NITON XL3t 500 Analyzer

User's Guide

Version 6.5

Thermo SCIENTIFIC

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About This User's Guide

WARNING! Do not attempt to use this analyzer without first reading and understanding the entire User's Guide! ♦

CAUTION NITON Analyzers are not intrinsically safe analyzers in regard to sparking. All pertinent Hot Work procedures should be followed in areas of concern. ♦

Unpacking and Assembling Your NITON XRF Analyzer

- Inspect the shipping carton for signs of damage such as crushed or water damaged packaging. Immediately notify the shipping company and Thermo Fisher Scientific, in the United States, toll free, at (800) 875-1578, or outside the United States, at +1-978-670-7460, if there is any visible damage to the shipping container or any of its contents.
- Open the packing carton. If your analyzer is not packed in its carrying case, please call Thermo Fisher Scientific immediately, in the United States, toll free, at (800) 875-1578, or outside the United States, at +1-978-670-7460.
- Verify the contents of the shipping container against the enclosed packing list. If there are any discrepancies between the actual contents of the shipping container and the enclosed packing list, please notify Thermo Fisher Scientific immediately, in the United States, toll free, at (800) 875-1578, or outside the United States, at +1-978-670-7460.
- Open the carrying case and visually inspect the analyzer for damage before removing it from the case. Call the shipper and Thermo Fisher Scientific if you find any damage to the case or its contents.
- Save the shipping carton and all packing materials. Store them in a safe, dry area for reuse the next time that you ship the analyzer.

The NITON XRF Analyzer Overview

The NITON XL3 Analyzer is a single unit, hand held, high performance portable x-ray fluorescence (XRF) elemental analyzer.

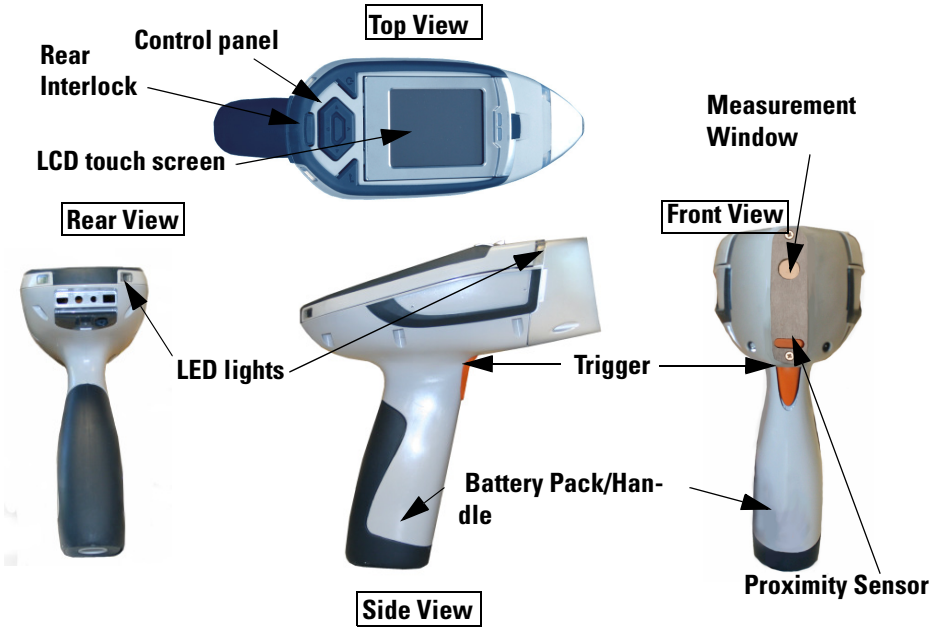

Figure 0-1. Analyzer Overview

The Control Panel

The control panel is located on the analyzer's top housing, directly below the LCD touch screen (see Figure 0-1). The control panel consists of a 4 way touch pad, a center button, and two control buttons, one on each side. Using either the control panel or the touch screen you may navigate through all of the analyzer's screens and menus. You can control the movement of the screen cursor by pressing the four way control pad in one of four directions to highlight each of the menu options. The Select button in the center of the four way touch pad is used to select highlighted menu options. The on/off/escape button both controls the power to the analyzer and serves as an "escape" button. When the on/off/escape button is pushed and immediately released, it functions as an "escape", and brings you back to the Main Menu from the current screen in the menu system.

Figure 0-2. The Control Panel

Push and hold the on/off/escape button for at least 3 seconds to turn the analyzer on.Push the on/off/escape button and hold it down for about 10 seconds to shut off power to the analyzer from any screen in the menu system.

You also have the option of operating the analyzer, including navigating the menu system, by using the built in touch screen. To select a menu option, tap on the icon once. The touch screen icons have the same functionality as the four way touch pad, the on/off/escape button, and the select or enter button. This User's Guide will refer to the process of choosing a course of action by selecting an icon from a menu, either using the touch screen or using the control panel buttons, as “selecting.”

Selecting the **Return** icon works everywhere throughout the User Interface to bring you back to the previous menu from the current menu in the menu system. Use the on/off/escape button to return to the **Main Menu**.

The LCD Touch Screen

The LCD Touch Screen on your XL3 Analyzer is designed to swing up and down to different angles for ease in viewing and interacting with your analyzer. The LCD Touch Screen is connected to your analyzer along the base of the screen, right above the Control panel. The screen is not designed to separate from the analyzer, but can be adjusted to any arbitrary angle between zero degrees - that is, flush with the analyzer - and 85 degrees, which is almost perpendicular. The LCD Touch Screen will stay at any given angle between these extremes until moved to a different angle. When in closed position, the screen is secured by a catch at the top center of the screen housing.

Figure 0-3. XL3 Analyzer Showing LCD Screen Tilted.

- To raise the LCD Touch Screen, disengage the catch at the top-center of the LCD Touch Screen housing and gently pull the screen towards you until it is at the best angle for your use.

- To close the LCD Touch Screen, gently push away from you along the top edge of the screen housing. The screen will swing down until the catch solidly engages with an audible click.

Note The LCD Touch Screen cannot be removed from your XL3 analyzer. Removing or attempting to remove the LCD Touch Screen will damage your analyzer and void your warranty.

Note Always close your LCD Touch Screen before storing or transporting your XL3 analyzer.

The Data Ports

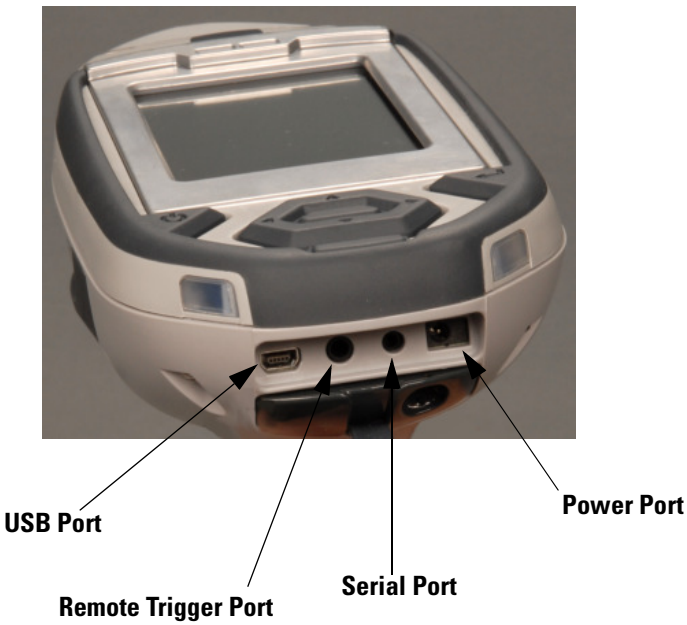

Figure 0-4. Data Ports on the XL3

USB Port The USB Port is a communications and control port, for uploading and downloading data, configuration files, and software to the analyzer.

Remote Trigger Port The Remote Trigger Port controls the analyzer's trigger function, for use with the Extend-a-pole, In Situ Tripod, and test stands.

Serial Port The Serial Port is a communications and control port, for uploading and downloading data, configuration files, and software to the analyzer.

Power Port The power port is used to run the XL3 under external power.

Instrument Startup

To turn on the analyzer, depress the **on/off/escape** button on the control panel for approximately 10 seconds.

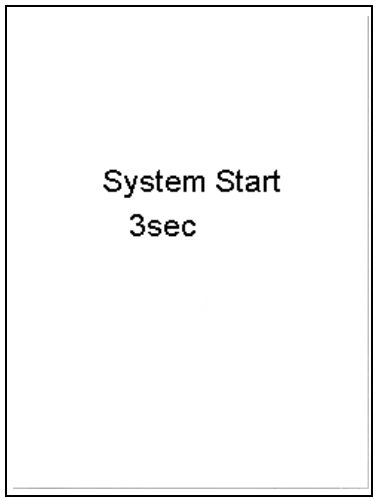

Figure 0-5. System Start Screen

On startup, the screen will be replaced by a **Start Screen** (see Figure 0-5) which will automatically count down from 9 to 0 in increments of one second.

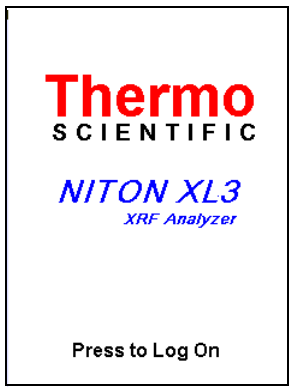

Figure 0-6. Logon Screen

When the Start is complete, the Start Screen will be replaced by the Logon screen (see Figure 0-6.) Tap anywhere on this screen to continue.

The Logon Screen will be replaced by a Warning Screen, see Figure 0-7, advising you that this analyzer produces radiation when the lights are flashing. You must acknowledge this warning by selecting the “Yes” button before logging on. Selecting the “No” button will return you to the Logon Screen.

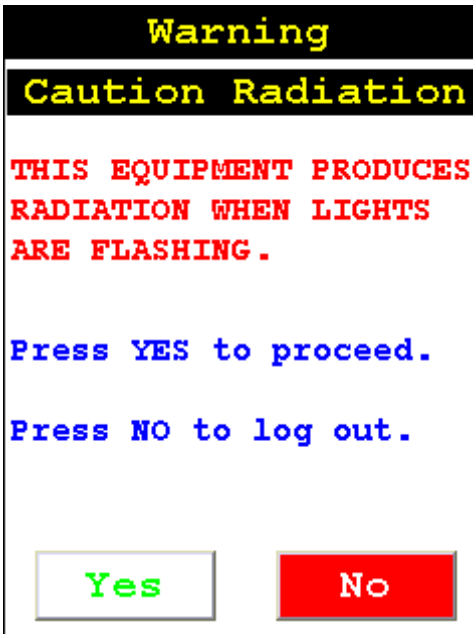

Figure 0-7. Warning Screen

After selecting the "Yes" button, the Virtual Numeric Keypad becomes available for you to log onto the analyzer.

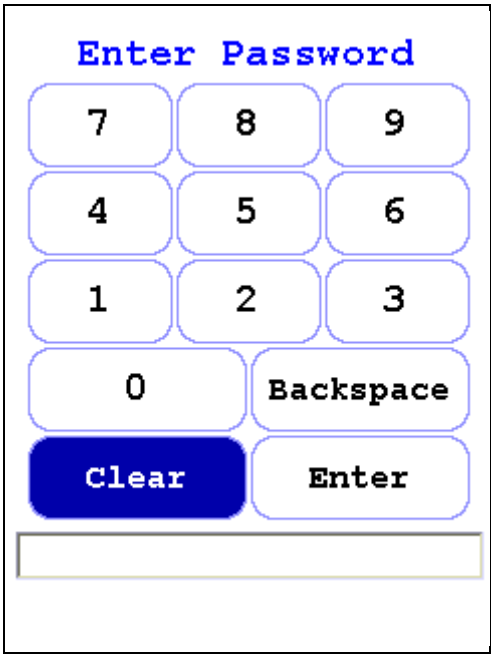

Figure 0-8. Virtual Numeric Keypad for Logon

Select your 4 digit security code, followed by the enter (E) key. The temporary password assigned by default is 1-2-3-4, followed by the “E” key. If you enter an incorrect number, you can use the “<“ key to backspace over it, ot use the “C” key to clear everything. After you have completed the log on procedure, the word "USER" will appear on the bottom of the screen, then the Main Menu will appear. Note that security codes are editable. Please see the NDT manual for instructions on creating user-definable passwords.

Check the date/time. The time should be set correctly for accurate and verifiable record keeping (See Chapter 1 page 72).

Your analyzer can be stored and operated safely in temperatures from -5º C (23º F) to 50º C (122º F). You will not be able to take a measurement if the analyzer overheats. If it is hot to the touch, you should allow it to cool before testing.

The NAV Menu

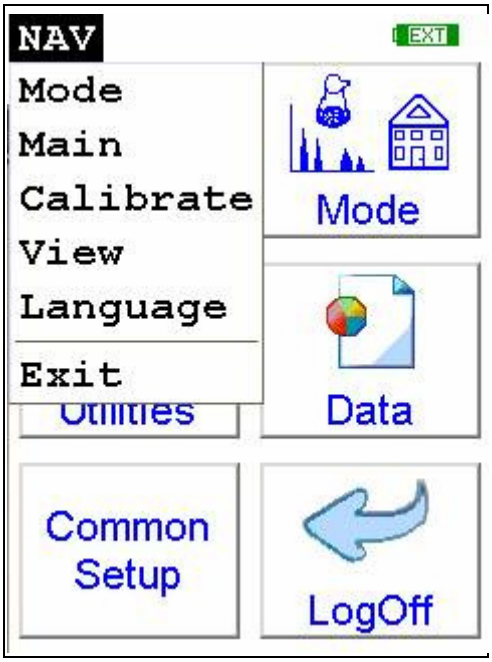

Figure 0-9. The NAV Menu

The Navigation Menu, or NAV Menu, is available in all screens, though only through the touch screen interface. Within a menu, the particular options available from the NAV Menu may change with the context. For example, within the View Menu, the NAV Menu changes options depending on the mode you are currently using.

Access the NAV Menu by selecting the word NAV in the screen. A drop-down menu of choices will appear. Selecting an option from the NAV Menu will take you directly to a particular menu, no matter where you are in the menu hierarchy. Selecting the "View" option from the NAV Menu, for example, will bring you directly to the Data Menu.

The NAV Menu cannot be selected through the Control Panel.

The Battery Life Indicator

The Battery Life Indicator is visible on all screens in the menu system. The indicator is visible in the top right portion of the screen, and graphically shows you how much battery life is left, enabling you to change batteries as needed to avoid unexpected shutdowns.

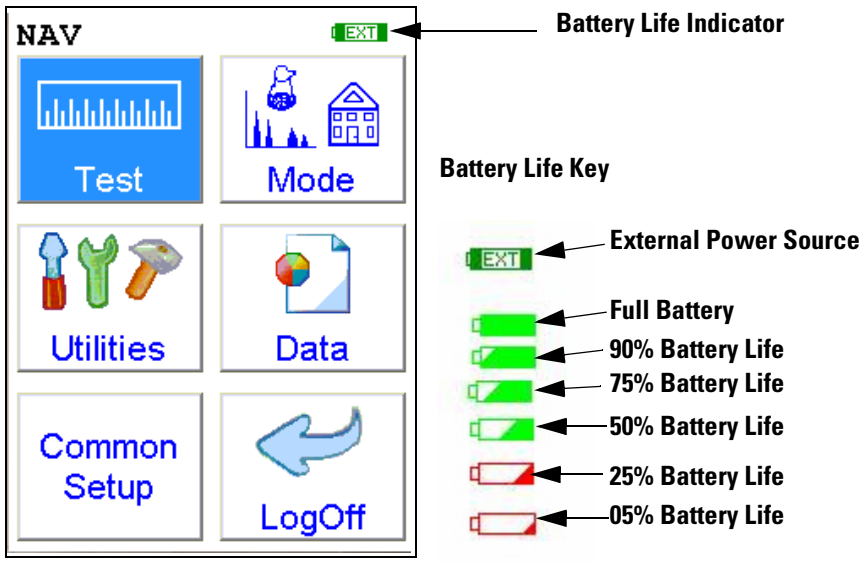

Figure 0-10. Battery Life Indicator

The more green visible in the indicator, the higher the charge. The more red visible in the indicator, the lower the charge. It's best to charge one battery while using the other, to avoid work slowdowns or stoppages due to battery charge conditions.

WARNING! In the highly unlikely event that the x-ray tube remains on when the trigger is not depressed, disconnect the battery pack immediately to turn off the x-ray tube, and call Thermo Fisher Scientific's Service Department in the United States, toll free, at (800) 875-1578, or outside the United States at +1-978-670-7460, or your local Authorized NITON Analyzers Service Center. ♦

The Menu Path

The Menu Path shows you graphically how to get to the function being described in several discrete steps from the universal start position, the Main Menu.

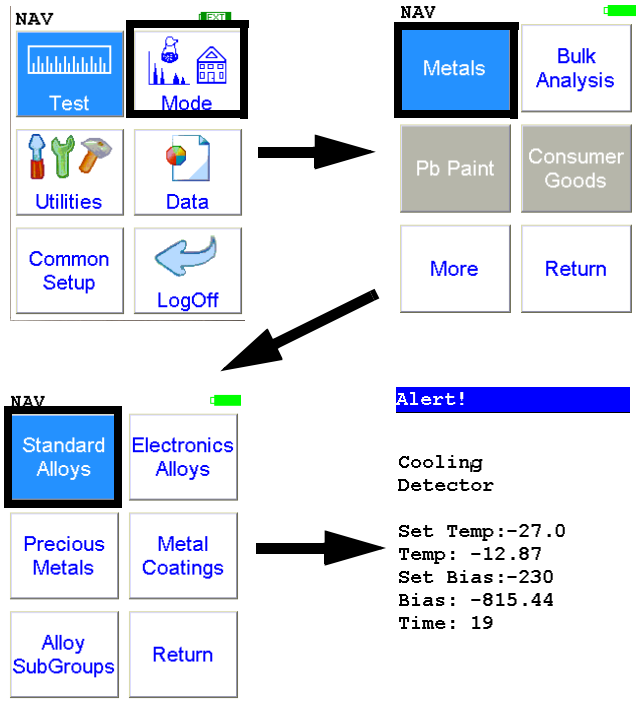

Figure 0-11. Example Menu Path

In the Menu Path, the order is top to bottom, then if needed left to right, starting with the Main Menu and ending with the function wanted. The arrows show the succession of menus, while the icon to be selected is highlighted by a heavy rectangular border.

This Menu path should be read as:

> To get to this screen, starting at the Main Menu, select the Mode icon, select the Metals icon, then select the Standard Alloys icon.

Chapter 1 Applications

The NAV Menu

The **NAV Menu** enables you to move between various menus and screens directly, without going through the intervening screens. Select a destination from the drop down menu and you will be brought directly to that menu or screen.

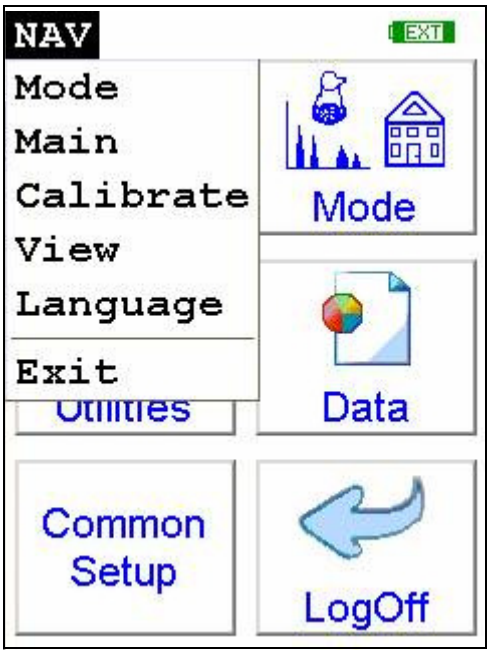

Figure 1-1. The NAV Menu

The Tools Menu

The **Tools Menu** enables you to perform common data-related tasks such as printing and averaging. Select a task from the drop down menu to initiate that task.

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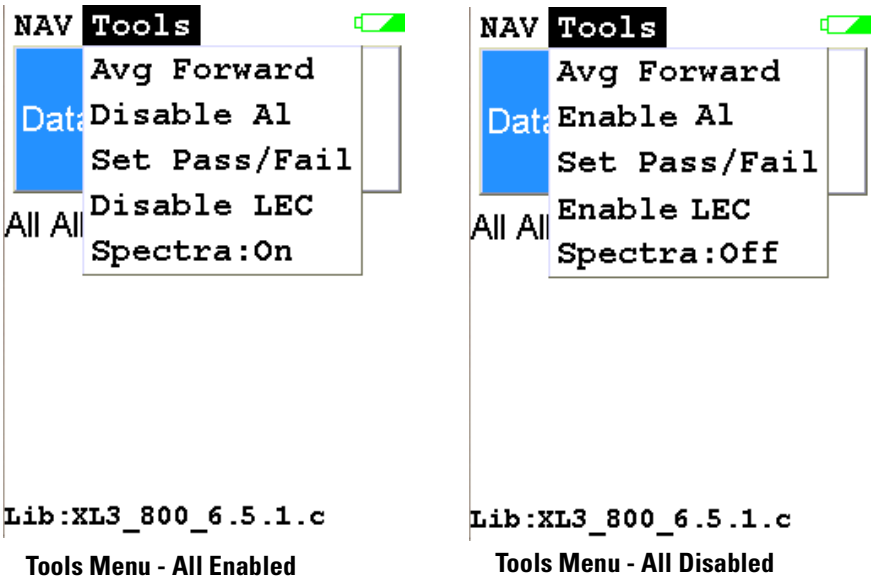


Figure 1-2. The Tools Menu

The Tools Menu, like the NAV Menu, uses context sensitive menus. The following is the most common menu set.

Avg Forward

Enables you to average different readings together from this analysis forward. Select **Avg Forward** to initiate future sample averaging. **Avg Forward** will set up an automatic personal averaging protocol to be followed until your analyzer is shut down, or this feature is disabled. To begin, select the number of readings you want to average from the virtual numeric keypad. Your analyzer will calculate an average reading after that number of tests, and continue this pattern until stopped. For example, if you select 3 on the virtual keypad, the analyzer will automatically calculate, average, and store a reading for every three tests you take, storing the individual readings along the way.

Avg Back

Enables you to average different readings together from this analysis backward. Select **Avg Back** to initiate backwards sample averaging. **Avg Back** will take a number of readings you select and average their analytical results. The range is counted from the last reading backward by the number

of readings selected. If your last reading was #15, selecting 3 would average readings #13, 14, and 15. The average is calculated, displayed, and stored into memory as the next sequential reading number.

The range number is selected using a virtual keypad on your analyzer similar to the keypad used for login. Select the digits in the range number from the keypad, then select the "E" key to enter the number. "C" will clear all, and "<" will clear the last digit entered. The average will automatically be displayed.

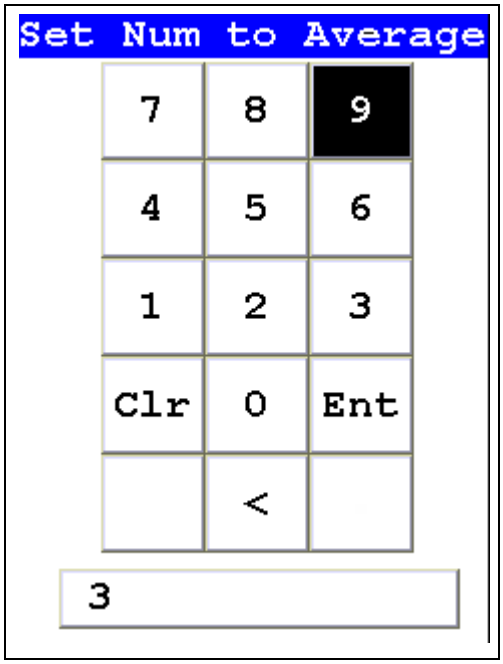


Figure 1-3. The Virtual Numeric Keypad for Averaging

Note You cannot average readings taken with different element lists - or with different filter settings if the settings have different element lists - with either **Avg Back** or **Avg Forward**. Alloy and Mining modes each use the same element lists with the different filter settings, so averaging works when switching between filter settings when in either of these modes. Thin Film and Bulk modes both use different element lists for different filter settings, and readings with different filter settings cannot be averaged when using either of these modes. You can never average readings taken in different modes.♦

Note The **Tools Menu** is only available when viewing readings, and the menu is only accessible through the touch screen interface or NDTr. ♦

Stop Avg Fwd/Back

Avg Back and Avg Forward are toggles. The option on the Tools Menu changes to its opposite when selected. To stop averaging, select Stop Avg Fwd or Stop Avg Back from the Tools Menu as appropriate.

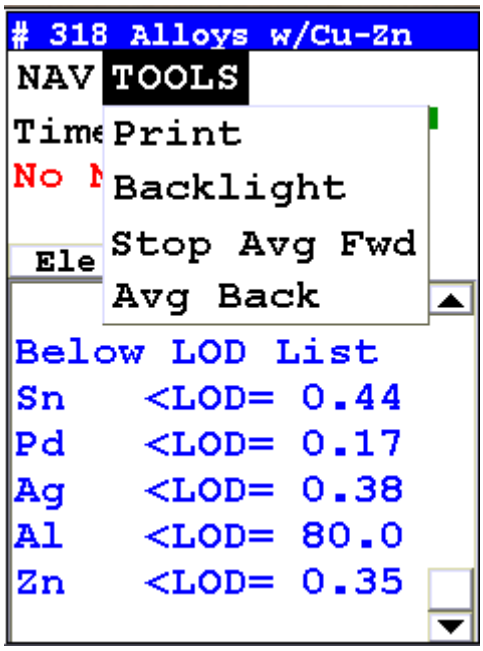


Figure 1-4. The Tools Menu - Averaging Toggles

Example Averaging

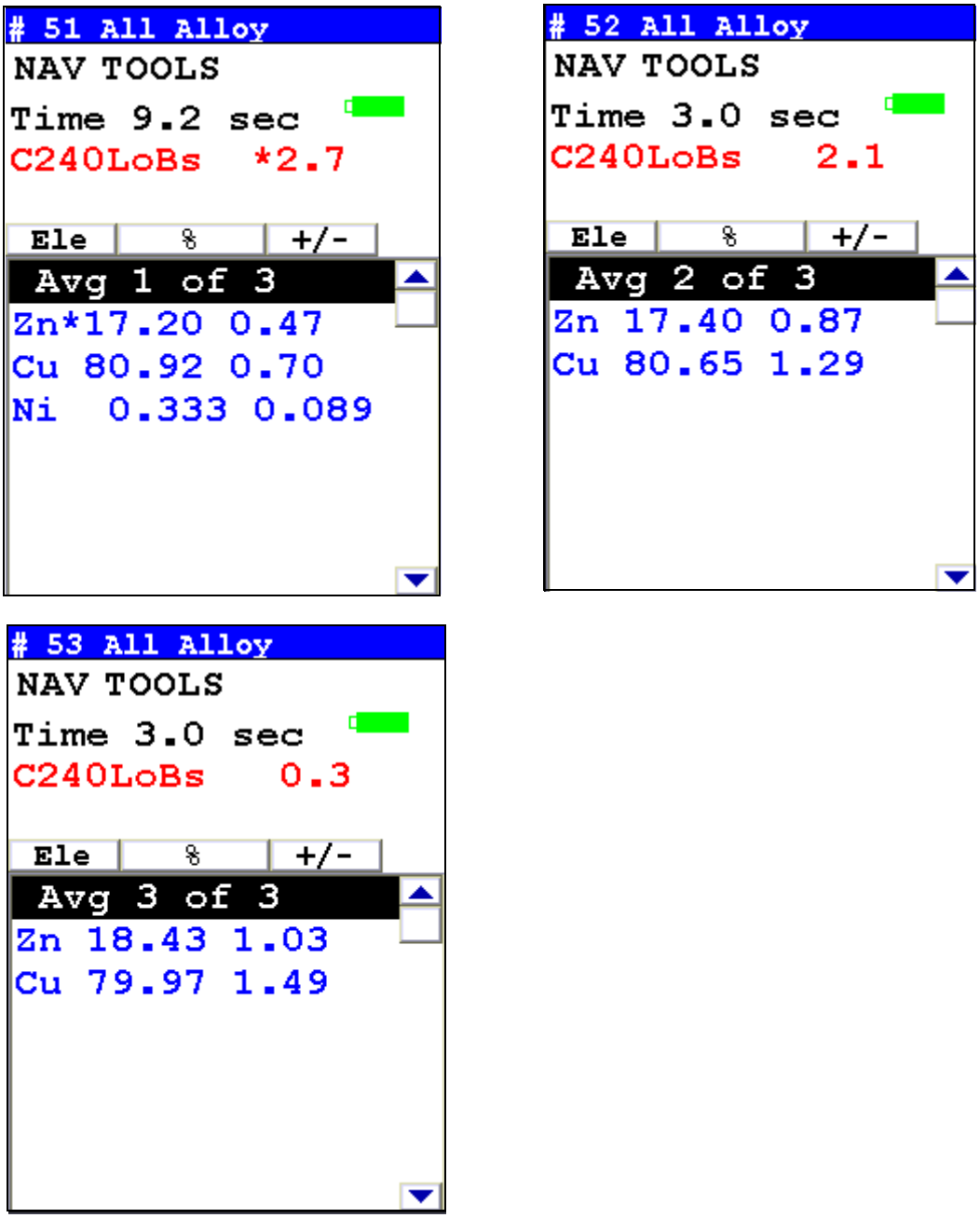


Figure 1-5. Averaging example: 3 readings

Live Spectrum Feed

The Tools Menu may contain a toggle option to display live spectra as sample analysis occurs.

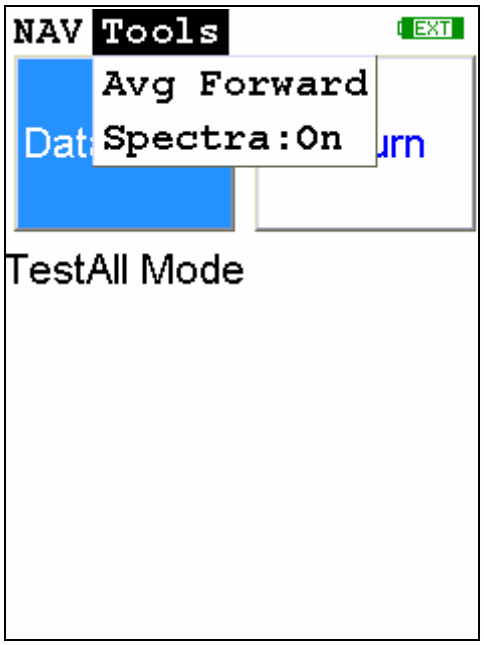


Figure 1-6. The Tools Menu showing the Spectra On/Off Toggle

Activating and Deactivating the Live Spectrum

From the Tools Menu, select Spectra : On to turn the Spectrun feed on. Once the spectrum is displayed, selecting Spectra : Off from the Tools Menu will stop the live spectrum display.

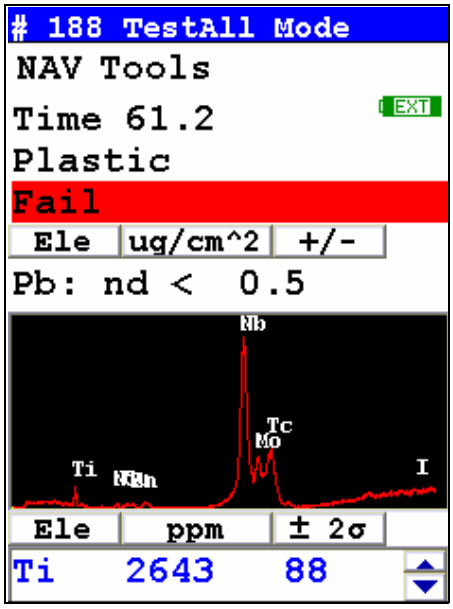


Figure 1-7. Test Screen Showing Live Spectrum

Analyzing Bulk Samples

CAUTION Whenever you turn on your NITON Analyzer after it has been off for more than 30 minutes, you should measure your check sample to assure proper operation. If the instrument is not reading properly, you should re-calibrate your NITON Analyzer's sample analysis electronics before you start to take readings. When the instrument is turned on after being off for more than 30 minutes, your NITON analyzer will require a 10 minute warm-up period before the instrument can be calibrated, unless this 10 minute warm-up period is manually overridden.

There are six different methods of operation for taking a sample measurement, and your analyzer will be configured to use one of those methods for soil samples, depending on the regulatory requirements of your locality. These methods are:

- Trigger-Only method. With the Trigger-Only method, you only need to place the measurement window close to the sample to be analyzed and pull the trigger for sample analysis to be initiated.

- Trigger-and-Proximity-Sensor method. With the Trigger-and-Proximity-Sensor method, you must place the measurement window against the sample to be analyzed to engage the proximity sensor on the front of the instrument, then pull the trigger for sample analysis to be initiated.

- Momentary-Trigger-Touch-and-Proximity-Sensor method. With the Momentary-Trigger-Touch-and-Proximity-Sensor method, you must place the measurement window against the surface to be analyzed to engage the proximity sensor on the front of the instrument, then pull the trigger. The trigger may be released and the reading will continue until you release the proximity button, or other criteria (such as Max Time) are reached.

- Trigger-and-Interlock method. With the Trigger-and-Interlock method, you need to place the measurement window close to the sample to be analyzed, press and keep pressing the interlock button at the rear of the instrument with your free hand, then pull the trigger for sample analysis to be initiated.

- Trigger-Interlock-and-Proximity-Sensor method. With the Trigger-Interlock-and-Proximity-Sensor method, you must place the measurement window against the sample to be analyzed to engage the proximity sensor on the front of the instrument, press and keep pressing the interlock button at the rear of the instrument with your free hand, then pull the trigger for sample analysis to be initiated.

- Easy Trigger method. With the Easy trigger method, you need only place the measurement window against the sample area and pull the trigger once to initiate a sample analysis. Your analyzer will continuously sample the backscatter, using a complex internal algorithm, to determine if the measurement window is against a sample or pointing to the empty air. If it finds that there is no sample directly against the measurement window, the analyzer will stop directing radiation through the window as soon as this determination is made.

Note The analyzer is constantly checking the backscatter characteristics to determine if a sample is against the measurement window, whether or not the Easy Trigger method is being used, and will shut off any radiation directed through the window if it determines that there is no sample present.

