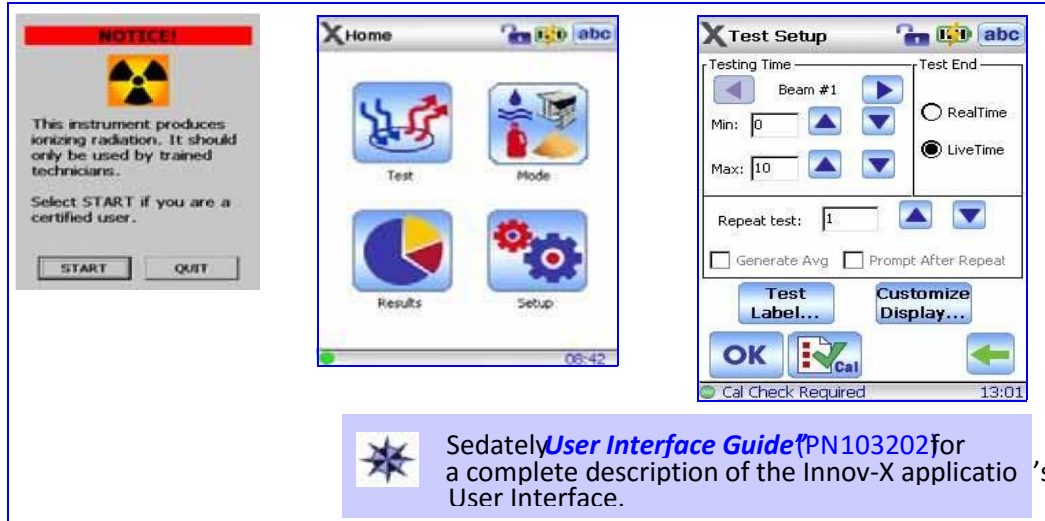
PN 103115 REV A
Kapton Windows
for Classic



PN 102999
Prolene windows for
Standard and Premium

Application Software

The **Delta** instrument is shipped with proprietary InnovX data acquisition and processing software and Windows Embedded CE® operating system. The User Interface employs an icon-based home page graphic style. Factory calibration has been completed on all purchased modes.



OPTIONAL Accessories

AC Power Adapter

PN 100043: This accessory enables the user to operate the instrument without the limitation of battery charge status. The unit comes with approximately ten feet of power cord that defines the effective range of use.



PC Software

This application package permits an operator to execute Innovx S/W functions from a PC. With cable PN 101310, a user can connect from the Delta's mini-USB data port to a PC's USB port.

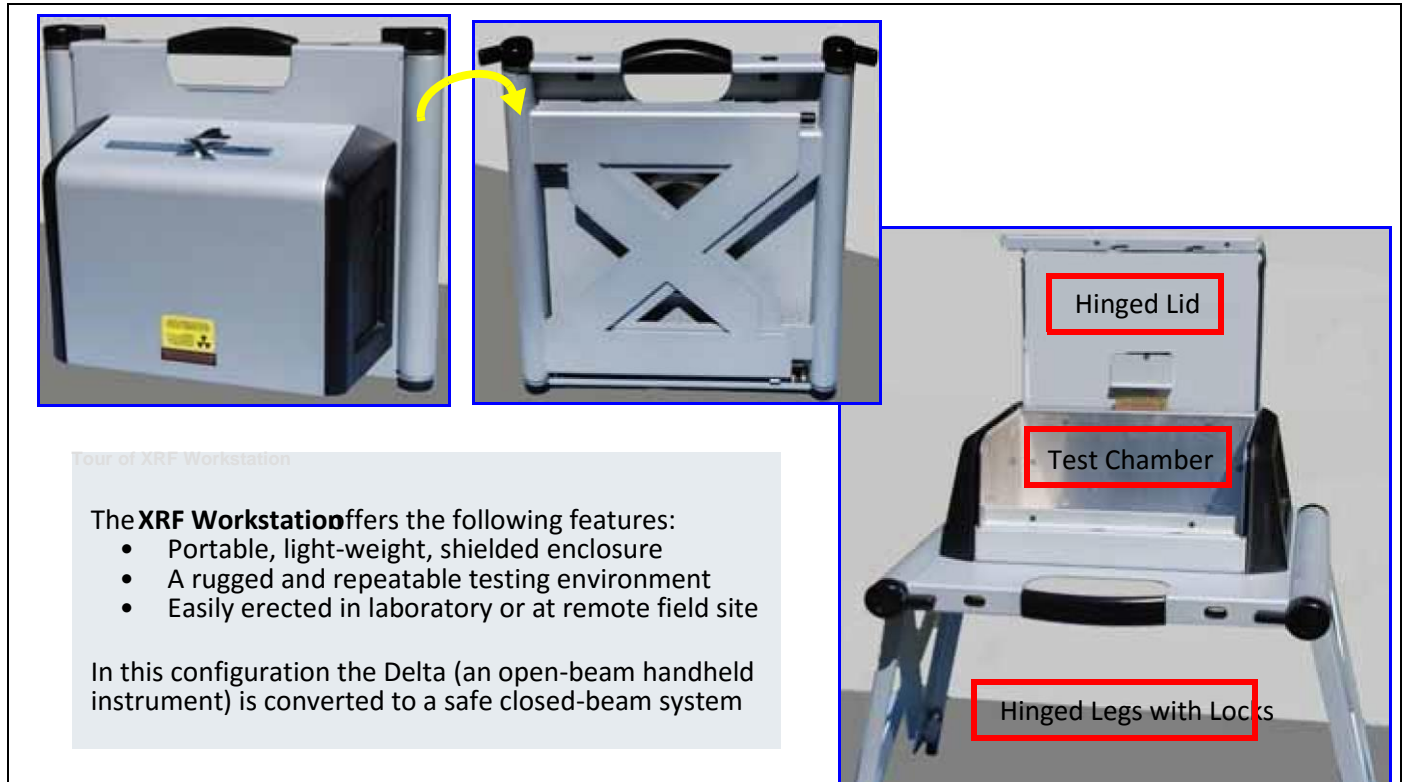
This package is optional for a handheld instrument and standard for A-020-D TestStand/Workstation. When used with the A-020-D the proper configuration cable is the powered USB assembly (PN 103209 - PN 103210)

XRF Workstation

The Delta XRF Workstation is comprised of two major components:

- A-020-D Test Stand, and
- Any Delta analyzer

In this configuration, the Delta is controlled by Innovx Delta PC Software. The open-beam handheld instrument is converted to a closed-beam workstation.



Safety Information

Presents the following information:

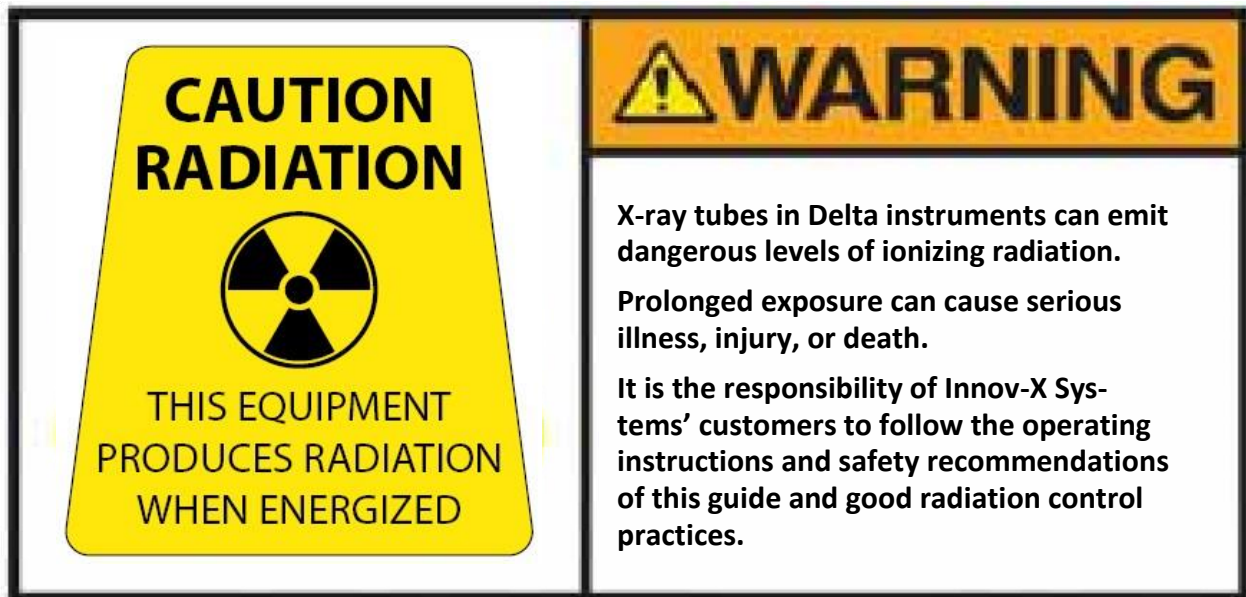
- Radiation Safety Information
- General Precautions
- Electrical Precautions
- X-Ray Safety
- Compliance
- Instrument Usage Scenarios
- Radiation Dosage for Several Scenarios
- Radiation Safety: Common Questions and Answers
- Analyzer Shut Down Procedure

Radiation Safety Information

Always make Operational Safety your HIGHEST PRIORITY.

The *Delta* Handheld XRF Analyzer is a secure and dependable instrument when used according to Innov-X's recommended testing techniques and safety procedures. However, this instrument produces ionizing radiation; only individuals trained in correct operating techniques and authorized to use X-ray producing devices should be permitted to use it. The radiation detected at any outside surface (excluding the Prolene, Mylar, or Kapton window area) is below that required for an unrestricted area.

- Heed all warning labels and messages
- Observe the safety interlock features




Radiation Safety Program

Innov-X strongly recommends that organizations using *Delta* analyzers implement a formal *Radiation Safety Program* that includes:

- Dose monitoring of critical personnel.
- Monitoring of area radiation levels.
- Information specific to the site and application of the XRF system.
- An annual review (and update, if necessary).

X-Ray Safety

X-ray safety is a priority at any time and in any testing situation.

	WARNING
	<ul style="list-style-type: none">• Innov-X analyzers must be used by trained and authorized operators, according to proper safety procedures. Improper usage may circumvent safety protections and could potentially cause harm to the user.• Heed all warning labels and messages.• DO NOT USE the instrument if there is any chance that it is damaged or might leak radiation. In such a case, arrange for qualified personnel to perform a radiation safety test and repair any analyzer damage.

General Precautions

Apply these general safety guidelines when managing or operating the *Delta* instrument:


- Retain and follow all product safety and operating instructions.
- Comply with all warnings on the product and in the operating instructions.

Comply with the precautions listed in this section to reduce the risk to:

- Users
 - Physical injury
 - Electric shock
 - Radiation exposure
- Equipment damage
 - Measurement window
 - Overheated electronics and other internal components

Service Considerations

Except as expressly noted here, do not service any Innov-X product yourself. Opening or removing the external housings may expose you to electric shock and the instrument to mechanical damage. It also voids the warranty.

	CAUTION
	If service is required, it must be performed by Innov-X or its authorized service representatives. Failure to observe this can result in loss of warranty. The ONLY EXCEPTION is replacing a damaged measurement window (see <i>A5. Window Replacement</i> ”).

Damage Requiring Service

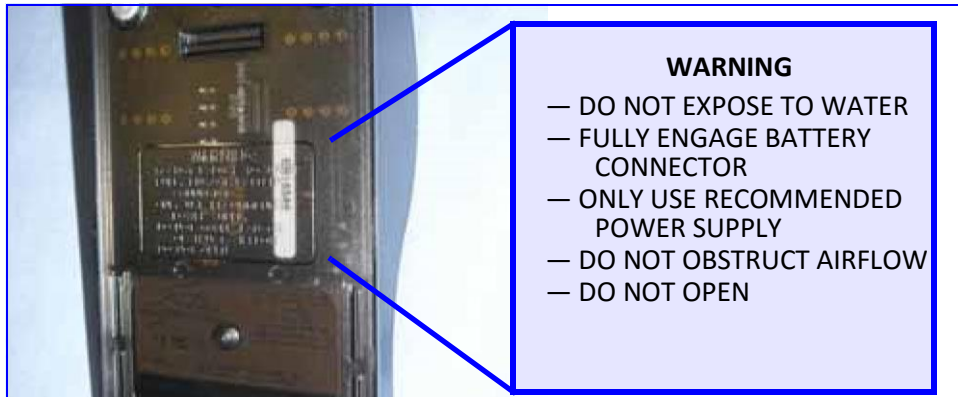
Types of problems or conditions that require service are (*but not limited to*):

- Power cords are damaged.
- Excessive or corrosive liquids spilled on the instrument or accessories.
- Instrument impacted, dropped, or physically damaged.
- Noticeable signs of overheating.
- Instrument or docking station does not perform normally when you follow the usual operating instructions.

Electrical Precautions

Guidelines for safe electrical operation of a *Delta instrument*:

- Use the correct battery or AC power adapter.
- Install the battery or AC power adapter carefully, don't damage connections.
- Use the correct external AC power sources for the Delta Docking Station (DDS) (battery charging and Cal Checking) and the AC power adapter:
- Ensure that the voltage is appropriate (100V-240 V/ 50-60 Hz) for operating either accessory.
See "[A3. Specifications](#)" for electrical specifications.
- Do not overload an electrical outlet, power strip, or convenience receptacle.
- Do not exceed 80% of the branch circuit rating.
- Comply with the warning messages on the under side of the Battery Charger.
- Similar precautions should be observed for the Delta Docking Station (DDS).



Cables and Cords

The *Delta* instrument and docking station is delivered with:

- AC power adapter (1) for Docking Station (standard)
- AC power adapter (2) as battery replacement for instrument (optional) Each device has a standard IEC 3 conductor power cord which includes a safety grounding plug.
- If necessary, have an authorized individual replace these plugs to conform to local conventions.

Two data cables are supplied:

- Data cable (1) with connectors — USB A to USB B
- Data cable (2) with connectors — USB A to mini USB B

Cable Guidelines

Use these guidelines to ensure safety and proper equipment performance:

- The power cords **MUST** be connected to a properly grounded and easily accessible power outlet.
- Use a surge protector device, if possible.
- Do not defeat or bypass the ground conductor.
- Do not pull on cords or cables. Grasp the plug housing when removing the cord from the electrical outlet.
- Install all cords in accordance with applicable regulations.
- If you substitute a USB cable, ensure that the length doesn't exceed 10 feet.

Delta Docking Station (DDS) and Li ion Battery Packs


Plug the Delta Docking Station (and optional battery charger, if utilized) into a grounded electrical outlet that is easily accessible at all times.

- To handle battery packs properly do not:
 - Disassemble
 - Crush
 - Puncture
 - Short external contacts
 - Dispose of in fire or water
 - Expose to temperatures higher than 60 °C (140 °F).

Indicator and Warning Lights


Power Switch w/ Integral Indicator Light

The Delta power switch is located at the upper rear of the unit.



POWER ON

- Press the I/O switch to turn on the power.
 - A green LED indicator comes on.
- This switch **DOES NOT** turn on the x-ray tube.
 - No tube power supplied until the Innov-X software is launched and a test is initiated.





POWER OFF

- Press and hold switch for 3 seconds.
 - Unit powers off. (See page 36 for more Exit options)

X-Ray Indicator Light Array

An indicator light array (six red LEDs) alerts the operator when the tube is receiving power, and when x-rays are emitted from the analyzer through the measurement window.





- When the unit is initially powered ON, the Indicator array remains Off.
- As test is conducted, array is in **flashing** state.
- At the test's conclusion, the array **stays continuously** until the beginning of the next test.

X-Ray Indicator ON (*Blinking*)

When the indicator array is flashing, this signifies:

- X-ray tube is powered to full operational level
- Internal filter wheel is in operational position
- Analyzer is emitting x-ray radiation through the analysis window.

In this condition, the analyzer must be pointed at a test sample.

X-Ray Indicator ON Continuously (*Not Blinking*)

When the indicator array is on continuously, this signifies:

- X-ray tube's current is set to 0.0
- X-ray tube is producing a minimum level of x-rays
- Internal filter wheel is closed so there is no radiation exposure to you or bystanders.

The instrument is *safe* to be carried or set down in this condition.

Back of Analyzer



Navigation Buttons

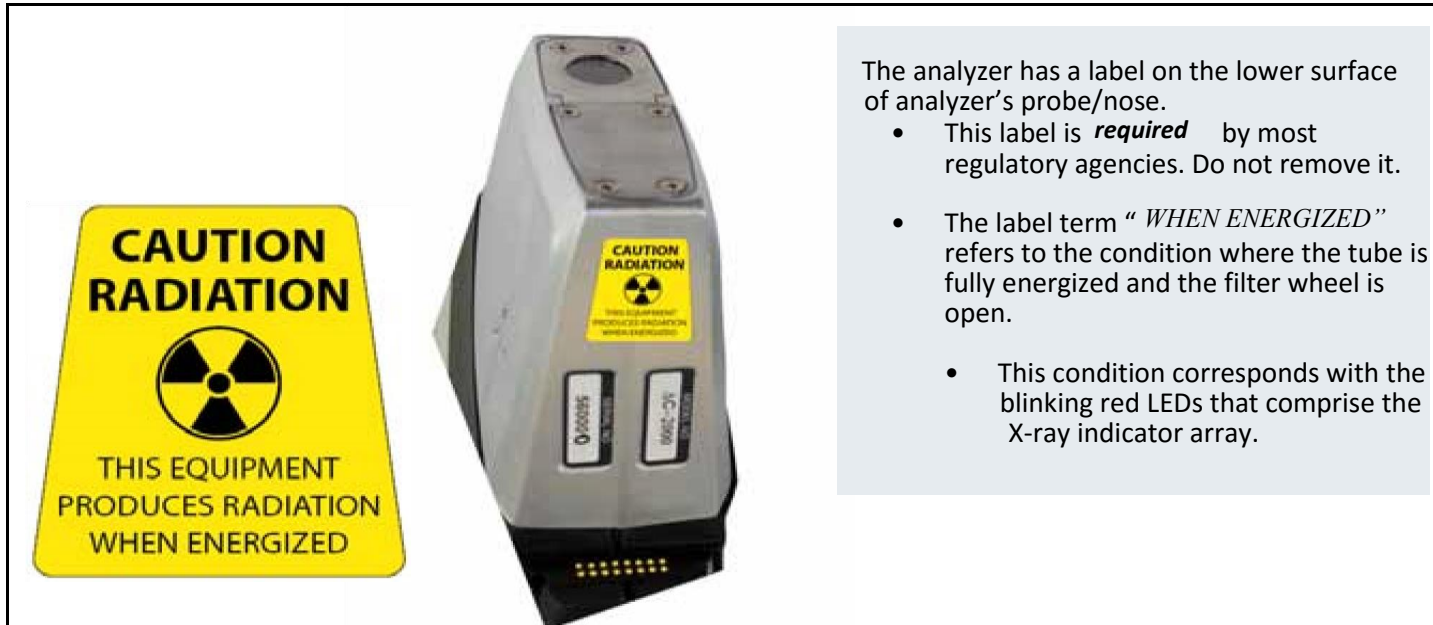
In addition to the I/O switch and the X-Ray indicator array, the back of the Delta analyzer has:

- **Touch screen** which displays and controls the Delta User Interface.
- **Three Navigation Buttons** below the screen. They permit the user to conveniently step through the Test Results Spectrum screens.



X-Ray Label

The Delta has a warning label affixed to the lower surface of the probe.



The analyzer has a label on the lower surface of analyzer's probe/nose.

- This label is **required** by most regulatory agencies. Do not remove it.
- The label term "*WHEN ENERGIZED*" refers to the condition where the tube is fully energized and the filter wheel is open.
- This condition corresponds with the blinking red LEDs that comprise the X-ray indicator array.

Other Safety Features

Proximity Sensor


The Delta automatically detects when it is engaged with a test sample. It immediately shuts off the X-ray tube if:

- (a) Initially there is no sample in front of the window,
— or —
- (b) Instrument is pulled away from the sample before the test time has expired.

Safety Interlock Structure

For controlling the Delta's X-ray emissions and therefore minimizing the possibility of accidental exposure, there is a standard safety interlock structure consisting of the three features listed below.

Software Trigger Lock

- If five minutes elapse between tests (default time), the trigger locks automatically and you must tap on the lock icon  to unlock it. See Safety Software instructions in "*Delta User Interface Guide*".

Software Proximity Sensor

- Within two seconds of a test start, the analyzer detects a sample in front of the measurement window. If not, the test aborts, the filter wheel closes, and the x-rays shut off. The tube is placed in standby and the red light stops blinking.

Safeguards

As an owner of an Delta handheld XRF instrument, your safeguards are:

- A. Limited Access
- B. Trained Operators
- C. Shielding Issues

A.Limited Access

Keep the instrument in a controlled location, where only trained and authorized users are likely to have access.

B.Trained Operators

Keep a sign with the analyzer indicating that in order to use it an operator must have completed a training class provided by your company, or must have attended an Innov-X training course and completed any other requirements as dictated by the local regulating authority. When the Innov-X system is turned on, the controller screen displays a message indicating that the system should only be used by authorized personnel.

C. Shielding Issues

Background

The Delta emits a tightly collimated beam of X-ray radiation. The beam projects many meters when only air attenuates it.



NOTE

Refer to governing regulations on compliance in the jurisdiction installed, dose limits, etc. Requirements differ from state to state, region to region, country to country. *DO NOT* rely solely on this manual for instruction.

Action

Adequate shielding is achieved by:

- Establishing a *no-admittance zone* sufficiently distant from the instrument's measurement window that allows air to attenuate the beam.
- Enclosing the beam working area with *protective panels* (for example, 1/8" stainless steel can attenuate the beam to background levels)

Contact your Innov-X Systems representative for assistance and suggestions on interlocks and applications for limiting radiation exposure.

Instrument Usage Scenarios

The Delta is used in several testing configurations. Obey the guidelines listed below.

Practical Safety Guidelines for Handheld Analyzers



WARNING

- DO NOT POINT the unit at yourself or any other person during operation.
- Never perform a test by holding the sample with your fingers or in the palm of your hand.
- Always wear both a ring-style and a badge-style dosimeter.

Correct Usage

Test in Place

Test targets can include pipes, valves, large pieces of scrap metal, soil, or any sample large enough to be tested in place.

In this configuration the proper procedure is as follows:

1. Always observe the relevant parts of the *Practical Safety Guidelines* shown above.
2. Point the instrument at the sample such that *no part* of your body (including hands and/or fingers) is near the measurement window.
3. Ensure that the Delta's nose (with window) is firmly placed on the target.
4. Perform the test using one of these methods:
 - Tap **Start** on the UI
 - or –
 - Pull the trigger (this toggles the instrument to ON state)
 - or –
 - Pull-and-hold the trigger with the “deadman trigger” active.

Employing Steps 3 & 4 assures that no operator's body part is exposed to an excess radiation dose. The radiation detected at user interface areas is < 5 $\mu\text{Sv/h}$.

Take care that during testing, personnel are not located within three feet (one meter) of the Delta's probe head, in the direction of the x-ray beam. Provided the window is completely covered, there is minimal radiation being emitted around the area of the sample.

Small Component Testing

Examples of small component targets include metal turnings, weld rod, wires, fasteners, nuts and/or bolts.

For analysis of these types of components, use this procedure:

1. Always observe the relevant parts of the *Practical Safety Guidelines* shown above.
2. Place the sample on a flat surface.
3. Carefully place the nose/window over the sample.
4. Perform the test using one of these techniques:
 - Tap **Start** on the UI
 - or –
 - Pull the trigger (this toggles the instrument to ON state)
 - or –
 - Pull-and-hold the trigger with the “deadman trigger” active.

1. Sample lying on a flat surface



SAFETY PRECAUTIONS

WARNING



Do not test samples while sitting at a desk or table. If the desk is made of wood or another non-metallic material, some radiation will penetrate the desk and may provide exposure to legs or feet.

ANALYTICAL PRECAUTIONS

NOTE



If the sample does not completely cover the window, ensure that your *background surface* does not contain metals or even trace levels of metals, as this may affect the accuracy of the XRF result. The XRF may report the presence of additional metals in the surface material.

2. Clamp-held sample



NOTE



A handheld plastic locking clamp can be an effective and safe tool when analyzing small, irregular shaped samples.

Incorrect (Unsafe) Usage



WARNING

Never hold a sample in your hand such that any part of your body or appendages are exposed to the x-ray beam. Testing samples in this way may generate significant radiation exposure to your fingers.



The sample is held up to the measurement window with fingers. The sample does not completely cover the window.
Even though the analyst is wearing a ring dosimeter, this is an unsafe testing technique.
Here, the only value that the ring provides is to validate the level of unnecessary radiation exposure that has been experienced.

The sample is held up to the measurement window with fingers. The sample does not completely cover the window.
To compound the danger, the analyst is not wearing a ring dosimeter.
There is no measure of the radiation exposure endured.

Summary

InnovX repeats the Warning ---

NEVER hold a sample in your hand.

Testing samples in this way generates significant radiation exposure to your fingers.

Complying Agency Statements

United States of America: FCC

Changes or modifications not expressly approved by Innov-X Systems, Inc. could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio

frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Radiation Doses for Several Scenarios

In this section we provide data, concrete examples of use and misuse of the analyzer and common questions and answers we encounter when training personnel on the safe use of the Innov-X analyzer. The goal is to explain scenarios of safe versus improper usage.



WARNING

For the x-ray energy emitted by portable XRF analyzers (8-60 keV region), the bone in the fingers will absorb radiation about 3-5 times more than soft tissue, so the bone would be at an elevated radiation risk compared to soft tissue.
For this reason, no person shall hold a test specimen in front of the window with the fingers in the direct beam, or direct the beam at any part of the human body.

Reference: *Health Physics* 66(4):463-471;1994.

The table below presents radiation doses for normal operating conditions and also for examples of misuse of the analyzer and even extreme misuse. Innov-X provides installation training that includes detailed radiation safety training and documentation designed to prevent misuse of the analyzer.

Although the doses shown below are derived from experiments with TLD (thermo-luminescent dosimeters) and may or may not represent actual absorbed dose in human tissue and bone in each scenario, they are examples of the level of x-ray radiation being emitted from the device.

The message is simple:

USE CAUTION AND PROPER TECHNIQUE when operating the device.

Example: Instrument Usage	Radiation Exposure and Comments
<p>Normal Operation- Dose to Hand</p> <p>User analyzes samples according to standard operating procedures described in this manual.</p> <p>Assumption: Operator using system with x-ray tube ON for eight hours/day, five days/week, 50 weeks/year. (Alloy sample).</p>	<p>Maximum exposure is to operator's hand, at the trigger is < 1μSv/h. Annual exposure to hand is then < 2mSv.</p> <p>Maximum exposure under ICRP regulations is 500 mSv for radiation workers and 50 mSv for the general public. Thus continuous operation provides a dosage 250 times lower for a radiation worker and 25 times lower for the general public.</p>

<p>Normal Operation- Dose to Torso</p> <p>Analyzer is used under the same operating conditions described above.</p>	<p>Exposure to Torso is so low it cannot be measured (essentially background). To be conservative we use 1/2 the value as the trigger, < 0.5µSv/h.</p> <p>Annual exposure using operating conditions above is then estimated at less than 1 mSv.</p> <p>Maximum allowed is 20 mSv under ICRP for radiation workers (1 mSv for general public).</p>
<p>Misuse Example 1:</p> <p>Operator holds samples in front of window with fingers, such that fingers are directly in the primary beam. Presumption is sample does not block any radiation.</p> <p>Do not do this!</p>	<p>At the window, in the primary beam, the maximum dose to the fingers is 20,000 mSv/hr.</p> <p>Assume an operator performs a 10 sec. test (typical). The dose to the operator's fingers or hand is $20,000 \times (10/3600) = 550$ mSv. If the operator did this just once a year he would exceed the allowable annual dose of 500 mSv to an extremity.</p> <p>Take the extra time to test a sample on a surface or use a testing stand.</p> <p>Note: If the operator takes a shortcut and places his/her fingers within the primary x-ray beam at the window, they will exceed the annual dose rate.</p>
<p>Misuse Example 2:</p> <p>Operator places analyzer against body and pulls the trigger to start a test. Analyzer tests to preset testing time (usually ten seconds) unless operator pulls trigger again to stop test. This applies to analyzer being in contact with operator or with bystander.</p> <p>Do not do this!</p>	<p>Dose at exit of sampling window is 20,000 mSv/h.</p> <p>Dose for a ten second exposure with analyzer in contact with Torso: 550 mSv.</p> <p>If an operator did this act just once, he would exceed the annual safe dosage to the torso of 20 mSv/year by a significant amount!</p> <p>PLEASE NOTE:</p> <p>The maximum dose of 20 mSv/year is a whole body limit, which does not truly apply in this case because the x-ray beam size is small (about 25 mm² area at the port). Applying correction factors for the beam size is complex and beyond the scope of this manual. The important point is that for proper operation there is no reason to ever expose any part of the human body directly to the x-ray source. This example serves to provide estimated exposure in the event this occurs.</p>

Misuse Example 3:

Operator manages to initiate a test for ten seconds running normal soil mode and exposes a bystander that is standing ten cm away from analyzer port. What is exposure to bystander?

Note: The proximity sensor would automatically shut down the x-ray tube immediately, so this is an extremely improbable occurrence. It would require a malfunction of the instrument - this safety feature is NOT modifiable.

Note 2: Equations to scale these to other scenarios involving longer or shorter tests, and bystander being at distances other than ten cm are provided at right.