With any of these methods, analysis will stop if any one of the preconditions are violated. For example, with the Trigger-Interlock-and-Proximity-Sensor method, if the trigger or the Proximity Sensor or the Interlock is released, the reading will stop immediately, and the X-ray tube will shut down.

After your NITON analyzer is calibrated, initiate a sample reading using the appropriate method. If you attempt to initiate a sample reading using a different method, the analyzer will inform you that one or more of the preconditions need to be met in order for sample analysis to begin. Initiate the proper preconditions for operation to turn on the x-ray tube, and begin a measurement. Although the four LED lights will begin to flash as soon the initiating preconditions are met, as a safety precaution, the x-ray tube will not turn on immediately, and no reading will begin for approximately 0.5 seconds.

Note The four LED lights will blink during calibration. ♦

WARNING! The preconditions for operation must be continued for the duration of the reading. If the preconditions are violated, the x-ray tube will turn off, the calibration shutter will close, and the measurement will end. The four LED lights will stop blinking when the measurement is ended. The flashing of the LED lights is not synchronized to minimize power consumption. ♦

To end the test, simply release the trigger mechanism, or any other applicable preconditions.

WARNING! When all four LED lights are blinking, the x-ray tube is on. This should only occur during a measurement, while the preconditions for operation are met. On startup, the front pair of lights will blink. If the LED lights blink at any other time, disconnect the battery pack and call Thermo Scientific's Service Department in the United States, toll free, at (800) 875-1578, or outside the United States, at +1-978-670-7460, or your local Authorized NITON Analyzer Service Center. ♦

Your NITON Analyzer will display the Results Screen throughout the duration of each reading, The Results Screen is updated regularly throughout the reading. When the reading is complete, a final screen update will appear, and your NITON analyzer will display the final results of the measurement which has just been completed.

WARNING! Do not attempt to take measurements while downloading readings! This will generate an error requiring a system reset, and may corrupt your stored readings, requiring all stored readings to be erased. ♦

The Data Entry Screen

The **Data Entry Screen** is accessed whenever you select the **Data Entry** icon from any screen. This screen allows you to input data in several different fields, or categories, concerning your sample, in several different ways:

- By selecting the Virtual Keyboard button and typing the parameter in using the **Virtual Keyboard**.
- By creating a new, or editing your analyzer's existing, '.ndf' file through the NDT program. You can then select from the various custom options you have created using the Drop-down List button.

These fields are saved along with the subsequent reading, and allow you to associate important information about the sample directly with the reading, so that you have a full description of the sample tied into the reading itself.

Once you have input data into a field, that information carries over into the next reading, so that you only have to input the information that has changed since the last reading. For example, if you are analyzing several samples of a particular lot, you only need to input the lot information once during that series of readings, changing only the sample name.

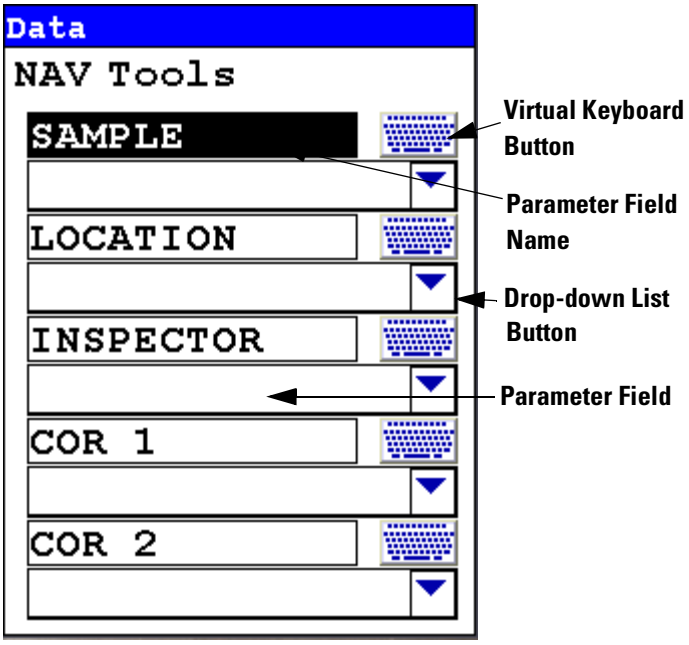


Figure 1-1. The Data Entry Screen - First page

This is the first section of the **Data Entry Screen**. There are five parameters in this section.

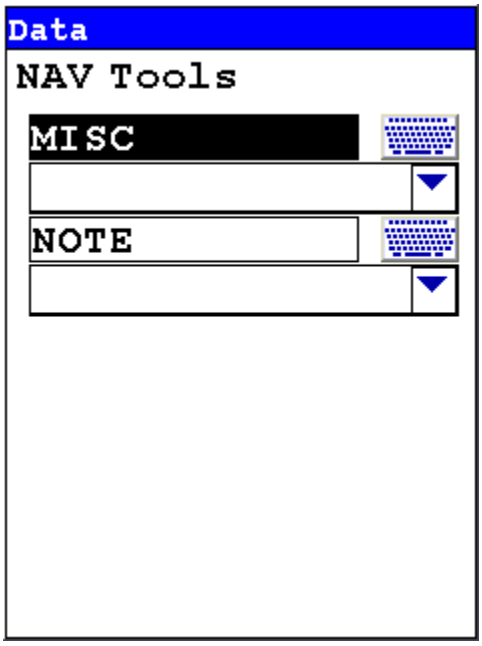
Selecting **Sample** allows you to input the sample name parameter.

Selecting **Location** allows you to input the particular Location information, if known.

Selecting **Inspector** allows you to input the parameter for the Inspector's name.

Selecting **Cor1** allows you to input information on the sample's origin Latitude Coordinate.

Selecting **Cor2** allows you to input information on the sample's origin Longitude Coordinate.

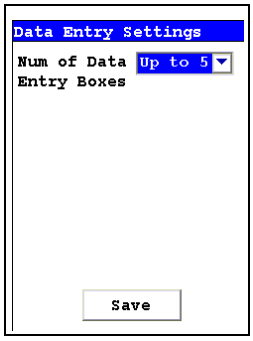


This is the second section of the **Data Entry Screen**. There are two parameters in this section.

Selecting **Misc** allows you to input the any miscellaneous parameters.

Selecting **Note** allows you to input any Note information, if wanted.

Changing the Data Entry Screen to Two Column



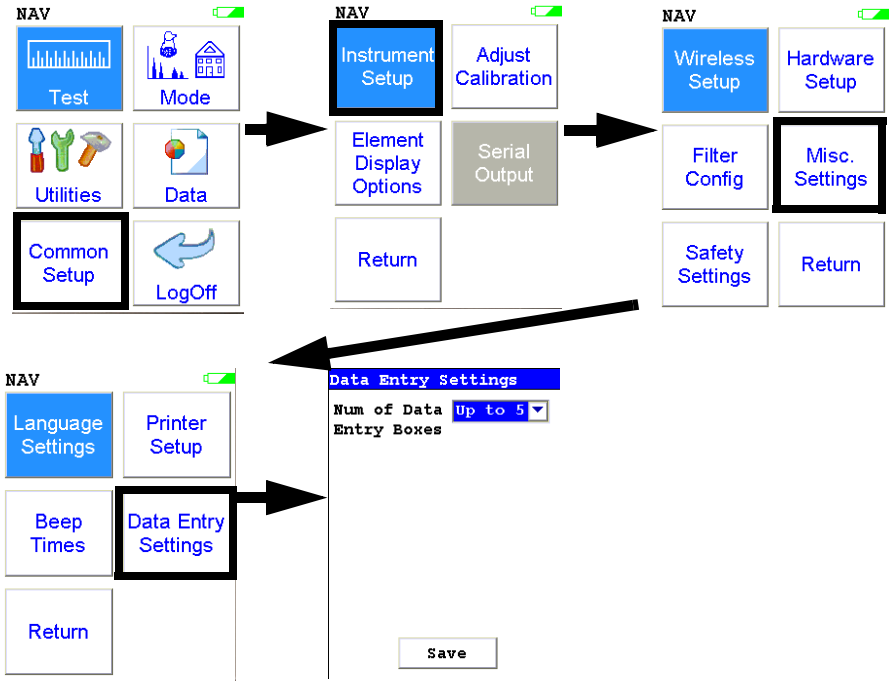


Figure 1-2. Data Entry Settings Menu Path

You can change the Data Entry display from the default single column to two columns in order to fit all the fields on one page, if you prefer. Select the Data Entry Settings icon from the Misc. Settings Menu to change your preferences.

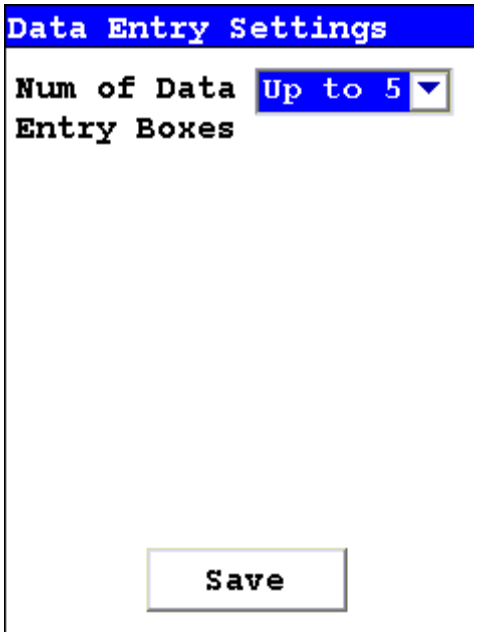


Figure 1-3. Data Entry Settings Screen

Selecting the triangle button to the side of the Num of Data Entry Boxes field will open a drop down menu. From this menu you can choose between showing up to five boxes per page, the default, and up to eight boxes per page. Select the option you prefer, and select the Save button to save the setting.

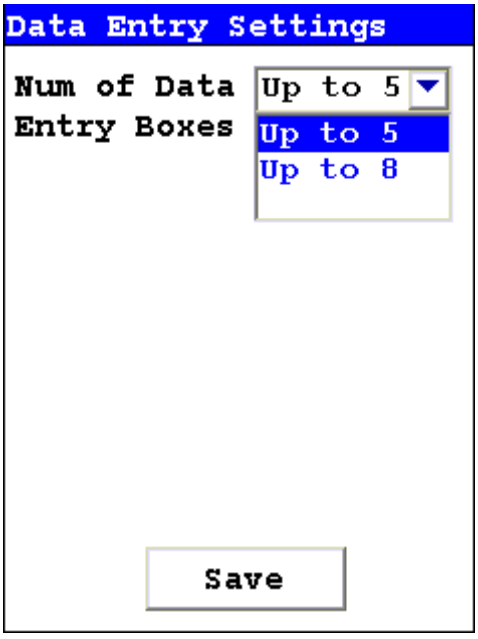
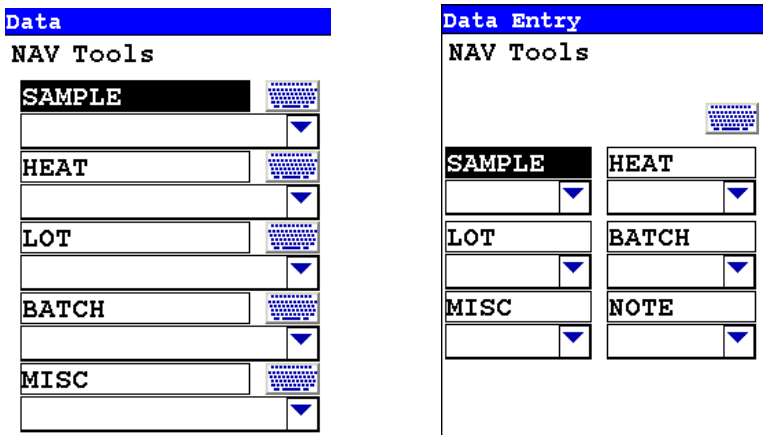


Figure 1-4. The Drop Down Menu

Under the default setting, a mode with more than five boxes will open up a second page to display the remaining boxes. Under the optional setting, a mode with up to eight boxes will display on one page, with the overflow page not opening unless there are nine or more Data Entry boxes.



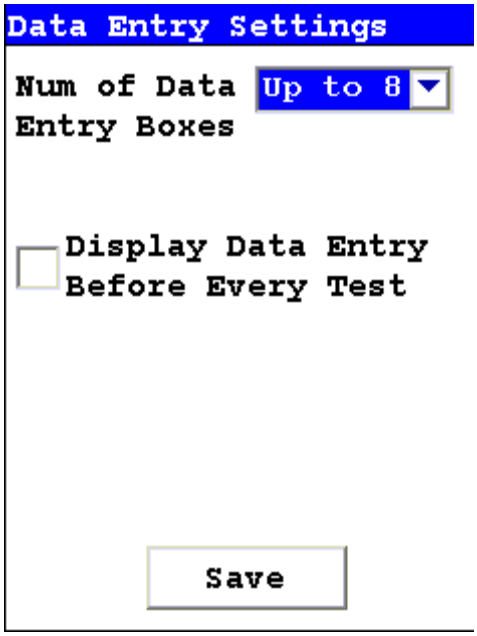
Up to Five Boxes

Up To Eight Boxes

Figure 1-5. Comparing the Data Entry Display Options

With the default, up to five boxes, setting, the boxes are longer, and can display more descriptive test. With the optional, up to eight, setting, the boxes are shorter, but retain the full descriptive text internally. Choose whichever settign you feel most comfoortable working with.

Displaying Data Entry Boxes After Testing By Default



On the Up to Eight boxes screen, there is a checkbox to force the Data Entry screen to display. Checking the Display Data Entry Before Every Test checkbox will enable this, which can serve as a reminder to the user to enter data at test time. Despite the text, though, this checkbox forces the Data Entry screen to display *after* every test, not before every test. This only works with the "Up to Eight" option enabled.

Selecting Data Entry from View Data Mode

You can select Data Entry from the NAV Menu while in View Data Mode, but the ability to edit or enter data is disabled. The screen will show the data already entered, with no buttons for drop down menu selection or Virtual Keyboard.

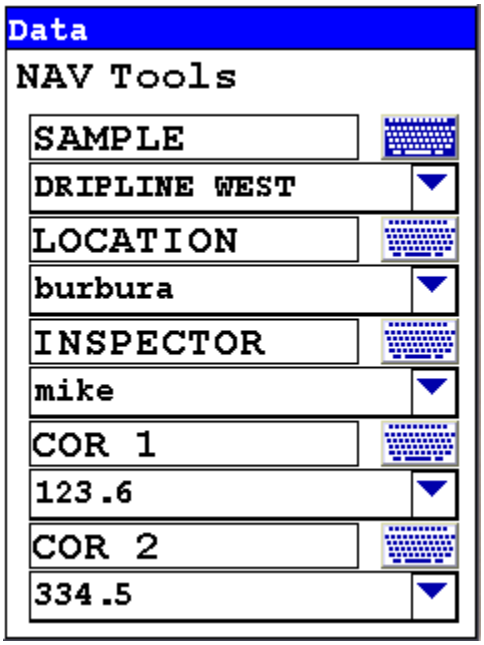


Figure 1-6. Data Entry Screen while Viewing Data

Navigating the Data Entry Screen

Figure 1-7. The Control Panel

The following description of screen navigation using the control panel assumes that the analyzer is held so that the display is held upright as in Figure 1-7.

- To move from column to column, use the Right and Left portion of the 4-way touch pad.
- To move from row to row, use the Up and Down portions of the 4-way touch pad.
- To select the highlighted option, press the Enter button on the control panel.

The **Data Entry Screen** is divided into sections of 5 setting parameters. By using the Down portion of the 4-way touch pad when you are on the last row of a section, the display will change to the next section. By using the Up portion of the 4-way touch pad when you are on the first row of a section, the display will change to the previous section.

By selecting the **On/Off** button, you can exit the **Data Entry Screen**.

The Virtual Keyboard

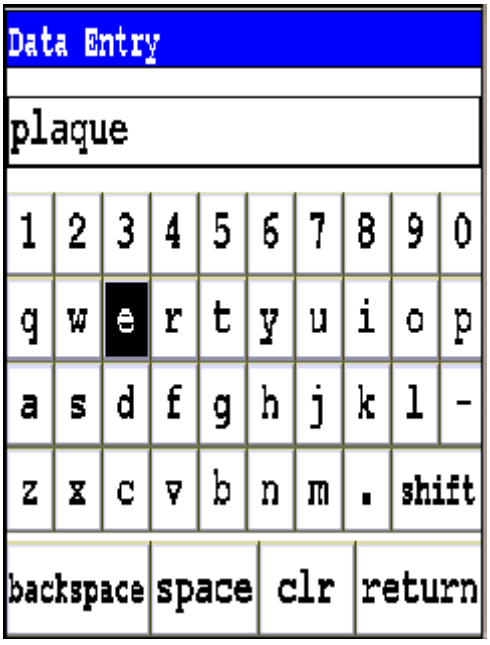


Figure 1-8. Lower Case Virtual Keyboard

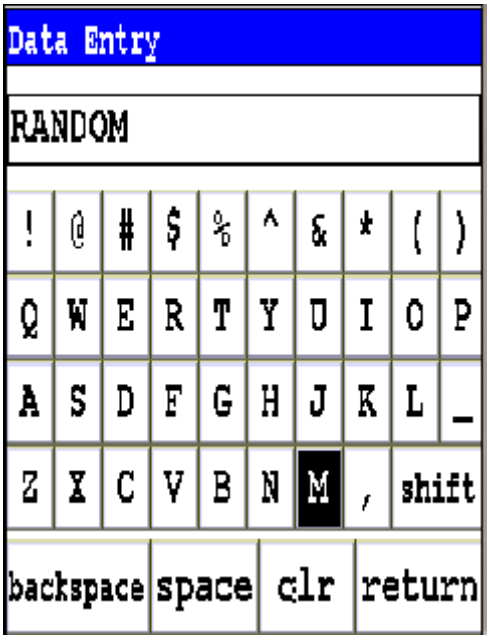


Figure 1-9. Upper Case Virtual Keyboard

The Virtual Keyboard is an alphanumeric keyboard which appears on the LCD Touch Screen Display. You can use the Virtual Keyboard either with the four-way touch pad and control panel buttons, or using the touch screen display directly.

At the top of the screen is the data field you are entering data into, in this case"A1234567890A". Also in this field is the underscore cursor, which graphically shows where the next character will be placed. Up to 25 characters can be stored in the data fields, though only the first 15 will be displayed on the analyzer's touch screen.

Next is the Virtual Keyboard itself, with numbers 0-9, letters A-Z, the special characters *,<,>, and -, and the Shift key, to toggle between upper and lower case keyboards.

Last is the control key line. This contains the keys for Return, Space, Clr, and Backspace. The Return key will enter the data and return you to the Data Entry Screen, the Backspace key will delete the last entered character, the Space key will insert a space at the cursor position, and the Clr screen button will clear the data you have entered.

Since the **Virtual Keyboard** is oriented 90 degrees from the standard in order to use a landscape display, the down portion of the 4-way touch-pad will select the key to the right of the current position, the left portion will select the key immediately below, the up portion will select the key to the left, and the right portion will select the key will select the key immediately above, Use the Select and Enter button to enter the currently selected key.

All screen areas can be directly accessed using the LCD Touch Screen by touch.

The Measurement Screen

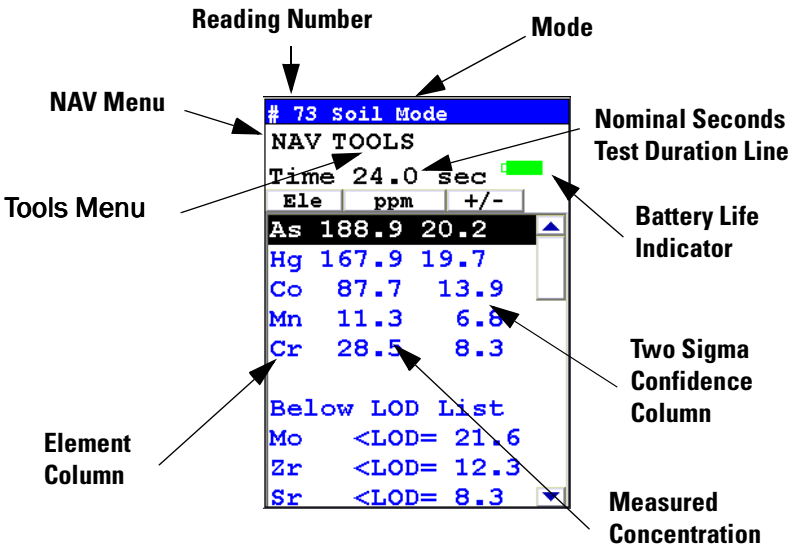


Figure 1-10. The Standard Bulk Measurement Screen

The Results Screen displays the following information:

- The Reading Number line shows a number automatically assigned by your NITON analyzer in order to uniquely identify each reading. The reading number automatically increments up by one with each successive reading.
- The Nominal Seconds Test Duration line shows the number of nominal seconds elapsing since the initiation of the reading. Nominal seconds are true, clock seconds slowed down to compensate for the electronic dead-time that occurs when the analyzer is taking a measurement.
- The Mode line displays the test mode in use during the measurement.
- The **Element** (left) column shows the elements that have been detected in the sample.
- The **Concentration Level** (central) column shows the concentration levels of the corresponding elements in percentages.
- The **Confidence** (right) column displays the 2 sigma (95%) confidence interval for the corresponding elements.

Standard Soil Mode

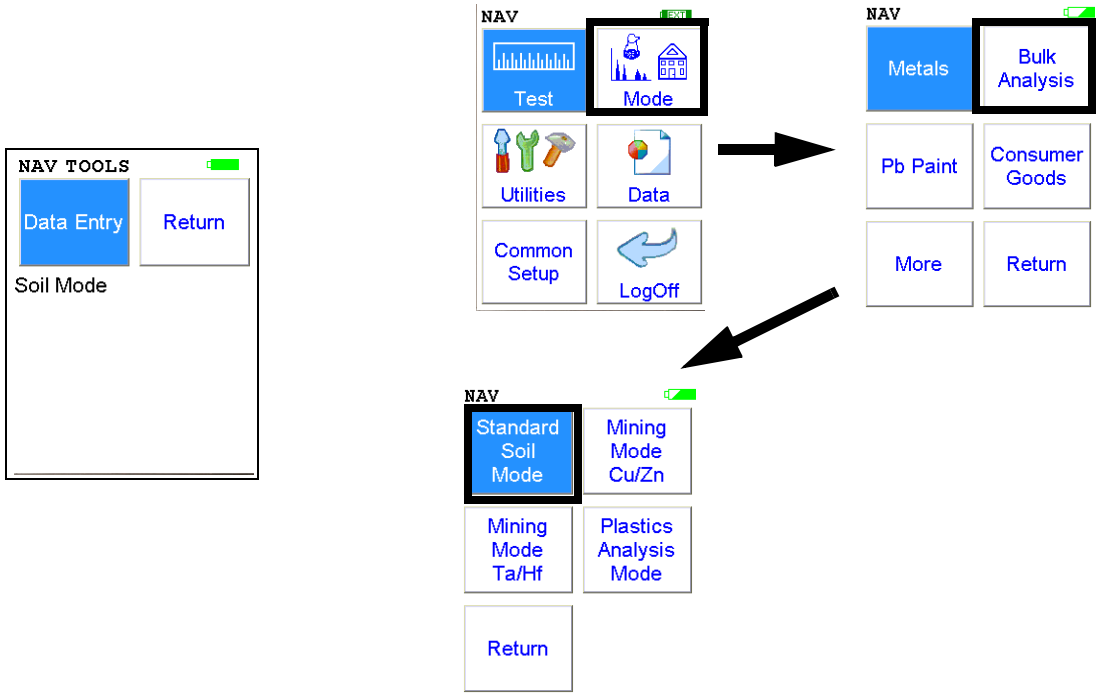


Figure 1-1. Standard Soil Mode Menu Path

To use the **Standard Soil Mode,** simply select the **Standard Soil Mode** icon from the **Bulk Analysis Menu** to place your instrument into **Standard Soil Mode**. Use the **Standard Soil Mode if**:

- The percentage of the elements of interest are <1.0%
- The material is of a light matrix, for example aluminum silicate
- Elements with atomic number greater than iron do not exceed several percent

This mode of operation is optimum for any sample whose elements of interest are present at less than 1%. **Standard Soil Mode** utilizes the Compton Scatter (Inelastic Collisions) of a particular sample. Compton scatter occurs when primary X-rays do not cause fluorescence but instead collide with the atoms of the sample. The Compton Scatter that occurs is directly proportional to the density (average atomic number (Z)) of the sample. A light matrix material, such as an oil or sand, will have a much greater scatter than that of a heavy matrix, such as ore. The analyzer measures this scatter peak and automatically adjusts the concentration based on the matrix of the material and allows for the analysis of a bulk sample without the use of site

specific calibration standards. This mode is used chiefly for the analysis of contaminants in soils.

Standard Soil Mode

NITON provides three soil standards: Lead high, Lead medium, and Lead low, to check the calibration of the instrument when testing in **Standard Soil Mode**.

Note Although the standards do not contain every element that the Environmental Analyzer is capable of testing, when an instrument correctly measures the standards you have received with your instrument, your instrument will correctly measure all other elements.

Test the standards regularly. NITON recommends testing immediately after the instrument finishes self-calibration. Test the standard samples appropriate to the type of tests you are conducting, and once every 1–2 hours thereafter.

Note For defensible Quality Control, keep a record of the time and precision of every calibration**.**

WARNING! Tampering with the 5,500 ppm (lead high) lead-in-soil standard may cause exposure to lead dust. Keep all standards out of the reach of children.

CAUTION Never tamper with Test Standards. They should not be used unless they are completely intact.

During each test, the instrument looks at the full range of x-ray spectrum and continuously corrects for cross-element interference.

The Measurement Screen

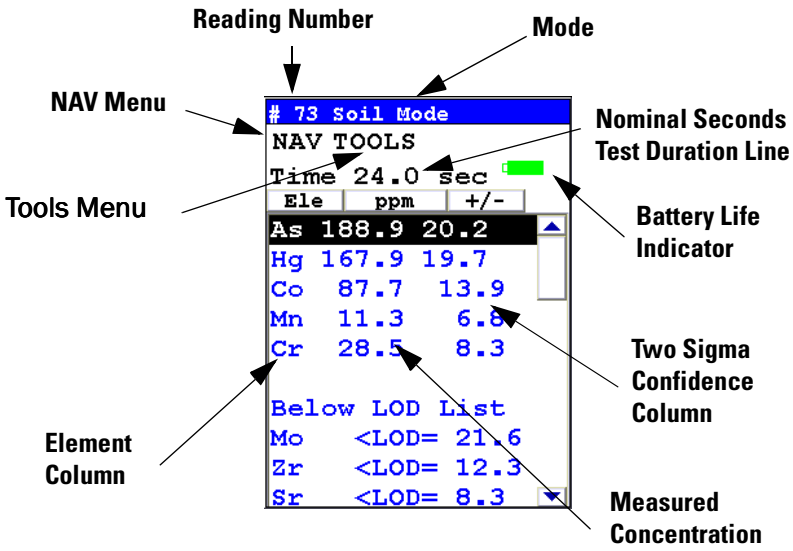


Figure 1-2. The Standard Bulk Measurement Screen

At the top are the elements detected in the sample, and underneath this, elements that are below the detection limit.

Use the 4 way touch pad or touch screen to scroll through the elements.

Detection Limit

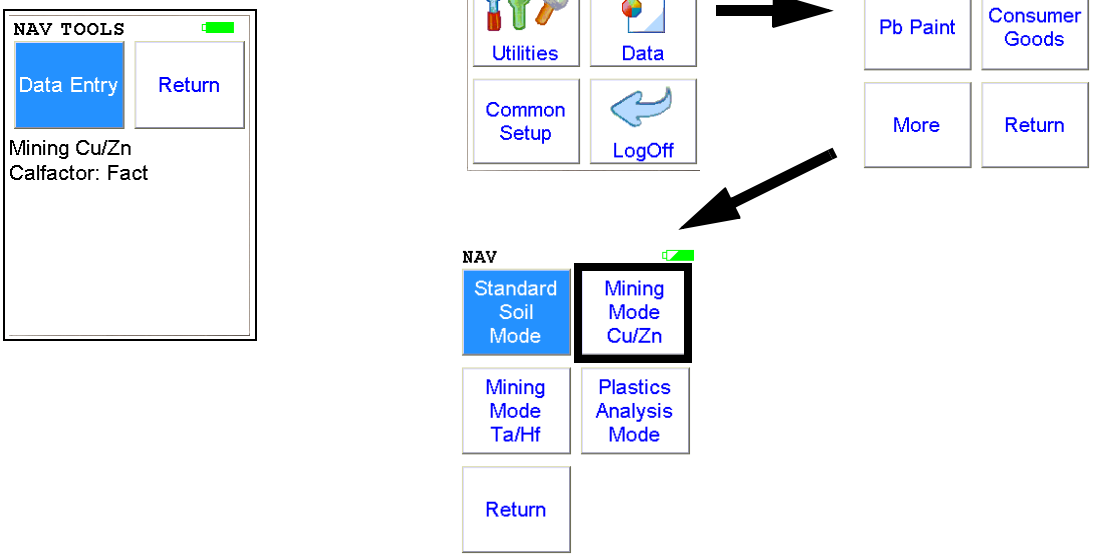
For an element to be detected by your analyzer in a given sample, the measured concentration of the sample must be at least three times the standard deviation of the measurement. This detection limit will depend on the composition of the sample.

Precision

The measurement precision for each element displayed appears to the right of the measured concentration, under the heading "+-". The precision of each measurement is two times the standard deviation (sigma).

An element is classified as "detected" if the measured concentration (in ppm) is at least 1.5 times the precision. Detected elements are displayed in ppm, followed by the measurement precision. Non-detected elements are shown as < the detection limit for that sample. The detection limit for a given element varies depending on the other elements in the matrix.

Mining Cu/Zn Mode



The **Mining Cu/Zn Testing Mode** allows you to perform tests on soil and other bulk samples without adjusting for a particular matrix. **Mining Cu/Zn Testing Mode** is ideal for finding concentrations of analytes in rock or soil. This mode of operation is optimum for any sample whose elements of interest are present at 1% or greater. **Mining Cu/Zn Testing Mode** utilizes Fundamental Parameters to analyze the sample. From the **Mining Cu/Zn Testing Mode Menu**, you can immediately initiate a sample test using the proper preconditions for operation, enter data about your sample using the **Data Entry** icon, or return to the **Main Menu**.

This mode of the operating software is intended primarily for the detection of metal concentrations in light matrices. The full fundamentals parameter (FP) algorithm accurately measures elemental concentrations from trace levels to 100%, and automatically corrects for inter-element effects. However, elements lighter than magnesium cannot be detected by XRF and light element combinations, such as oxides, carbonates, and silicates are common matrix components. To fine-tune results, you may enter calibration factors for individual elements to adjust for effects of light element interference. These calibration factors are linear corrections, which adjust the FP calculation. Calibrations only need to be entered once per matrix. However, as matrices can vary considerably from one sampling area to another, it is recommended that new calibrations be done for each change in matrix.

Concentrations for the following analytes can be determined:

Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, W, Pb, Bi, Zr, Nb, Mo, Sn, Ba, Sb, Cd, Pd, Sr, Rb, Se, and Ag.

All concentrations are displayed in units of wt. % by default, but can be changed to ppm.

Note For defensible Quality Control, keep a record of the time and precision of every calibration**.**

WARNING! Tampering with the 5,500 ppm (Lead high) lead-in-soil standard may cause exposure to lead dust. Keep all standards out of reach of children. ♦

CAUTION Never tamper with Test Standards. They should not be used unless they are completely intact. ♦

During each test, the instrument looks at the full range of x-ray spectrum and continuously corrects for cross-element interference.

Testing Prepared Samples

Set the NITON test platform on a flat, solid surface. Open the lid and place the sample cup in the holder, then shut the lid. Insert the instrument into the nose cone adaptor and follow in-situ bulk sample instructions

The Measurement Screen

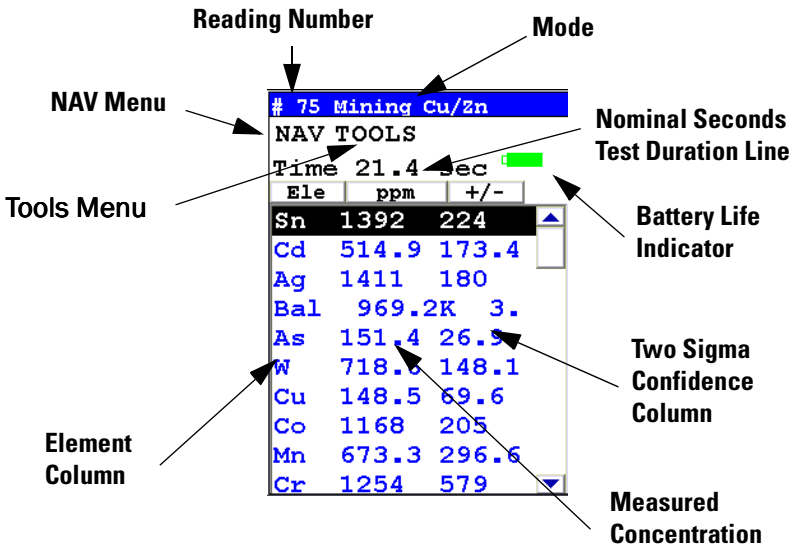


Figure 1-1. The Standard Bulk Measurement Screen

The Result Screen

When you end a reading, the **Measurement** screen will be replaced by the **Result** screen. These screens displays the reading grouped as follows:

At the top, elements detected in the sample, and, underneath this, elements that were below the detection limit.

Use the 4 way touch pad or touch screen to scroll through the elements.

Detection Limit

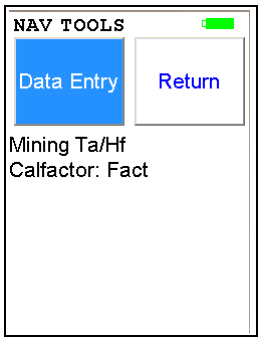
For an element to be detected by the analyzer in a given sample, the measured concentration of the sample must be at least three times the standard deviation of the measurement. This detection limit will depend on the composition of the sample.