Comparative Analysis:

Radiation Doses from Typical Exposures to Ionizing Radiation

Activity	Typical Dose
Smoking	2.8 mSv per year
Dental x-ray	100 μ Sv per x-ray
Chest x-ray	80 μ Sv per x-ray
Drinking water	50 μ Sv per year
Cross country round-trip by air	50 μ Sv per trip
Mammogram	1-2 mSv per examination
Yearly exposure from background* radiation * depends on geographic location	3.6 mSv

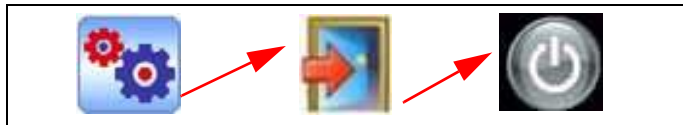
Analyzer Shut Down

There are several techniques for shutting off the Delta. They can be categorized by whether the action is taken under normal or emergency conditions. *Shut down* or *turned off* is defined as: *The analyzer cannot provide X-ray emissions.*

Under normal conditions

Use one of following actions:

- Press the trigger.
- Tap **STOP** icon on the UI touchscreen.
- Navigate from **Setup > Exit**, then choose the Power OFF icon.



- Release the trigger if in “Deadman Trigger” mode.
- Press the I/O power switch; ensure that the On/Off LED goes off.

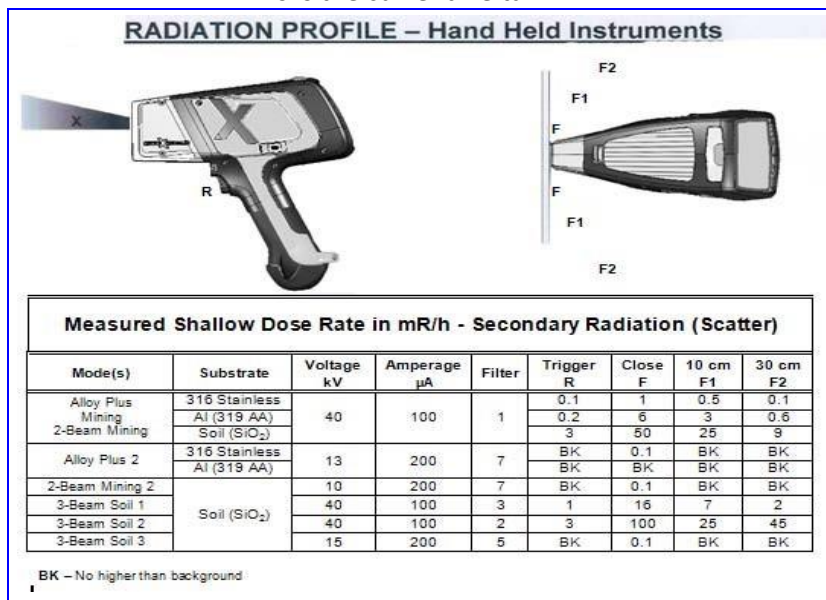
In an emergency

Because the Innov-X system is a battery-operated, x-ray tube-based analyzer, the Emergency Response plan is simple. If you believe that the analyzer is locked up in an *OPEN* position, the red X-ray indicator array remains illuminated or blinking:

1. Press the I/O power switch as noted above. If the power does not turn off, continue to Step 2.
2. Open the battery cover and immediately remove the battery. If you are using the AC Power Adapter:
 - Remove the Battery Eliminator from the Delta’s handle– or –
 - Pull the AC cord from the AC Power Adapter or pull the plug from the receptacle.

Delta Radiation Profile

This is the current Delta



Safety Administration

Provides information regarding:

- Radiation safety training recommendations
- Dosimeter badges
- A typical dosimeter monitoring program
- Dosimeter service contractors
- Typical registration requirements for operating XRF equipment (in the USA)

Radiation Safety Training Recommendations

Individual companies and states have specific regulations and guidelines for using ionizing radiation generated by an X-ray tube.



NOTES

For the convenience of clients, Innov-X has compiled a list of recommendations that:

- Provide generic guidance for an ALARA (*as low as reasonably achievable*) approach to radiation safety.
- Do not replace the requirement to understand and comply with specific policies of any state or organization.

Personal Monitoring

Radiation control regulations may require implementation of a radiation monitoring program, where each instrument operator wears a film badge or TLD detector for an initial period of one year to establish a baseline exposure record. Continuing radiation monitoring after this period is recommended, but may be discontinued if accepted by radiation control regulators. See *Dosimeter Suppliers* for a list of film badge providers.

Proper Usage

Never point the instrument at a person. Never point the instrument into the air and perform a test. Never hold a sample in your hand during a test.

Establish Controlled Areas

Restrict access to the location of instrument storage and use to limit potential exposure to ionizing radiation. In use, the target should not be hand held and the area at least three paces beyond the target should be unoccupied.

Specific Controls

When not in use, store the instrument in a locked case or locked cabinet. When in use, keep it in the direct control of a factory trained, certified operator.

Time - Distance - Shielding Policies

Operators should minimize the time around the energized instrument, maximize the distance from the instrument window, and shoot into high density materials whenever possible.

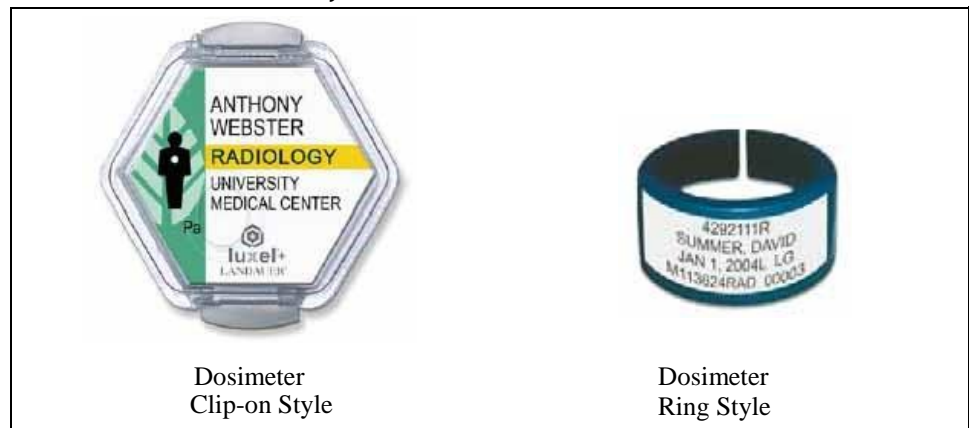
Prevent Exposure to Ionizing Radiation

All reasonable measures, including labeling, operator training and certification, and the concepts of time, distance, & shielding, should be implemented to limit radiation exposure to *as low as reasonably achievable* (ALARA).

Dosimeter Badges

A dosimeter badge consists of a radiation-sensitive material, generally an aluminum oxide crystalline layer, which is worn in a small container. It is most often attached to a person's clothing, on a belt loop, or shirt pocket. It is worn on the body in location(s) that most closely simulate the pattern of potentially absorbed dose.

The protection can also be provided in a plastic ring format. Here the detection material is lithium fluoride crystal.



These devices record a person's accumulated radiation exposure over a period of time. They monitor individuals working with, or near someone working with devices which emit ionizing radiation.

Dosimeter badges are required by some regulatory agencies, and are optional with others.

Innov-X recommends that (at a minimum) all *Delta* operators wear badges (both clip-on and ring styles) for the first year that their system is in use.

NOTE



- When purchasing a badge or ring, always select the type used for X-ray and low energy gamma radiation.
- Innov-X suggests that the ring badge be worn on a finger of the *opposite hand* used to hold the analyzer. This records accidental exposure for the most likely case: An operator grabbing a small sample and holding it in a hand while analyzing it.

Every country (including every region, state, or province within a country) can have differing regulations. Always consult your local radiation protection authority or Innov-X Systems for information and recommendations.

Dosimeter Safety Program

A typical dosimeter-based safety program uses the following steps:

1. The company develops a dosimeter program with an independent service contractor.
 - They establish the quantity of badges needed and the frequency of analysis (a monthly or quarterly interval)
2. The company receives the first lot of badges and provides them to their analyst/operators.
3. At the end of the interval:
 - The company collects the badges and returns them to the service contractor for analysis.
 - Simultaneously, the service contractor delivers another lot.
4. The company provides the new set of badges to maintain a continuous protection /monitoring program for their employees.
5. The service contractor prepares a report for the company that tabulates any X-ray dose received and identifies any personnel with readings higher than typical background radiation.
6. The safety monitoring cycle repeats with Steps 1 through 5.



NOTE

The service contractor's written records are very important to a company's overall safety documentation plan.

Dosimeter Suppliers

Some dosimeter service companies are:

Company	Location	Telephone
AEIL	Houston, TX	713-790-9719
Global Dosimetry Solutions	Irvine, CA	800-251-3331
Landauer	Glenwood, IL	708-755-7000
• Landauer, Inc.	Oxford, England	+44-1 86-537-3008
• Nagase Landauer, ltd.	Japan	+81-3-36 66-4300
• LCIE Landauer	Paris, France	+33-(0)1-40 95 62 90
• Landauer	Beijing, China	+86-10-62 21 56 35

Registration Requirements

Contact Innov-X for assistance with locating registration requirements information.

- Most states require some form of registration. Generally they require the registration to be received within 30 days of receipt of the system.
- Some states require no registration.
- Some states require notification in advance.

Customers are advised to consult their local radiation protection authority for specific regulatory information.

Typical Device Registration Information

The following information is usually requested by a licensing agency:

Purpose of device:

Response is *Analytical or Industrial*.

Be sure to inform the government registration office that the system will NOT be used for radiography or for medical uses.

Radiation Safety Officer:

List person who monitors training, safe use, and controls access to the system.

Authorized Users:

List the analyst/operators who have been trained and authorized by the instrument owner and/or regulating agency to operate the XRF equipment.

Operating parameters of the Delta XRF analyzer:

8– 40 kV, 5 - 200 uA max.

Type of system:

Response is: *Handheld/Portable*

User Training Specified:

Indicate that only individuals receiving manufacturer training, **documented by a manufacturer's training certificate**, will operate the system. Additional training may be required. Verify with the local regulating agencies the level and type of training required.

Personal Monitoring

Many government agency registration forms require that you indicate whether or not you intend to perform dosimeter monitoring.

See “Dosimeter Safety Program” on previous page for information regarding typical personal radiation monitoring.



CAUTION

Always keep the following documentation at the job site:

- Copy of *License Registration*
- Other pertinent *government agency* documentation • Copies of any *dosimeter analysis* reports
- Copy of this equipment's *User Manual*.

Operations

This chapter provides information regarding:

- Configure the Delta Docking Station (DDS)
- Use DDS for Initial Cal Check
- Operation - General
- Start Up Procedure
- Snapshot of Delta User Interface
- Typical Test Procedure
- Ending Test Operations
- Battery Issues
- Additional Cal Check Information
- TIPS - Things You Should Know About the Delta

Safety First !

As emphasized in *“Safety Information,”* it is a priority to keep the analyzer operator’s safety in mind at all times.

- Operators, ***before turning on the analyzer or using the Delta Docking Station,*** should review the safety procedures (*“Safety Information”*).

Set Up and Use the Delta Docking Station



Background

The Delta Docking Station (DDS) provides several key functions:

- Supports an automatic or on-demand Cal_Check procedure
- Charges the “Main” battery located in the instrument’s handle
- Simultaneously charges a “Spare” battery in an auxiliary socket
- Provides control information so that both batteries’ status can be monitored
- Allows data communication from the Delta to a PC via a powered USB cable

The first phase for preparing to operate a Delta involves:

1. Configuring the DDS with its power and communication cables
2. Using the DDS to support the Delta’s initial:
 - a. Start up sequence, and
 - b. Cal Check procedure.

	NOTE A new instrument is shipped with two fully charged Li Ion batteries. Therefore, prior to initially using the analyzer, it is not necessary to charge a battery.
	GO TO • See Pages 45 and 50 for battery information, including charging, changing, determining status, and Hot Swap techniques. • See Page 51 for Cal Check background information.

Configure Delta Docking Station



Rear View - DDS



PN 103209 & PN 103210
Powered Hub USB Cable Assembly



Power Adapter for DDS

Configure DDS with this procedure:

1. Plug the AC power adapter's line cord (1) into suitable AC outlet.
2. Plug the AC power adapter's DC jack (2) into the 12Vdc socket on the rear of DDS
3. {Option at this point: Powered USB cable assembly
 - Insert connector B (3) into DATA port
 - Insert connector A (4) into USB port of PC

Use the Delta Docking Station for Charging Batteries

The Delta analyzer has a multi-purpose standard accessory: the **Delta Docking Station** or **DDS**.

In addition to providing an automatic Calibration Check, the DDS delivers **two** charging functions:

1. It charges the installed “Main” battery in the instrument’s handle.
2. Simultaneously, it charges a spare or “Dock” battery when its inserted into the special auxiliary charging **socket**.

Charge status is shown in real-time on the Delta’s display screen.

The second docked battery’s status is also shown by the battery icon located on the rear left side of the DDS.

(either “charging = red” or “full = green”)



Battery Status Screen

Delta Docking Station Procedure for **Battery Charging Functions**:

Ensure that the DDS has DC power cable installed
See [page 44](#)

1. The Icon lights are Off {1} With Delta Off, place instrument in cradle.
2. Take care that Analyzer Icon comes On (Green) {2}
The main battery in the handle is charging although there is no indicator.
If Delta On, the Battery Status Screen appears
3. Place a spare battery in the auxiliary socket
4. Battery Icon is On (Red - unless fully charged) {3} Both batteries will charge; their real-time charge status is displayed.
5. When both batteries are fully charged, the Icons display
6. Green. {4}



Cradle



Delta Docking Station Procedure for **Automatic Cal_Check**

Ensure that the DDS has DC power cable installed
See [page 44](#)

1. The all Icon lights are Off {1} With Delta On, place instrument in cradle.
Take care that Analyzer Icon comes On (Green) {2}
2. Battery Status screen is displayed.
Ensure that the Battery Status screen stays On.
3. Do not exit this screen --> the automatic Cal_Check function will not work.



Use the Delta Docking Station for Startup - Initial Cal Check



DDS w/Empty Cradle



DDS w/Premium Delta in Cradle



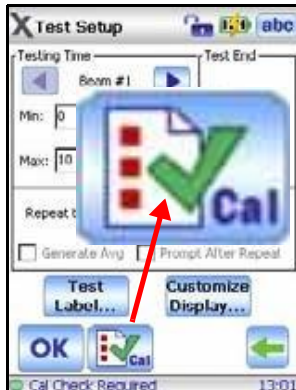
1. Place analyzer into the Delta Docking Station cradle. Ensure that the Delta indicator light is ON. This signifies that the instrument is properly seated in the cradle.
2. Press analyzer's I/O switch (>1 second to turn it ON.)



DDS - Indicator Light
Delta is engaged in cradle

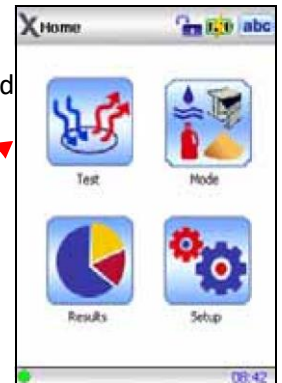


Radiation Safety **NOTICE** appears after a few seconds.