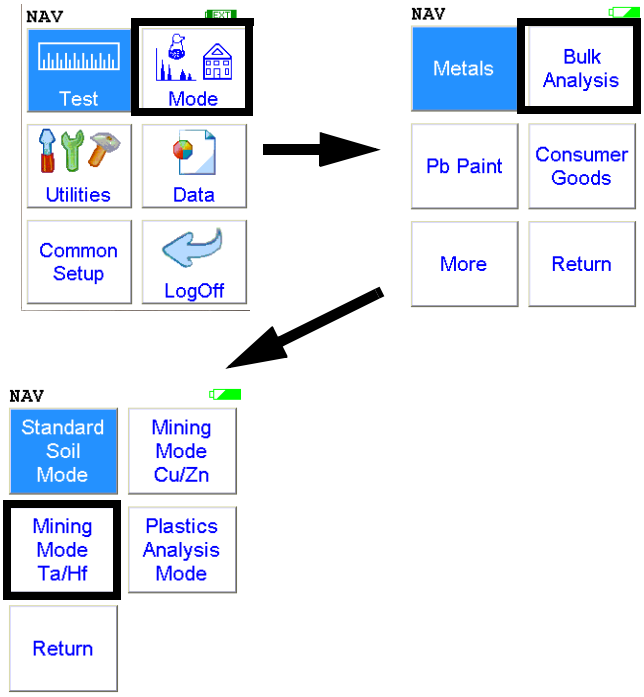
Precision

The measurement precision for each element displayed appears to the right of the measured concentration, under the heading "+-". The precision of each measurement is two times the standard deviation (sigma).

An element is classified as “detected” if the measured concentration (in ppm) is at least 1.5 times the precision. Detected elements are displayed in ppm, followed by the measurement precision. Non-detected elements are shown as < the detection limit for that sample. The detection limit for a given element varies depending on the other elements in the matrix.

Mining Ta/Hf Mode





The **Mining Ta/Hf Testing Mode** allows you to perform tests on soil and other bulk samples without adjusting for a particular matrix. **Mining Ta/Hf Testing Mode** is ideal for finding concentrations of analytes in rock or soil. This mode of operation is optimum for any sample whose elements of interest are present at 1% or greater. **Mining Ta/Hf Testing Mode** utilizes Fundamental Parameters to analyze the sample.From the **Mining Ta/Hf Testing Mode Menu**, you can immediately initiate a sample test using the proper preconditions for operation, enter data about your sample using the **Data Entry** icon, or return to the **Main Menu**.

This mode of the operating software is intended primarily for the detection of metal concentrations in light matrices. The full fundamentals parameter (FP) algorithm accurately measures elemental concentrations from trace levels to 100%, and automatically corrects for inter-element effects. However, elements lighter than calcium cannot be detected by XRF and light element combinations, such as oxides, carbonates, and silicates are common matrix components. To fine-tune results, you may enter calibration factors for individual elements to adjust for effects of light element interference. These calibration factors are linear corrections, which adjust the FP calculation. Calibrations only need to be entered once per matrix. However, as matrices can vary considerably from one sampling area to another, it is recommended that new calibrations be done for each change in matrix.

Concentrations for the following analytes can be determined:

Ti, V, Cr, Mn, Fe, Co, Ni, Hf, Re, W, Pb, Bi, Zr, Ta, Nb, Mo, Sn, Ba, Sb, Cd, Pd, Sr, Rb, Se, and Ag.

All concentrations are displayed in units of wt. % by default, but can be changed to ppm.

Note For defensible Quality Control, keep a record of the time and precision of every calibration.

WARNING! Tampering with the 5,500 ppm (Lead high) lead-in-soil standard may cause exposure to lead dust. Keep all standards out of reach of children. ♦

CAUTION Never tamper with Test Standards. They should not be used unless they are completely intact. ♦

During each test, the instrument looks at the full range of x-ray spectrum and continuously corrects for cross-element interference.

Testing Prepared Samples

Set the NITON test platform on a flat, solid surface. Open the lid and place the sample cup in the holder, then shut the lid. Insert the instrument into the nose cone adaptor and follow in-situ bulk sample instructions

The Measurement Screen

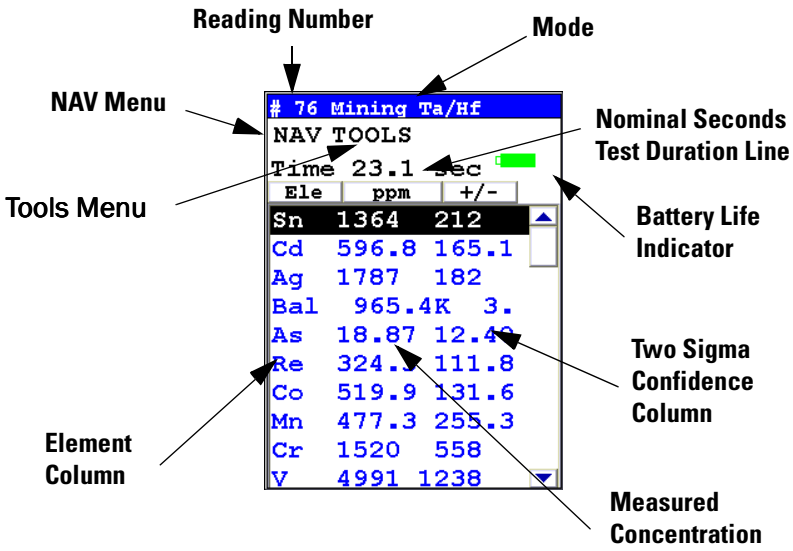


Figure 1-1. The Standard Bulk Measurement Screen

The Result Screen

When you end a reading, the **Measurement** screen will be replaced by the **Result** screen. These screens displays the reading grouped as follows:

At the top, elements detected in the sample, and, underneath this, elements that were below the detection limit.

Use the 4 way touch pad to scroll through the elements.

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For an element to be detected by the analyzer in a given sample, the measured concentration of the sample must be at least three times the standard deviation of the measurement. This detection limit will depend on the composition of the sample.

Precision

The measurement precision for each element displayed appears to the right of the measured concentration, under the heading "+-". The precision of each measurement is two times the standard deviation (sigma).

An element is classified as “detected” if the measured concentration (in ppm) is at least 1.5 times the precision. Detected elements are displayed in ppm, followed by the measurement precision. Non-detected elements are shown as < the detection limit for that sample. The detection limit for a given element varies depending on the other elements in the matrix.

To Prepare or Not to Prepare - In Situ vs. Ex Situ

Bulk media are generally tested either on-site (*in situ*) for screening purposes, or removed and prepared (*ex situ*) to enhance the accuracy of the measurement. The degree of preparation may vary depending on the accuracy desired, the characteristics of the sample, and the characteristics of the site.

Understanding the advantages of *in situ* testing and of various degrees of preparation is crucial to obtaining useful data. *In situ* measurements should be used to profile an area, to locate areas of interest, to determine the boundaries of such areas, or to gather data that will subsequently be used to design a sampling plan.

In situ measurements are usually only approximations, though they may correlate very well with lab analysis if the site tested is highly homogeneous. If the site is non-homogeneous, as is often the case, then in situ measurement results may differ greatly from laboratory obtained results. Both sets of results may be correct. The difference arises from the fact that actual samples tested were different.

Analysis of Unprepared Samples – In Situ

Figure 1-1. In-Situ Soil Testing

♦Screening Techniques

There are many techniques you can use in analyzing samples in-situ. None of them are correct or incorrect - the only thing that matters is if they suit your particular interests. Following are some typical sampling techniques used in the field.

Exploration - Greenfields

Greenfields sampling is done as a preliminary mineral survey of a plot of land, to get an overview of surface deposits and signs of sub-surface deposits. The area to be surveyed is gridded at a constant spacing - usually 100m apart. Samples are taken at each grid intersection, first cleaning off the surface to a depth of 1 cm or so to avoid windblown contamination. GPS links via Bluetooth assures location and elevation information are recorded with each sample, which can be loaded into GIS mapping software to give a 3D map of the site with mineral readings plotted.

- Clean the measurement window of your analyzer before and after taking a sample to prevent cross-contamination.
- Check the Bluetooth connection to your GPS locator.

- Clear the sample area of vegetation and the top cm or so of soil to avoid windblown contamination.
- Press the measurement window of your analyzer against the soil and take a reading for the required sample time. This time may vary due to local conditions and/or customer preferences. In general, the longer the test, the more precise the result.
- Your GPS unit will log the sample location and elevation to your analyzer.
- Clean the measurement window of your analyzer before and after taking a sample to prevent cross-contamination.

Repeat this process at each grid intersection.

Infilling Areas of Interest

If there are areas of interest - particularly high readings of the minerals you are looking for - you can infill the sampling by taking readings at a closer spacing, for instance every 20 m. You may want to do this to get a better idea of the extent of the signs of any sub-surface deposit.

Tracking Placer Deposits

Streambeds and gullies can concentrate placer deposits as markers of minerals found upstream. It may be valuable to work up water-erosion channels separately to find the location of these deposits. Rather than working off a grid, such a survey would sample at a constant spacing, working upstream from outflow to the source.

Note Be mindful of the possibility of windblown contamination, especially if there is a working mine or processing plant upwind of the survey area.

Note Be careful not to puncture the measurement window. Replace any punctured window immediately.

Note Keep the measurement window clean to prevent cross-contamination from other sample areas.

Note Be careful of water content in the sample, particularly in srreambeds and water courses. You want the sample to be dry as possible.

Exploration - Drilling

These techniques are used after initial surveying to identify the location, extent, and configuration of mineral deposits. Drill holes are sunk in the areas of mineral concentration likeliest to correlate with an underground

deposit. The drill cores are analyzed stratigraphically to map in three dimensions the extent and concentration of ore throughout the site's volume.

Drill Cores

There are several types of drilling, which result in different types of core.

Figure 1-2. Core sample analysis

Diamond Drilling

Diamond drilling generally results in a solid core, cut into meter-long cylindrical segments, though drill core from loosely compacted strata can fragment easily. The cores are usually split along their length, giving half- or sometimes quarter-round sections. There are several ways you can analyze these cores, depending on what you want to know about them.

Spaced dots - Take a sample every 10 cm, If you bypass visibly different sections, it's a good idea to infill with analyses in these sections. This gives a trend overview over the length of the core.

Slide - Take a single sample over the whole length of the core segment by starting the sample at one end and sliding the analyzer over the surface at a constant speed, ending the analysis when you reach the end of the core segment. The sample should take approximately 30 seconds. This gives an averaged overview of the whole segment at once.

Slide and retest - Perform a Slide test, then resample spots of visibly different materials.

Note Change the filter timing on Slide type tests to correlate properly with the testing times. Otherwise, you may end up with faulty readings.

Rapid End Blast (REB) Drilling

REB drilling results in a fragmented core sample. The usual way to analyze these cores is through a cloth sample bag, taking several analyses from different parts of the bag. You can either use the samples as is, or average them for the entire content of the bag.

Wet Drilling

Wet Drilling results in a slurry. Slurries need to be dried before they can be analyzed,

Mining - Drilling Exploration/ Expansion/ Defining Ore Body

These techniques are much the same as those used in Exploration Drilling. The purpose, however, is different. The cores are taken around the edges of an already developed mine to define the extent and shape of the ore body.

Testing In Situ

These are readings taken directly from rockfaces and mine walls to determine the composition of the ore prior to removal and processing.

- Clean the measurement window of your analyzer before and after taking a sample to prevent cross-contamination.
- Check the Bluetooth connection to your GPS locator.
- Press the measurement window of your analyzer against the rockface and take a reading for the required sample time. This time may vary due to local conditions and/or customer preferences. In general, the longer the test, the more precise the result.
- Your GPS unit will log the sample location and elevation to your analyzer.
- Clean the measurement window of your analyzer before and after taking a sample to prevent cross-contamination.

Repeat this process at specified intervals, as appropriate.

Figure 1-3. Taking a reading from a rockface

Mining - Grade Control

Grade Control is the analysis of mined ore for the purpose of assuring that the metal content of the ore is within desirable limits. Samples are taken from the lot of ore and tested. The following technique may be used:

- Clean the measurement window of your analyzer before and after taking a sample to prevent cross-contamination.
- Crush the sample to roughly gravel sized pieces.
- Place the pieces into a cloth bag.
- Take several readings of the bagged sample. For a 7 inch by 12 inch bag, take at least three sample readings. If the readings vary widely, take more readings, as the sample is not very homogeneous. The more readings you take, the more accurate the estimate will be.
- Average the readings.
- Send the samples on for laboratory analysis if the averaged reading looks interesting.
- Clean the measurement window of your analyzer before and after taking a sample to prevent cross-contamination.

Because you are testing through a bag, test results will tend to be lower than test results obtained from direct analysis. This effect will vary depending on the element analyzed and the thickness and composition of the cloth through which the sample is tested. Bagged samples can be retested and/or be further prepared and then retested, allowing samples of particular interest to be more accurately analyzed.

Environmental

Environmental testing is used to assure that the site stays within the environmental guidelines of the government overseeing the operation. Environmental testing can give warning of possible environmental guideline violations, giving the site ownership opportunity to fix the problem before regulatory processes intervene. Areas downwind and downstream from the site should be patricularlyclosely moitored for higher than normal levels of metals.

Screening Techniques

Use direct measurement when you need to determine whether an element is present (rather than in accurately measuring how much is present). Use preliminary direct measurements to survey a site quickly even if you intend to take samples

WARNING! When taking samples from a site where toxic chemicals may be present, always use gloves and respiration equipment for your own protection. ♦

1. **Select a measurement site, and clear away any surface debris and vegetation.**

Note Valid results will depend on a sufficient and appropriate selection of sites to sample. Lead-in-soil from paint, for instance, will usually be concentrated within a few feet of the painted structure.

2. **Choose an area to test where the measurement window of the analyzer will be flush with the test media. Position the nose against the surface to be analyzed and initiate a reading by squeezing the shutter release, and firmly pressing the instrument flat against the surface.**

3. **After the test, inspect the nose of the instrument for contamination, which may affect future analysis. If the nose appears to be soiled, clean it with a soft cloth or tissue.**

WARNING! Always treat radiation with respect. Do not hold your instrument near the measurement window during testing. Never point your instrument at yourself or anyone else when the tube is on. ♦

Note Never use in situ testing with field portable XRF when comparing field results with laboratory results to justify XRF usage. Always collect samples and prepare them before testing. Refer to the instructions on sample collection and preparation in *Ex Situ* Testing.

In Situ Depth Profiling

XRF analysis for soil is a surface technique. To perform a depth profile, remove a vertical slice of soil and test several samples taken from different depths. This procedure will yield information, rapidly, about the depth of contamination.

WARNING! Always treat radiation with respect. Do not hold your instrument near the measurement window during testing. Never point your instrument at yourself or anyone else when the shutter is open. ♦

Note Never use in situ testing with field portable XRF when comparing field results with laboratory results to justify XRF usage. Always collect samples and prepare them before testing. Refer to the instructions on sample collection and preparation in *Ex Situ* Testing. ♦

On-site vs. Lab Analysis

When comparing field screening to laboratory analysis, it is preferable to compare results obtained from the same samples. Start by collecting a sample large enough to be divided into two parts, with one portion stored for future reference and the other submitted to a laboratory for independent analysis. For best results, follow the complete protocol for sample preparation, including drying and grinding of the sample. Grinding is essential for homogenizing the sample, ensuring that the portion sent to the lab is the sample as that analyzed on-site.

Analysis of Prepared Samples – Ex Situ

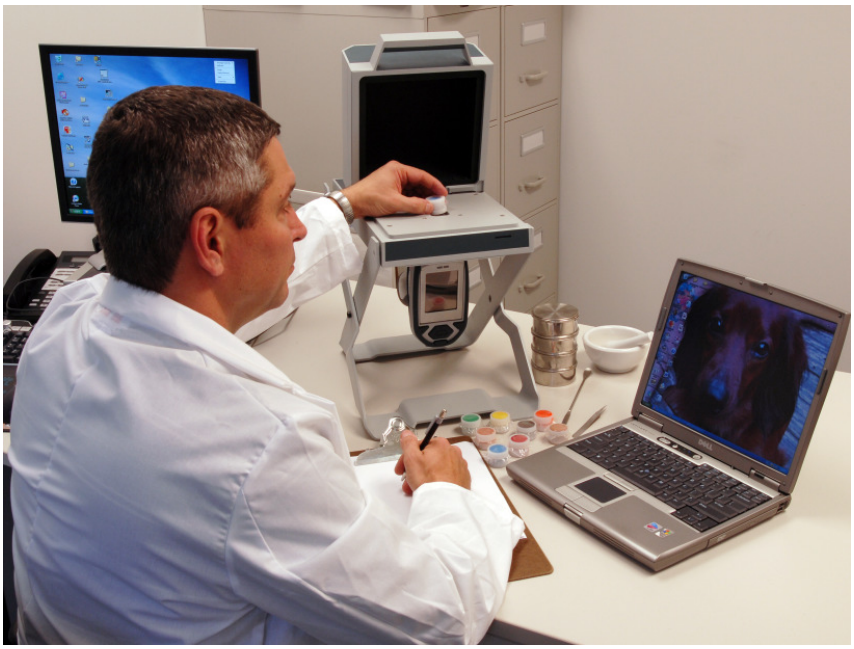


Figure 1-4. Ex-Situ Analysis of Prepared Samples

Sample Collection

Examine the site for differences in surface characteristics before sampling. Valid results depend on a sufficient and appropriate selection of sites to sample. Incorrect sample collection may give rise to misleading or meaningless results, regardless of the analysis method. Delineate sections with different characteristics and treat them as different areas. It may be desirable to subdivide larger areas even if they have the same characteristics to ensure a thorough examination.

Make certain to label each bag thoroughly. Common information included on each bag includes the person and/or the company who collected the sample, the location and area where the sample was taken, and the date the sample was collected.

Prepared sample analysis is the most accurate method for determining the concentration of elements in a bulk medium using the instrument. Sample preparation will minimize the effects of moisture, large particle size, variations in particle size and sample non-homogeneity.

Note More sample preparation (drying, milling and sifting) will yield greater accuracy. The drier, finer, and more homogeneous the particles, the better the measurements. ♦

Specimen Preparation - Fused Glass Disk;

The samples need to be predried for 2-6 hours in 105°C depending on the moisture content.

1. **Grind the dried samples to ~200mesh (74 µm).**

2. **Calcination (Ashing) the sample;**

   a. About 4-6 g of dry pulverized sample is calcinated in an alumina or platinum crucible in a muffle furnace at 1000°C for 1 hour.

   b. The sample is cooled in a dedicator and loss on ignition (LOD) is calculated from weight difference before and after Calcination.

3. **Weight 1.0g of calcinated sample into fusion crucible add 5.0 g of lithium tetraborate and 0.3 lithium fluorife, and 10-20 mg lithium bromide as a nonstick agent.**

4. **Fuse in a fluxer for at least 4 min in the flame.**

5. **The resulting disk is released from the mold, cooled the presented to the spectrometer.**

Specimen Preparation - Pressed powder briquette preparation;

1. **Thoroughly remix the sample in its jar by rotating in a figure-eight motion with two hands**

2. **Weight 7.0g of sample into weighting boat by taking several separate gram-size portions then fine grind sample using a swing mill.**

3. **Add 2 small drops of propylene glycol on the top of the powder sample in the mill as a grinding aid, grind 4min at 1000rpm to obtain 10 µm particle size.**

4. **Add 0.5g binder to the sample and continue grinding for 30sec more.**

5. **Brush the finely grounded samples into 31 mm aluminum sample cap and press at 50,000psi for 1 min.**

Preparing Bulk Soil Samples

We recommends establishing a specific sample protocol. Following this protocol for preparing and testing samples is vital for achieving a level of accuracy comparable with laboratory results.

The equipment you need to prepare samples is included in your kit. Among these are a mortar and pestle, several different sized metal sieves, cups to hold the samples, and the soil test platform.

CAUTION All test equipment must be kept clean to prevent contamination of samples. ♦

Cleaning Your Equipment:

The mortar, pestle, and grinding mill may be cleaned with dry paper towels. You can also clean the mortar, pestle, and the mill's container with water, but be sure each is absolutely dry before using them on another sample. The mortar and pestle may be cleaned by grinding clean, dry sand in the mortar. Use the short bristle brushes (included in your Soil Testing Kit) to clean the sieves. If you have an electric soil grinder in your kit, when the soil grinder blades wear out, unbolt the worn blades and replace them. Call the Thermo Sales Department at 1-800-875-1578 for replacement blades.

Note Using the soil grinder may artificially increase the amount of Fe in soil samples. ♦

Sample Preparation

Prior to analysis, the material should be dry and well homogenized. Ideally, the entire sample should be dried to constant weight, sifted to remove gravel and debris, and ground or milled to a fine powder.

Dry the sample if it is moist and cohesive. The sample can be dried in any of several ways. Choose one of the following:

- Oven dry the sample for approximately 2 hours at 150° C, until the sample reaches a constant weight. Note: Oven drying is inappropriate when volatile compounds may be present in the sample. For example, lead present as tetraethyl lead would be driven off by the heat of drying. Some forms of mercury and arsenic are volatile. Air drying will preserve more of these volatile substances.

- Air dry the sample overnight at room temperature in a shallow pan.

- Stir gently and warm the sample in a pan over a hot plate or burner.

Coning and Quartering

You may need to divide your sample at various times during preparation. Coning and quartering is a method for dividing the sample into homogenous quarters.

- Pour the dry material slowly and carefully onto a flat sheet or pan, forming a symmetrical cone. Divide the cone into equal piles using a flat thin-bladed tool, such as a knife or ruler. Divide these in half again.
- Now you have four samples, each one-quarter the size of the original and each more homogenous than the original.
- Grind the sample to break up dirt clods and/or paint chips.

WARNING! Grinding and sifting dried samples produces dust. Even clean soil contains silica, which may be hazardous when airborne. Prepare all samples in a ventilated area; wear a mask, gloves, and an apron; and spread a drop cloth. ♦

Sift using the #10 (2mm) mesh and separate out the larger pieces (stones, organic matter, metallic objects, etc. Examine the larger particles by eye but do not include in the sample. Grind the sample again so its particles will be finer and more homogenous. Use mortar and pestle, or an electrically powered grinding mill. Sift at least 10 grams of the sample through #60 (250 µm) and #120 (125 µm) mesh. Re-grind the un-passed material until the entire fraction is able to pass. Mix the resulting sample.

Placing the Sample in an XRF Sample Cup

Note The sample container should be a sample cup of a type that can be filled from the rear; that is, the side opposite the window (e.g. Thermo NITON Part Number 187-466). Thermo recommends using a 1/4 mil Polypropelene film (e.g. Thermo NITON Part Number 187-461). A supply of cups and films are included.

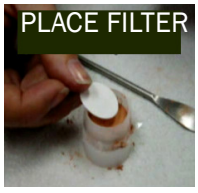
The container used to hold the sample will affect the accuracy of the measurement. Use a container with as thin-walled a window as is convenient and use the same kind of container and window for each sample. Consistency and careful attention to detail are keys to accurate measurement.

Place a circle of polypropelene film on top of an XRF sample cup. This film goes on the end of the cup with the indented ring. Thermo recommends preparing the cup ahead of time, if possible.

Secure the film with the collar. The flange inside the collar faces down and snaps into the indented ring of the cup. Inspect the installed film window for continuity and smooth, taut appearance.

Set the cup on a flat surface film-window-side down. Fill it with at least five grams of the prepared sample, making sure that no voids or uneven layers.

Lightly tamp the sample into the cup. The end of the pestle makes a convenient tamper.



Place a filter-paper disk on the sample after tamping it.

Fill the rest of the cup with polyester fiber stuffing to prevent sample movement. Use aquarium filter or pillow filling as stuffing. A small supply of stuffing comes with your bulk sample kit.

Cap the cup.

Place a label on the cup. Using a pen with indelible ink, write identifying information on the cup. Keep a record of the sample designation, the site and location, the date of the sample, and any other relevant comments.

Cup is ready for testing.

Preparing Liquids and Sludge

Liquids

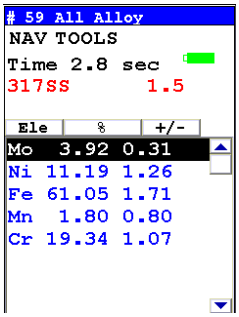
Fill an XRF sample cup with the liquid to be tested (do not pad the sample with cotton). The cup must be full so it is best if some liquid is allowed to overflow when the cap is put on.

Sludge

Sludge can be placed directly into an XRF cup for screening. This is considered in-situ testing because no attempt has been made to prepare the sample. For more accuracy, the sludge can be dried, sieved, and ground.

Prepare in an XRF sample cup and test the same way you would with a soil sample. For risk analysis, it is advisable to use a 60-mesh sieve to isolate and test only fine particles.

The View Data Screen



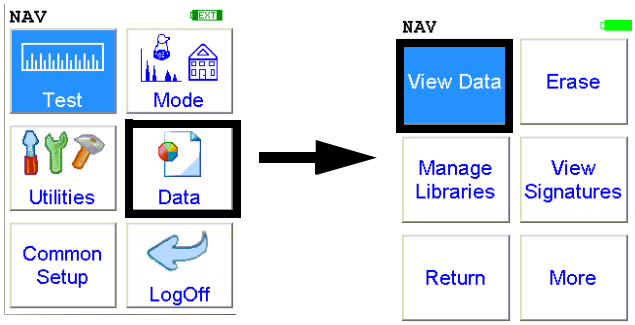
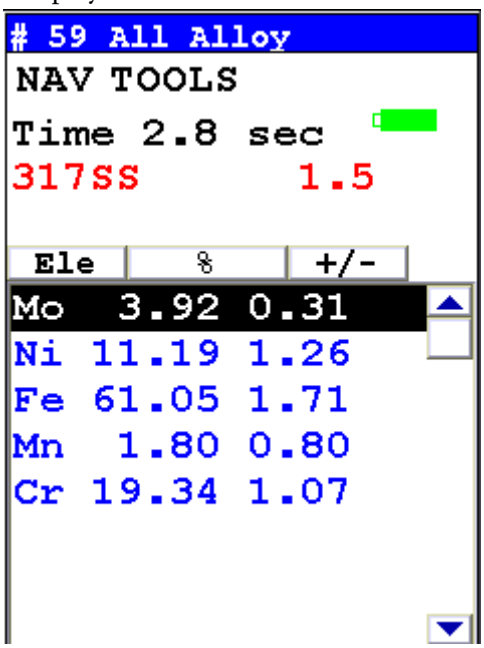


Figure 1-5. The View Data Menu Path

Use the Data Screen to view previously taken test result readings. When the **View Data** icon is selected, the Results screen of your most recent test is shown on the LCD display.



Using the buttons on the control panel, you may view different readings or additional data for individual readings.

Your analyzer will display the standard screen analysis. Pressing the "Down" arrow on the 4-way touch pad will display a complete scrolling elemental chemistry listing. Each press of the “Down” arrow scrolls the screen down to the next element. You can also use the scroll bar along the right side to scroll or page through the elements.

Scrolling Down Through the Complete Listing of Elements

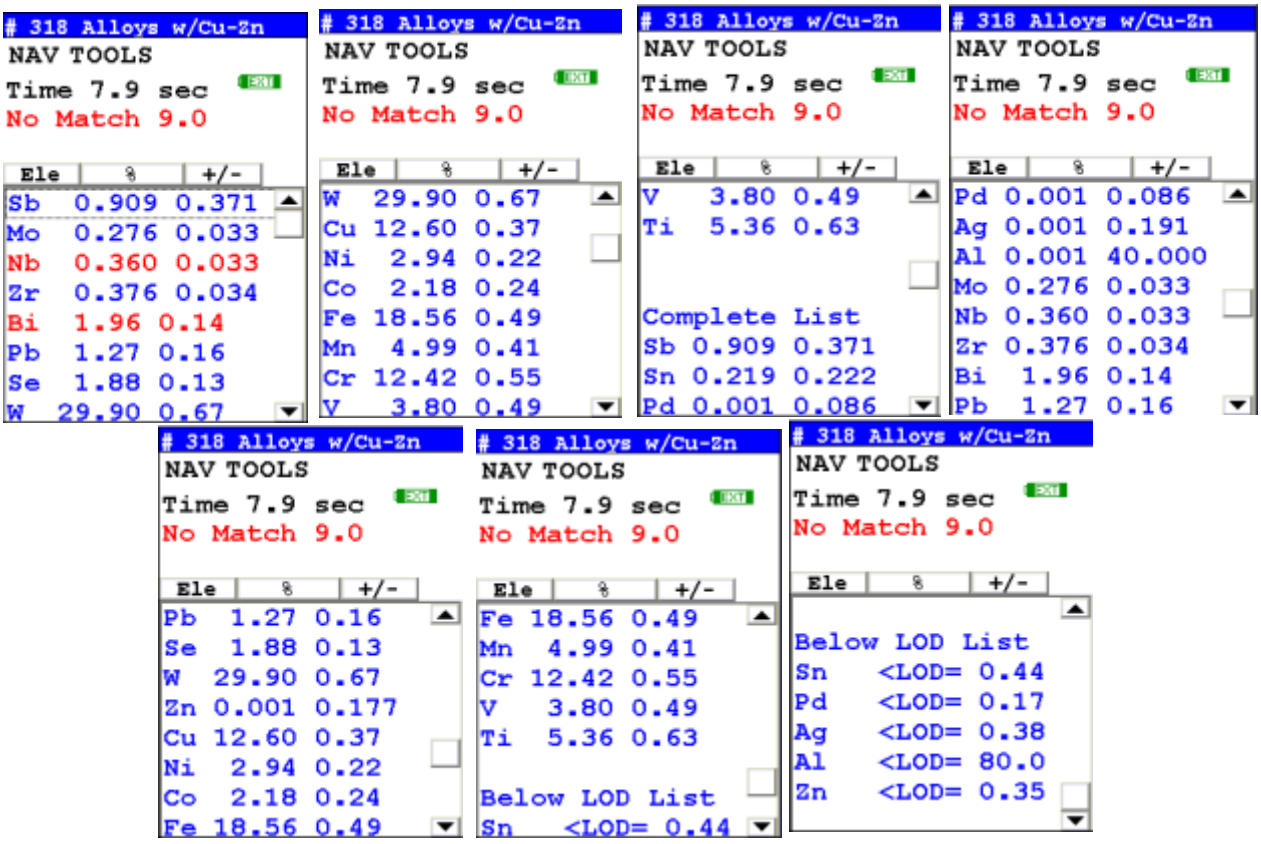


Figure 1-6. Complete Listing of Elements

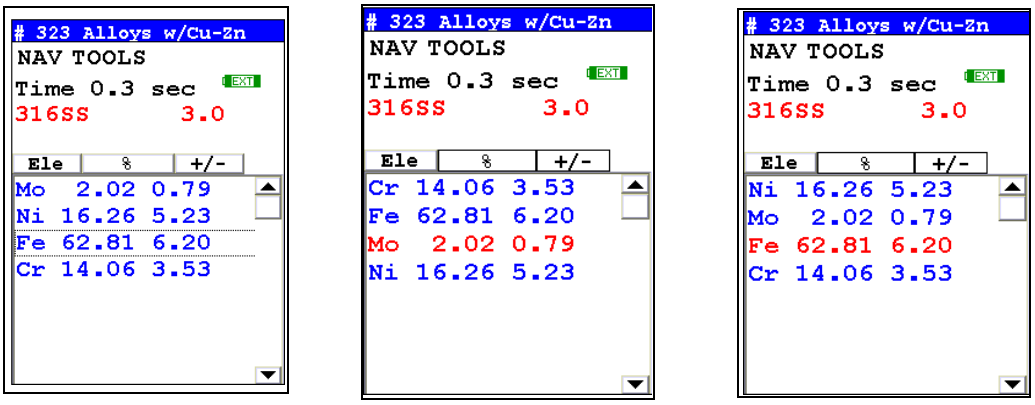
Pressing the "Left" arrow on the 4-way touch pad of your analyzer will display the previous reading, or if the first reading is currently displayed, the last reading. Pressing the "Right" arrow on the 4-way touch pad will display the next reading, or if the last reading is currently displayed, the first reading in memory. NITON Analyzers can store between 3000 to 6000 readings.

You can also look at the complete x-ray spectra for each reading stored in the analyzer's memory.

Sorting Elements

You can sort element rows by various criteria in order to view your data in the manner you prefer.The Sort Buttons, which double as column headings, can be used to re-sort the data in different ways. The Data Screen always begins as a Standard Sort, as you have defined it. Selecting the appropriate

sort button once toggles the sort order to High-to-Low. Selecting the sort button again toggles the sort order to Low-to-High. To return to the Standard Sort, view a different reading and return.



Standard Sort Low-to-High Sort High-to-Low Sort

Figure 1-7. Element Sorts

Element Sorts

Element sorts are performed alphabetically based on the element name.

Composition Sorts

Composition sorts are performed numerically based on the percentage of composition.

Error Sorts

Error sorts are performed based on the range of error in the reading.

Spectrum Graph

For any reading result, simply use the **NAV Menu** to gain access to the reading's spectrum graph. Selecting Spectra will show a graphed spectrum of this reading, called SpectraView. SpectraView can be a useful tool for rapid, qualitative analysis of a sample. See "SpectraView" on page Appendices-vii for details.