3. Read and respond to notice
Tap **START** to acknowledge that you are a certified user.
The UI begins its launch with the following messages:
Initializing System
Starting System
Loading Files

4. Unit displays **Test** screen using the Mode last selected
4a. If the mode should be changed, go to **Home** screen.
4b. Select the Mode button
4c. Choose the desired Mode



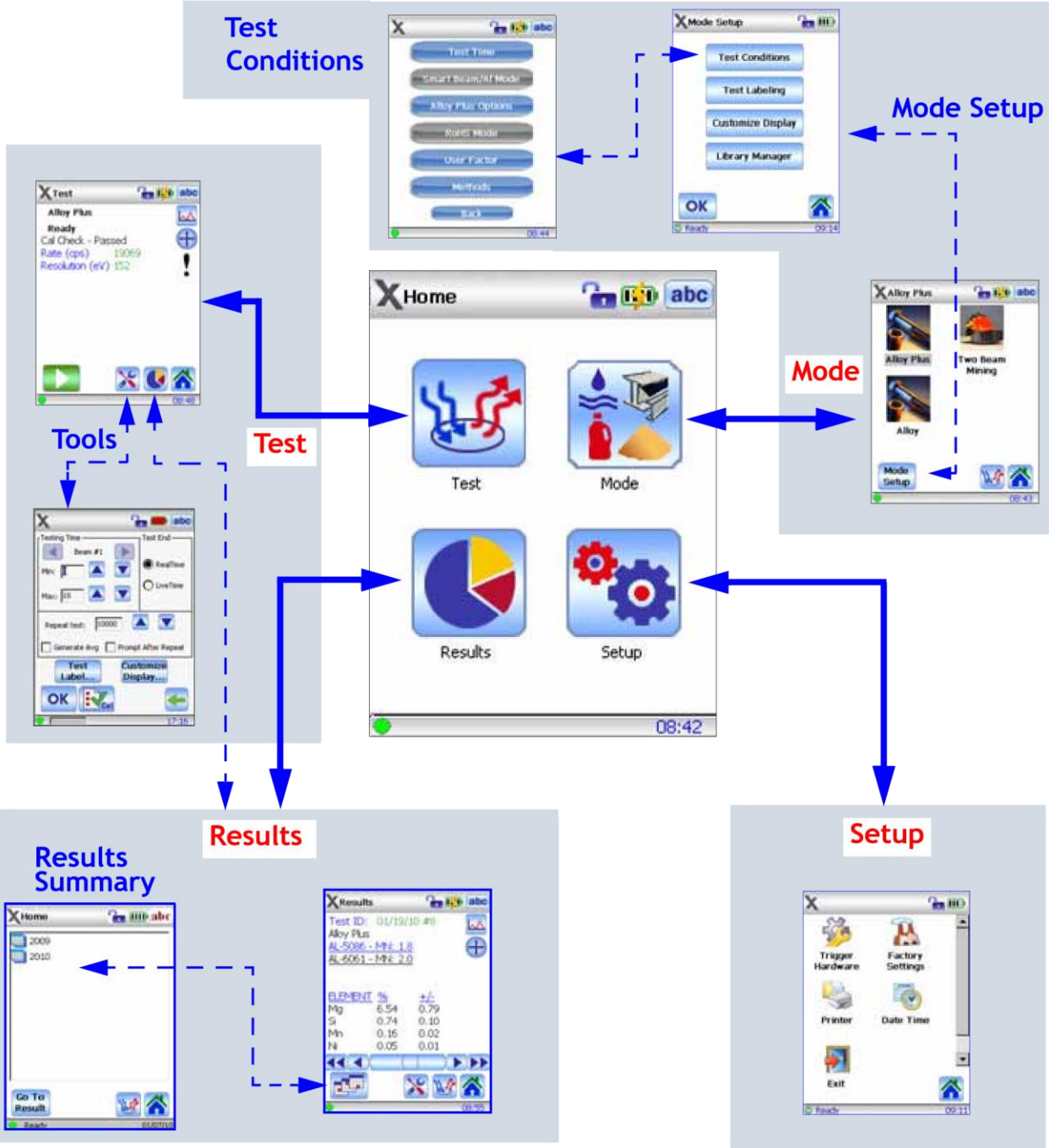
5. Return to **Test** (now with your selected Mode)
Note that message **Cal Check Required** is present.



6. Choose **Tools** icon:
This launches **Test Setup** screen with Cal_Check button
7. Tap **Cal_Check**
If necessary, unlock the **trigger** with the icon at top of screen.
Procedure begins immediately; it concludes in about 15 seconds.
8. Message **Cal Check - Passed** means you may begin testing.
Message **Cal Check - Failed** will give error message, such as "Wrong Count Rate"
Re-try the procedure
If unit fails repeatedly, contact InnovX service or your local distributor.

SNAPSHOT of Delta's User Interface

The Delta's user interface is introduced by the startup Radiation Safety and Initialization screens. Main operations then revolve around the Home screen.



Typical Test Procedure

Background

Details of routine testing operations vary depending on the selected analysis mode. Some relevant modes for Delta XRF users are:

<ul style="list-style-type: none"> Alloy Modes <ul style="list-style-type: none"> –Alloy Plus –Fast ID & Pass/Fail –Precious Metals 	<ul style="list-style-type: none"> Mining Modes <ul style="list-style-type: none"> –Two-Beam Mining –Mining –Car Catalyst 	<ul style="list-style-type: none"> Soil Modes <ul style="list-style-type: none"> –Environmental –Exploration 	<ul style="list-style-type: none"> Consumer Goods <ul style="list-style-type: none"> –RoHS –Consumer Products
--	--	--	---

For the test sequence (below) the instrument has:

- Mode selected (Soil 3 Beam), and
- Cal Check procedure successfully completed.

To conduct a typical test:

1. Remove the instrument from the Delta Docking Station. Place the measurement window flush against the sampling area. Ensure the sampling area is covered by the window.



WARNING

Do not point the unit at yourself or any other person during operation. Do not test small samples in your hand. Place them on a surface for testing. See [C2, Safety Information, Pages 29-31](#) for examples of safe and unsafe testing techniques.

2. Use one of these techniques to initiate the X-ray beam:
 - a. Tap Start Test (Green Arrow Icon), or
 - b. Pull the trigger (toggles unit ON); can release the trigger during the test, or
 - c. Pull-and-hold the trigger (deadman trigger function is enabled)
 This is a mandatory technique in Canada. Trigger options are configurable from:

Setup > Trigger Hardware > Trigger Settings

The Test screens are as follow:

The figure displays three sequential screenshots of the XRF software interface:

- Left Screenshot:** Shows a table of detected elements and their concentrations in PPM. A green progress bar is visible at the bottom.

Detected	PPM	+/-
Ti	2651	134
Mn	449	28
Fe	24004	258
Co	10	1
Cu	98	7
Zn	308	8
Rb	104	2
Sr	226	5
Zr	248	5
Cd	44	6
Sb	49	12

 Status: Elapsed 23 sec Em #2 16:35
- Middle Screenshot:** Shows the same table of detected elements, but the progress bar is complete. The status at the bottom is "Ready 16:30".

Detected	PPM	+/-
Ti	2605	110
V	239	66
Mn	481	23
Fe	24448	215
Co	10	1
Cu	97	6
Zn	309	7
Rb	108	2
Sr	236	5
Zr	244	5

 Status: Ready 16:30
- Right Screenshot:** Shows a spectrum plot with two peaks labeled "Beam1" (red) and "Beam2" (green). The x-axis is "Energy keV" (0 to 40) and the y-axis is "Counts/s" (0 to 150).
 Status: 7.8 counts @ 2.41 keV, Counts/s 04/29/10 #22, Ready 16:31

Test results with progress status bar

Test result complete; Elements are listed

Spectrum screen for this result (ID: 4/29/10 #22)

End of Day Operations

Save Results

When finishing testing for the day (or shift, or current session) InnovX recommends that test results be saved (e.g. exported) to a PC.

A necessary prerequisite is a DATA connection between the analyzer and PC.

This connection is made in one of two ways:

- Analyzer in DDS cradle – use the powered hub USB cable assembly (PN 103209 and PN 103210) from the DDS' rear Data port to a USB port of the PC
- Analyzer NOT in DDS cradle – use the mini USB B to USB A (PN 101310) cable from the analyzer's Data port to a USB port on the PC

The UI operational sequence is:

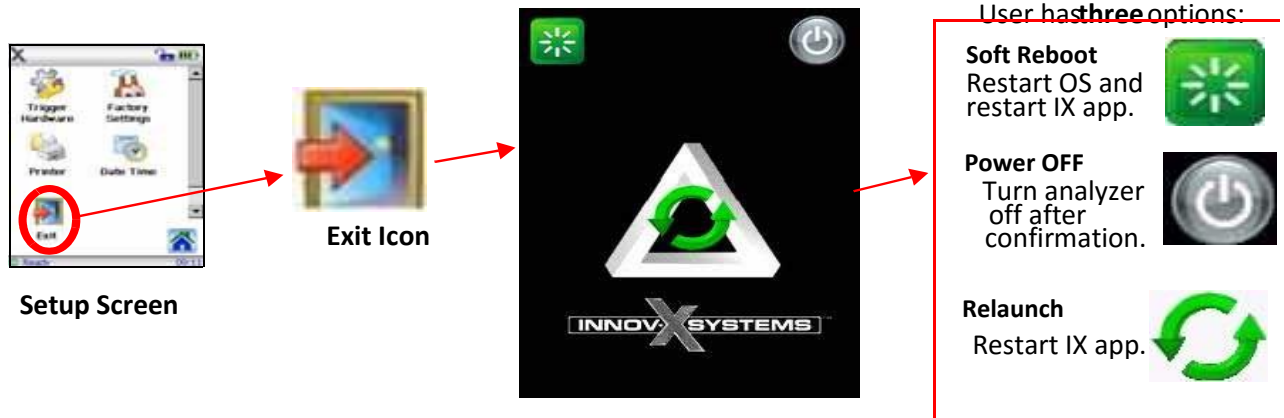
1. Navigate from **Home > Results > Calendar**
2. Select Year, Month, Day listing; it lists the total number of tests for the day
3. Select **Tools**, then **Results Setup**
4. Select the **Export** icon (button)
5. Choose the results to be exported
6. Name the export file (or accept default name)
7. Select Destination to save to
8. Tap the **Export** button The file is exported.
- 9.

Ending Test Operations

When testing and exporting are complete, the user has the following options:

- Turn off Delta with I/O switch or UI (see Exit Options procedure below); store unit in a secure location
- Place Delta in Docking Station and use the "Automatic" option:
- Leave Delta powered ON;
- Ensure that DDS is On (Delta ICON is lit);
- Unit initiates Cal_Check after being idle for five minutes, then every ten hours thereafter.

Exit Option Procedure from UI



Battery Issues

1 — Changing a Battery

To CHANGE the battery:

1. Hold the instrument by the handle, upside down, so the bottom of the instrument base is pointing upward with the nose pointing away from the operator.
2. Pull the rubber latch and lift cover.
3. Remove the existing battery using the tab. A new instrument will **not** have an installed battery.
4. Insert the charged battery into the analyzer with the battery connectors facing to the left. The battery slot is keyed so that the battery can be inserted only one way.



2 — Battery Status

To TEST a Li-ion battery's charge status:

EXTERNAL battery test —

1. Push the white button on the battery. The green lamps indicate the percent of charge, from less than 25% to 100%.
2. If a battery has a charge of less than 25%, use the Delta Docking Station to establish a full charge. See [Page 45](#)

INTERNAL MAIN battery test —

1. The battery icon from any UI screen (upper right side) shows an approximate value of charge.
2. Tap the battery icon and a more precise charge percentage is displayed as a number.



3 — HOT SWAP for Delta Battery

A battery HOT SWAP capability is a **standard feature** with the Delta analyzer. An operator can remove and replace a battery without having to shut down, restart, or Cal Check.

When the battery is removed:

- A "Shutdown" status display gives the percentage of internal charge remaining.
- If the internal charge reaches 0, you have to re-start the unit with the I/O switch, after inserting a fresh battery.
- If red X-ray indicator lights flash, the battery voltage is too low.



Cal_Check Information

Cal_Check Facts

Question: What is involved with the Cal_Check procedure?

Answer: The analyzer:

- Collects a spectrum on a known standard (Alloy 316 Stainless Steel)
- Compares a variety of parameters to values stored when the instrument was calibrated at the factory.
- When comparisons are within pre-set tolerances, the unit determines that it remains properly calibrated.

GENERAL FACTS INCLUDE:

- Cal_Check must be performed when the analyzer requests the procedure.
- The *Start* button and trigger are disabled until a successful Cal_Check is achieved.
- You can run a Cal_Check at any time during *InnovX* software operation, except during a test.
- When Cal_Check is in progress, the x-ray indicator light assembly blinks. This indicates that the X-ray tube is energized and the filter wheel is operational. In addition, a status bar appears on the UI display, showing the percentage completion for the measurement.
- The Cal_Check procedure takes about 15 seconds.

There are two separate techniques:

- **In the test laboratory** - Use the DDS to initiate “on-demand” procedure.

Described above in *“Use the DDS for Startup - Initial Cal Check”*:

Leave Delta powered On and InnovX software running;
Ensure that DDS is On (Delta ICON is lit);
Unit initiates Cal_Check after being idle for five minutes, then every 10 hours thereafter.



Also have the “Automatic” option, as follows:

- **In the field** - Use the Coupon {the procedure is described below)

1. Place the 316 stainless steel Cal_Check coupon on a flat surface.

See *C2. Safety Information, Page 29* for safety measures that must be observed.

2. Position the analyzer’s measurement window flush over the coupon.

3. With the Test Setup screen invoked, tap the Cal Check icon. There are now two techniques to choose from:

- Tap the “Start Test” icon, or
- Pull the trigger (or pull-and-hold if using “Deadman Trigger”)

4. The procedure takes about fifteen seconds.

Cal_Check Procedures



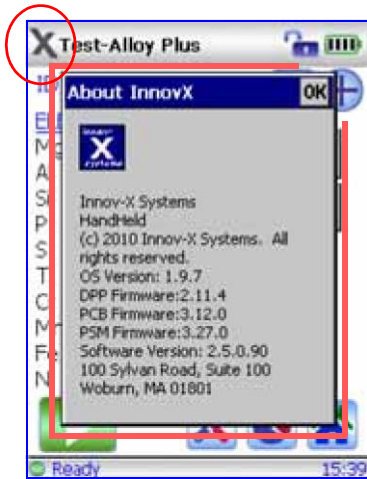
NOTE

Improperly positioning the window over the coupon can result in a failure.

5. When Cal_Check completes successfully, you may begin testing.
6. If Cal_Check fails, ensure that:
 - Coupon is positioned correctly.
 - X-ray indicator assembly is blinking during the procedure.
 - You have waited several seconds before starting the procedure.
7. If Cal_Check fails again,
 - Shut down the Delta software.
 - Shutdown and restart the analyzer.
 - Launch another attempt to Cal Check.

If Cal_Check fails repeatedly, contact Innov-X Systems Customer Service or your local distributor. Contact information is available at appendix [A6. Packing and Shippin](#)

TIPS - or - things you should know about the Delta



System Information

To call information "About InnovX" tap the X (InnovX icon) in upper left of UI screen. This provides various firmware and software versions that are installed on the analyzer.

UI Screen Note

All User Interface screens have a time-out (power saving) feature that causes the screen to go blank after 45 seconds if the UI is not accessed or the unit is not moved.

However, the analyzer is still running.

Restore the screen by tapping it or by moving the instrument.