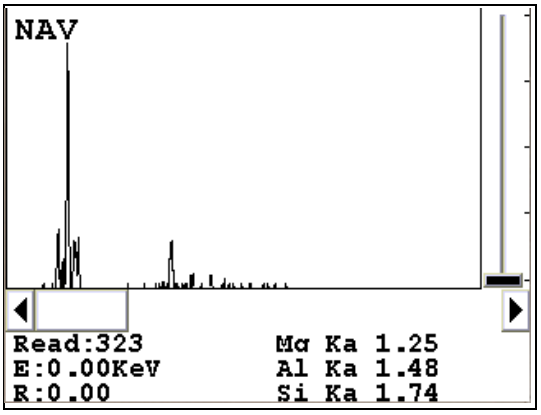


Figure 1-8. The SpectraView Screen

The Erase All Data Screen

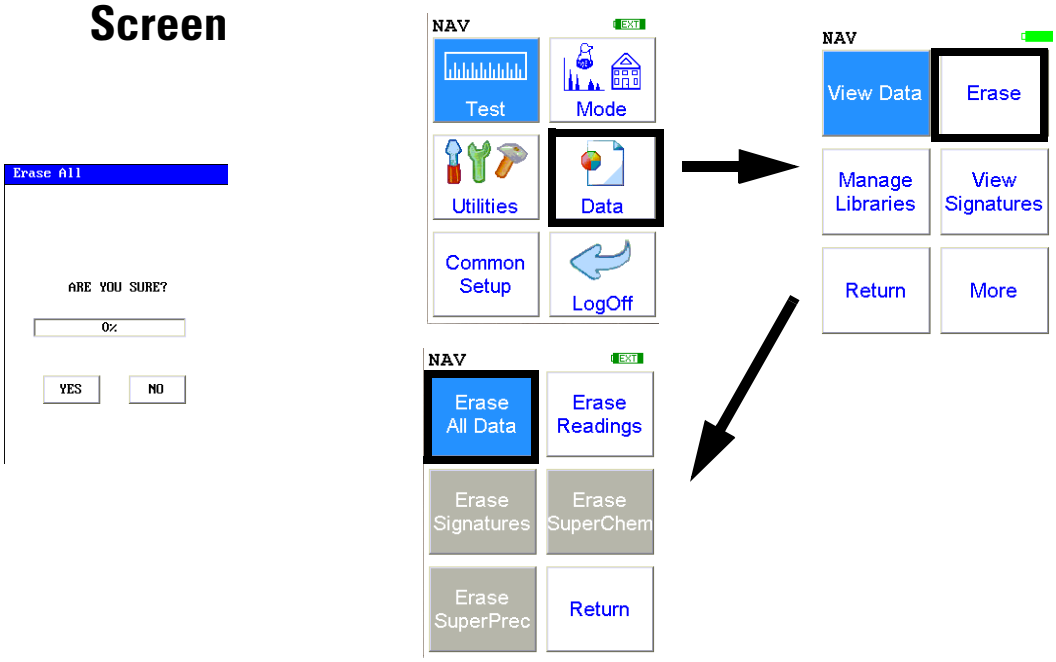


Figure 1-9. The Erase All Data Menu Path

Select the **Erase All Data** icon to erase all data, including signatures and SuperChem reference readings, from your analyzer. Selecting the **Erase All Data** icon will bring up a confirmation screen (see upper left) asking you "Are you sure?" with options to select "YES" or "NO". Selecting "YES" will erase all reading data from your analyzer. Selecting "NO" will return you to the **Erase Menu**.

CAUTION Never turn off the analyzer while data is being erased! ♦

WARNING! Do not attempt to take measurements while downloading readings! This will generate an error requiring a system reset, and may corrupt your stored readings, requiring all stored readings to be erased. ♦

The Erase Readings Screen

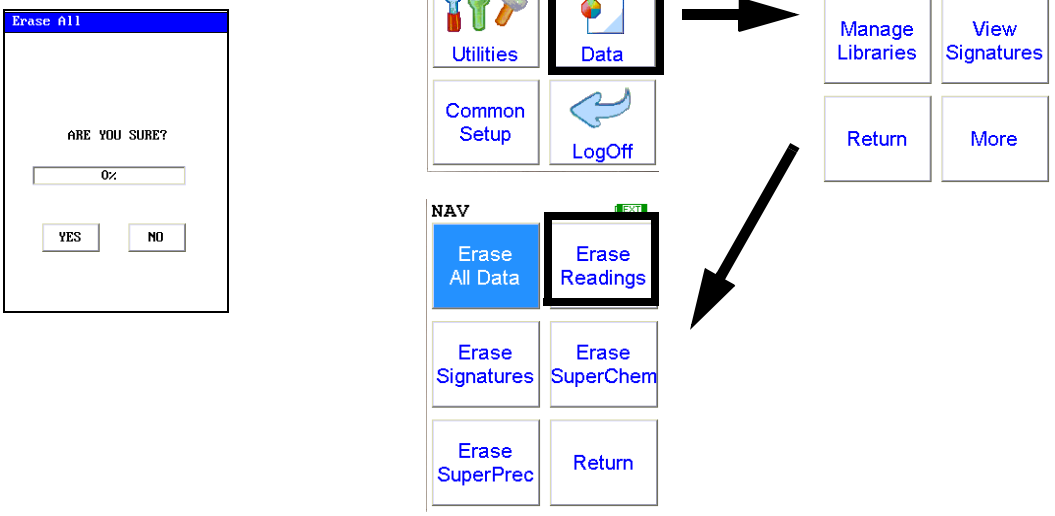


Figure 1-10. The Erase Readings Menu Path

Select the **Erase Readings** icon to erase all accumulated test readings from your analyzer. Selecting the **Erase Readings** icon will bring up a confirmation screen (see upper left) asking you "Are you sure?" with options to select "YES" or "NO". Selecting "YES" will erase all test reading data from your analyzer. Selecting "NO" will return you to the **Erase Menu**.

Note We recommend that you download all your readings into an NDT file for recording purposes before erasing all data. ♦

Figure 1-11. Select the **Switch Libraries** icon to toggle between the standard library and the currently loaded alternate library. Select the **Switch Libraries** icon again to toggle back.**Main Library and Alternate Library**

Click OK to return to the **Manage Libraries Menu**.

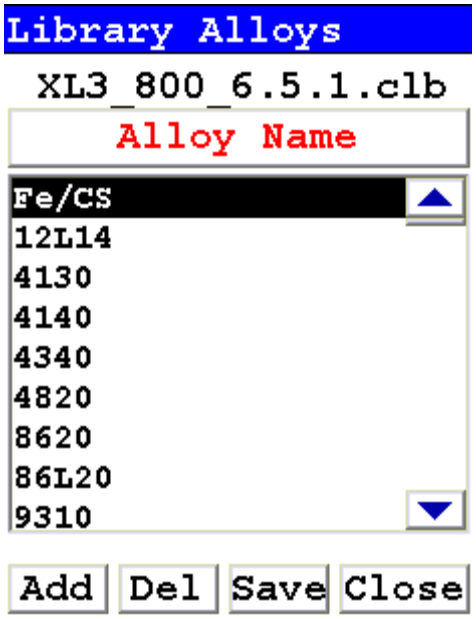


Figure 1-12. The Library Editor

Using the Library Editor

The Library Editor enables you to edit any library to conform to your specifications.

Alloy Name Button Selecting this button sorts the list alphanumerically.

(Name in List) Selecting the actual name of the alloy - i.e. “Fe/CS” - will bring up the **Element Specification Screen**.

Add Selecting the Add button will add a new alloy to the Library. First the Alloy Name Editor will appear, enabling you to enter the name of the new alloy.

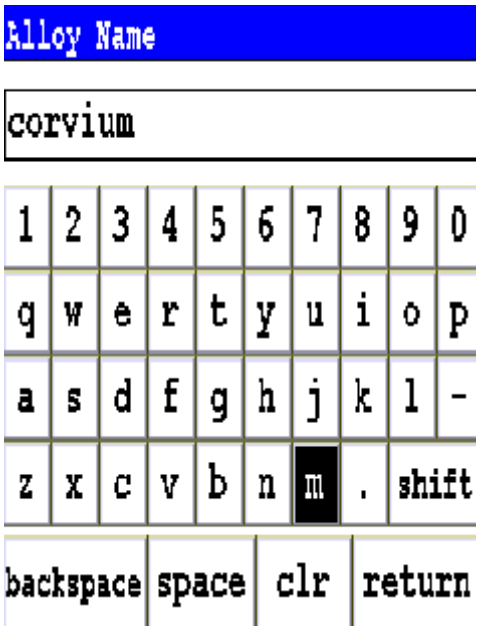


Figure 1-13. The Alloy Name Editor

The **Alloy Name Editor** is a standard Virtual Keyboard. Use it as you would any Virtual Keyboard.

Hitting the return key enters the name into the alloy list. Select the name to enter the **Element Specification Screen** and enter the specification of the alloy.

Del Selecting the Del key will delete the currently selected alloy. First a confirmation screen appears.

Figure 1-14. Confirmation Screen

Selecting Yes will delete the alloy from the list. Selecting No will return you to the Alloy List.

Save Selecting the Save button will save the current Library.

Close Selecing the Close button will close the current Library without saving it.

The Element Specification Screen

The Element Specification Screen allows you to edit the elemental content of any alloy.

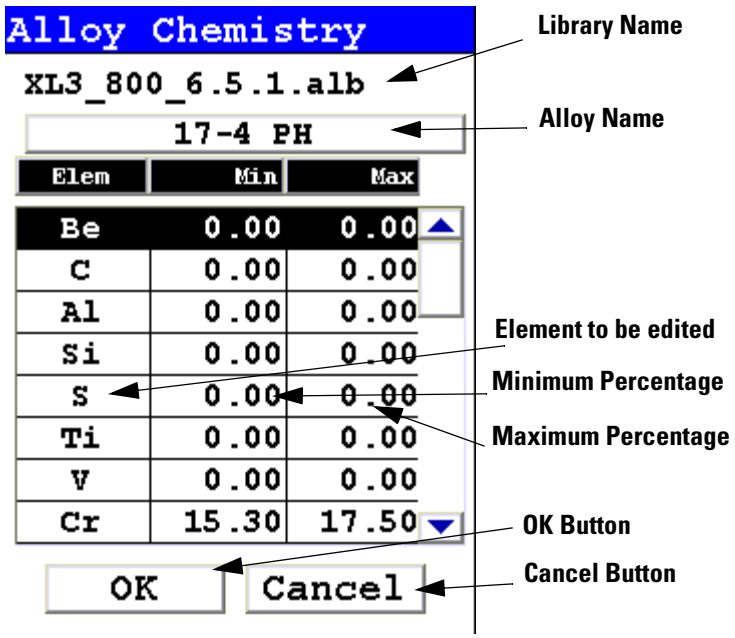


Figure 1-15. The Element Specification Screen

Library Name This is the name of the library you are editing. Make sure you are editing the correct library before proceding further.

Alloy Name This is the name of the alloy you are editing. Make suere you are editing the correct alloy before proceding further.

Element to be Edited This is the element you need to edit for this alloy.

Minimum Percentage This is the lowest amount of the element in question you want to be in the alloy. If the element in the analyzed sample is any lower, the sample will not be recognized as this alloy. Selecting the element minimum will open the Minimum Editor.

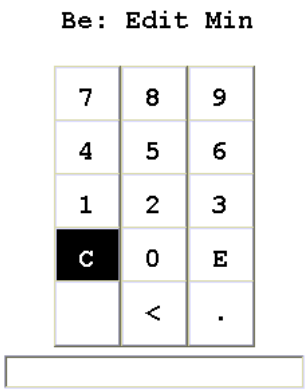


Figure 1-16. Minimum Editor

This is a standard numerical entry keypad. “C” = clear the current display, “<“ means backspace one space, and “E” means enter this number as the minimum. After selecting “E”, you will be returned to the Element Specification Screen.

Maximum Percentage

This is the highest amount of the element in question you want to be in the alloy. If the element in the analyzed sample is any higher, the sample will not be recognized as this alloy. Selecting the element maximum will open the Maximum Editor.

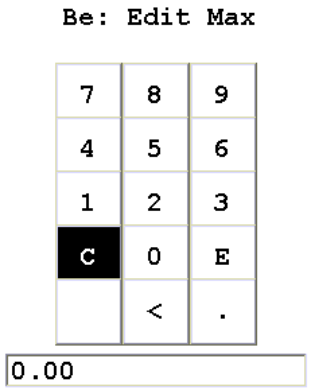
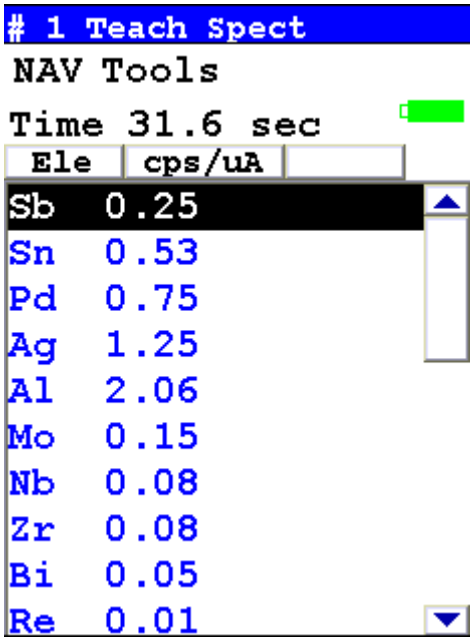


Figure 1-17. Maximum Editor

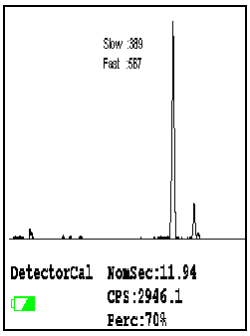
This is a standard numerical entry keypad. “C” = clear the current display, “<“ means backspace one space, and “E” means enter this number as the maxiimum. After selecting “E”, you will be returned to the Element Specification Screen.

OK Button Selecting this button will save the editied library.

Cancel Button Selecting this button will exit the Element Specification Screen for this alloy, returning you to the Library Editor.



The Calibrate Detector Screen



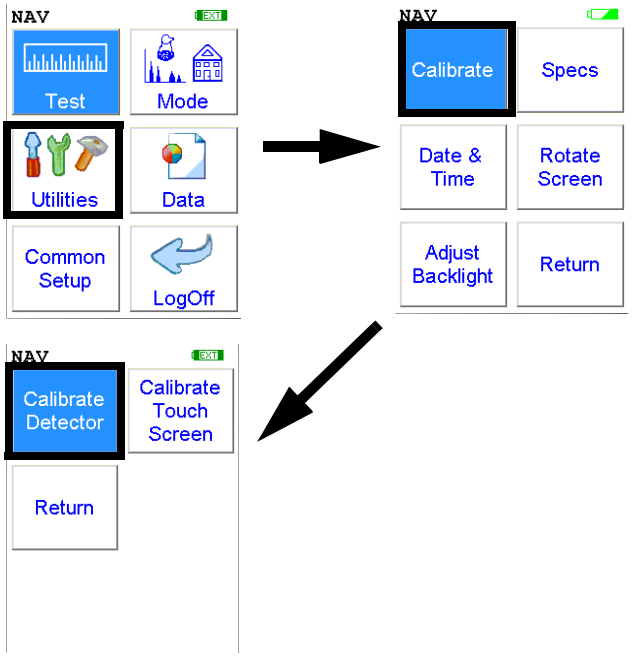


Figure 1-18. The Calibrate Detector Menu Path

Select the **Calibrate Detector** icon to begin a standard calibration of your analyzer's detector. Once you select the **Calibrate Detector** icon, calibration will begin immediately. The analyzer is programmed to calibrate for a specific, predetermined period in order to ensure proper operation of your NITONXL3 analyzer in the field.

CAUTION Avoid any vibration, loud noise, strong electronic fields, or other possible interference when your analyzer is calibrating its detector. ♦

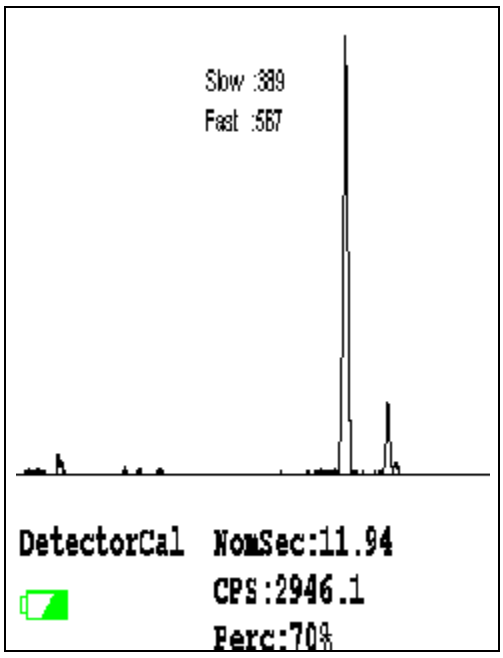
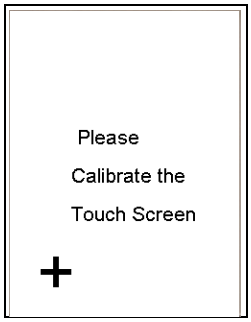


Figure 1-19. Detector Calibration Screen

The analyzer calibration screen will be displayed until calibration is complete. After the calibration has finished, the calibration results will be displayed.

Press the on/off/escape button or the **Return** icon to return to the **Main Menu**. In order to ensure good test results, it is essential that you calibrate your XL3 Analyzer's detector daily, and if a check sample test reveals discrepancies in the reading.

The Calibrate Touch Screen Screen



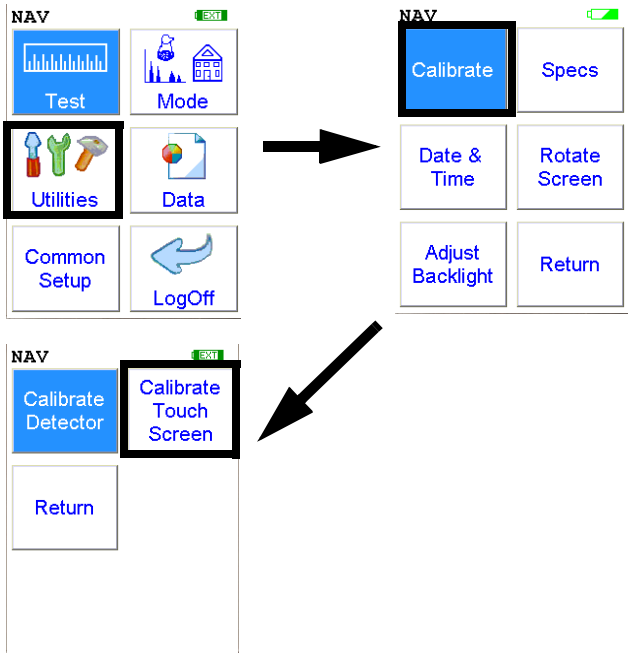


Figure 1-20. The Calibrate Touch Screen Menu Path

Select the **Calibrate Touch Screen** icon to re-calibrate the analyzer's touch screen display. This procedure establishes the display boundaries for the touch screen interface. When the **Calibrate Touch Screen** icon is selected, the display will show the message: "Calibrate Touch Screen". There will be a small cross in the upper left-hand corner of the display. Tap on this cross with the stylus, and the cross will disappear and reappear in the upper right-hand corner of the screen. Tap on the cross again, and it will reappear in the lower right-hand corner of the screen. Tap on the cross again and it will reappear in the lower left-hand corner of the screen. Tap on the cross once more, and you will be presented with the **Calibrate Menu**

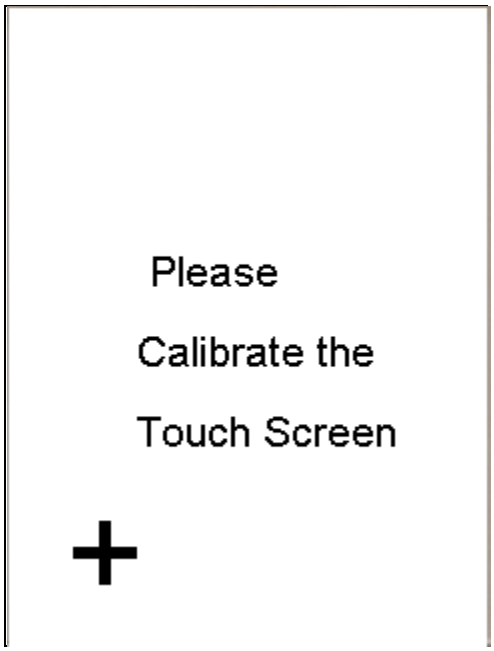


Figure 1-21. The Touch Screen Calibration Screen

Calibrating the Touch Screen Without Using the Touch Screen

Because there may be a severe issue with the touch screen itself, you may need to use the buttons below the screen to complete this process. There are 3 single buttons and a 4 way switch located to the rear of the display screen. The button at the left is the On/Off/Escape button. The button to the right is the enter button and the center keypad is a 4 way switch.

The 4 way switch has 4 positions, Up, Down, Left and Right. The select and interlock buttons are not used in this procedure.

Figure 1-22. The Control Buttons for the XL3

1. **Please, turn on your XRF analyzer using the On/Off button.**

Note From this point please DO NOT touch the touch screen.

2. **Press the enter button. You are now at the Radiation warning screen.**

3. **Using the 4 way touch pad on the on the cover of the instrument, move the cursor around the screen by pressing the appropriate Up down left or right button. Please move the cursor such that the Yes option is highlighted in green.**

4. **Press the "enter" button. You are now at the Enter Password Screen.**

5. **Move the cursor to the appropriate first number in your password and then using the enter button on the right (it has the arrow/enter key symbol on it) press this "enter" key. The first number of your password should appear in the lower left of the LCD screen.**

6. **Repeat step 5 until you have entered the entire password. Then move the cursor to the letter "E" and press the "enter" key to enter it.**

7. **You will now be at the main screen.**

8. **Again using the four way touch pad, move the cursor to highlight the "Utilities" icon and press the "enter" key to select.**

9. **You will now be at the Utilities screen**

10. **From the Utilities screen, move the cursor to highlight the "Calibrate" icon and press the "enter" key.**

11. **Now move the cursor to highlight "Calibrate Touch Screen" and press the enter key.**

12. **You are now at the Touch Screen Calibration screen.**

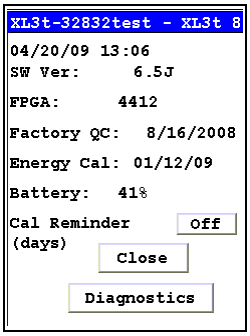
Note You must now use the touch screen for the balance of this procedure

13. **In the upper left hand corner you will see a crosshair "+", using the stylus or a pen, tap the center of the "+".**

14. **Repeat this for each "+" sign that appears, there should be one for each of the 4 corners.**

Your touch screen should work properly after this and you may use it from this point forward. If it does not, please repeat the process.

The Specs Screen



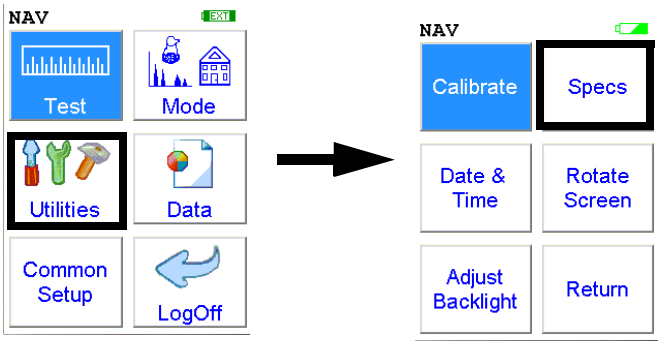


Figure 1-23. The Specs Menu Path

Select the **Specs** icon to display the analyzer's specifications. These specifications include your NITON analyzer's serial number, software and firmware versions, temperature, bias, and data coprocessors. Press the Close button to return to the Utilities Menu.

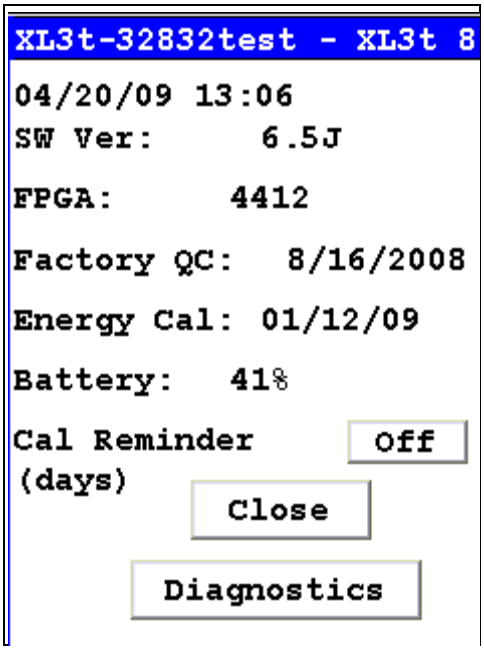


Figure 1-24. The Specs Screen

On the Specs Screen, standard information on the state of your analyzer is shown for your reference. This information should be reported to Service if there is a problem.

Specs Information

The following is the information supplied on the Specs Screen:

Instrument Specific Serial Number This is located in the left part of the blue band at the top of the screen.

Model Number This is located in the right part of the blue band at the top of the screen.

Date And Time This is the current Date and Time. This is particularly important for date stamping.

SW Version This is the currently loaded software version, which should be reported to Service if there is any problem.

FPGA This is the currently loaded FPGA software version, which should be reported to Service if there is any problem. FPGA versions are always a four digit number. Any other number of digits may be a sign of a problem in the FPGA code.

Factory QC This is the date that the machine was QCed at the factory.

Energy Cal This line notes the last time a user detector calibration was performed.

Battery This line gives the proportional charge remaining to the battery.

Cal Reminder

Select the Cal Reminder Button to set a reminder to calibrate your analyzer. Selecting the button will open the Cal. Reminder Editor. Select the number of days you want between reminders with the numeric keys. Of the other keys, C = Clear All, E = Enter, and OFF shuts off the Reminder Function. Selecting E will enter the current value as the reminder interval and return to the Specs Screen.

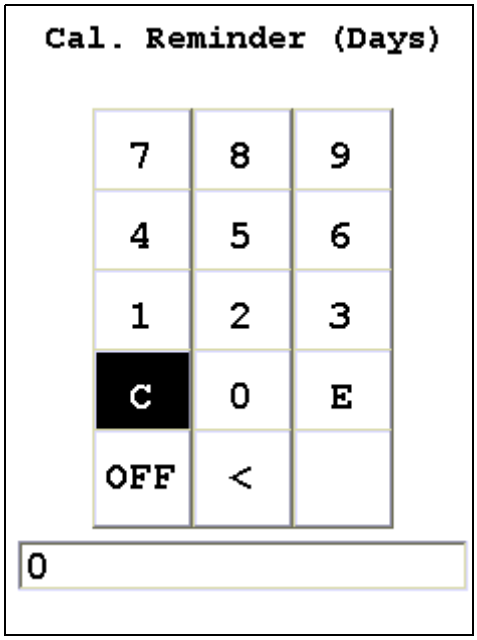


Figure 1-25. Cal Reminder Edit Screen

Diagnostics

Select the Diagnostics Button to load the Diagnostics Screen. the Diagnostics Screen shows Detector Temperature, Bias, Cooler Voltage, SubBias, Energy Scale, and Temperature in C and F scales.

The Diagnostics Screen can be of great utility in assuring proper operation of your analyzer.

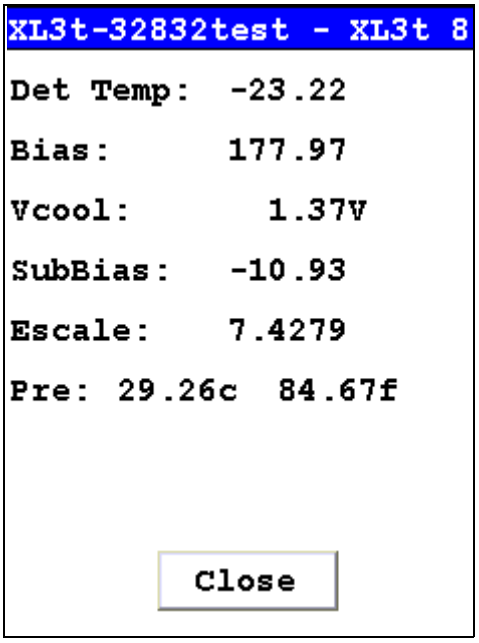


Figure 1-26. Diagnostics Screen

The proper ranges of operational values on the Diagnostics Screen follow.

Det Temp:

Detector Temperature should be within these ranges:

Standard 6 mm Detector: -25 ± 5 degrees F

GOLDD SDD Detector: -27 ± 3 degrees F

Bias: Bias should be within these ranges:

Standard 6 mm Detector: 175 ± 10

GOLDD SDD Detector: -220 ± 15

VCool: VCool will vary with the ambient temperature.

SubBias: SubBias should be within these ranges:

Standard 6 mm Detector: -11 ± 3

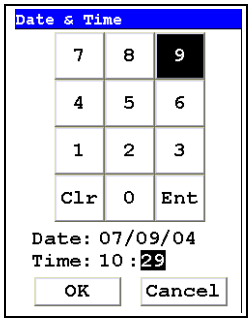
GOLDD SDD Detector: -8 ± 3

Escale: Escale should be within these ranges:

Standard 6 mm Detector or GOLDD SDD Detector: 6.6 - 9

Preamp: Preamp value should only be noted, and reported to Service if there is a problem.

The Date and Time Screen



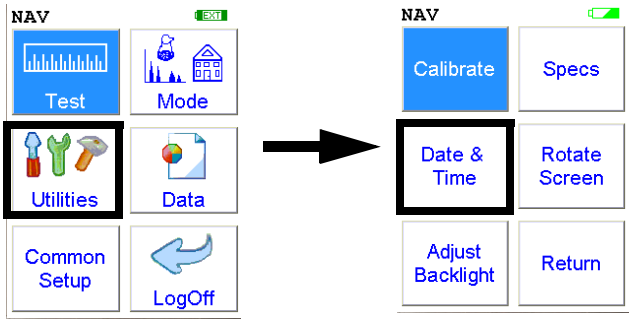


Figure 1-27. The Date and Time Menu Path

Select the **Date & Time** icon to set the date and time as needed for different time zones, daylight savings time, or any other reason. The date and time are factory preset prior to shipping. The format used is month/day/year - MM/DD/YY, and hour/minute - HH/MM, for the 24 hour clock.

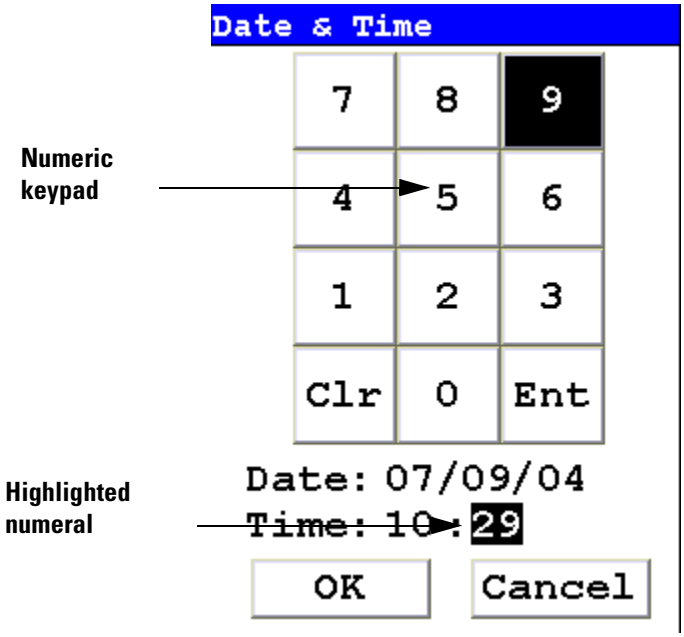


Figure 1-28. Setting the Date & Time

When the **Date & Time** icon is selected, the **Date & Time Screen** comes up on your analyzer's LCD Screen. Initially, the first character of the month is highlighted in reverse video (white on black), as in the sample display shown here. To change a character, select the digit you want to replace the character with from the virtual numeric keypad displayed on the screen,

then select the Enter (Ent) character from the virtual numeric keypad. Your analyzer will then accept the entry and automatically advance to the next digit. To skip a character, simply select the Enter (Ent) character from the virtual numeric keypad without selecting a replacement character.

For example, on the sample display, if you wish to change the "06" of the month to "07", the display appears with the first character (0) highlighted. Select the Enter (Ent) character to skip the zero. The "6" will now be highlighted. Select the "7" digit from the virtual numeric keypad, then select the Enter (Ent) key from the virtual numeric keypad. The change is accepted and the next digit is highlighted. Continue to select the Enter (Ent) symbol from the virtual numeric keypad to skip over the remaining characters of the date and time until the last character is reached. When you select the Enter (Ent) key from the virtual numeric keypad to confirm the last character, the word "SUCCESS" will appear beneath the Time field, and you will be returned to the Main Menu. The date is given in month/day/year format.

Note The analyzer will automatically return you to the **Main Menu** when the entry is complete. ♦

The Rotate Screen 180 Toggle

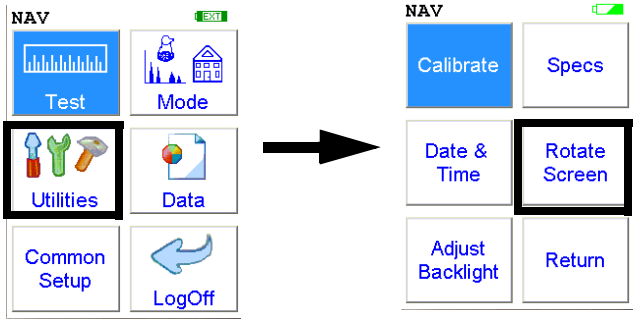
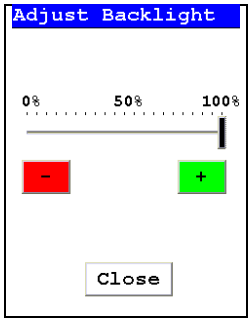


Figure 1-29. The Rotate Screen 180 Menu Path

Select the **Rotate Screen 180** icon to toggle the orientation of the screen between right side up and upside down.

The Adjust Backlight Screen



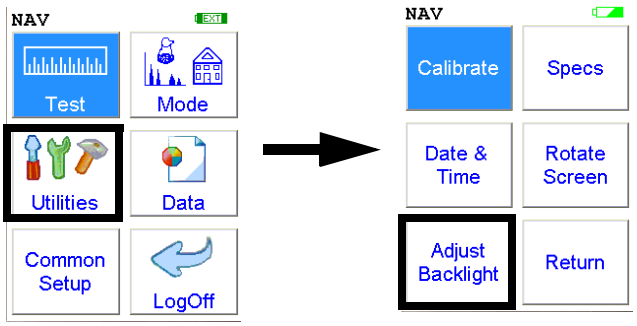
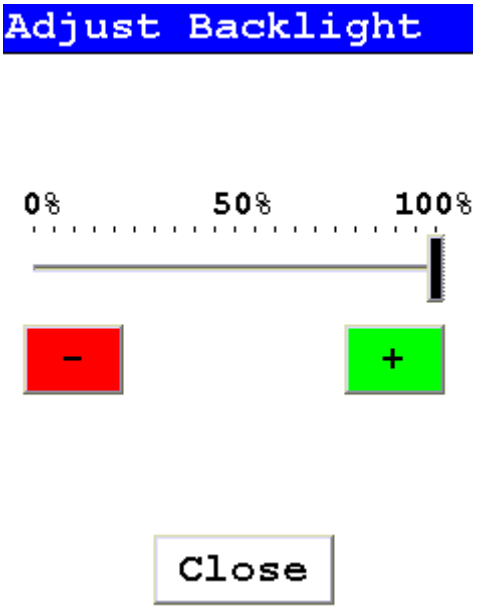


Figure 1-30. The Adjust Backlight Menu Path

Select the **Adjust Backlight** icon to adjust the brightness of the analyzer screen.