Battery Status Info #1

When you turn on the instrument and you may not be aware that the battery is low, the X-ray indicator (Red LEDs) flashes dimly and briefly. The unit will not turn ON. Swap out the battery.



Battery Status Info #2

The on-screen battery icon (in upper right corner of UI) shows "real-time" battery charge status in a graphical way.

Tap this icon to receive a numeric value for battery charge level.



Delta Docking Station to Delta Analyzer: Contact Status

Keep the rubber boot attached to instrument when inserting it into the DDS. This helps ensure that the DDS contact pins are engaged.

The DDS analyzer icon (rear left corner) should be ON.

If the rubber boot is not available, and the analyzer icon remains OFF, use a small piece of padding under the handle to ensure contact.

Alloy Analysis Modes

- Alloy analysis for the Delta family includes:
- Wide range of modes and calibrations
 - Outstanding performance for a variety of materials
- There are five Alloy modes/calibrations:

ALLOY

Use with: **ALL Models**



Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, W, Hf, Ta, Re, Pb, Bi, Zr, Nb, Mo, Ag, Sn, Sb

Fundamental Parameters Analysis for metal alloys.
Alloy library including 300+ grade specifications, common tramp limits, **ALLOY** including full editing capabilities.

ALLOY Plus

Use with: **Premier and Standard Only**



Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, W, Hf, Ta, Re, Pb, Bi, Zr, Nb, Mo, Ag, Sn, Sb
PLUS Mg, Al, Si, P

Fundamental Parameters Analysis for metal alloys.
ALLOY PLUS Optimized beam condition for extended light element performance.
Alloy library including 300+ grade specifications, common tramp limits, including full editing capabilities.

FastID

Use with: **All Models**



Spectral signature matching for alloy grade & chemistry calculation.
Full library editing & alloy matching capabilities included.

Pass/Fail

Use with: **All Models**



Spectral signature or **chemistry matching** for alloy grades.
Customer created library with min/max grade specifications.
Full library editing & alloy matching capabilities included.

Precious Metals Additions

Use with: **All Models**

ADDS Ir, Pt, Au, Rh, and Pd to **Analytical Analysis** calibration suite.

Introduction to Alloy Analysis Modes

The Delta family of instruments currently presents six unique modes for alloy analysis. The core analytical analyzer modes/types are: **Alloy mode - Classic** (PiN detector based) type



Alloy Plus mode - Standard (SDD detector based) type
- **Premium** (SDD detector based) type

All three analyzer types can support additional alloy-oriented modes, such as **FastID**

Pass/Fail

Precious Metals (No added details)

Alloy analysis utilizes a Fundamental Parameters (FP) algorithm to determine elemental chemistry. This method calculates chemistry from the spectral data, without the requirement of stored fingerprints. The Analytical FP calibration is done at the factory, and requires no user set-up or recalibration. The software also searches an alloy grade library to produce a grade match based on the calculated chemistry. Analytical mode can provide a **grade ID** and **chemistry** in as little as one second, with increased precision for longer test times.

Alloy mode/Classic type supports Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, W, Hf, Ta, Re, Pb, Bi, Zr, Nb, Mo, Ag, Sn, Sb.

Alloy Plus mode /Standard type and **Premium** type supports light elements Mg, Al, Si, and P in addition to the core list of elements from the Alloy mode.

Standard and Premium units expand the Limits of Detection range permitting operators to analyze these light elements without a vacuum or helium purge requirement.

Both modes have a feature, **Altitude Compensation**, which automatically corrects calibrations based on barometric pressure.

Determination of Grade Identification:

Analytical modes utilize a **Factory Grade Library** consisting of a set of minimum and maximum values for each element in an alloy.

There is a SPECIFIC Alloy Factory Grade Library for EACH Delta model.

See appendix **A8. Alloy Grade Libraries** for a listing of the alloys that are contained in each **Factory Grade Library**.

Additionally, every analyzer is shipped with a “**Tramp**” library comprised of seven base alloys. These seven items with their min/max element values are increasingly valuable to fast and accurate sorting in **Pass/Fail** and **FastID** modes.

The libraries can be searched individually or together. All libraries, including each **Factory Grade Library**, can be edited by the user. However, **InnovX** strongly suggests that users NOT edit the **Factory Grade Library**. Instead, copy the **Factory Grade Library** to a **USER** library, then make any edits on it.

Match Number Concept

After calculating chemistry with the Fundamental Parameters algorithm, **InnovX** compares the chemical composition values to grade tables stored in a grade library. The application calculates the value for a parameter called **Match Number**. This provides an indication of how close the measured alloy's chemistry is to library values.

- The *lower* the Match Number, the *better* the match.

A Match Number of 0 is an *exact match*, meaning that the calculated chemistry for all elements falls within the grade table specifications.

Match Issues

There are three Match determination possibilities provided within the Analytical modes:

EXACT MATCH

An unknown alloy is matched to one of the grades contained in the Grade Libraries, and a *Grade ID* appears on the *Results* screen. Often other grades are listed with their accompanying Match Numbers. The analyst has the opportunity to view their elemental chemistries and see how they differ from an exact match.

MULTIPLE MATCHES

In some cases, several grades are shown as possible matches. This can signify one of two conditions:

- There was not enough statistical information to definitively separate two or more alloys. The actual identification of the unknown alloy is one of the grades listed. Often increasing the testing time makes it possible to separate the alloys.
- There was sufficient statistical information, but the test sample did not meet any of the existing specifications with enough precision to cause an exact match identification.

NO MATCH

If no matches are found within the libraries, the words *NO MATCH* appear.

There are several causes for a NO MATCH result:

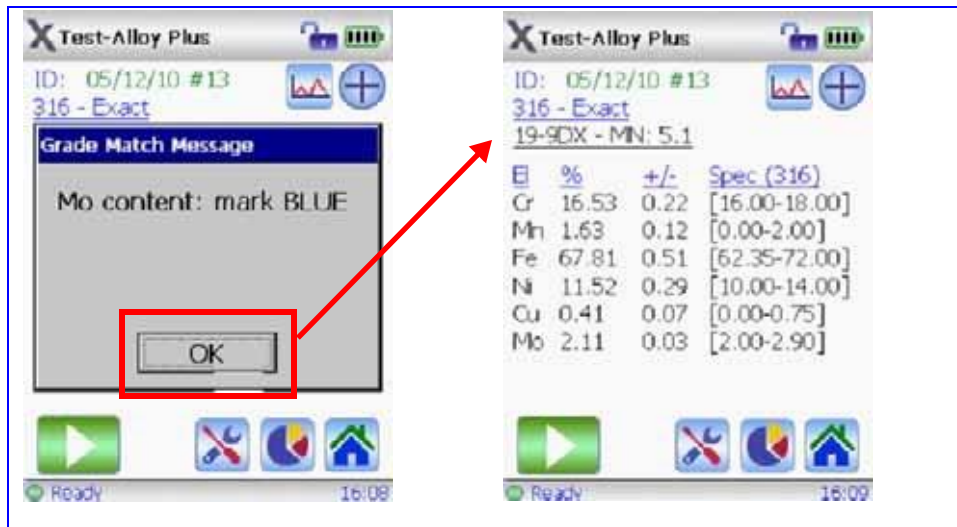
- The test sample does not meet any of the specifications in the Grade Library.
- The test sample is coated; Remove the coating by grinding, filing, or sanding and repeat the test.
- The testing time was too short.
 - Increase the testing time and measure the sample again.
- The Match Number is too low.
 - If possible, increase the Match Number

Scrap and Recycling Features

Delta analyzers in Alloy or Alloy Plus modes support many new features to specifically enhance scrap processing by maximizing speed and accuracy.

Grade Match Messaging (GMM)

User or Yard Manager can assign pop-up messages to specific alloy grades



- Quick start for next test, or view the chemistry details with one click
- Grade Match Messaging offers:

- Immediate sorting instructions
- Less operator training
- More efficiency and higher throughput

SmartSort

Automated sorting decisions that allow users to maximize speed and sorting accuracy.

Some features include:

- Specific grades set up to automatically extend testing time.
- Maximize efficiency for speed testing by automatically extending test time for light elements (Mg, Al, Si, P, S)
- Eliminate unnecessary long tests

Nominal Chemistry

Nominal Chemistry looks for 'invisible' elements, based on grade ID, including:

- Elements not tested under active beam, (like Al in Beam 1) — or —
- XRF invisible elements (like B or C)

Tramp Library

Analyzers with Alloy or Alloy Plus mode come pre-loaded with a tramp library based on industry standards.

- Operators may assign other "Tramp" elements with max tolerated concentration for individual elements in seven unique graded families.
- Analyzers can report tramp material (optionally) and simplify grade match by not counting small, expected amounts of tramp elements against the grade match.

El	%	+/-	Spec (Ti 3 2-5)
Al	3.0	Nom.	[2.00-4.00]
Ti	94.25	0.52	[95.88-98.97]
V	2.67	0.16	[2.06-3.09]
Fe	0.09	0.02	Tramp

See appendix [A8. Alloy Grade Libraries](#) for a discussion of the Tramp Library concept, including:

- How the InnovX Tramp Library works
- Practical advantages of the Tramp element approach
- List of seven Tramp Base Alloys

Test Sample Considerations

Coated or Painted Samples

XRF is a surface analysis technique, where X-rays penetrate a very short distance into most alloy samples. Therefore, the analyzer detects what is on the surface of an alloy, rather than what comprises the bulk of the material. If a material has been coated, plated, painted, or has had some sort of surface treatment, such as heat treating, it may be misidentified.

For example, a steel piece painted grey may show high concentrations of titanium from the paint, and may be misidentified as a titanium alloy. In another example, large amounts of metal dust or turnings on a surface may be detected by the analyzer.

To ensure proper identification of coated materials, grind an area slightly larger than the analyzing window to remove the coating. It is important to select the correct grinding material so as to not interfere with the analysis.

Do not use Silica for a Silicon analysis.

It may not be necessary to completely clean and polish all materials, however, remove obvious metal dust.

Mixed Samples, Heterogeneous Materials

Often finished metal pieces may consist of more than one type of metal. In addition, you may wish to measure mixed turnings, or an assortment of small pieces. In these cases, remember that the analyzer measures the entire area covered by the analyzing window and reports an average chemistry. For turnings, this is useful, as the analyzer provides an average composition. However, if two or more pieces of metal cover the window, the results is just an average reading, and may tell very little about the composition of one piece or the other.

When shooting metal pieces, or welds, ensure that **only** the metal of interest is covering the analyzing window.

Small and Irregularly Shaped Samples

To measure samples smaller than the analyzing window:

- Increase the testing time.
- Maximize the material in contact with the window. The precision of analysis for small parts measurements is reduced, as the signal from smaller samples is less than for samples that completely cover the window. If possible, analyze the largest, flattest side of an irregularly shaped object.



Introduction to FastID Mode (All Models)

FastID mode is designed to quickly identify an alloy. It uses an empirical calibration method known as a “type” calibration. It is most useful where the number of alloys to test is small and well known.

FastID is best suited for Positive Material Identification (PMI) and QA/QC applications.

For example, where alloy producers or fabricators handle materials that may be very similar or where maximum user simplicity is a primary concern.

This mode offers:

- Simplified results (grade name only or less information on tramp elements).
- A narrow, customized grade library base upon stored spectral fingerprint reference standards.
- **Full chemical analysis based on reference standard assays.**
- Results which are the best combination of SPEED and ACCURACY.
 - A Grade and Chemistry result in as little as one to two seconds.
- User selectable match criteria settings.
- Expansion of up to 500 additional alloy grades and assays (alloy chemistries) – password protected.
- Multiple independent grade libraries. You choose to search one or more libraries.
- All libraries are editable

How FastID works:

Prerequisite: The operator creates a “custom FastID fingerprint” library by testing an array of reference standards. This list spans the number of alloys for which he is interested.

1. Delta’s XRF process allows a test sample to create a spectral fingerprint.
2. Analyzer compares this spectral fingerprint to entries from library of many certified spectra, the “custom FastID fingerprint” library.

Analyzer finds the best spectral match to the sample spectra: thus identifying and reporting the matching alloy grade.

3. If concentration data has been entered for the standards, the instrument then calculates the sample’s **chemistry**.

The reported chemistry data are an extrapolation from standard intensity data stored in the customer -generated fingerprint library.

The user gets a real time grade match and a precise report of the chemical composition of the sample.



NOTE

- Because FastID mode performs a spectral match to a library of reference standards, it is important that before testing, a “likely” stored reference standard be in the customer-created FastID fingerprint library.

Introduction to Pass/Fail Mode (All Models)



Pass/Fail mode is designed for high-throughput alloy sorting and quality control.

Mode Features

- All test samples are sorted by comparison to an operator-selected reference standard.
- Results are displayed as a *PASS* or a *FAIL*, depending on whether they match the reference standard.
- Pass/Fail criteria may be based on:
 - “quality of fit” to the selected spectral fingerprint — or —
 - elemental chemistry.
- Pass/Fail ranges may be implemented for one or more elements.
- This mode offers a full range of options from the simple sorting of mixed loads in a recycling facility to QC on specific element(s) of the most complex superalloys.

Pass/Fail mode has two options: *Fingerprint and Chemistry*:

1. Fingerprint Option

Select this method when the goal is to determine whether or not test samples are a **specific grade**.

Fingerprint Pass/Fail and FastID use the same method to determine a match.

Data from analyzed samples are compared to the reference standard fingerprint.

If the differences between the fingerprints are small enough, the sample is judged to be of the same grade as the reference sample.

This method requires:

Only that the library contains a valid fingerprint for the reference standard.

2. Chemistry Option

Select this method to determine whether the chemistries for specific elements fall **within specified min/max grade** specifications. Chemistry pass/fail process is:

1. Analyzer uses the fingerprint method to determine whether the sample matches the reference sample.
If it does not, it automatically fails.
2. If Step 1 has a match, the alloy chemistry is calculated from assays stored for the standard fingerprint.
3. The calculated chemistry for each element is compared to the values stored in a *Grade Table*.
In order for a sample to pass, all the chemistries must be within “n” standard deviations of the min and max values specified in the grade table. Number “n” is specified by the user.

This method requires three items:

(1) a valid fingerprint, (2) assays for that fingerprint, and (3) Min/Max values saved in the library.

Mining Modes

There are three Mining modes

MINING	Use with: ALL models
 Mining	Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, W, As, Pb, Bi, Zr, Mo, Ag, Cd, Sn, Sb (elements may be customized on request) Fundamental Parameter based calibration for ore grading and percent-level analysis of process bulk samples. Suitable for measurement of percentage level analyte concentrations, 0.5% and greater.
2 BEAM MINING	Use with: Premier and Standard Only
 Mining	Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, W, As, Pb, Bi, Zr, Mo, Ag, Cd, Sn, Sb (elements may be customized on request) Mining mode optimized for SDD based systems to enhance SPEED and LOD for light elements
CAR Catalyst	Use with: All Models
Mode ICON T.B.A.	Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, W, Hf, Ta, Re, Pb, Bi, Zr, Nb, Mo, Ag, Sn, Sb PLUS Rh, Pt, Pd Accurate analysis of bulk recycled catalyst materials

The Mining modes/types are:

Mining mode - Classic (PiN detector based) type

2 Beam Mining mode - Standard (SDD detector based) type **Beam Mining mode - Premium** (SDD detector based) type **Car Catalyst mode - All** types

These modes utilize a Fundamental Parameters algorithm which automatically corrects for inter-element results.

The units can analyze:

- *in situ* (directly on the ground),
- prepared soil samples (in sample cups)
- bagged samples

Best Practices

Check Standards

Measure a check standard after each Cal Check, and periodically throughout the day. This confirms that data continues to be as accurate as possible. The standards provided with Delta instruments are contained in special XRF sample cups. These cups have film windows (through which the soil can be viewed and analyzed) on one side, and solid caps on the other side.

Sample Presentation

in situ testing

In situ testing is performed by pointing the analyzer at the ground. Clear any grass or large rocks away and hold the analyzer with the probe head front flush to the ground.

Since dirt can accumulate on the analyzer window, wipe the window clean after each analysis. Ensure the window is not ripped or punctured.

Bagged or prepared sample testing

Analyze prepared samples in a sample cup, through its Mylar window. Place the instrument's measurement window directly over the sample cup with the Mylar side up.

Preparation considerations include:

- Avoid measuring very thin samples, as this can affect results. Prepare samples cups to contain at least 15 mm of packed samples.
- When analyzing bagged samples, ensure that sufficient sample material exists in the bag to completely cover the window with a sample thickness of a minimum of 15 mm.
- When using bags, cheaper bags (having thinner plastic walls) are better than more expensive ones (which have thicker plastic walls).

Optional Accessories

Accessories that can assist in Mining mode testing are:

- A-035: Soil Foot
- 990055: Soil Extension Pole
- A-020-D: Workstation - portable, fully shielded, closed beam test stand for bench-top or remote controlled testing. • Trimble Xplorer Package

Mining Mode Options

Test length in Mining Mode is user defined.

Factors

Mining modes allow you to create your own set of **factors**, focusing on particular elements of interest or correcting for matrix effects.

You can make several different *Factor* tables, allowing analysis of a variety of samples.

Setting Mining User Factors

Example:

A group of samples covering the full concentration range for each element of interest are identified. Each sample is homogenized and split. A portion of each sample is sent to an outside lab for analysis. The other portion is analyzed with the analyzer. For best results ensure that the samples are very well homogenized, and characterized, so the correlation is quite good.

Procedure:

Plot the data. Innov-X data must be on the X-axis, lab values on the y-axis.



CAUTION

ENSURE that you use this order: Innov-X data on X-axis and lab data on the Y-axis.

Determine the linear best fit with both the slope and intercept for each element. The slope and intercepts for these graphs are entered directly into the analyzer. In many cases it is sufficient to enter just a correction for the slope as the intercept is almost zero. In others, enter the slope and intercept. You can enter multiple sets of user factors for different applications, or different ore bodies. A group of factors is given a name, and then the factors are entered. The factor set can then be selected by name.

Overview: X-Ray Fluorescence (XRF) Spectrometry

Basic Theory

Although most commonly known for diagnostic applications in the medical field, x-rays are the basis of many powerful analytical measurement techniques, including X-ray Fluorescence (XRF) Spectrometry.

XRF Spectrometry determines the elemental composition of a material. This method identifies elements in a substance and quantifies the amount present of those elements. An element is defined by its characteristic X-ray emission wavelength (λ) or energy (E). The amount of an element present is determined by measuring the intensity of its characteristic line.

All atoms have a fixed number of electrons (negatively charged particles) arranged in orbitals around their nucleus. The number of electrons in a given atom is equal to the number of protons (positively charged particles) in the nucleus. In the classical Periodic Table of Elements, the Atomic Number is specified by the number of protons. Each Atomic Number is assigned an elemental name, such as Iron (Fe), with Atomic Number 26.

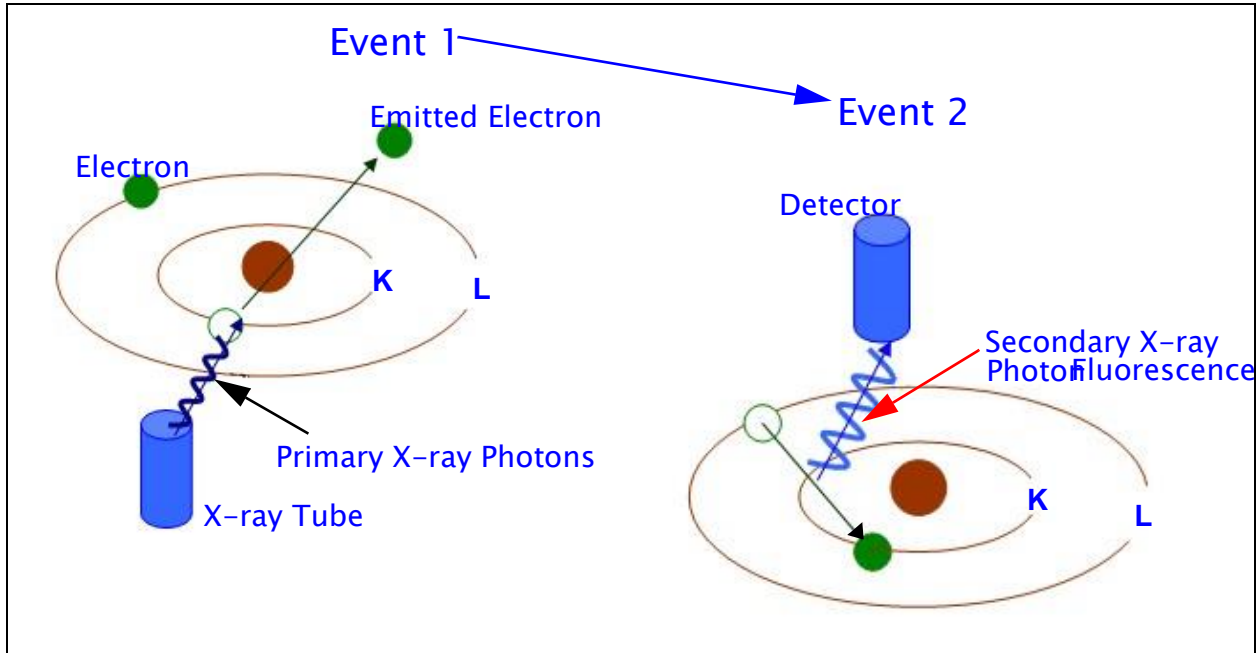
XRF Spectrometry typically utilizes activity in the first three electron orbitals, the K, L, and M lines, where K is closest to the nucleus. Each electron orbital corresponds to a specific and different energy level for a given element.

In XRF Spectrometry, high-energy primary X-ray photons are emitted from a source (X-ray tube or *radioisotope*) and strike the sample. The primary photons from the X-ray source have enough energy to knock electrons out of the innermost, K or L, orbitals. When this occurs, the atoms become unstable ions. Electrons seek stability; therefore, an electron from an outer orbital, L or M, moves into the newly vacant space at the inner orbital. As the electron from the outer orbital moves into the inner orbital space, it emits an energy known as a secondary X-ray photon.

This phenomenon is called **fluorescence**.

The secondary X-ray produced is characteristic of a specific element. The energy (E) of the emitted fluorescent X-ray photon is determined by the difference in energies between the initial and final orbitals of the individual transitions.

This is described by the formula $E=hc/\lambda$ where **h** is Planck's constant; **c** is the velocity of light; and λ is the characteristic wavelength of the photon.

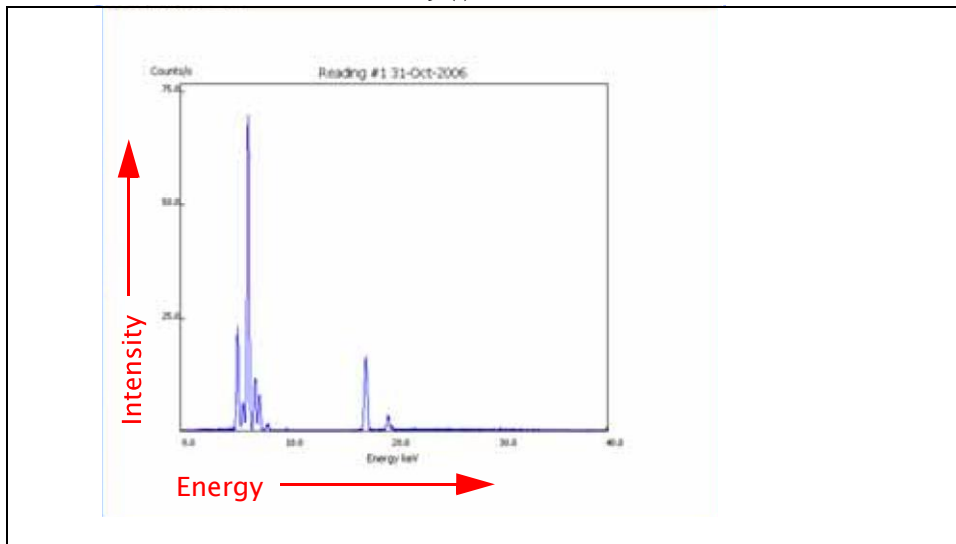


Creating a Secondary X-ray - Photon Fluorescence

Wavelengths are inversely proportional to the energies; they are characteristic for each element.

For example, the Ka energy for Iron (Fe) is about 6.4keV. The number of element-specific characteristic X-rays produced in a sample over a given period of time, or the intensity, is measured. This determines the quantity of a given element in that sample.

Typical spectra for EDXRF Spectrometry appear as a plot of **Energy (E)** versus the **Intensity (I)**.



Typical Spectrum Plot: Energy vs. Intensity

History

Timeline for XRF Spectrometry

- Wilhelm Roentgen discovered X-rays in 1895.
- Henry Moseley first published methods for identifying and quantifying elements using XRF in 1913.
- XRF research and development continued, especially during WWII.
 - Critical developments in the aircraft, automotive, steel, and other metals industries increased the need to identify alloys *quickly* and *reliably*.
- The first commercial XRF Spectrometers became available in the early 1950's. These systems were based on **Wavelength Dispersive (WD) XRF** technology.
 - The characteristic wavelength of an element was measured one element at a time.
 - WDXRF systems were useful for elemental analyses, however, the equipment had the following properties:
 - Large size
 - High initial cost
 - Required highly skilled operators to use and maintain them.
 - In the late 1960's, **Energy Dispersive (ED) XRF** technology emerged as a viable commercial choice:
 - EDXRF measured the characteristic energy of an element.
 - Improvements in solid state detectors offered better energy resolution of the signal.
 - Had potential to collect and display information on all of the elements in a sample at the same time.
 - Many of the early EDXRF systems used radioisotopes for excitation. They had the following properties:
 - Required changing sources to determine all the elements of interest. — Did not easily resolve multiple elements in a single analytical run.
 - The current state-of-the-art in EDXRF is the result of
 - Advancements in technology (particularly X-ray tubes, solid-state components, electronics, computers, software)
 - Application of the technology by instrument manufacturers, research scientists, engineers, and industrial users.
 - Now a mature technology, XRF Spectrometry is routinely used for R&D, QC, production support, and regulatory compliance.

Elemental Analysis

Investigators involved with elemental analysis generally have two working instrument techniques – *Wet Chemistry* and *XRF Spectrometry*. They are compared operationally as follows.

Wet Chemistry

Important considerations are:

- Instrument techniques are *time-consuming*.
 - Often takes twenty minutes to several hours for specimen preparation and analysis.
- Specimen is *destroyed*.
- Often necessary to employ *concentrated acids* or other *hazardous materials*.
- Requires *disposal* of waste streams generated during the analytical process.
- Relatively *high cost* per sample.

However, wet chemistry instrument techniques are necessary if the primary measurement requirement involves elemental concentrations in the PPB (or lower) range

XRF Spectrometry

Important considerations are:

- Easily and quickly identifies and quantifies elements over a wide dynamic concentration range, from PPM levels up to virtually 100% by weight.
- Does *not destroy* the sample.
- Overall sample turnaround time is *fast*.
 - Requires little, if any, specimen preparation.
 - Often results are available within seconds, minutes for some details.
- Relatively *low cost* per sample

Interferences

All elemental analysis techniques experience chemical and physical interferences. They must be corrected or compensated for in order to achieve adequate analytical results.

WET CHEMISTRY ISSUES

Most suffer from interferences that are corrected only by extensive and complex specimen preparation techniques.

XRF SPECTROMETRY ISSUES

The primary interference is from other specific elements in a substance that can influence (matrix effects) the analysis of the target element(s) of interest.

However, this interference style is well known and documented.

Both types of analyzer techniques benefit from (a) instrumentation advancements, and (b) mathematical corrections in the system's software.

In certain cases, the *geometry* of the sample can effect XRF analysis.

- This is compensated for by:
 - Grinding or polishing the sample
 - Pressing a pellet
 - Making glass beads

Quantitative analysis

XRF Spectrometry supporting quantitative analysis typically employs one of two software applications:

- **Empirical Methods**

Uses calibration curves derived from standards similar in property to the target unknown sample.

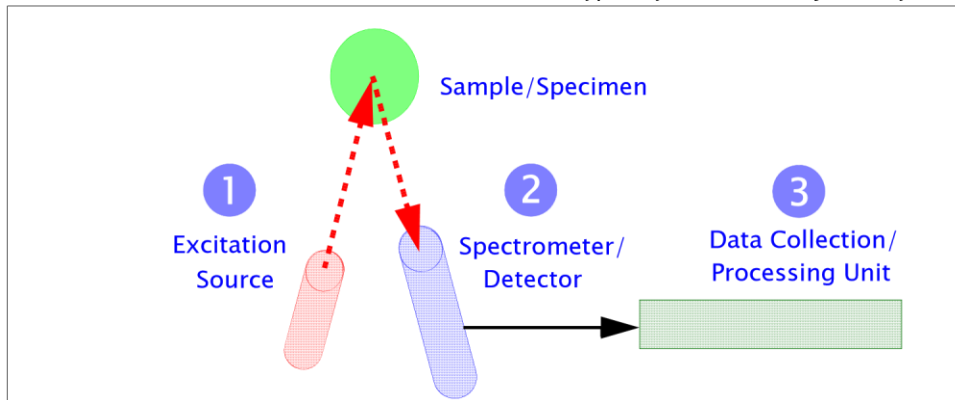
- **Fundamental Parameters (FP)**

FP is frequently preferred because it allows elemental analysis to be performed *without* standards or calibration curves. The analyst can use the system immediately.

Modern computers support this *no-standard* mathematical analysis, FP, accompanied by stored libraries of known materials. These systems quickly determine not only the elemental composition of an unknown material, but even identify the unknown material itself.