Selecting the red [-] box will cause the slider to move some to the left and the screen to dim a bit. Selecting the green [+] box will cause the slider to move a bit to the right and the screen to brighten somewhat. Find the setting most harmonious with the ambient lighting. Selecting Close saves the backlight setting in the current state, and returns you to the Utility Menu.

Camera and Small Spot Video

The Camera feature is only usable with properly configured analyzers, and the Small Spot feature is only available on Small Spot analyzers.

If your analyzer is equipped with an internal video camera, you can turn that camera on and off, and turn the saving of images with the readings on and off through an interface. When the camera is on, the image will show in the Ready to Test screen, as in Figure 1-4. If the camera is off, saving of images will also be off. If the camera is on and the image saving function is also on, the images will automatically be saved with the reading. Saving images will curtail the maximum number of readings stored.

How to Use the Camera

When a Camera equipped XL3 analyzer is in the Ready to Test screen, the video feed appears live on the analyzer's touch screen. This is the image that can be saved with the sample analysis. When you take a measurement, if you choose to do so, the bitmap image will be saved on the analyzer along with the analysis results. The interface is accessible through the Instrument Setup/Hardware Setup menu, as in Figure 1-2.

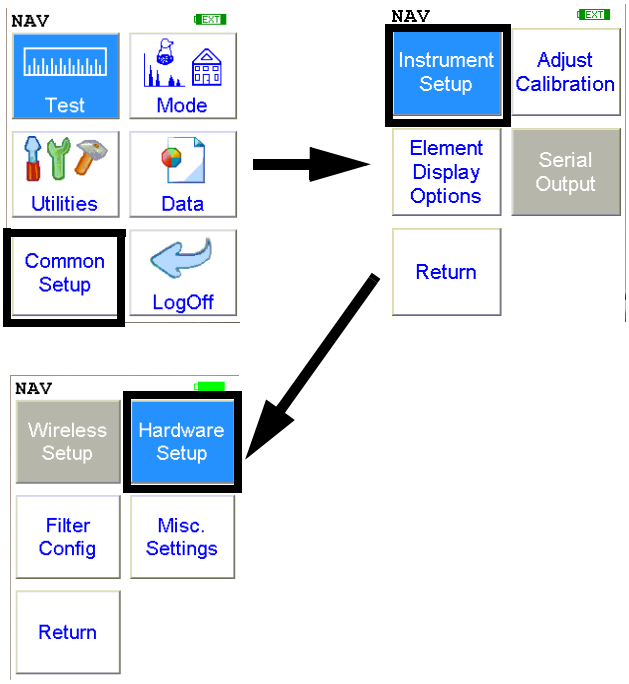


Figure 1-1. The Hardware Setup Menu Path

Figure 1-2. Setting Up the Camera View and Image Saving

Stored camera images from previous measurements can be viewed on the analyzer.

How to Use the Small Spot Technology

With a properly equipped Small Spot analyzer, you can restrict the analysis to a small spot within the camera view. You can toggle the Spot on and off from the Tools Menu as in Figure 1-3.

A red circle with a small hash mark (#) will appear on the display. The small hash marks the center of the x-ray analysis spot, while the larger circle marks the area analyzed.

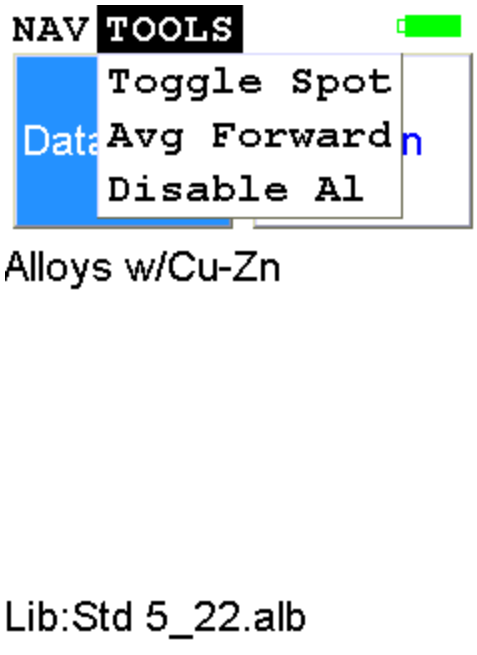


Figure 1-3. Toggling the Small Spot from the TOOLS Menu

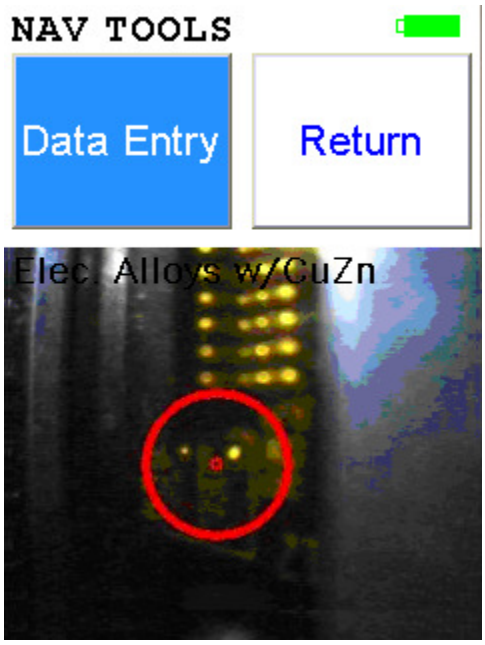


Figure 1-4. Camera View

Using the Small Spot

The Small Spot can be used in several different modes.

Mining

3mm spot size allows analysis of veins and inclusions in mineral samples

Initiate from Tools - Small Spot

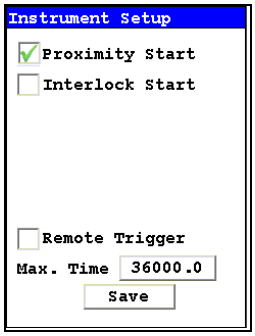
He Purged

Helium purge allows analysis of light elements (Mg, V and Ti)

Small spot enables analysis of light elements in welds and inclusions

Helium and Small Spot modes can be used simultaneously for Alloy and Mining modes

The Hardware Setup Screen



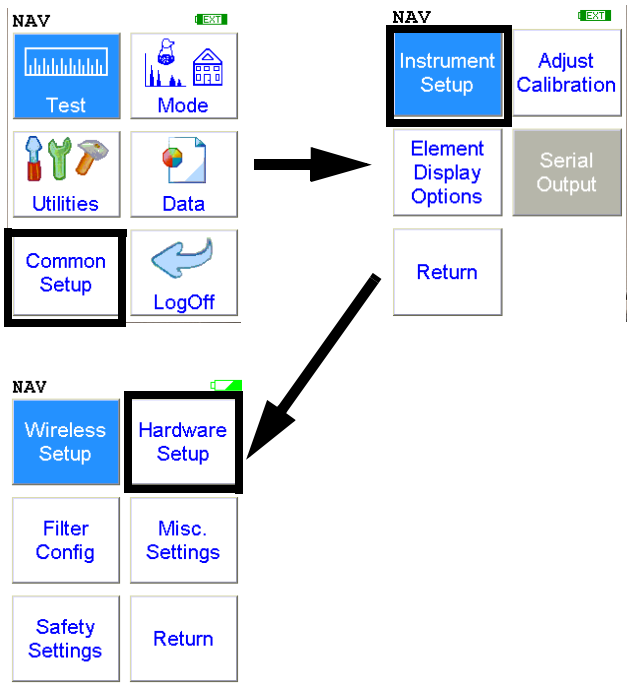


Figure 1-5. The Hardware Setup Menu Path

The **Hardware Setup Screen** enables you to toggle various options on or off, as well as select certain hardware dependant modes. Selecting an empty checkbox enables the option and places a check in the box. Selecting a checked box disables the option and clears the box.

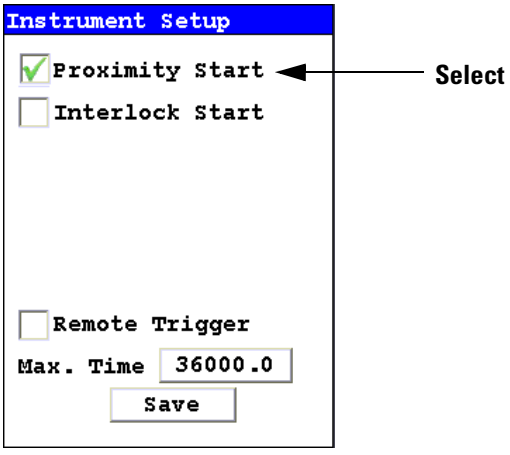


Figure 1-6. Selecting Options

Select the Proximity Start checkbox to toggle the use of the front proximity button. This enables the proximity button to be used to start taking a sample on contact. Some nations have laws or regulations which prohibit use of this feature. In this case, the feature will be disabled before shipping.

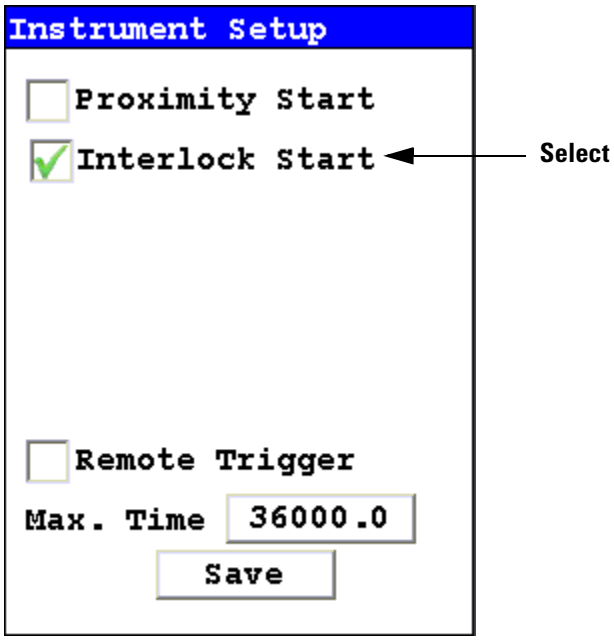


Figure 1-7. Selecting Interlock Start

Select the Interlock Start checkbox to toggle the use of the rear interlock button. This requires the interlock button to be used to start taking a sample on contact. Enabling the "Interlock Start" feature allows the user to start an analysis by depressing the rear interlock button on the analyzer.

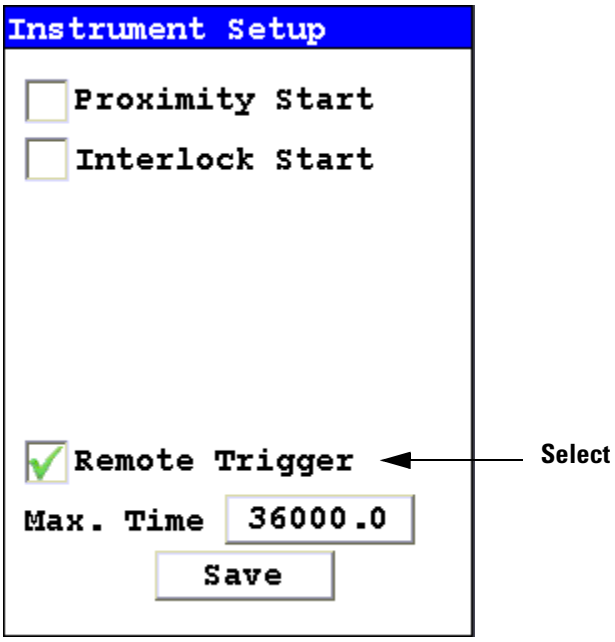


Figure 1-8. Selecting Remote Trigger

Select the Remote Trigger checkbox to toggle the use of the Remote Trigger. This is used when your XL3 is in a test stand or with the Extend-a-Pole. Enabling the "Remote Trigger" feature allows you to start an analysis by remote control.

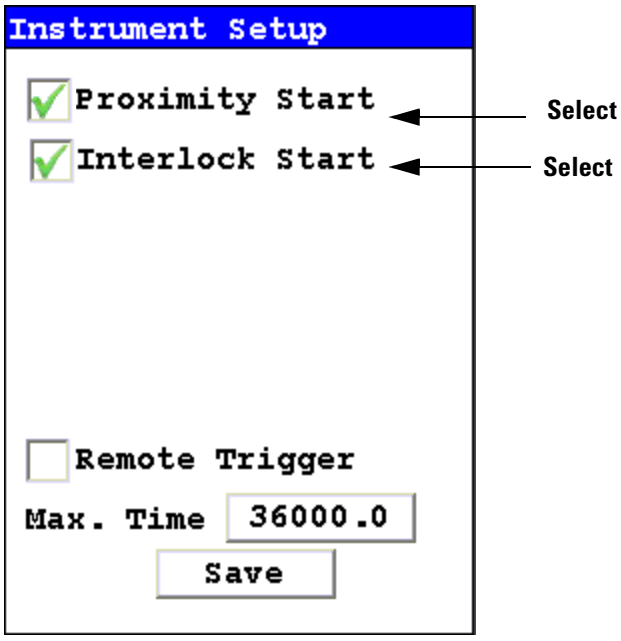


Figure 1-9. Selecting Option Combinations for Multiple Effects

.

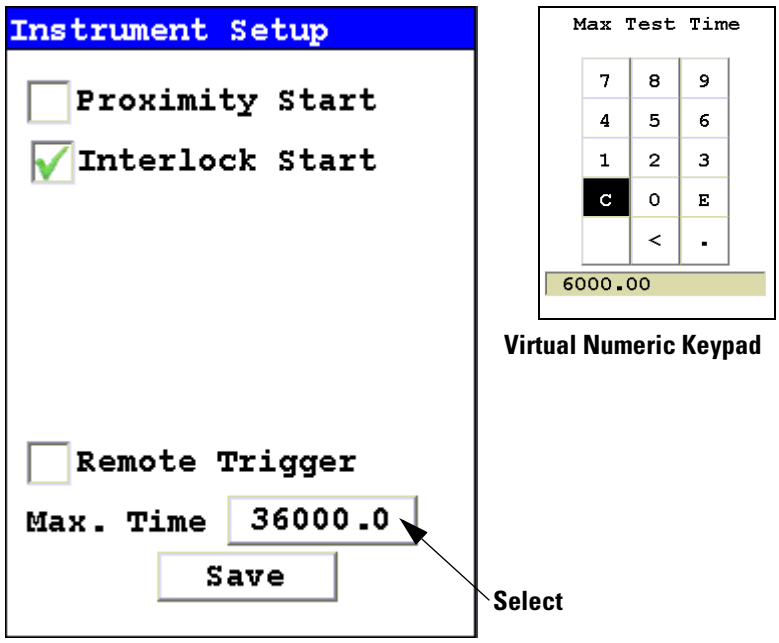
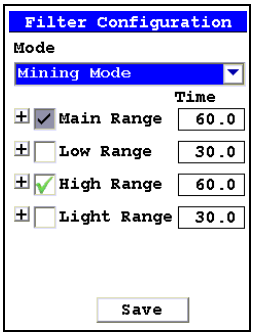


Figure 1-10. Changing the Max Time Parameter

Select the numbers box in the Max Time field to change the maximum seconds per reading. A virtual numeric keypad will appear, allowing you to set the number to whatever value you want, up to the maximum of 36000. When the max testing time is reached during an analysis, the analyzer reading will be automatically ended. Your analyzer will continue switching filters as needed until you terminate the reading or the Max Time is reached.

The Filter Config Screen



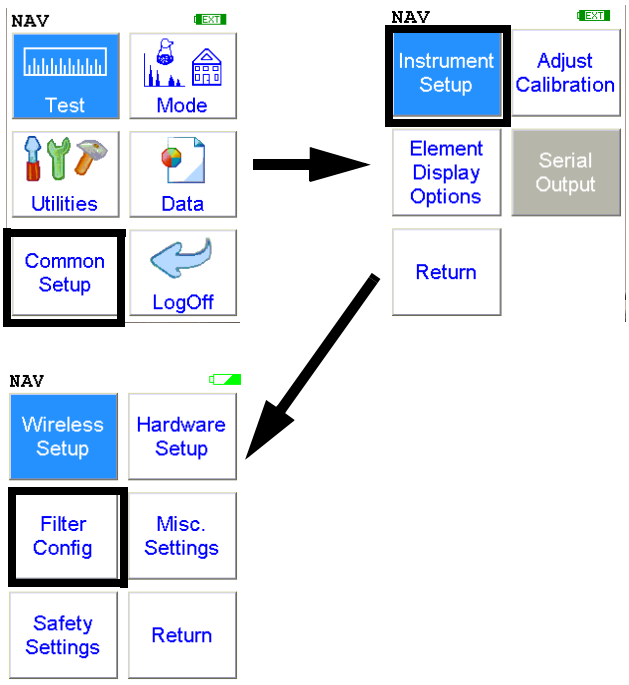


Figure 1-11. The Filter Config Menu Path

Multi-Filter tests are used to either preferentially excite specific elements for increased sensitivity, or to cover a wider element range than one filter alone can provide. Most modes, when enabled, will use two filters in sequence to produce a combined analysis result. In typical alloy analysis applications, Main Range is used for the analysis of most elements, and Low Range is utilized for the subsequent high sensitivity analysis of V, Ti, and Cr. Multi-filter switching can be set to activate off time alone, or, when time switching is disabled, off settings in the alloy grade library. In environmental modes, Low Range adds the capability to analyze light elements which cannot be efficiently excited by Main Range.

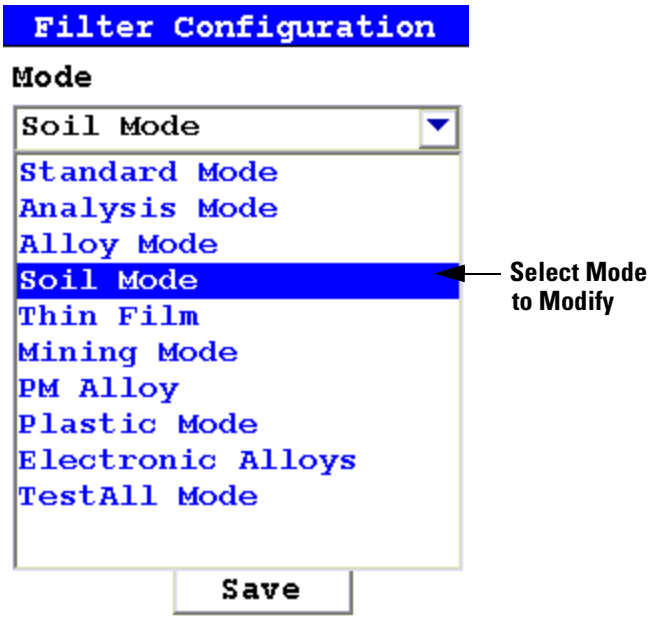


Figure 1-12. Selecting the Mode

Select the mode you wish to configure. You can set different configurations for different modes.

The **Filter Config Screen** enables you to directly enable or disable any filter, or control the time that a filter alters the irradiation of the sample before auto-switching to another filter. Not all filters are available in all modes.

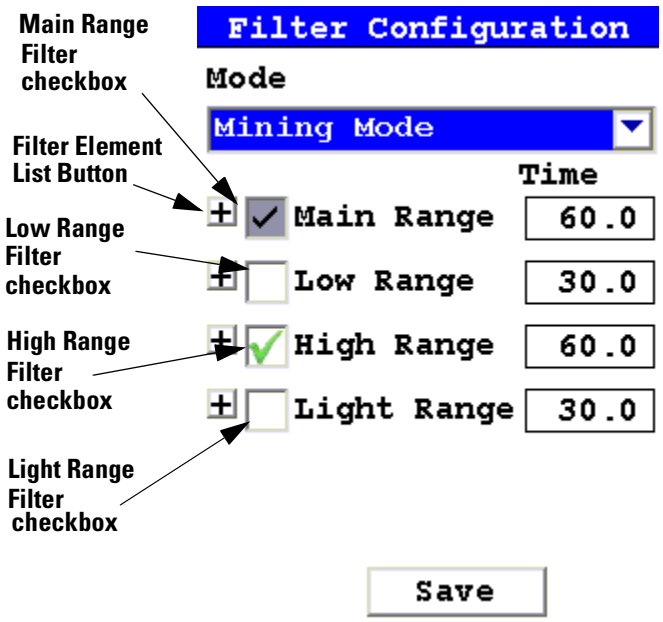


Figure 1-13. The Filter Checkboxes In Mining Mode

Select the checkbox next to the filter you want to use to determine exactly which of the filters contained in your NITON Analyzer is used for sample testing. Selecting an empty checkbox will enable that filter and place a check into the box as an indicator. Selecting a checked box will disable the filter and clear the box.

In typical alloy analysis applications, Main Range is used for the analysis of most elements

Low Range is utilized for the subsequent high sensitivity analysis of V, Ti, and Cr.

High Range is not used in alloy and plastic analysis.

Light Range is available only with He-purged and 900 series GOLDD technology analyzers, and is typically used in light element analysis.

Filter Change on Time Only

In Alloy and Electronic Alloy modes, there is an additional option which enables you to control whether the time you set or the alloy library controls the switching of the filters.

Select the Filter Change on Time Only checkbox to override the alloy library's settings. When this box is checked, your analyzer will ignore the alloy library settings and change filters only according to the time intervals you have set for each filter.

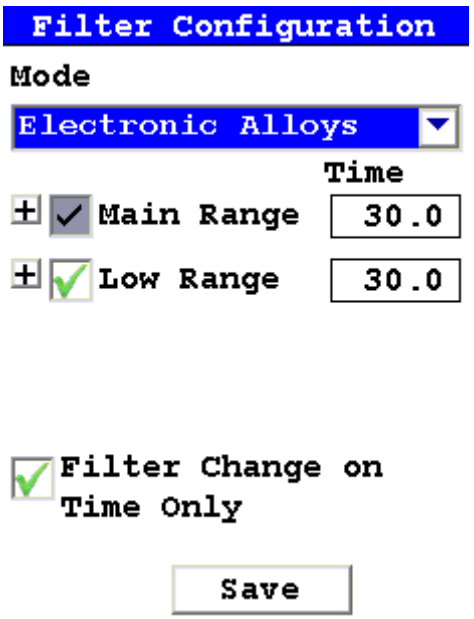


Figure 1-14. The Filter Checkboxes In Electronic Alloy Mode

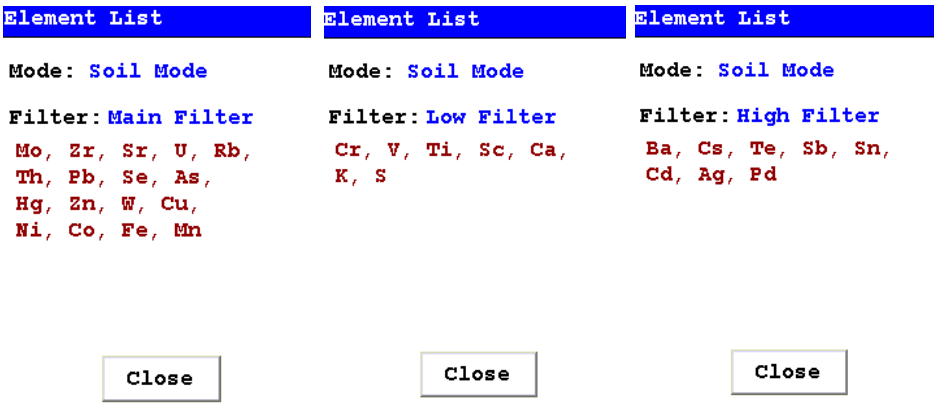


Figure 1-15. The Filter Element Lists

Select the Filter Element List Button to display the Element List for that filter. This list shows the elements that the filter is best designed to detect.

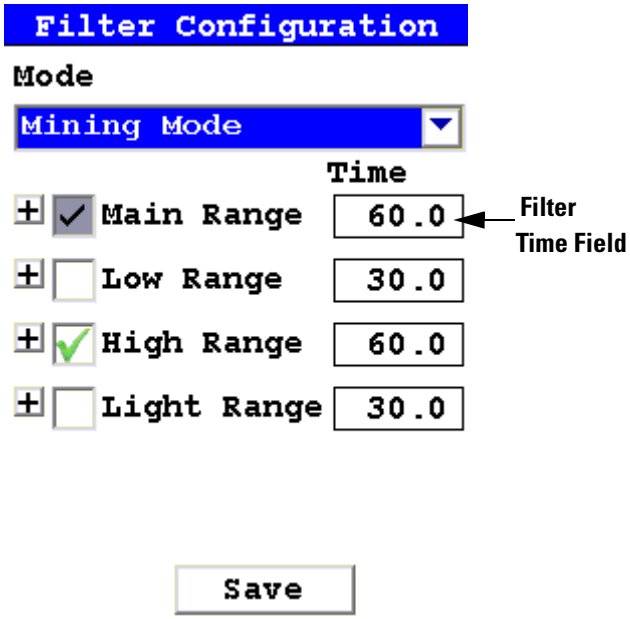


Figure 1-16. The Filter Time Fields

Select the Time field for the intended filter to change the filter switch time for that Filter. The Filter Time Editor will appear. This enables you to set the number of seconds each enabled filter is allotted before auto-switching will occur when needed during sample testing. Your analyzer will auto-switch from one filter to another when the testing time for that filter is greater than or equal to the time you have chosen, and the identified alloy is flagged as needing the switch in the NITON Alloy Library.

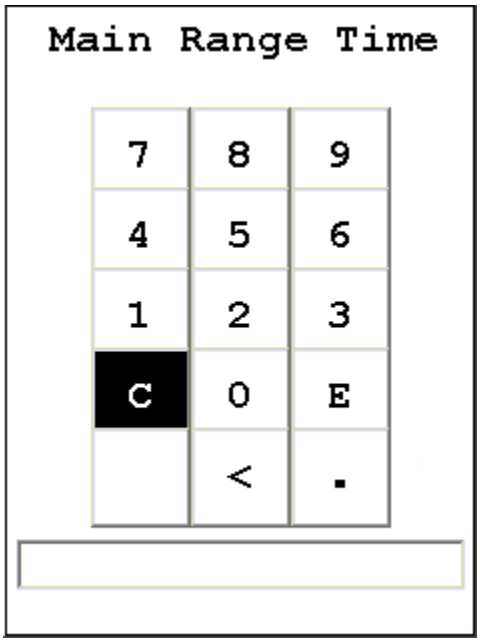
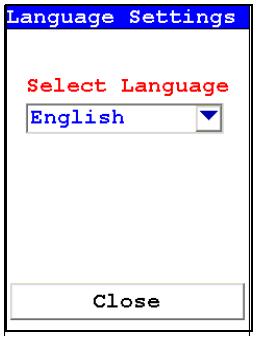


Figure 1-17. The Filter Time Editor

Select the “C” key to clear the current time, then from the virtual numeric key pad, select each digit you want to input, then select “E” to enter.

The Language Settings Screen



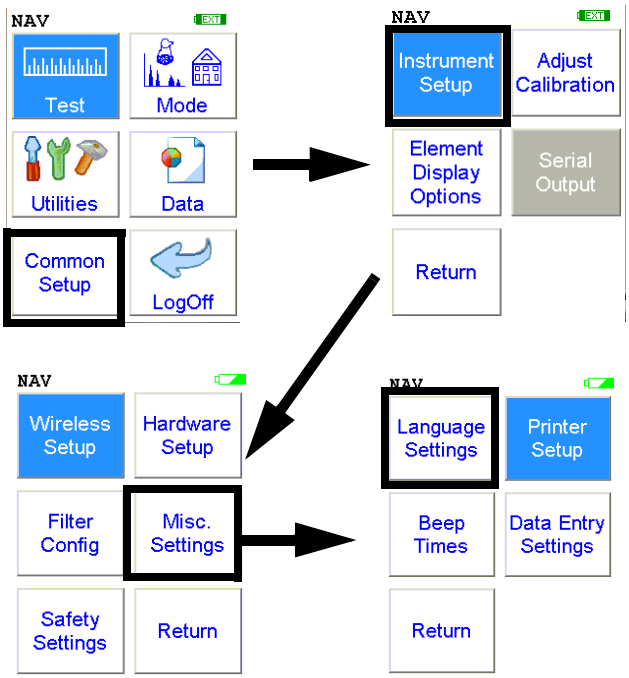


Figure 1-18. The Language Settings Menu Path

Selecting the **"Language Settings"** icon will load the **Language Screen,** allowing you to change the language from the default English to French, Spanish, Portuguese, or German.

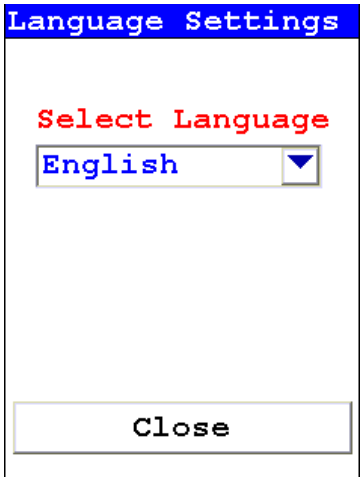


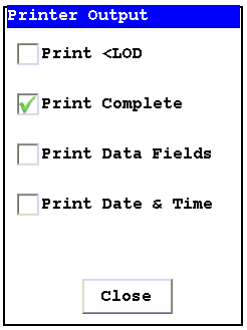
Figure 1-19. The Language Setting Screen

Select the down-pointing triangle, and then select the language you want from the drop down menu. The Menu system will now show on screen in the language you have selected.

Figure 1-20. Selecting Language From the Drop Down Menu

Figure 1-21. The Main Menu in Chinese

The Printer Setup Screen



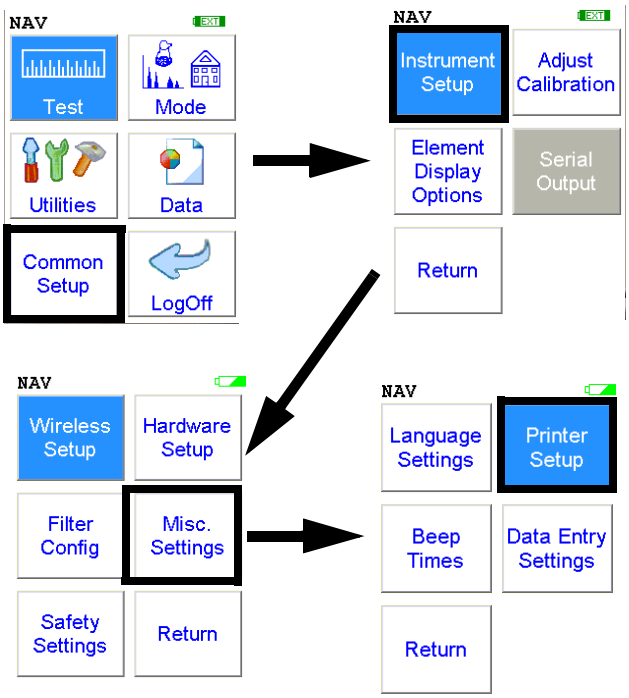


Figure 1-22. The Printer Setup Menu Path

The Printer Setup Screen allows you to adjust which sections of your reading data are sent to your optional printer. By default, your analyzer prints the detected list, reading number, reading length, reading mode and any applicable measurement data such as Alloy match grade names. You can select any combination of options on the Printer Setup Screen to change what is printed.

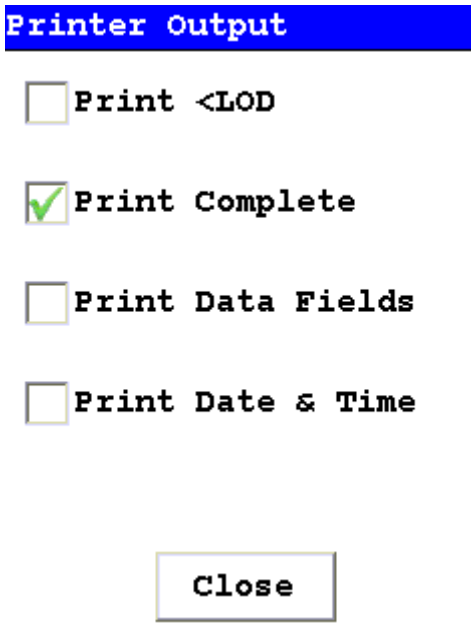


Figure 1-23. The Printer Setup Screen

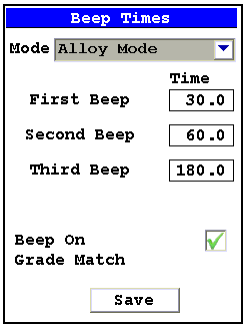
Print < LOD Selecting this option will enable printing of readings which are lower than the Limit of Detection.

Print Complete Selecting this option will enable printing of all the data fields in the reading.

Print Data Field Selecting this option will enable printing of all entered data fields.

Print Date & Time Selecting this option will enable printing of the Date and Time.

The Beep Setup Menu



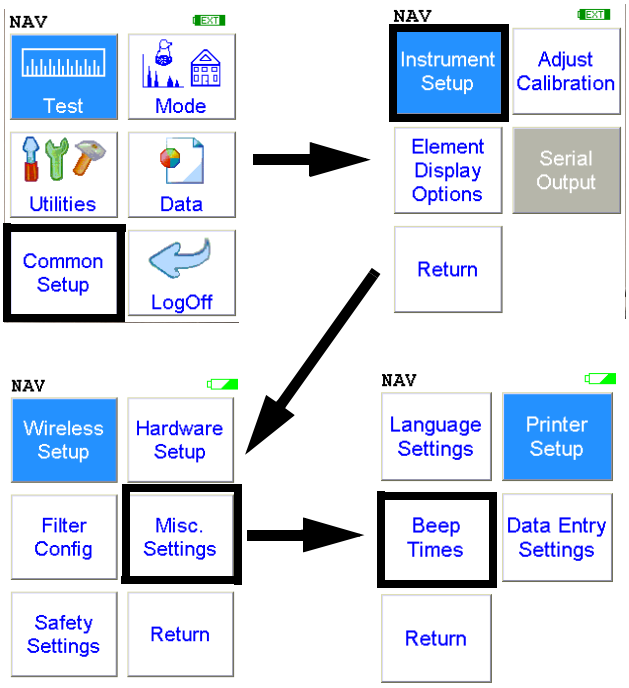


Figure 1-24. The Beep Setup Menu Path

Selecting the Beep Times icon opens the Beep Setup Screen, enabling changes to the beep settings for various modes. The beeps sound as follows:

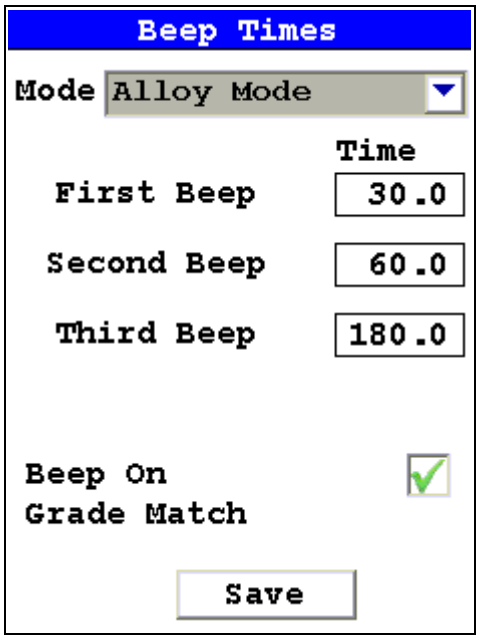


Figure 1-25. The Beep Setup Screen

Mode This option allows you to change the beep settings for different modes independently. Select the down arrow to access the list of modes.

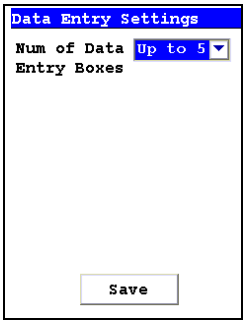
First Beep This option allows you to change the delay before the First Beep.

Second Beep This option allows you to change the delay before the Second Beep.

Third Beep This option allows you to change the delay before the Third Beep.

Beep on Grade Match Selecting this option will enable a special beep when the reading chemistry matches and alloy grade.

The Data Entry Settings Menu



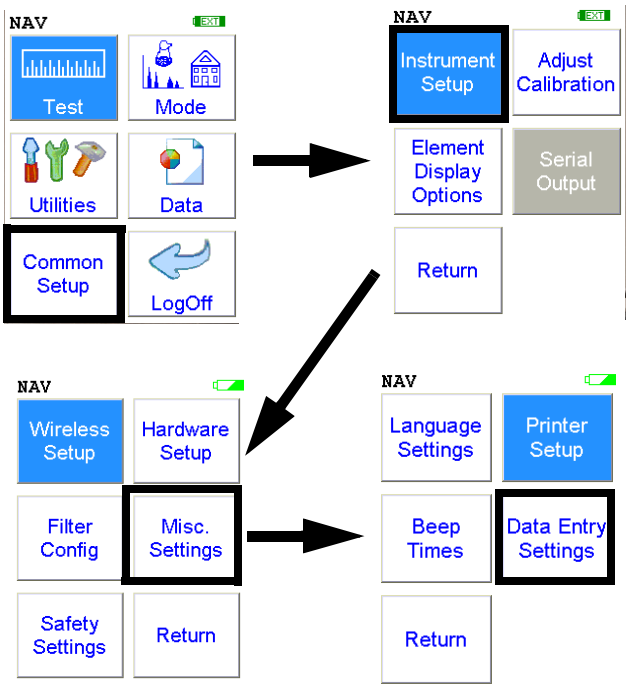


Figure 1-26. The Data Entry Settings Menu Path

Selecting the **Data Entry Settings** icon opens the **Data Entry Settings Screen,** enabling changes to the data entry settings for various modes.

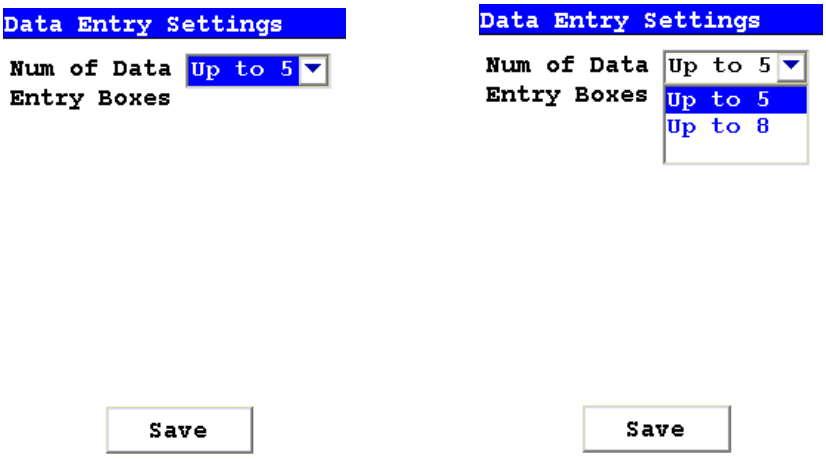
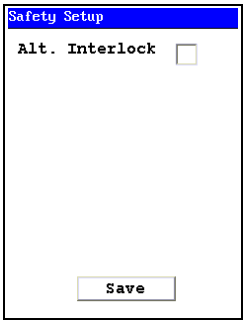


Figure 1-27. The Data Entry Settings Screen

By selecting the down arrow at the right of the "Num of Data Entry Boxes" field, you may choose between Up to 5 or Up to 8 from the drop down menu, changing the number of data entry boxes in the Data Entry Screen.

The Safety Settings Menu



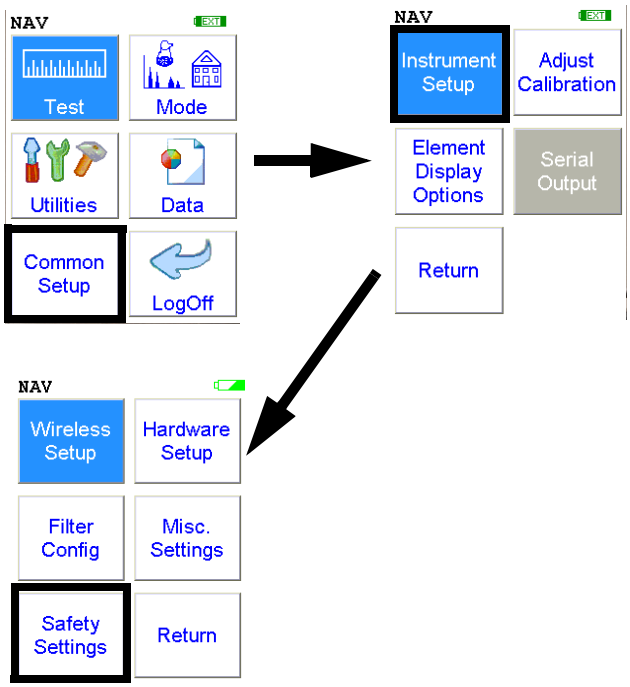
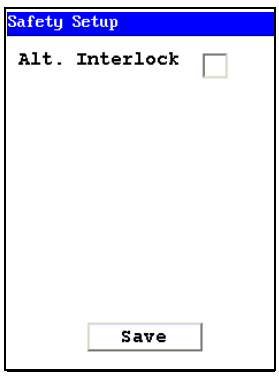


Figure 1-28. The Safety Settings Menu Path

Selecting the **Safety Settings** icon opens the **Safety Settings Screen,** enabling changes to the location of the rear interlock button.



Alt Interlock Disabled (Default)

Alt Interlock Enabled

Figure 1-29. The Safety Settings Screen

By selecting the checkbox, you can toggle between the rear interlock button's normal location, and it's alternate location as the center "Select" button on the four-way touch pad.

The Adjust Calibration Screen

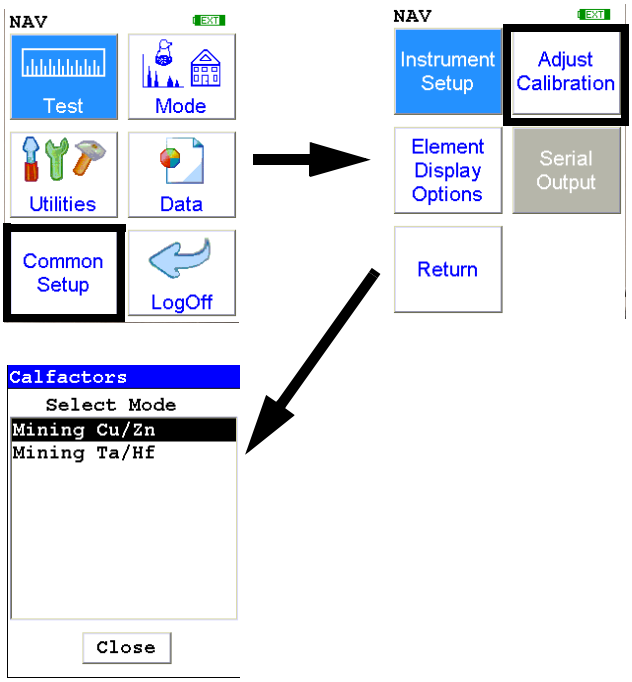


Figure 1-30. The Adjust Calibration Menu Path

The **Adjust Calibration Screen** enables you to change calibrations for Mining Modes. Select the mining mode you are using from the list.

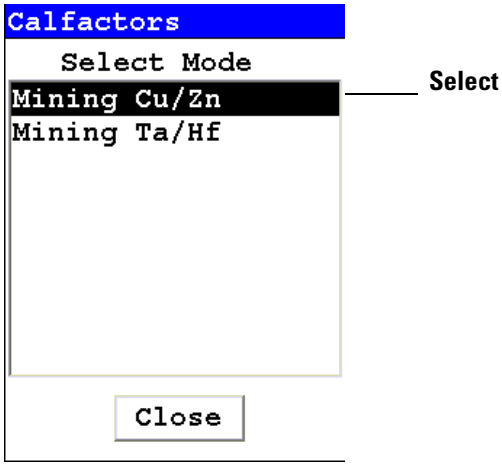


Figure 1-31. Select Mode Screen

The Calfactors Screen will now appear.

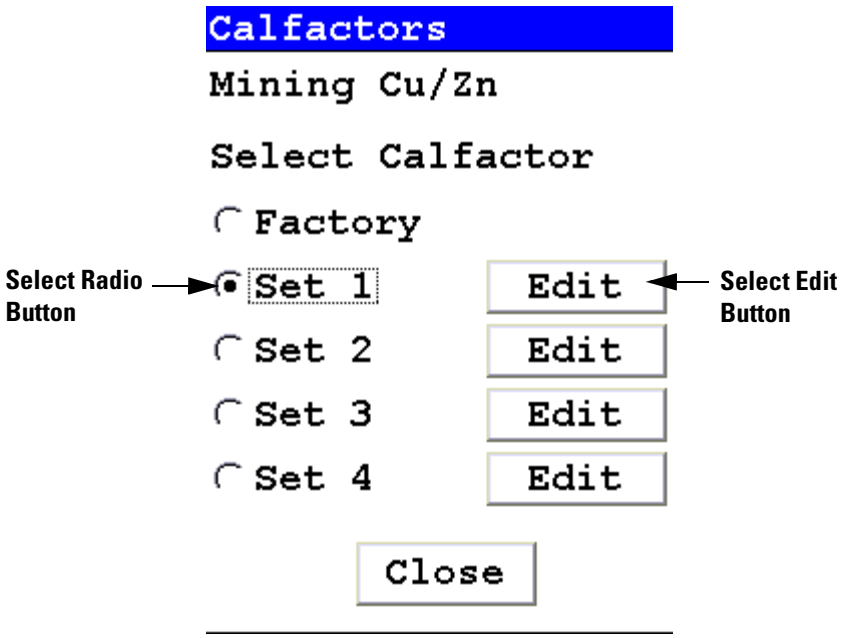


Figure 1-32. The Calfactors Screen

Select the radio button of the Calibration Factor you wish to edit, then select the appropriate Edit Button. The Calibration Edit Screen will open.

You cannot edit the Factory Calibration. You may edit and store up to four alternate calibrations per Mode.

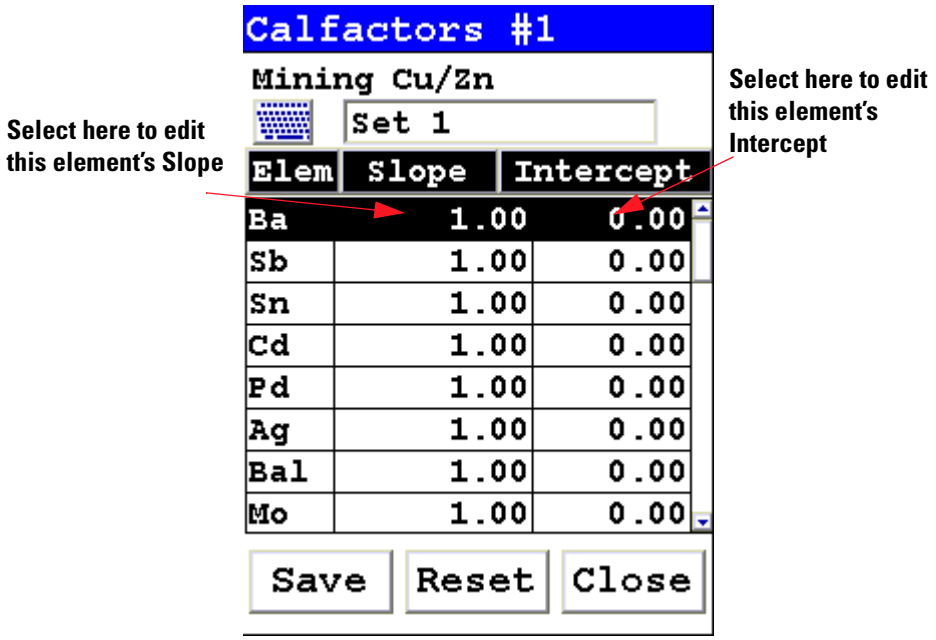


Figure 1-33. The Calibration Edit Screen

Calibration Factors

Although the FP software automatically corrects for most inter-element matrix effects, NITON tube-based analyzers cannot currently detect elements lighter than magnesium. As a result, the oxidation state of elements can bias measurements of other elements. In many cases, this bias is small, and uncorrected results provide sufficient accuracy, especially when data is for screening purposes only. For cases when more accurate results are required, NITON has provided slope/intercept calibration software with the instrument to improve the quality of the data. The calibration software is element specific, and calibration factors can be entered for individual elements, independent of the other elements. A user may choose to correct a single element or a suite of elements.

The degree of severity of the bias should be evaluated before proceeding with routine measurement. A few test samples should be carefully measured by another technique, or by an outside lab. These samples should then be analyzed using the analyzer. If the agreement is good enough to provide the accuracy required for the application, the instrument can be operated as shipped. If it is determined that a bias correction is necessary, the procedure for establishing calibration factors should be followed. As site characteristics change, it is good practice to run a few check standards to ensure that the instrument results are still within an acceptable error range.

Note With the exception of Mining Mode, Calibration Factors cannot be changed at the User Log-in level. This must be done while logged in at Supervisor level. See the NDT manual for details.

Oxides vs. elemental concentrations

Labs and other XRF instruments often report data as oxides. We can only report data as elemental concentration. Therefore, oxide data must be converted to elemental concentration for comparison with NITON results using the conversion factors and equation below. This factor can be multiplied by oxide concentration to convert to elemental.

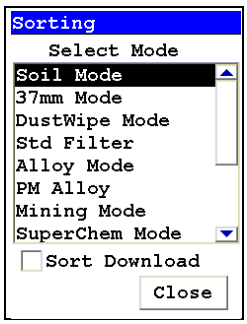
Formula

Conc. (metal) = Conc. (oxide) * Mol.Wt. (metal)/Mol.Wt. (compound).

Table 1-1. Oxide Conversion

Oxire	Conveersion Factor
MgO	0.603
Al2O3	0.529
SiO2	0.467
SO3	0.400
K2O	0.825
CaO	0.715
TiO2	0.5995
V2O5	0.5602
Cr2O3	0.6842
Mn3O4	0.7203
MnO	0.7745
Fe2O3	0.6994
FeO	0.7773
Co3O4	0.7342
NiO	0.7858
CuO	0.7988
ZnO	0.8034
PbO	0.9283
Fe2O3	0.6994
Bi2O3	0.8970
ZrO2	0.7403
MoO3	0.6665
WO3	0.7930
Ta2O5	0.8190
Nb2O5	0.6990
SnO2	0.7876

The Sort Element Display Menu



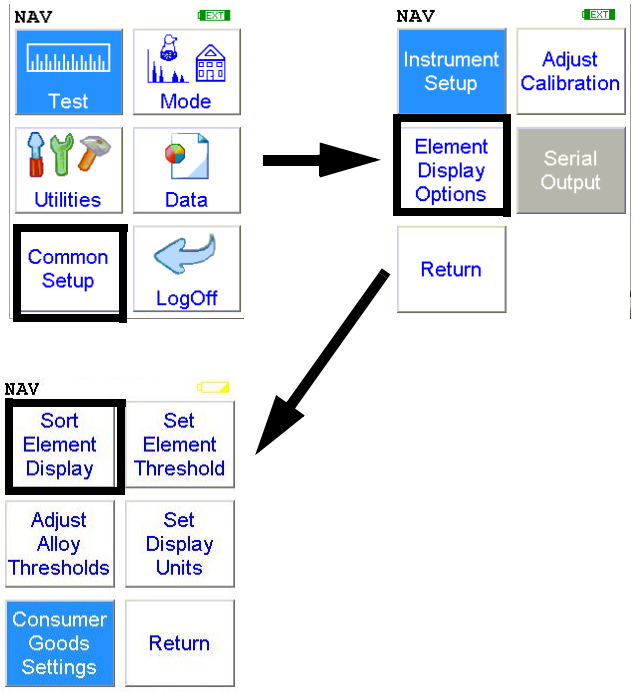


Figure 1-34. The Sort Element Display Menu Path

Select the **Sort Element Display** icon to configure sorting criteria used for analysis display. Selecting the **Sort Element Display** icon opens up the **Sort Criteria Screen**.

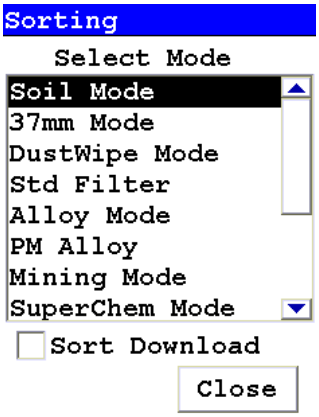


Figure 1-35. Selecting the Mode from the Sort Element Display screen

Select the mode you wish to change, and the **Sorting Options Screen** will appear.

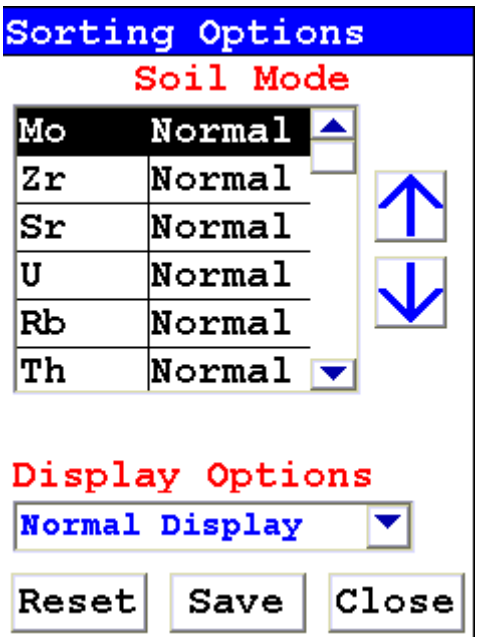


Figure 1-36. The Sort Element Display

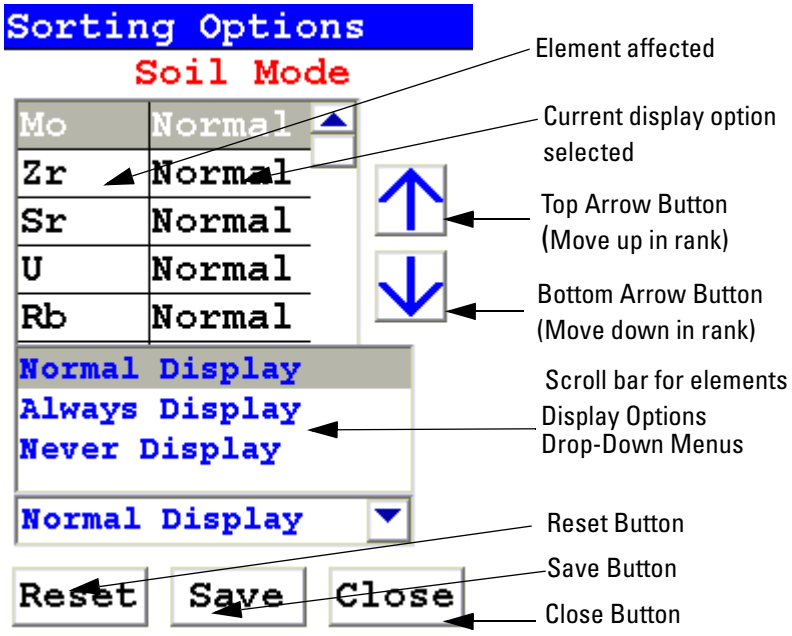


Figure 1-37. The Sorting Options Screen

On the left of the display are elements, each with its currently selected display option beside it to the right. The element list is ranked by importance, with the most important element on top, and each one lower down of less importance than the one above it.

By selecting an element and using the arrow buttons to the right of the list, you can change its ranking. Use the Top Arrow Button to move an element one rank closer to the top with each click. Use the Bottom Arrow Button to move an element one rank closer to the bottom with each click.

.

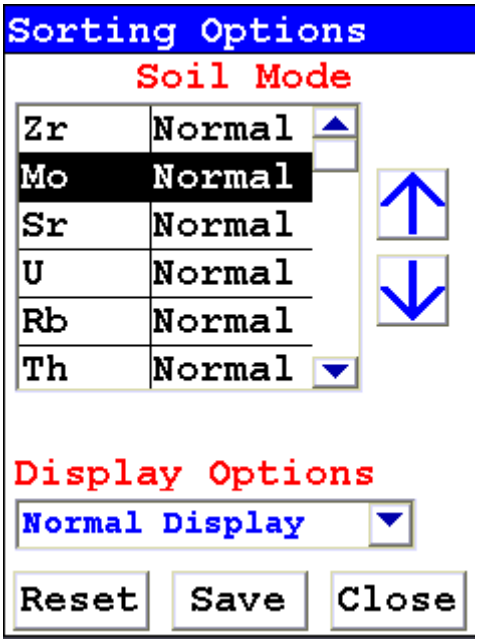


Figure 1-38. Changed Sort Order

Display Options

The Display Options Drop Down Menu allows you to change the display status of any element to one of three states:

- Normal - The standard state. Element displays only when the elemental value is greater than the limit of detection.
- Always - Always display the results for this element. Use this state for elements critical to all of your analyses.
- Never - Never display the results for this element. Use this state for elements which are unimportant to your work. This makes your instrument display less complex.

Select the element you want to change, then select the menu option corresponding to your choice of display status. The currently selected element is displayed in white on black.

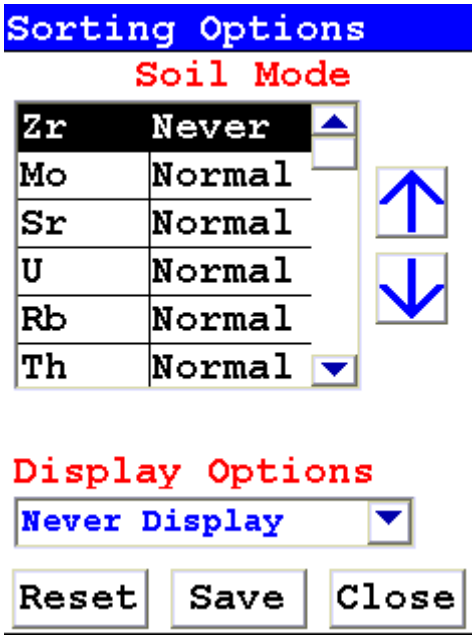


Figure 1-39. Changed Display Options

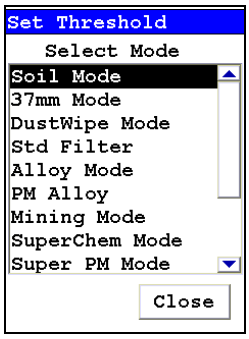
Select the Save Button to save your current status as the new default. After saving, you will go back to the **Element Display Menu**.

Close Button

Select the Close Button to exit without saving. When you select the Close Button after changing the display state of any element, a screen will open asking you if you want to save the changes you made. Selecting "Yes" will save these changes as the new default. Selecting "No" will return you to the **Element Display Menu** without saving the changes.

Figure 1-40. Save Changes

The Set Element Threshold Menu



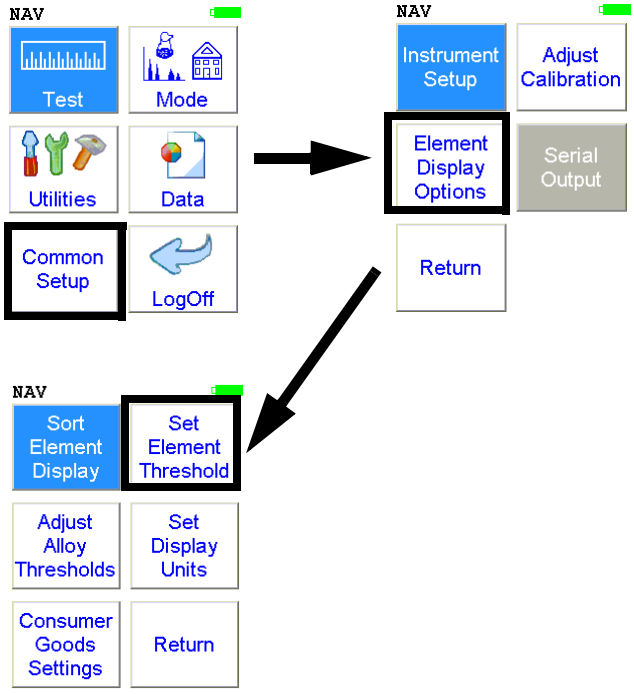


Figure 1-41. The Set Element Threshold Menu Path

Select the **Set Element Threshold** icon to configure pass and fail criteria for elemental analysis. Selecting the **Set Element Threshold** icon opens the **Set Threshold Screen**.

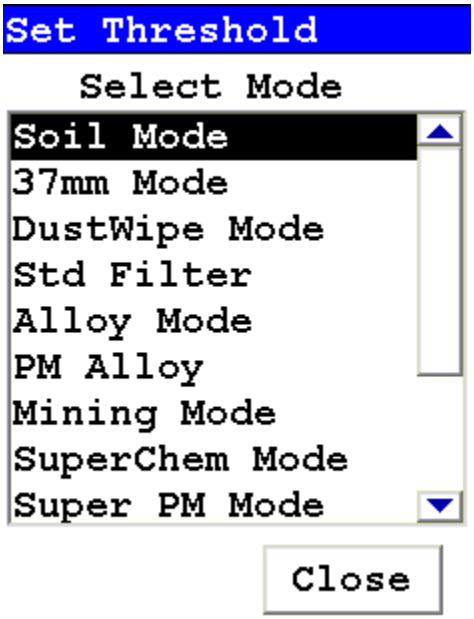


Figure 1-42. Set Threshold Screen

Select the mode you wish to work with from the scrollable list. This will open up the **Settings Screen** for that mode.

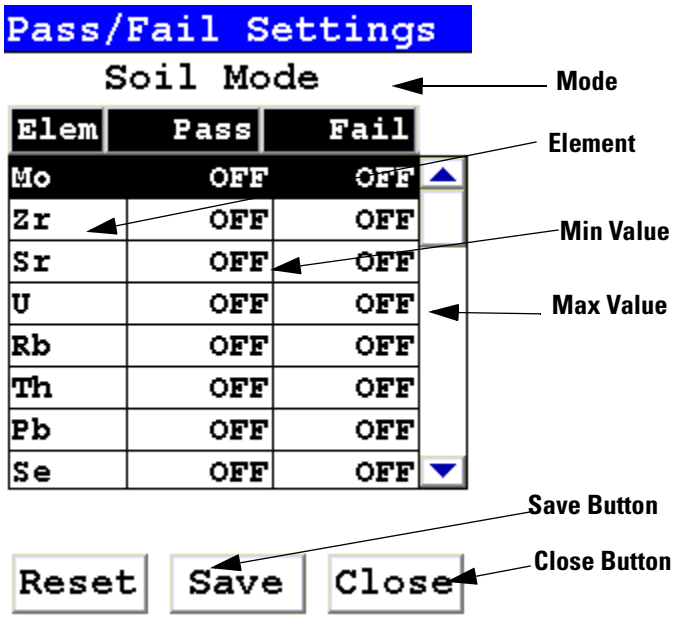


Figure 1-43. Pass/Fail Settings Screen

Selecting the Pass Value will open up the Pass Editor for the selected element.

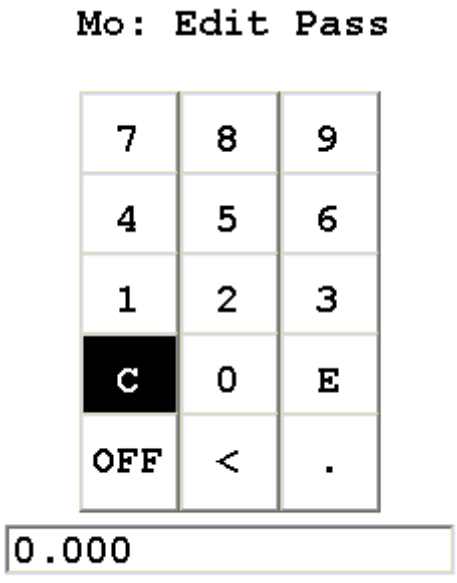


Figure 1-44. The Pass Editor

The Editor is very similar to the Logon Screen. The “C” button clears the field, and the “<“ button clears the last numeral. Select the numerals you want, then press “E” to enter the number. “OFF” resets the value to “OFF”

Selecting the Fail Value will open up the Fail Editor for the selected element.

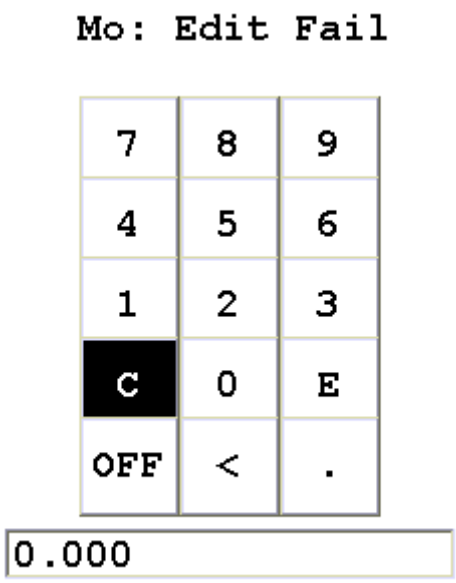


Figure 1-45. The Fail Editor

The Fail Editor works the same as the Pass Editor.

When you press the “E” button in either editor, you are returned to the Pass/Fail Settings Screen, with your new values in place.

Selecting the “OFF” button not only sets the value to “OFF” but also saves the new value.

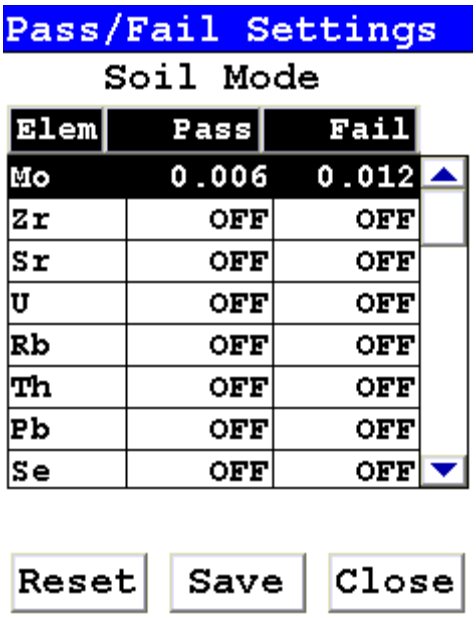


Figure 1-46. The Settings Screen with new parameters

Select the Save Button to save your current status as the new default. After saving, you will go back to the **Element Display Menu**.

Select the Close Button to exit without saving. When you select the Close Button after changing the display state of any element, a screen will open asking you if you want to save the changes you made. Selecting "Yes" will save these changes as the new default. Selecting "No" will return you to the **Element Display Menu** without saving the changes.

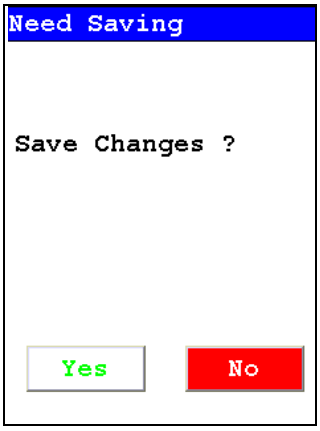


Figure 1-47. Save Changes Screen

Selecting the triangle next to the Analysis Options Field will open a pop up menu allowing you to choose between the three Analysis Option Modes. Select the mode you wish to edit.