EDXRF Spectrometers

An EDXRF instrument typically has three major subsystems:



Three Subsystems of EDXRF Analyzer

EDXRF analyzers are mechanically very simple; there are *no moving parts* in the excitation and detection subsystems. However, a bench-top analyzer can have moving parts. When compared to WDXRF systems, EDXRF systems exhibit the following attributes:

- Ease of use
- Rapid analysis time
- Lower initial purchase price
- Substantially lower long-term maintenance costs

EDXRF analysis equipment is useful for many applications, including:

- Environmental analysis
- RoHS/WEEE compliance
- Scrap alloy sorting
- Forensic science
- Archaeometry

Specifications

Handheld Analyzer	Description
Weight	3.35 lbs. (Base wt.), 3.70 lbs. (1.6 kg) with battery
Excitation Source	4 Watt X-ray tube - Au, Ag, Rh, or Ta anode (application optimized), 8-40 keV, 5 - 200 µA, eight filter positions
Detector	Various: Si PIN diode or Si Drift detector, thermo-electrically cooled, high resolution
Power	Removable Li-ion batteries, or AC power unit
Battery Life	Battery life varies depending on usage patterns
Display	Color “transflective” touchscreen (800 x 600) with 16-bit LCD interface)
Cal Check Coupon	316 Stainless Steel Alloy -- see also Docking Station
Power Requirements for AC Adapter	110-220 VAC, 50-60 Hz, 600 W max (P/N 100043)
Pressure Correction	Built-in barometer for automatic altitude correction

Operating specifications are posted as **nominal**.

Humidity: 10 to 90% Relative Humidity, non-condensing
 Altitude Rating: 2000 meters

Operating System	Windows Embedded CE®
Application Software	Innov-X Systems’ proprietary Data Acquisition and Processing package.
USB Interface	USB 2.0

Docking Station	Description
Operating Environment Temperature:	-10°C to 45°C
Dimensions	L=14.0 in x W=8.75 in x H=4.75 in (H w/ spare battery = 6.5 in); Wt = 3.25 lbs.
Power Requirement	AC adapter standard: 110-220 VAC, 50-60 Hz, 600 W max
Cal Check Cup	Automatically performs Cal Check on inserted instrument
Battery Charging	Charges battery in unit; can simultaneously charge spare battery in separate socket

Accessories	Description
AC Battery Charger	P/N 120253
TestStand/Workstation	A-020-D - portable equipment stand making a fully shielded closed beam system. Uses Delta PC Software.
Soil Foot	A-035
Soil Extension Pole	P/N 990055

Trimble Xploration Package (P6000FDC)	XPLORER FIELD DATA COLLECTION BUNDLE Trimble Nomad 800G-LC - Ruggedized 800Mhz Field Computer with integrated GPS, Wi-Fi, Bluetooth, Camera, 16Gb Memory, SD Card Slot Options: Barcode Scanner, Cell Phone Interface, Fully DGPS compatible running Windows Mobile 6.0 OS.
Trimble Xploration Package (P6000TFG)	XPLORER TOTAL FIELD GEOCHEM BUNDLE Includes all features supplied with Field Data Collection Package and: Soil Extension Pole - Ergonomic extension pole facilitating soil analysis by a standing (and walking) operator. Soil Foot - Attaches to nose of DELTA analyzer balancing analyzer on ground for hands-free, extended in-situ testing. ioGAS - ioAnalytics GeoChemical Analysis Software Suite, an advanced spatial data analysis package for visualization, interrogation & validation of geochemical data for mineral exploration, mining, & environmental industries.

Typical Delta Test Sequence

Innov-X Delta User Interface

Operators manage their measurement, analysis, and results activities from the *Innov-X* UI when in ANY of the Alloy modes/calibrations. This Appendix presents:

- Typical Sample Test Procedure, and
- Prerequisites for testing necessary for various modes

Typical Sample Test Procedure

This sample procedure features the **Alloy Plus** mode.

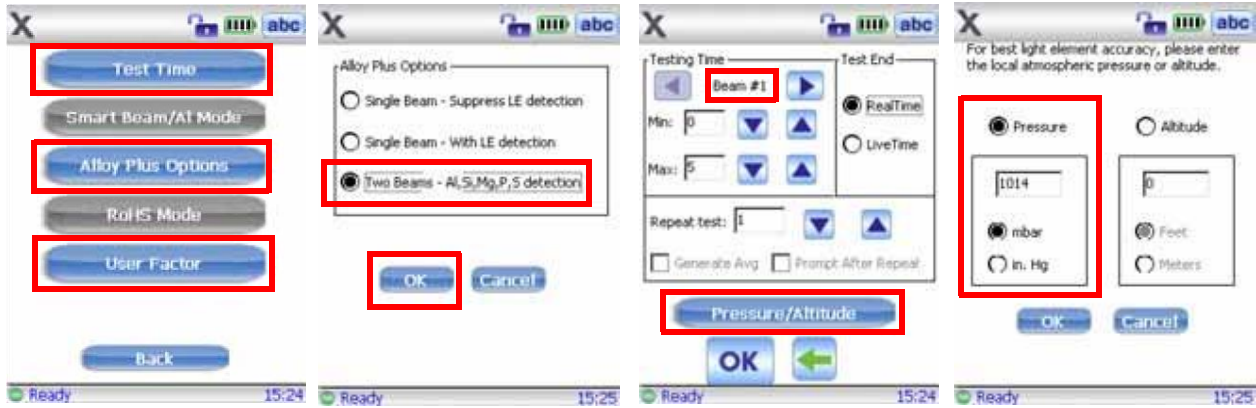
Other modes follow a similar sequence, however, the **Test Condition** screens are generally unique to each testing situation.

Use these steps:

1. From the **Home** screen, tap **Mode** icon
2. From **Mode** screen, tap the **Alloy Plus** icon
3. Select **Mode Setup** button



4. Select **Test Conditions**, then **Test Time**
5. Ensure that the **Testing Time** and other parameters are properly selected



6. Press OK button, the Back, then OK again
7. Return to Home screen, select Test to call the *Test-Alloy Plus* screen

Testing Tips for Certain Modes

Alloy:

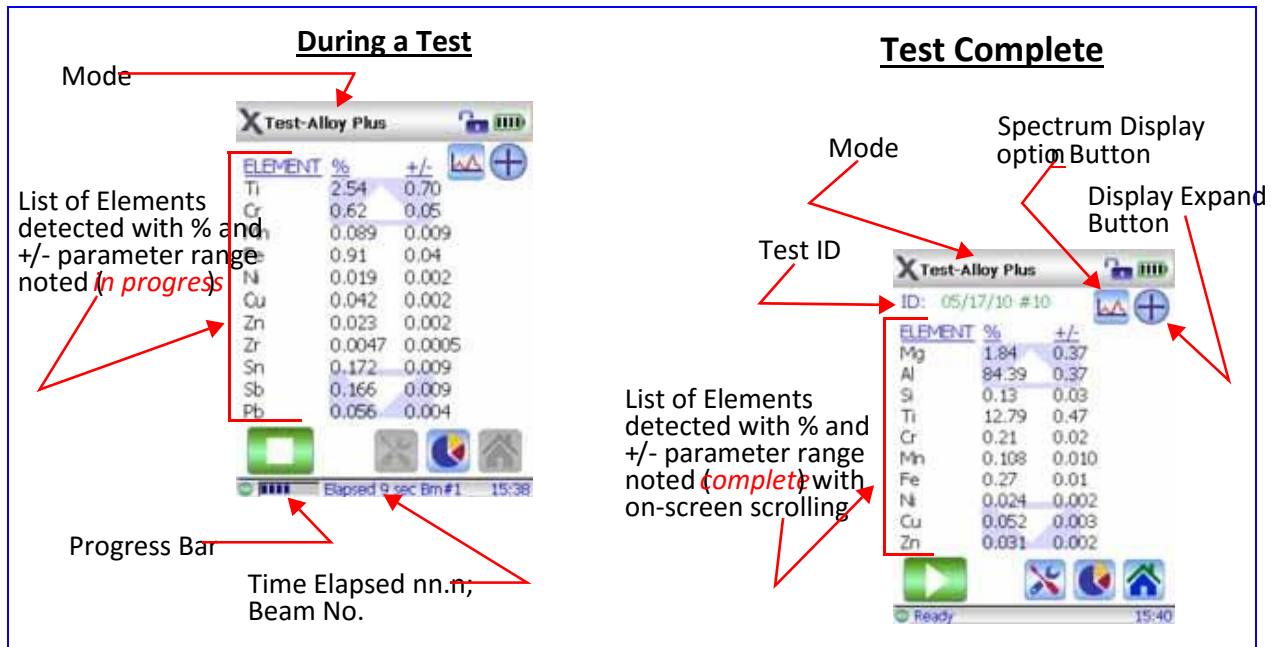
- Place the analyzer's window on/over the test specimen, cover the window completely.
- Remember the Safety information (C2, Pages 29-31) to ensure your own personal safety.
- Take care not to damage the window film, such as when testing "metal turnings" or hot surfaces. **Soil or Mining:**

- Place the analyzer's measurement window directly over the sample cup with the film side up.
- Specify the altitude or atmospheric pressure to gain increased accuracy for light elements.
- Confirm that the Testing Time and other parameters are properly selected
- Take care not to damage the window film, such as when testing uneven surfaces

RoHS:

- In order for XRF testing to be *quantitative*, samples must be:
- Homogeneous
- Have a certain minimum sample thickness
 - Five (5) mm for polymers and light alloys
 - Fifteen (15) mm for liquid samples
 - One (1) mm for other alloys
- If samples are heterogeneous, too thin, or too small, only *qualitative* screening is possible.

8. Start a new test by using one of these methods:
 - a. Tap **Start** button on the UI (toggles Delta to X-ray ON state)
 - or –
 - b. Pull the trigger (toggles instrument to X-ray ON state)
 - or –
 - c. Pull-and-hold the trigger when the "Deadman Trigger" is active.



Best Practices for Testing

Alloy Mode

Prior to a test session, analysts should have an understanding of *Innov-X's* implementation of:

- **Grade Libraries** -> populated by alloy Grades -> their chemistry characterized by Grade Tables. See [Grade Libraries](#) for library management procedures.
- **Match Issues** including the concept and use of Match Numbers. See [Match Issues](#)

Prior to initiating testing with the analyzer software, **ensure** that the following tasks are complete:

1. Analyzer does not require a Cal Check procedure.
2. The analyzer's measurement window is properly positioned in front of or over the test sample.
3. The *Match Cutoff* and *nSigma* parameters are configured.

Mining and Soil Modes

Check Standards

- Measure a **check standard** after each Cal Check, and periodically throughout the day. Test for a recommended minimum of one minute.
- Concentrations for elements of interest, in the range expected, plus or minus the error on the reading, should be within 20 percent of the standard value.
- [A2.Soil Testing](#) describes recommended quality assurance details.

- The standards provided with the analyzer are contained in XRF sample cups. These containers have a window (through which the soil can be viewed) on one side, and a solid cap on the other side.

Always measure samples through the window.

Sample Presentation

IN SITU TESTING

In situ testing is performed by pointing the analyzer at the ground. Clear any grass or large rocks away and hold the analyzer with the probe head front flush to the ground.

Since dirt can accumulate on the analyzer window, gently wipe the window clean after each analysis. Ensure the window is not ripped or punctured.

BAGGED OR PREPARED SAMPLE TESTING

Analyze prepared samples in a sample cup, through its window. Place the instrument's measurement window directly over the sample cup with the film side up.

Preparation considerations include:

- Avoid measuring very thin samples, as this can affect results. Prepare samples cups to contain at least 15 (usually 4-8 grams) mm of packed samples.
- When analyzing bagged samples, ensure that sufficient sample material exists in the bag to create a sample thickness of a minimum of 15 mm for a spot size that is larger than the analyzer's measurement window.
- When using bags, cheaper bags (having thinner plastic walls) are better than more expensive ones (which have thicker plastic walls).

Consumer Mode

RoHS Best Practices

Check Standards

Innov-X Systems recommends that a check standard be measured after each Cal Check procedure, and periodically throughout the day.

Two certified standards are provided for verification.

- At least one standard should be measured for a minimum of two minutes.
- Concentrations for target elements (plus or minus the error on the reading) should be within 20% of the standard value.
- Standards provided are contained in XRF sample cups with a window (through which the plastic pellets can be viewed) on one side, and a solid cap on the other side.
- Samples should be measured in the sample cup, through the window.

Sample Presentation

Since many pieces of plastic analyzed for ROHS compliance are very small, take care to measure them in a safe and accurate manner.

User Maintenance

Alternative Techniques for Powering or Charging the Delta

AC Power Adapter Kit

The kit is an **optional** accessory.

It is supplied with a 10 foot AC power cord, a switching AC adapter, and a Battery Module. This kit eliminates the Li-ion battery requirement, however the user is constrained by the length of the AC power cord.

The procedure for using the AC adapter is shown below.



WARNING

Ensure that each AC supply circuit has adequate power load capability and is provided from a grounded AC receptacle.

To SETUP THE ADAPTER:

1. Plug the three-prong male plug into the receptacle.

Female Plug →

← Male Plug



2. Insert the three-prong female plug into the male receptacle on the *Switching AC Adaptor* brick.



3. Slide the Battery Eliminator unit into the analyzer with the contacts to the left. It is keyed to only go in oriented this way. Contacts



4. The user now has no limit to instrument power; not restricted by battery charge level. The range of action is constrained by the length of the power cord.

Li ion Battery Charger Assembly

This section describes the procedure for charging the Li-ion batteries when the Delta Docking Station is **NOT** available. It features a single socket standalone battery charger (P/N 120253) The unit takes about two hours to completely charge a battery. Status of the battery's charge is shown by two lights on the power adaptor.

TO CHARGE THE BATTERY:

1. Plug the three-prong male plug into the Modes receptacle.



2. Plug the three-prong female plug into the male receptacle of the AC Adaptor brick.



3. Plug the connector labeled *CH4500 24 VDC* into the connector labeled *SWC* on the back of the charger.



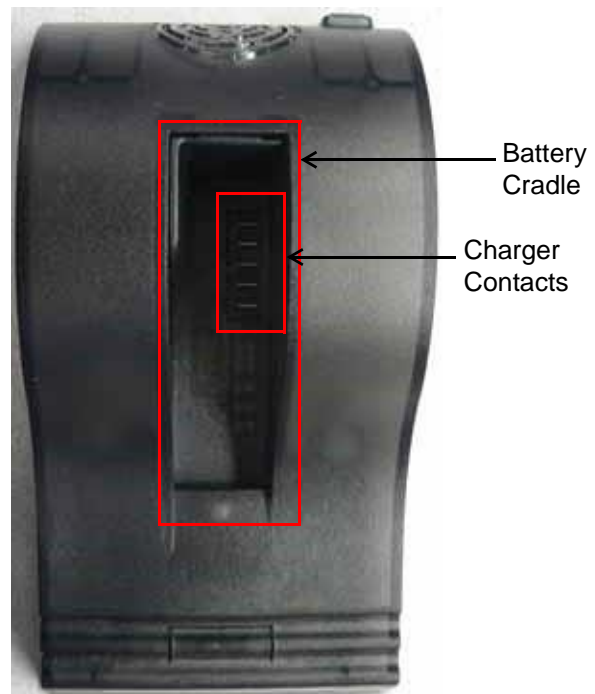
4. Insert the Li-ion battery into the charger with the contacts facing right.




CAUTION

Forcing the battery in with the contacts oriented improperly will injure the contact and destroy the battery.