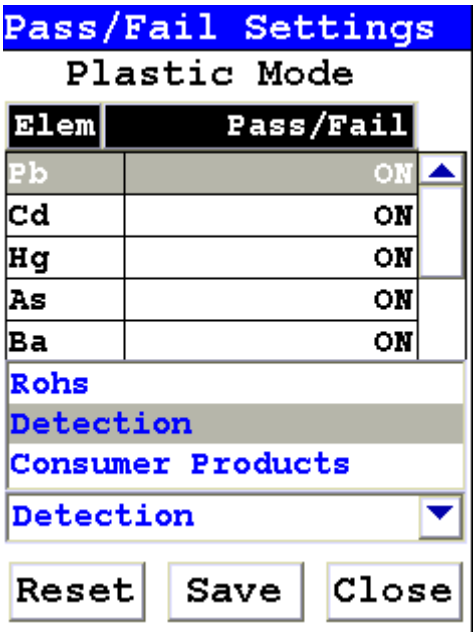
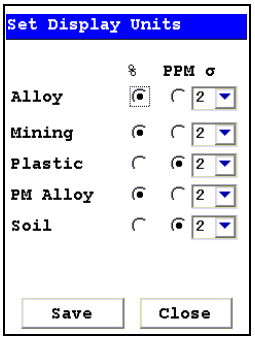


Figure 1-48. The Analysis Options Pop-up Menu

Changing the settings for one mode will not affect the settings for other modes, and the configurations can be saved independently.

The Set Display Units Menu



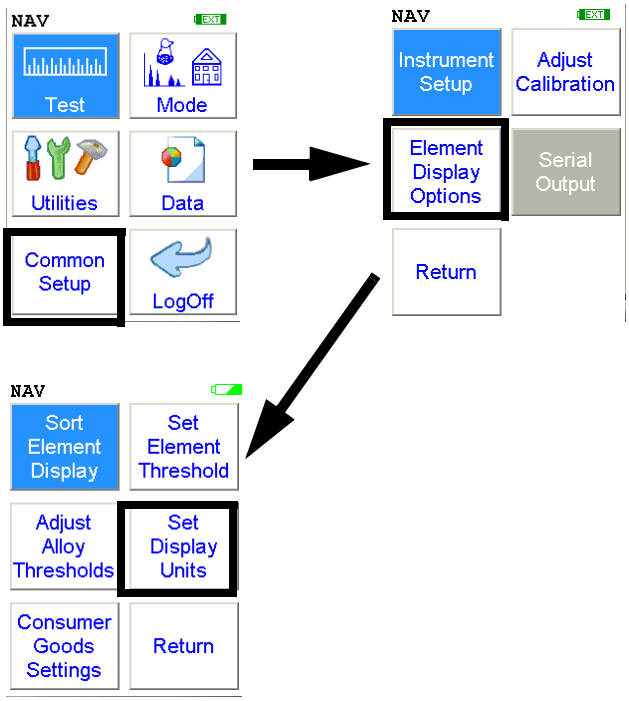


Figure 1-49. The Set Display Units Menu Path

Select the **Set Display Units** icon to choose between ppm (parts per million) and percentage (hundredths of whole) displays when taking readings, and to change the Sigma value you want for the reading. Selecting the **Set Display Units** icon opens the **Set Display Units Screen**.

Setting Display Units

In the Set Display Units Screen, you can select between Percent composition and Parts per Million as the units displayed in a measurement, and you can change this setting independently for Alloy, Mining, Plastic, Precious Metal, and Soil modes. You can also change the Sigma for each of these modes independently. See . Note that you can now set display units for Mining and Plastic modes.

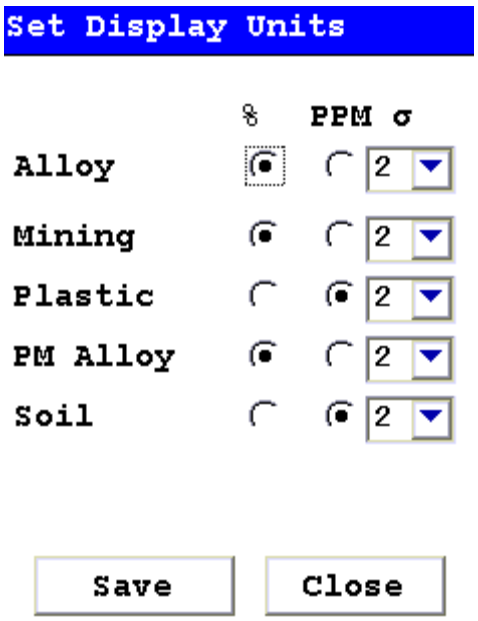


Figure 1-50. The Set Display Units Screen

Changing Sigma

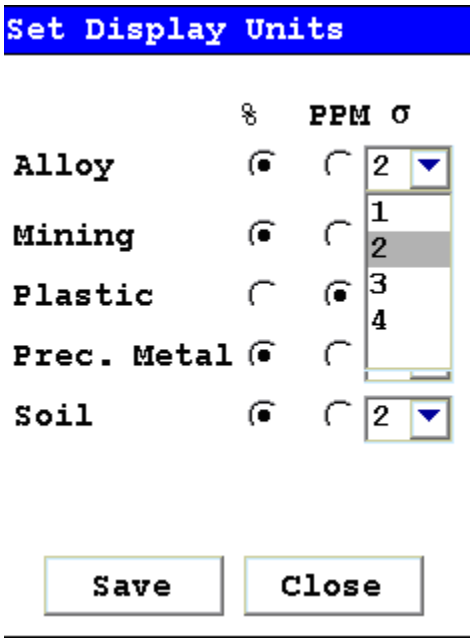


Figure 1-51. Selecting new Sigma values

Sigma

Sigma is the symbol used for Standard Deviation, a measure of how much a set of numbers deviates from the mean. For example, each of the three data sets {0, 0, 14, and 14}, {0, 6, 8, and 14} and {6, 6, 8, 8} has a mean of 7. Their standard deviations are 7, 5, and 1, respectively. The third set has a much smaller standard deviation than the other two because its values are all close to 7. In a loose sense, the standard deviation tells us how far from the mean the data points tend to be.

The number of standard deviations between the process mean and the nearest specification limit is given in sigmas. As process standard deviation goes up, or the mean of the process moves away from the center of the tolerance, the sigma number goes down, because fewer standard deviations will then fit between the mean and the nearest specification limit.

Confidence Intervals

Confidence intervals assume that the data are from an approximately normally distributed population - generally, sums of many independent, identically distributed random variables tend towards the normal distribution as a limit. Using this assumption, about 68 % of the values must be within 1 standard deviation of the mean, about 95 % of the values must be within two standard deviations, about 99.7 % must lie within 3 standard deviations, and about 99.99% of the values must lie within 4 standard deviations.

The greater the sigma value of the test, the more confident you can be that the sample is as it appears, but the more difficult and time consuming the testing must be to verify this. That's why it's important to use the most appropriate sigma value for the test. By adjusting the sigma value for each type of test, you can optimize the process for your needs.

Adjusting the Sigma Values

The sigma values are listed in the column headed " -- ". The default value is 2 sigma. You can change this value by selecting the down arrow next to the value, which opens up a drop-down menu from which you can select the desired sigma value by clicking on it.

When you have changed the sigma values to the appropriate number, select the Save button to save these settings for use. Select the Close button to return to the previous screen without saving any changes.

Chapter 2 Routine Maintenance Guidelines

Battery Pack and Battery Charger

Each NITON Analyzer is shipped with two lithium ion battery packs. When fully charged, the battery pack provides approximately 6-8-12 hours of use, depending on duty cycle.

Replacement battery packs (NITON part number 420-002) may be ordered from NITON in the United States, toll free, at (800) 875-1578, or outside the United States, at +1-978-670-7460, or from your local Authorized NITON Analyzers Service Center.

Note Before beginning a test, be certain that the battery has sufficient charge. ♦

CAUTION Do not leave the battery pack connected to the charger for excessive periods of time. Overnight recharging is recommended. ♦

CAUTION Store the analyzer and the spare battery packs in a cool place, away from direct sunlight. ♦

Replacing The Battery Pack

1. **Slide back the catch on the bottom of your analyzer's pistol grip and drop the battery out into your hand.**

2. **Place the old battery aside and slide the new battery up into the cavity in the bottom of the pistol grip. The battery is keyed, and will only insert fully one way.**

3. **Press in until the latch resets.**

Recharging The Battery Pack

Fully recharging a battery pack takes approximately 2 hours.

1. **Remove the battery pack from the analyzer.**

2. **Place the battery pack upside down into the charger. The battery pack is keyed, and will only fit into the charger fully one way. If your battery pack is resting on the back of the back of the charger rather than sliding all hte way to the bottom, remove the battery pack, turn it around, and re-insert it into the charger.**

3. **The red light is on when the charger is plugged in. This is the power indicator light.**

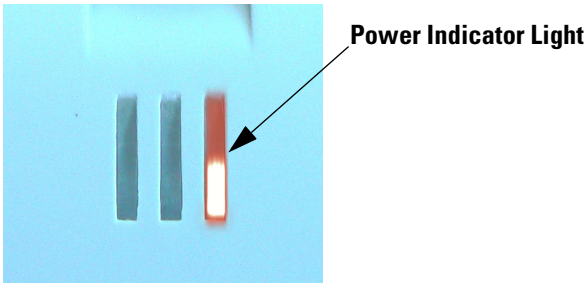


Figure 2-1. Power Indicator Light

4. **The yellow light indicates that the battery pack is currently being charged..**

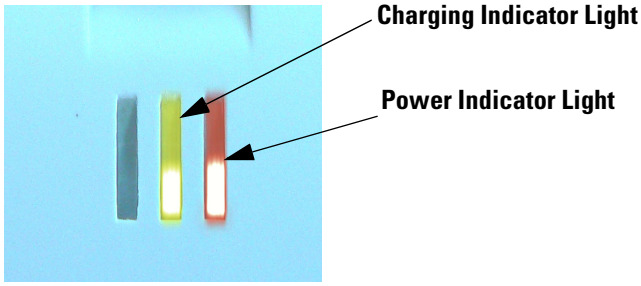
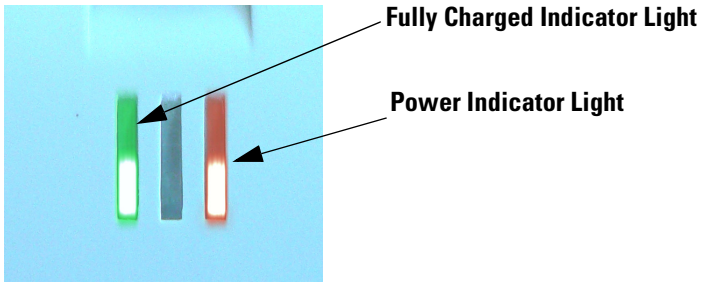


Figure 2-2. Charging Light

5. **The green light indicates that the battery pack has finished charging and is ready for use.**



6. **If there is a fully seated battery pack in the charger and only the red light is on, there is a fault with the battery pack or charger.**

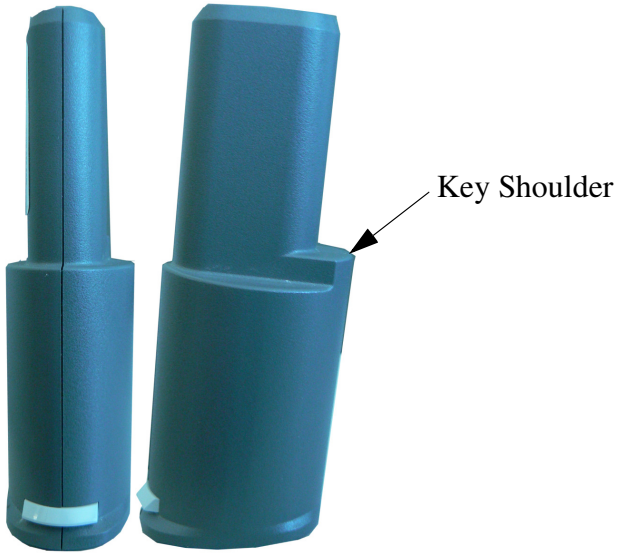


Figure 2-3. Rear and Side views of Battery Pack showing key

Figure 2-4. Battery Pack in the Charger

CAUTION Do not store battery packs or charger in direct sunlight. ♦

CAUTION Do not let the battery pack recharge for excessive periods of time. ♦

Maintenance, Cleaning and Repairs

To ensure the reliability, durability, and performance of your NITON Analyzer, keep it clean—especially the transparent measurement window covering the analysis window. Clean the measurement window gently with a cotton swab. Clean the body of the analyzer with a soft cloth. Never use detergents, or solvents on your analyzer, or immerse your analyzer in water. If the measurement window becomes frayed, ripped, or contaminated with metal particulates, replace it with a new window. measurement windows (Standard Window Niton P/N 187-1555 or Helium Purge Window Niton P/N 187-1454) may be ordered from Thermo Fisher Scientific's Service Department in the United States, toll free, at (800) 875-1578, or outside the United States, at +1-978-670-7460 or from your local Authorized NITON Analyzers Service Center.

From time to time, your touch screen will need cleaning. NITON recommends that you use a lens cleaning solution with a soft cloth. Do not use water to clean your NITON Analyzer.

WARNING! All Service, except exterior cleaning and measurement window replacement, must be performed by Thermo Scientific or an Authorized NITON Analyzers Service Center. Do not attempt to make repairs yourself. Opening the case of your NITON will void the analyzer Warranty in its entirety. ♦

CAUTION Always obtain a Return Authorization (RA) number from Thermo Fisher Scientific's Service Department in the United States, toll free, at (800) 875-1578, or outside the United States, at +1-978-670-7460 before returning your analyzer to the NITON Service Department or local Authorized NITON Analyzers Service Center. ♦

Replacing the Measurement Window

1. **Remove the two Phillips head screws.**

Figure 2-5. View of Face Plate and measurement window

2. **Remove the face plate and place it face down.**

Figure 2-6. Face Plate Removed showing measurement window on Reverse

3. **Remove the old measurement window.**

4. **Clean the back surface of the face plate and install the new Window.**

5. **Turn the face plate over and replace it on the analyzer's front end, fitting the plate carefully over the Proximity Button.**

Figure 2-7. Fitting Face Plate over Proximity Button

6. **Reinstall the two screws, being careful not to over-tighten them.**

Figure 2-8. Replacing the Screws.

Storing and Transporting Your XL3 Analyzer

All NITON Analyzers are transported in waterproof, drop-resistant, fully padded carrying cases with padlocks. In most countries, NITON XRF analyzers may be transported by car or plane or shipped as an *ordinary* package. For most courier services, no special labels are required on the outside of the NITON analyzer case or on additional packaging.

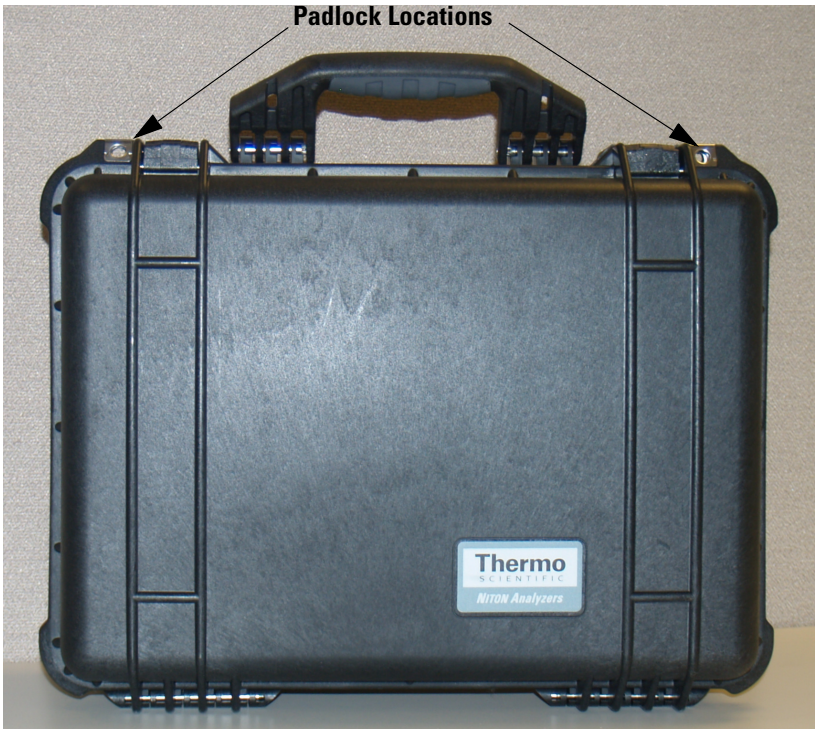


Figure 2-9. The NITON Carrying Case

All padlocks are shipped with a default combination of "0-0-0". If you change this combination, please inform Thermo of the new combination if you return the unit for service.

To change the combination:

1. **Dial the default combination to open the lock, and pull out the shackle.**

2. **Rotate the shackle 180 degrees and push it down as far as it can go.**

3. **While holding the shackle down, rotate it 90 degrees back in either direction and release shackle.**

4. **Change the dial settings to the desired combination, record the combination, and without disturbing the dials, rotate the shackle back 90 degrees to the position it had in step 2.**

5. **Pull shackle out and rotate it 180 degrees and secure it. Your lock now has its own secret combination.**

CAUTION Always transport the unit in its padded carrying case, and store the NITON Analyzer in its case whenever it is not being used. ♦

CAUTION In most cases, no notification is required if transporting within state boundaries. This may not be the case when entering federal properties. ♦

CAUTION Within the United States, always keep a copy of the US DOT compliance statement in your NITON analyzer case at all times. A copy is included with your analyzer. ♦

CAUTION Always follow all pertinent local and national regulations and guidelines, wherever your analyzer is transported or used. ♦

CAUTION Always obtain a Return Authorization (RA) number from Thermo Fisher Scientific's Service Department in the United States, toll free, at (800) 875-1578, or outside the United States, at +1-978-670-7460 before returning your analyzer to the Service Department or to your local Authorized NITON Analyzers Service Center. ♦

CAUTION If you return your NITON analyzer without the carrying case, you will void your warranty in its entirety. You will be billed for a replacement case plus any repairs resulting from improper shipping. ♦

CAUTION Always remove the battery pack when transporting or storing your analyzer. ♦

Networking and Connectivity

Setting up Wireless Networking

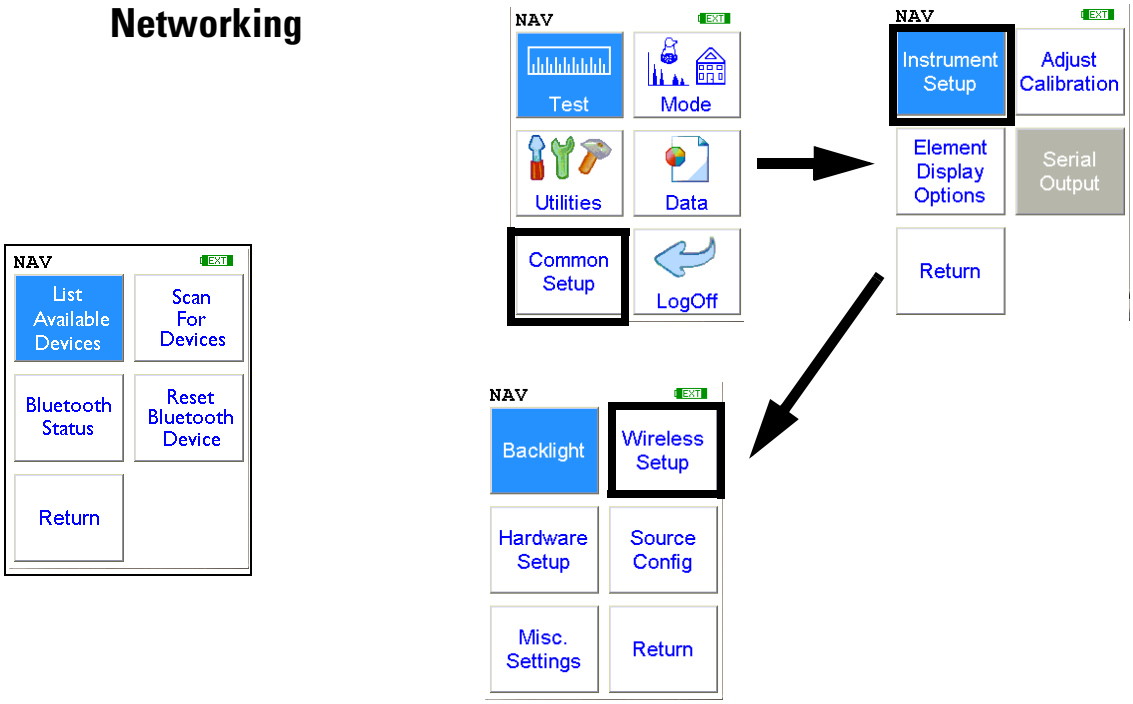
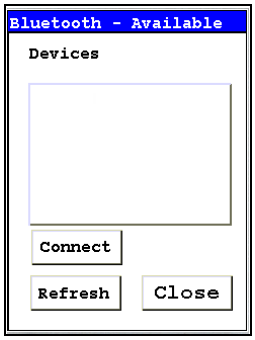
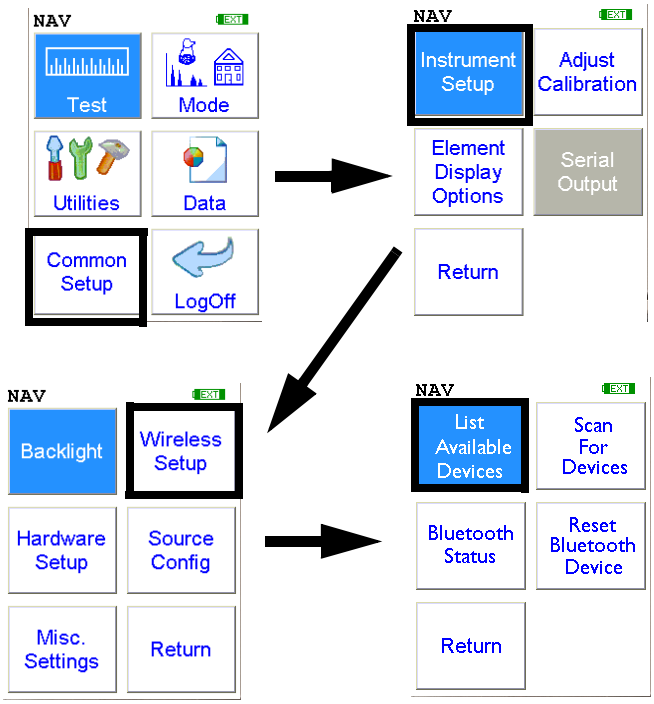


Figure 2-10. Wireless Networking Menu Path

Bluetooth Wireless Networking enables you to connect to your computer and other Bluetooth-enabled devices such as printers and GPS devices without the need of cabling, ports, or hubs.

Available Devices Screen





Select the List Available Devices icon to show a list of Bluetooth devices previously discovered. The Bluetooth devices listed are only those which were present at the last time you ran a discovery scan for Bluetooth devices, as the list is not automatically updated. Selecting the List Available Devices icon brings up the Available Devices screen. From the list, you can connect your analyzer to those devices.

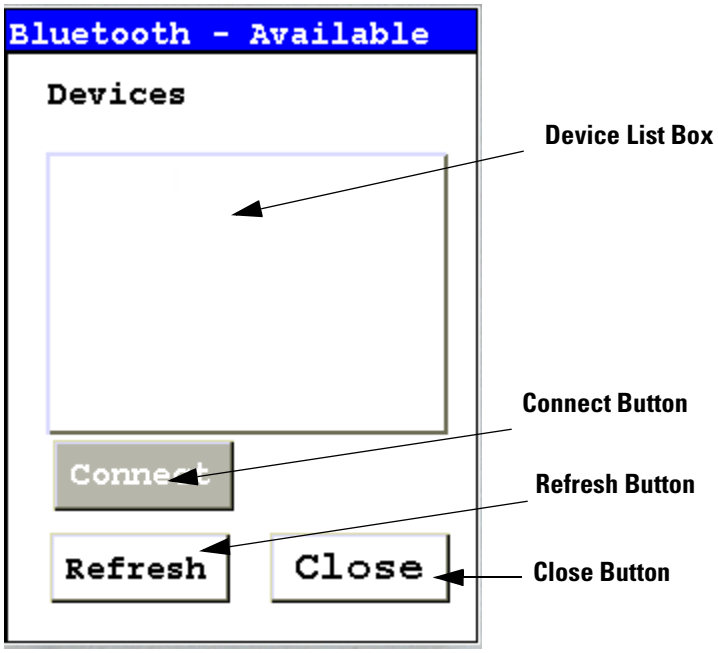


Figure 2-11. Available Devices Screen

Under "Devices," in the Device List Box, the Available Devices Screen lists all known applicable Bluetooth devices in the area found during the last refresh or scan.

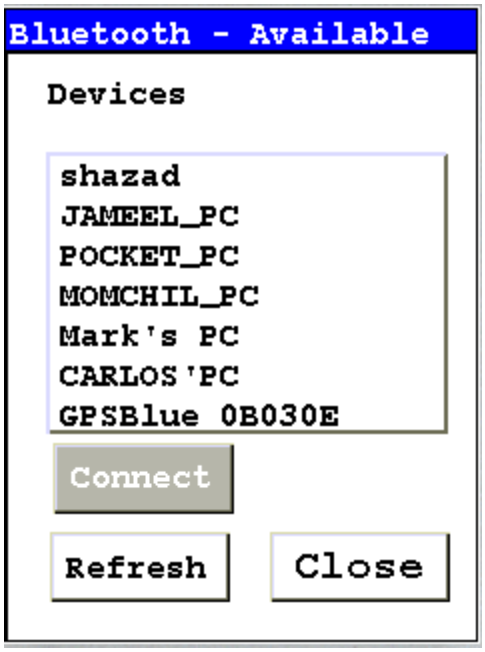


Figure 2-12. Example Device List

- Selecting the Refresh Button initiates a scan of the area for new Bluetooth devices. Devices no longer present are removed.

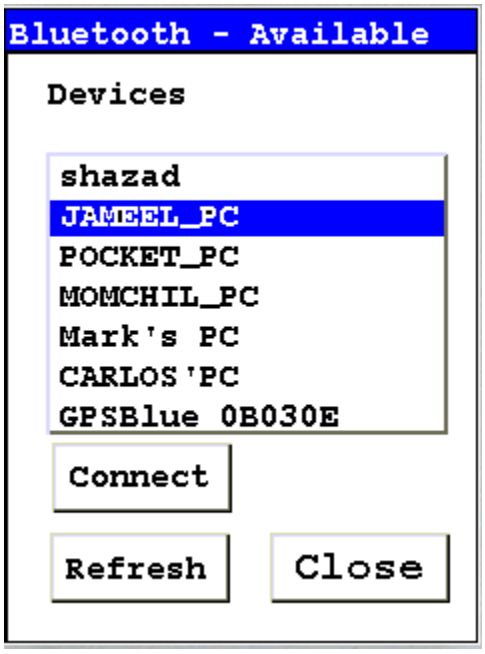
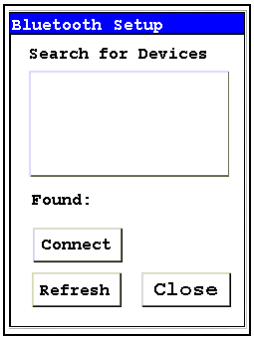
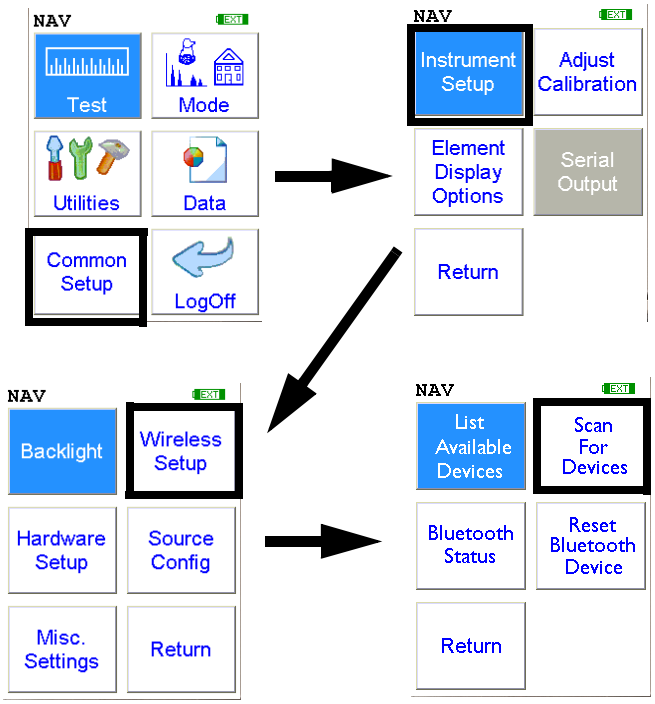


Figure 2-13. Available Device Refresh

- Selecting a listed Bluetooth Device enables the Connect Button.
- Selecting the Connect Button will connect your analyzer to the selected device. See the Connected Screen.

Bluetooth Search Screen





Select the Scan For Devices icon bring up the Bluetooth Search Screen, enabling you to initiate a discovery scan of Bluetooth devices in the operational area. This scan will find all appropriate Bluetooth devices in the operational area, enabling you to connect to those devices.

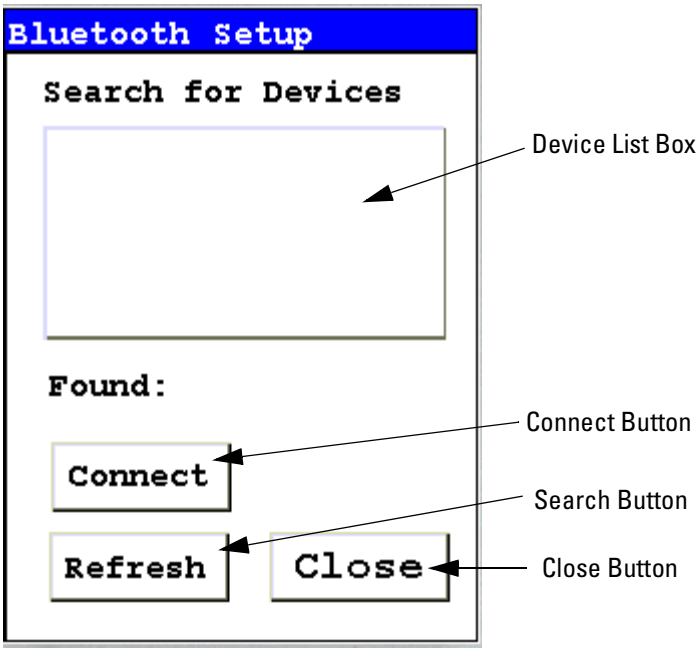


Figure 2-14. Bluetooth Search Screen

The Bluetooth Search Screen does not retain information about previously detected Bluetooth Devices. Each time the Bluetooth Search Screen is opened, the Device List Box is empty.

- Selecting the Search Button initiates a scan for Bluetooth Devices in the area.

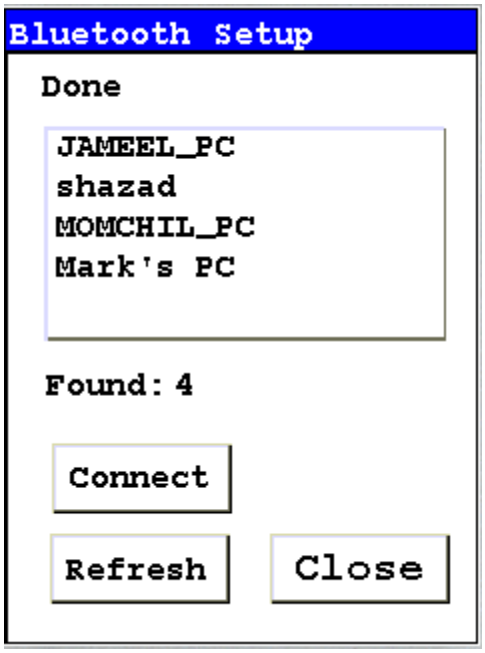


Figure 2-15. Example Search List

Depending on where and when the Search Scan is conducted, certain devices may or may not be detected. You can select a device and connect to that device in exactly the same manner as in the Available Devices Screen, once the search is finished.

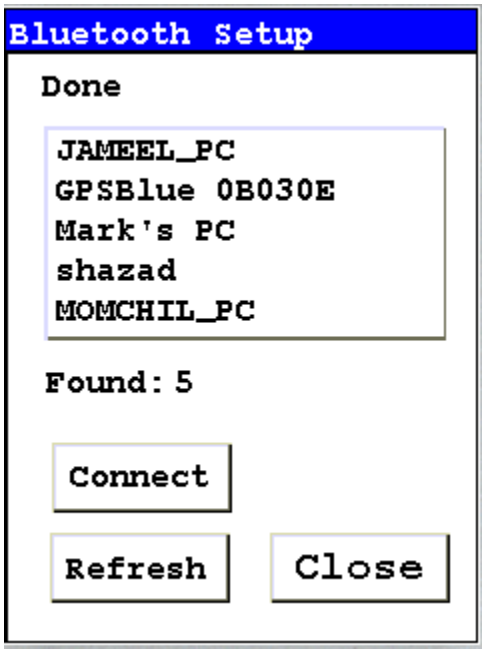


Figure 2-16. Search List with New Device Found

The Connected Screen

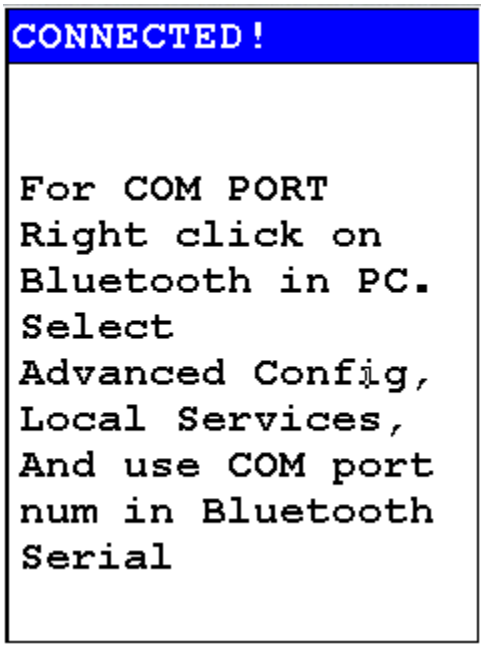


Figure 2-17. The Connected Screen

When you have connected your analyzer to a Bluetooth Device, you get the Connection Screen. The Connection Screen serves as a reminder of what needs to be done to use the connection. With simple devices like GPS devices, a notification that you are connected is given, and everything just works, but working with a PC is a bit more complex.

In order to use a Bluetooth Serial Connection with a PC, you need to know which COM port Bluetooth is connected through. To determine this, right click on the Bluetooth logo in your system tray on your PC. From the popup menu which appears, select Advanced Config., then select Local Services.