Battery
Contacts →



Battery Charger Status Lights

Left Light (Green only)	Right Light (Red only)	Status 
On - Flashing	Off	Battery is charging
On - Solid	Off	Battery is charged
Off	On - Solid	Error. Remove battery and replace on charger. If the error persists, call Innov-X Systems Technical support.
Off	Off	No battery is on charger

Window Replacement for “Hinged Plate” Analyzers

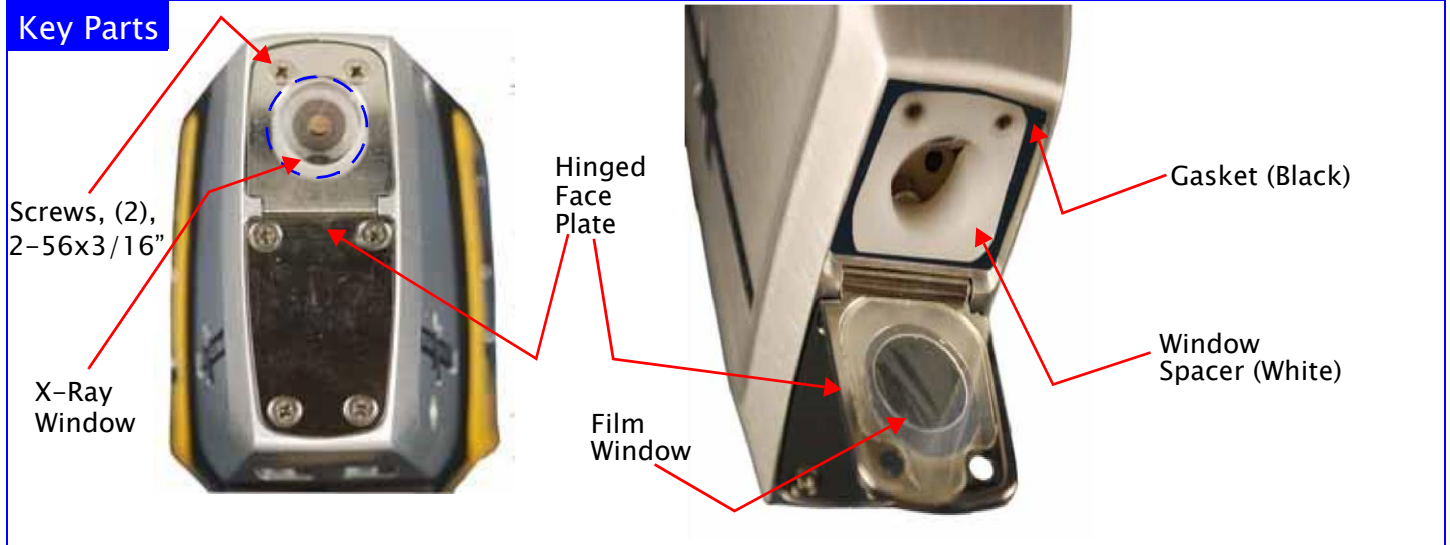
How to Replace the Window on a Delta Analyzer (All Models)

Tools: *Required* - Small Phillips Head Screwdriver

Recommended - Tweezers or Needle nose pliers; Can of compressed air

As needed: - Lint-free wipes or swabs

Key Parts



Remove Old Window

Use these guidelines:

- During this entire removal process, keep dust or foreign material out of the instrument.
- Ensure that the instrument is powered off.
- Take care to have clean hands.
- Orient the instrument with the nose pointing up.
- Review the **TIPS** section on next page **before** opening the hinged plate.
- Use Phillips head screwdriver to remove the two screws.
- Carefully set aside the screws.
- Swing the hinged face plate out to expose the film window.
- Remove the old window.
- Observe the white plastic window spacer and the black rubber gasket
- Remove any dirt or foreign material from the gasket with compressed air
- Take **EXTREME CARE** to not harm any internal components



CAUTION

Avoid expensive internal damage, **DO NOT INSERT** anything (fingers or tools) into the instrument.

Replacement Window Details

- Window assemblies are made from either **Prolene, Mylar, or Kapton** film.
 - Users must specify the proper material to match their original application and calibration.
- The selected film is adhered to the **back** side of a polyester backing plate; this creates a “front” and “back” surface
 - “Back” surface is completely covered with film.
 - “Front” surface shows a circular ridge where the film only is present, showing through the center hole of backing plate. This front surface also has a part type designator.
- Ensure that the “back” surface faces up when installing a new window (See below).



Install Replacement

Follow these steps:

- Remove new window assembly from shipping envelope.
- Handle it by edges or use tweezers.
- Apply canned compressed air to clear any contaminants from the surfaces.
- Place window assembly on the hinged plate with **film back surface facing up**.
- Center it to avoid the screw holes.
- Carefully rotate the hinged plate up to secure the window assembly.
- Insert the two screws; tighten only to “snug”.
- Don’t over-tighten them or strip the threads.

Packing and Shipping

If the instrument is not returned in the protective case, it can be damaged during shipping. Innov-X Systems reserves the right to void the warranty on instruments that are damaged during return shipping that are sent without the protective case.

Prior to returning a unit, contact Customer Service at the appropriate depot:

<p>— United States —</p> <ul style="list-style-type: none"> • Phone: 1-781-938-5005 • Mail & Shipping Address: • Fax: 1-781-938-0128 Innov-X Systems, Inc. • Email: 100 Sylvan Road Service@Innov-01801.Xsys.com Woburn, MA 		<p>— Europe —</p> <ul style="list-style-type: none"> • Phone: • Mail & Shipping Address: +31 (0)73 62 72 590 Innov-X Systems, Inc. • Fax: +31 (0)73 62 599 Kasteleinenkampweg 9R 's-Hertogenbosch • Email: 5222 AX info@innovx-europe.com The Netherlands 	
<p>— Canada —</p> <ul style="list-style-type: none"> • Phone: 1-778-960-6279 • Mail & Shipping Address: • Fax: 1-604-568-2474 Innov-X Canada • Toll Free Fax: 1201 West Georgia, Ste. 2 <p>1-888-873-6598 Vancouver BC</p> <ul style="list-style-type: none"> • Email: Canada V6E 3J5 service@innovx.ca 		<p>— Australia —</p> <ul style="list-style-type: none"> • Phone: 02 9577 9500 • Mail & Shipping Address: • Fax: 02 9519 1850 Innov-X Systems Australia • Email: PTY LTD service@innovx.com Suite 6, Level 3 <p>215 Euston Road Alexandria NSW 2015 Australia</p>	

Or call your local distributor.

Ensure that you receive the required RMA number.

Follow these instructions to return your XRF Analyzer:

1. Pack the analyzer in the black protective case in which it arrived, using the original packing materials.
2. Include the RMA in the case and reference the RMA number in your shipping documents.
3. Close the protective case and either:
 - Secure it with plastic zip ties,
 - or —
 - Pack the protective case within another box

Regulations for Shipping Products with Lithium Ion Batteries

The United States and many other countries have instituted regulations that require shippers to use a special Caution label referring to a Lithium Ion Battery.

- Label must be prominently displayed on the outer shipping container of any product that contains a Lithium Ion battery.
- Shipper may copy the label shown below to facilitate making the warning label.
Use a color copier if possible.



Legal Information

This section provides copies of the following:

- Delta Analyzer Limited Warranty
including: — Limitation of Liability
 - Warranty Period, Returns, and Repairs
 - Instructions for Contacting Innov-X
- End User Software License Agreement
including:
 - Use, Restrictions, and Termination of Software
 - Governmental End User Conditions
 - Limited Warranty and Limitation of Liability

Innov-X Delta Analyzer Limited Warranty

General Terms

EXCEPT AS EXPRESSLY SET FORTH IN THIS LIMITED WARRANTY, INNOV-X SYSTEMS, INC. (INNOV-X) MAKES NO OTHER WARRANTIES OR CONDITIONS, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. INNOV-X EXPRESSLY DISCLAIMS ALL WARRANTIES AND CONDITIONS NOT STATED IN THIS LIMITED WARRANTY. ANY IMPLIED WARRANTIES THAT MAY BE IMPOSED BY LAW ARE LIMITED IN DURATION TO THE LIMITED WARRANTY PERIOD.

This Limited Warranty applies to Innov-X analyzers sold or leased from Innov-X, its affiliates, authorized resellers, or country distributors (collectively referred to in this Limited Warranty as “Innov-X.”

Innov-X warrants that the analyzer and all its internal and external components that you have purchased are free from defects in materials or workmanship under normal use during the Limited Warranty Period. The Limited Warranty Period starts on the date of shipment by Innov-X. You may be required to provide proof of purchase or lease as a condition of receiving warranty service. You are entitled to warranty service according to the terms and conditions of this document if a repair to your Innov-X analyzer is required within the Limited Warranty Period.

During the Limited Warranty Period, Innov-X will repair or replace the defective component parts. All component parts removed under this Limited Warranty become the property of Innov-X. In the unlikely event that your Innov-X analyzer has a recurring failure, Innov-X, at its discretion, may elect to provide you with a replacement unit of Innov-X’s choosing that is at least equivalent to your Innov-X analyzer. This is your exclusive remedy for defective products. The repaired or replacement analyzer is warranted for the remainder of the limited Warranty Period.

YOU SHOULD MAKE PERIODIC BACKUP COPIES OF THE DATA STORED ON THE ANALYZER’S

SYSTEM COMPUTER AS A PRECAUTION AGAINST POSSIBLE FAILURES, ALTERATION, OR LOSS OF THE DATA. BEFORE RETURNING ANY UNIT FOR SERVICE, BE SURE TO BACK UP DATA AND

REMOVE ANY CONFIDENTIAL, PROPRIETARY, OR PERSONAL INFORMATION.
INNOV-X IS NOT
RESPONSIBLE FOR DAMAGE TO OR LOSS OF ANY PROGRAMS, OR DATA. INNOV-X
IS NOT
RESPONSIBLE FOR THE RESTORATION OR REINSTALLATION OF ANY PROGRAMS
OR DATA OTHER THAN SOFTWARE INSTALLED BY INNOV-X WHEN THE ANALYZER
IS MANUFACTURED. Innov-X does not warrant that the operation of this
analyzer will be uninterrupted or error-free. Innov-X is not responsible for
damage that occurs as a result of your failure to follow the instructions that
came with the Innov-X analyzer.
This Limited Warranty does not apply to expendable parts. This Limited
Warranty does not extend to any analyzer from which the serial number has
been removed or that has

Limitation of Liability

been damaged or rendered defective (a) as a result of accident, misuse, abuse,
or other external causes; (b) by operation outside the usage parameters stated in
user documentation that shipped with the product; (c) by modification or service
by anyone other than (i) Innov-X, or (ii) an Innov-X authorized service provider;
(d) installation of software not approved by Innov-X.

These terms and conditions constitute the complete and exclusive warranty
agreement between you and Innov-X regarding the Innov-X analyzer you have
purchased or leased. These terms and conditions supersede any prior agreements
or representations --- including representations made in Innov-X sales literature
or advice given to you by Innov-X or any agent or employee of Innov-X --- that
may have been made in connection with your purchase or lease of the Innov-X
analyzer. No change to the conditions of this Limited Warranty is valid unless it is
made in writing and signed by an authorized representative of Innov-X.

Limitation of Liability

IF YOUR INNOV-X ANALYZER FAILS TO WORK AS WARRANTED ABOVE, YOUR SOLE
AND
EXCLUSIVE REMEDY SHALL BE REPAIR OR REPLACEMENT. INNOV-X'S MAXIMUM
LIABILITY
UNDER THIS LIMITED WARRANTY IS EXPRESSLY LIMITED TO THE LESSER OF THE PRICE
YOU HAVE PAID FOR THE ANALYZER OR THE COST OF REPAIR OR REPLACEMENT OF
ANY COMPONENTS THAT MALFUNCTION IN CONDITION OF NORMAL USE.
INNOV-X IS NOT LIABLE FOR ANY DAMAGE CAUSED BY THE PRODUCT OR THE FAILURE
OF
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Software

This Limited Warranty does not warrant software products. The Innov-X software installed on the analyzer's system computer is covered by the Innov-X End User Software License Agreement.

Warranty Period

The warranty period for an Innov-X Delta Analyzer is two years. This warranty does not extend to expendable parts. Extended warranties are available from Innov-X.

Warranty Returns

A Return Material Authorization (RMA) Number must be obtained from the INNOV-X Service Department before any items can be shipped to the factory. Returned goods will not be accepted without an RMA Number. Customer will bear all shipping charges for warranty repairs. All goods returned to the factory for warranty repair should be properly packed to avoid damage and clearly marked with the RMA Number.

Warranty Repairs

Warranty repairs will be done either at the customer's site or at the INNOV-X plant, at our option. All service rendered by INNOV-X will be performed in a professional manner by qualified personnel.

Contacting Innov-X

Be sure to have the following information available before you call Innov-X:

- Analyzer serial number, model name, and model number
- Applicable error messages
- Description of problem
- Detailed questions

<p>— United States —</p> <ul style="list-style-type: none">• Phone: 1-781-938-01801• Fax: 1-781-938-01801• Email: Service@Innov-X.com <p>100 Sylvan Road Woburn, MA 01801</p>	<p>938-5005 • Mail & Shipping Address: 0128Innov-X Systems, Inc. Road Xsys.comWoburn, MA</p>	<p>— Europe —</p> <ul style="list-style-type: none">• Phone: +31 (0)73 62 72 9R• Fax: +31 (0)73 62 72 9R• Email: 5222 AX info@innovx-netherlands.com	<p>590Innov-X Systems, Inc. 62 72 599Kasteleinenkampweg 's-Hertogenbosch europe.comThe Netherlands</p>
<p>— Canada —</p> <ul style="list-style-type: none">• Phone: 1-778-1-888-873-6598• Fax: 1-604-568-1201• Toll Free <p>Vancouver BC</p>	<p>960-6279 • Mail & Shipping Address: 2474Innov-X Canada Fax:1201 West Georgia, Ste. 2</p>	<p>— Australia —</p> <ul style="list-style-type: none">• Phone: 02 9577 9500• Fax: 02 9519 1850• Email: PTY LTD	<p>• Mail & Shipping Address: 9500 • Mail & Shipping 1850Innov-X Systems Suite 6, Level 3</p>

Or call your local distributor.

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Legend

Administration Boundaries

- Mining Divisions
- Resident Geologist District
- Townships and Areas
- UTM Grid
- Geographic Lot Fabric
- Other Federal Land

Mineral Tenure Grid

- OM TG Tenure Grid

Alienations

- Withdrawal
- Notice

Unpatented Claim

- Active
- Reconciled
- Pending

Disposition

- Disposition

Disposition Symbols

- Camp
- Disposition Unknown/Pending
- Freehold Patent Mining Rights Only
 - Freehold Patent Surface Rights Only
 - Freehold Patent Surface and Mining Rights
- Land Use Permit
- Leasehold Patent Mining Rights Only
- Leasehold Patent Surface Rights Only
- Leasehold Patent Surface and Mining Rights
- License of Occupation Mining Use Only
- License of Occupation Surface Use Only
- License of Occupation Surface and Mining Rights
- License of Occupation Uses Not Specified
- Order in Council
- Tower
- WPLA

Geology Layers

- AMIS Sites
- AMIS Features
- Drill Holes
- Mineral Occurrences



Projection: Web Mercator



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