Figure 2-18. Advanced Configuration selection on PC

Service Name	Startup	Secure Connection	COM Port
Audio Gateway	Auto...	Not Required	
Headset	Auto...	Not Required	
PIM Synchronization	Manu...	Required	
Fax	Manu...	Required	
File Transfer	Auto...	Required	
PIM Item Transfer	Manu...	Not Required	
Dial-up Networking	Manu...	Required	
Network Access	Auto...	Required	
Bluetooth Serial Port	Auto...	Not Required	COM3

Figure 2-19. Bluetooth Service Listing on PC

In the Bluetooth Serial Port row, the COM port used by Bluetooth is identified. Use this port for any interactions between your analyzer and your computer, such as NDT or NDTr.

Make sure that the Secure Connection setting for the Bluetooth Serial Port is set to "Not Required."

Service Name	Startup	Secure Connection	COM Port
Audio Gateway	Auto...	Not Required	
Headset	Auto...	Not Required	
PIM Synchronization	Manu...	Required	
Fax	Manu...	Required	
File Transfer	Auto...	Required	
PIM Item Transfer	Manu...	Not Required	
Dial-up Networking	Manu...	Required	
Network Access	Auto...	Required	
Bluetooth Serial Port	Auto...	Not Required	COM3

Figure 2-20. Selecting Bluetooth Serial Port on PC

To edit the setting, double click the row.'

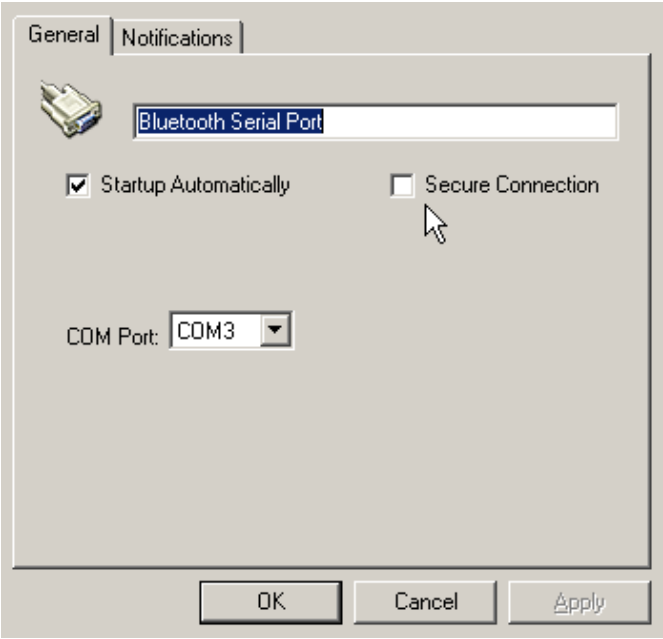
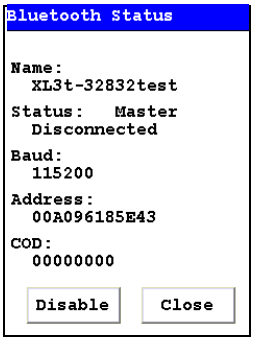
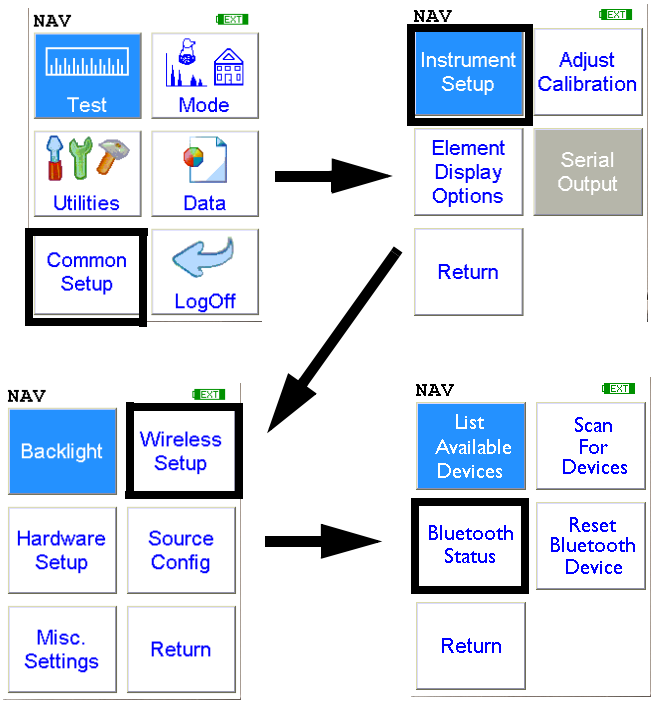


Figure 2-21. Changing the Bluetooth Secure Connection Checkbox on PC

Unselect the Secure Connections checkbox if it is already selected, then select the “OK” button.

Bluetooth Status Screen





The Bluetooth Status Screen enables you to see at a glance if and how your analyzer is connected to your computer.

Please Wait Status Screen

Normal Status Screen

Figure 2-22. Example Bluetooth Status Screen

Select the Bluetooth Status icon to view the current status of your Bluetooth connections on the Bluetooth Status Screen. The Bluetooth Status Screen will display your analyzer's serial number, connection status, the transfer rate, and your analyzer's address

In Figure 2-22, the first screen shown is the Please Wait screen. This screen is shown while the status inquiry is in process. When the inquiry is complete, the normal Status Screen will show.

The Bluetooth Status Screen shows your analyzer's identification label, its connection state, the speed of the communication port setting, your analyzer's network address, and the COD.

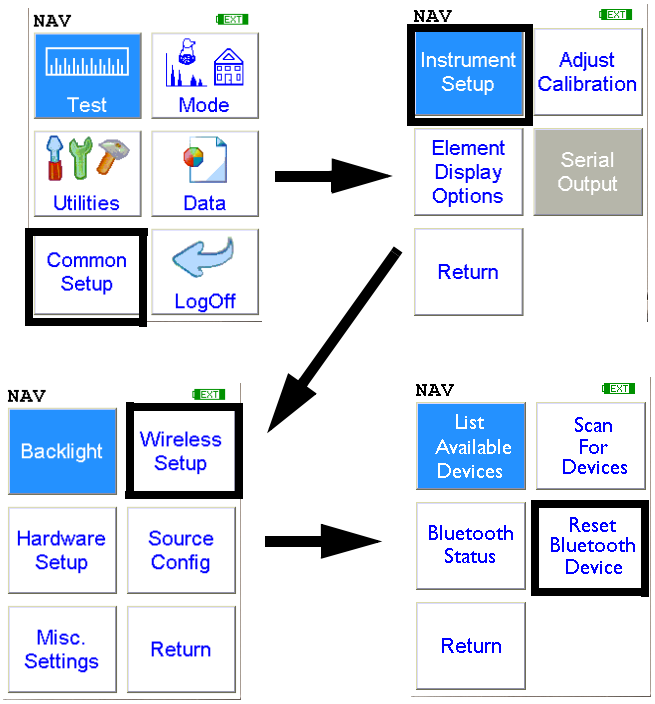
In Figure 2-22, the analyzer "XL3t-32832test" is not connected to any computer, was last in Master state - i.e. the last connection was initiated by the computer and not by the analyzer, has a com port set to communicate at 115200 baud, has the unique network (MAC) address of 00A096185E46, and has a COD (Class Of Device) of 00000000.

Selecting the Disable Button will shut down the Bluetooth device entirely. A "Bluetooth Disabled" mesage appears, and the Disable Button changes to "Enable".

The Close screen button will return you to the Wireless Setup Menu.

Figure 2-23. Bluetooth Status Screen Showing Bluetooth Disabled

Reset Bluetooth Device



Select the **Reset Bluetooth Device** icon to initiate an immediate reset of the Bluetooth Wireless Networking. Selecting the **Reset Bluetooth Device** icon will clear out old settings and data, as well as enabling you to switch between Bluetooth and standard serial cable. While resetting, your analyzer will show the following screen:

Figure 2-24. Bluetooth Reset Alert

GPS Data Tracking

Bluetooth equipped NITON XRF Analyzers are capable of communicating with GPS modules and saving GPS coordinates with every reading. Follow the Bluetooth connection instructions found in the Users Manual to scan for and connect to a Bluetooth enabled GPS device.

Once connected, the GPS unit sends out a number of signals that can be read. The analyzer will display the relevant information from the GPS after connection, as shown in Figure 2-25

As shown in Figure 2-26, these coordinates can be viewed in the Data screen in entry positions eight, nine, and ten. (Scroll down to reach these fields.) When the results are downloaded using the NDT software the GPS coordinates are also stored and downloaded in data entry fields eight, nine and ten.

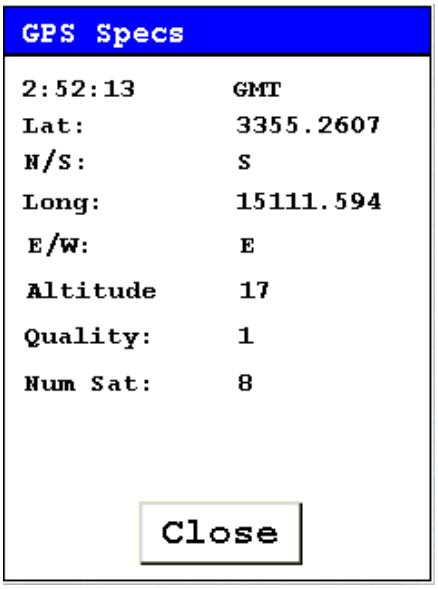


Figure 2-25. Example of GPS Data

Example of GPS Data

- 2:52:13 GMT - Greenwich Mean Time obtained from the GPS satellites.
- Lat: 3355.2607 -Latitude coordinate of current location. This should be read as:
  - All digits to the right of the decimal point are seconds.
  - First two digits to the left of the decimal point are minutes.

    - The next two or three digits to the left of the decimal point are degrees.
    - Thus 3355.2607 is read 33 degrees 55 minutes 26.07 seconds.
- N/S: S - Compass direction of Latitude.
- Long: 15111.594 - Longitude coordinate of current location.
    - All digits to the right of the decimal point are seconds.
    - First two digits to the left of the decimal point are minutes.
    - The next two or three digits to the left of the decimal point are degrees.
    - Thus 15111.594 is read 151 degrees 11 minutes 59.4 seconds.
- W/E: E - Compass direction of Longitude.
- Altitude: 17 - Height above sea level in meters.
- Quality: 1 - Quality of signal strength.
- Num Sat: 8 - Number of satellites signals being received by GPS. This number varies depending on your position, the current position of the satellites, and the signal strength.

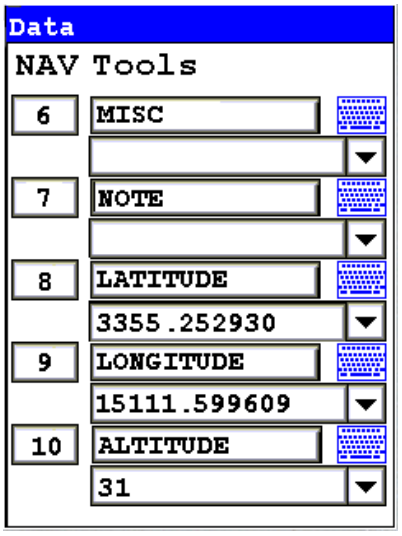


Figure 2-26. GPS Data Integrated Into Reading Data

GPS Options

The communication system standard required for compatibility is NMEA0182 ver. 3.0, using GPGGA, GPGSA, GPRMC, and GPGSV formats. This type of GPS is most commonly used for motor and marine directional mapping systems.

Tested Units include:

Copilot BTGPS3

http://www.alk.com/copilot/pocketpc.asp

RoyalTek Star111

http://www.royaltek.com/index.php/content/view/98/80/

IOGEAR Bluetooth GPS

http://www.iogear.com/main.php?loc=product&Item=GBGPS201W6

Note These GPS systems have an accuracy of about 10 meters.

Haicom HI-408BT GPS

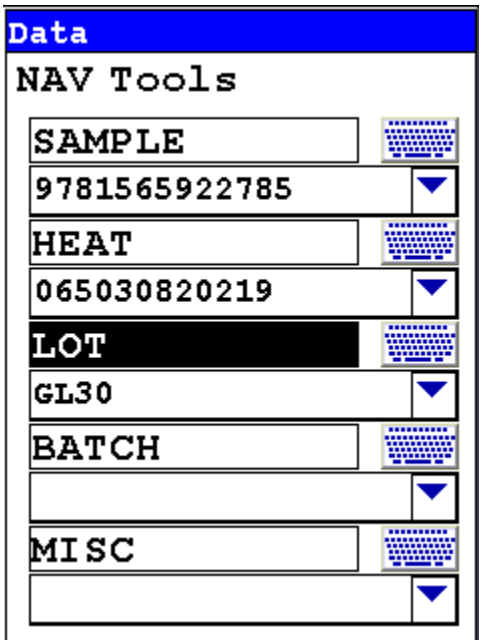
http://www.haicom.com.tw/hi_408bt.aspx

Note Claimed accuracy is 3 meters

Entering Data with a Barcode reader

You can also use Bluetooth barcode readers with your analyzer. Connect your reader to your analyzer in the usual way, see See Chapter 2 page 11 for details. Once the reader is connected, you can use it to input data into your analyzer.

- On the data entry screen, highlight the desired field.
- While pressing the button on the Barcode Pencil, swipe the desired barcode. If the pencil successfully reads the barcode, it will beep.
- The barcoded data will show up in the data field after the beep. There is a short delay while the information is being transmitted
- You may also use the Virtual Keyboard Screen to enter barcoded data.



You can replace, append or clear any field with a custom barcode:

- R05TEXT replaces field 5 with the TEXT
- A05C – appends field 5 with the letter C
- C05 – clears field 5
- C00 – clears all fields

Supported Barcode Readers

At the time of publication, supported readers include:

- The Baracoda Barcode Pencil

The Baracoda Barcode Pencil supports these barcodes for use with the XL3 system.

- Code 96
- Code 128/EAN 128
- EAN13/UPCA
- UPCE/EAN8
- Code 39
- Codabar
- Interleaved 2 of 5
- Standard 2 of 5
- Code 11
- MSI RSS14
- RS Limited

Consult your Baracoda Pencil Users Manual for more information and information on successful barcoding.

Setting Up and Using the USB port

The USB port is the narrow inverted trapezoidal port on the back of your XL3 Analyzer. You can use this port, along with the supplied cable, to communicate with your analyzer.

Figure 2-27. Location of Mini-USB port

Insert the smaller end of your USB cable into the Mini-USB port on the back of your XL3, and the larger end into any USB port on your computer.

When you turn your analyzer on after it is connected, or if you connect it while the analyzer is on, a "Found New Hardware" Wizard will open, as in Figure 2-28.

Figure 2-28. Found New Hardware Wizard

Note If, after installation, you plug your USB cable into a different USB port on your computer, you will get this Wizard again.

The Installation Wizard

Place the installation CD in the drive, select "No, not this time" then select "Next." The Wizard will now ask you what you want it to do, as in Figure 2-29. Select "Install the software automatically."

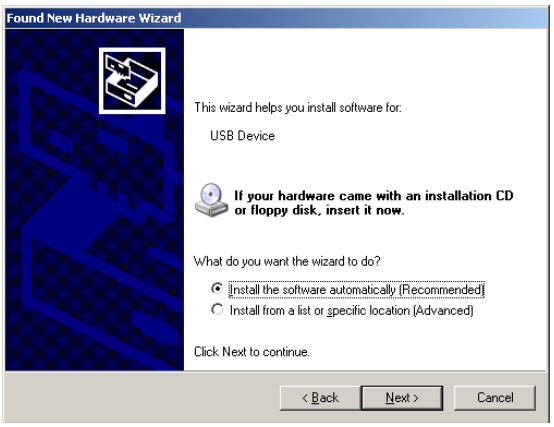


Figure 2-29. Wizard Choice

The Wizard will now search the CD for the proper software, as in Figure 2-30. When the Hardware Installation window comes up stating that the software has not passed XP logo certification, don't worry. The driver is from Microsoft. Select "Continue Anyway."

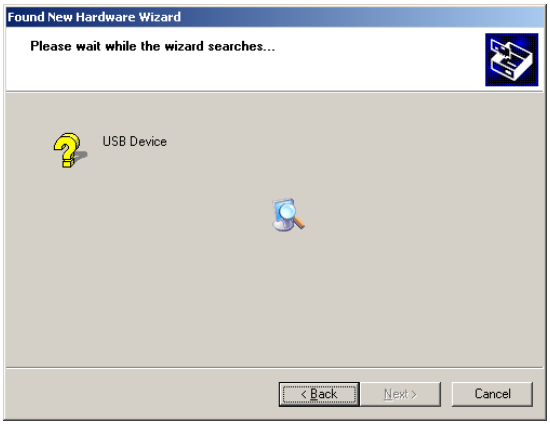


Figure 2-30. Installation Wizard Search

The Wizard will now install the software. This may take several minutes. At the end of this process, you will see the final Wizard screen, as in Figure 2-31, informing you the process is complete. Select "Finish."

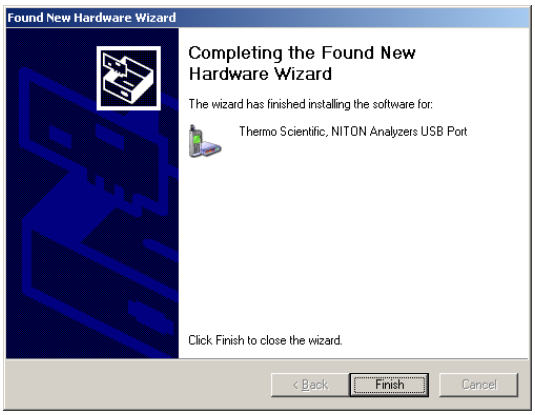


Figure 2-31. Final Installation Wizard Screen

The driver will install as the next free COM device - for example, if you have devices installed as COM1 through COM 5, the driver will install as COM 6. You can find how the software has been installed by starting up NDTr and selecting Settings. The Connect Using box shows you to which Comm port you are using - as in Figure 2-32.

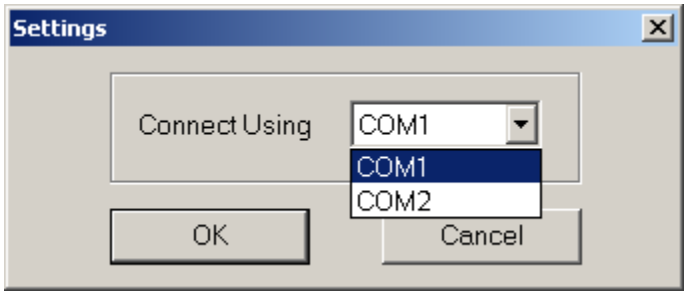


Figure 2-32. The Settings Pop-up Window

Chapter 3 Radiation and General Safety

This chapter covers topics related to radiation safety and general safety when using a Thermo Scientific NITON XL3t analyzer. At a minimum all operators of the XL3t should be familiar with the instructions provided in this chapter in order to handle the XL3t in a safe manner. In addition to reading the information presented on the following pages, Thermo Fisher Scientific recommends that instrument users participate in a radiation safety and operational training class.

WARNING! Always treat radiation with respect. Do not hold your analyzer near the measurement window during testing. Never point your analyzer at yourself or anyone else when the shutter is open. ♦

Radiation and General Safety

This chapter covers topics related to radiation safety and general safety when using a Thermo Scientific NITON XL3t analyzer. At a minimum all operators of the XL3t should be familiar with the instructions provided in this chapter in order to handle the XL3t in a safe manner. In addition to reading the information presented on the following pages, Thermo Fisher Scientific recommends that instrument users participate in a radiation safety and operational training class.

Radiation Protection Basics

The NITON Model XL3t analyzer contains an x-ray tube which emits radiation only when the user turns the x-ray tube on. When the x-ray tube is on and the shutter is open, as during a measurement, the analyzer emits a directed radiation beam (See Figures 0-6 and 0-7). Reasonable effort should be made to maintain exposures to radiation as far below dose limits as is practical. This is known as the ALARA (As Low as Reasonably Achievable) principle. For any given source of radiation, three factors will help minimize your radiation exposure: Time, Distance, and Shielding.

Time

The longer you are exposed to a source of radiation the longer the radiation is able to interact in your body and the greater the dose you receive. Dose increases in direct proportion to length of exposure.

Distance

The closer you are to a source of radiation, the more radiation strikes you. Based on geometry alone, dose increases and decreases with an inverse-squared relation to your distance from the source of radiation (additional dose rate reduction comes from air attenuation). For example, the radiation dose one foot from a source is nine times greater than the dose three feet from the source. Remember to keep your hands and all body parts away from the front end of the analyzer when the shutter is open to minimize your exposure.

Shielding

Shielding is any material that is placed between you and the radiation source. The more material between you and the source, or the denser the material, the less you will be exposed to that radiation. Supplied or optional test stands are an additional source of shielding for analysis. A backscatter shield accessory is also available and may be appropriate in some applications.

Exposure to Radiation

Human dose to radiation is typically measured in rem, or in one-thousandths of a rem, called millirem (mrem), 1 rem = 1000 mrem. Another unit of dose is the Sievert (Sv), 1 Sv = 100 rem. The allowable limit for occupational exposure in the U.S (and many countries internationally) is 5,000 mrem/year (50 mSv/year) for deep (penetrating) dose and 50,000 mrem/year (500 mSv/year) for shallow (i.e., skin) dose or dose to extremities. Deep, shallow, and extremity exposure from a properly used NITON XL3t analyzer should be less than 200 mrem per year, (2.0 mSv per year) even if the analyzer is used as much as 2,000 hours per year, with the shutter open continuously. The only anticipated exceptions to the 200 mrem maximum annual dose are: 1) routine and frequent analysis of plastic samples without use of a test stand, backscatter shield, or similar additional protective measures, or 2) improper use where a part of the body is in the primary beam path. NEVER OPERATE THE DEVICE WITH A PART OF YOUR BODY IN THE PRIMARY BEAM PATH OR WITH THE PRIMARY BEAM PATH DIRECTED AT ANYONE ELSE. Also, consider the use of protective accessories such as a shielded test stand or backscatter shield (or equivalent) when performing routine and/or frequent analysis of any of the following:

- plastic (or similarly low density) samples,
- thin samples (such as foils, circuit boards, and wires), or
- samples that are smaller than the analysis window.

Shown in Table 3-1 below are the typical background radiation doses received by the average member of the public. The radiation dose limits for radiation workers in the US are also shown in Table 3-2.

Table 3-1. Typical Radiation Doses Received (Source: NCRP 1987)

Category	Dose in mrem	Dose in mSv
Average total dose in US (annual)	360	3.6
Average worker exposure (annual)	210	2.1
Average exposure for an underground miner	400	4.0
Exposure for airline crew (1,000 hours at 35,000 ft)	500	5.0
Additional from living in Denver at 5300' (annual)	25	.25
Additional from 4 pCi/l radon in home	1,000	10.0
Typical Chest X-Ray	6	0.06
Typical Head or Neck X-Ray	20	0.2
Typical pelvis/hip x-ray	65	0.65
Typical lumbar spine x-ray	30	0.3
Typical Upper G.I. x-ray	245	2.45
Typical Barium enema x-ray	405	4.05
Typical CAT scan	110	1.10

Table 3-2. Annual Occupational Dose Limits for Radiation Workers (Source: Code of Federal regulations Title 10, Part 20)

Category	Dose in mrem	Dose in mSv
Whole Body	5000	50
Pregnant Worker (during gestation period)	500	5
Eye Dose Equivalent	15,000	150
Shallow dose equivalent to the skin or any extremity or organ	50,000	500
Maximum allowable dose for the general public (annual)	100	1.0
For a Minor	500	5.0

Monitoring your radiation exposure

Individuals can be monitored for the radiation dose they receive by use of radiation dosimetry devices (dosimeters). Monitoring dose using a dosimeter can be a way of identifying improper use and at the same time demonstrating proper use. In some locations, dosimetry is required by regulations and in others it is optional. It is normally required when the user could reasonably be expected to receive in excess of 10% of the annual dose limit. Thermo Fisher Scientific recommends that you determine and obey the local regulatory requirements concerning radiation monitoring of occupational workers.

Two common types of dosimeters are whole-body badges and ring badges. Whole body badges are often attached to the user's torso (e.g., clipped to the collar, shirt pocket, or waist as appropriate). A ring badge is worn on the finger as a measure of maximum extremity dose. When worn, the specific location of the dosimeter should be that part of the body that is expected to receive the highest dose. This location will depend on how the analyzer is used and so it may not be the same for all users. Dosimetry services are offered by many companies. Two companies offering dosimetry services in the USA and much of the world are:

Global Dosimetry Solutions

2652 McGaw Avenue

Irvine, CA 92614

www.dosimetry.com

(800) 251-3331

Landauer, Inc.

2 Science Road

Glenwood, IL 60425-9979

www.landauerinc.com

(800) 323-8830

Note Wearing a dosimeter badge does not protect you against radiation exposure. A dosimeter badge only measures your exposure (at the dosimeter location). ♦

Pregnancy and Radiation Exposure

International guidance documents (e.g., ICRP Publication 60 and NCRP Publication 116*) recommend that the radiation dose to the embryo/fetus of a pregnant woman should not exceed a total of 500 mrem (10% of normal radiation worker limit) during the gestation period. While this dose limit exceeds the dose limit to a trained operator, pregnant workers may want to take special precautions to reduce their exposure to radiation. For more information see the U.S. NRC Regulatory Guide 8.13 "Instruction Concerning Prenatal Radiation Exposure" which can be found on the resource CD.

* The International Commission on Radiological Protection, ICRP, is an independent Registered Charity, established to advance for the public benefit the science of radiological protection, in particular by providing recommendations and guidance on all aspects of protection against ionizing radiation.

* The National Council on Radiation Protection and Measurements (NCRP) was chartered by the U.S. Congress in 1964 as the National Council on Radiation Protection and Measurements.

How to Use the NITON XL3t Analyzer Safely

The NITON XL3t analyzer is designed to be safe to operate provided that it is used in accordance with manufacturers' instructions. Under conditions of normal use, monitored operators seldom receive a measurable dose and have not been known to receive in excess of 10% of the annual occupational dose limits (a criteria that would require monitoring under regulation in the U.S.). In addition to proper use of the XL3t, it is recommended that you follow these precautions to ensure your safety and the safety of those around you.

Know where the beam is

The primary beam is a directed beam out of the front of the analyzer that can have high dose rates. The secondary beam, or scattered beam, has much lower dose rates.

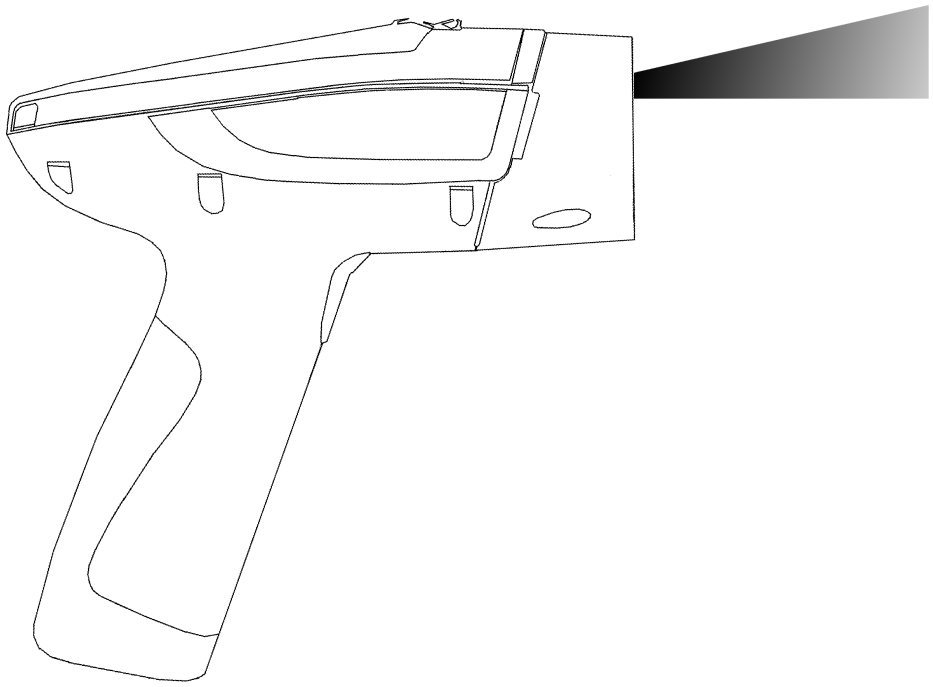


Figure 3-1. . Primary Beam

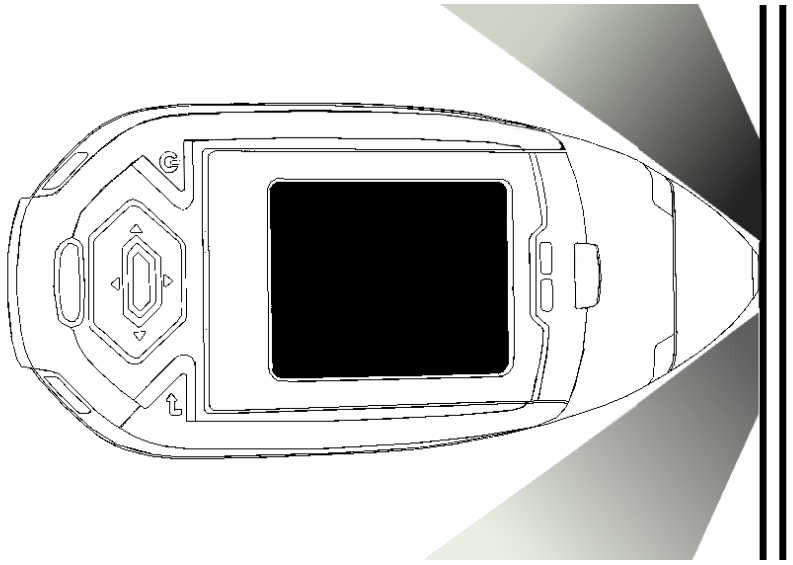


Figure 3-2. Secondary (Scattered) Beam

The Shutter-Open Indicator Lights

When the lights are flashing, the primary beam is on, the shutter is open, and radiation is being emitted from the front of the analyzer. (This does not include the brief flash of the lights when first turning the analyzer on.)

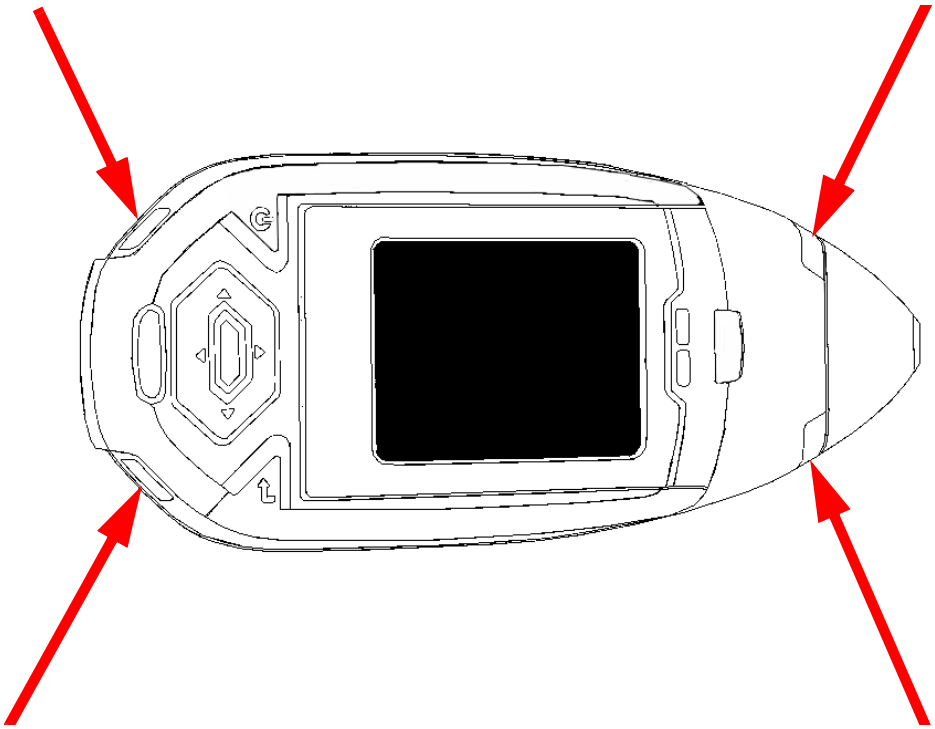


Figure 3-3. X-ray BeamThe Shutter Open Indicator Lights

Handle and Use with Respect

Avoid holding the front of the analyzer when the x-ray tube is energized and the shutter is open. Never point the instrument at yourself or anyone else when the shutter is open and the x-ray tube is energized. Never look into the path of the primary beam.

Follow a Radiation Protection Program

Your organization should establish, document, and follow a Radiation Protection Program. An example of such a program can be found on the resource CD (provided with the instrument).

Take Proper Care of your NITON XL3t Analyzer

Keeping your analyzer maintained in good condition will help minimize the risk of accidental exposure. Mechanical malfunction of the shutter can be avoided by maintaining the measurement window, as described in the User Guide. This prevents foreign objects from entering your XL3t.

Avoid Over-Exposures

Direct contact with the window could result in overexposures in the times indicated in Table 0-4 below.

Table 3-3. Potential Exposure Limit Times

Location of Dose	Limit	Time to Reach Limit
Deep Dose / Whole Body	5 rem (50 mSv)	2.1 minutes
Shallow Dose / Extremities	50 rem (500 mSv)	0.95 minutes
Member of Public (i.e. untrained operator)	0.1 to 5 rem (1 to 50 mSv)	2.5 to 9.5 seconds

Extremity is defined by the NRC as the hand, elbow, arm below the elbow, foot, knee, or leg below the knee. Whole Body is defined by the NRC as the head, trunk (including male gonads), arms above the elbow, or legs above the knee.

Safe Handling of Samples

As mentioned many times in this chapter, never place any part of your body in the path of the x-ray beam. There is always a safe way to handle samples whether they are small, irregularly shaped, or of low density. Never look into the path of the primary beam.

Small Samples

A small sample would be any sample that is smaller than the measurement window. Small samples present a unique risk because they don't block the entire beam path. The difficulty with placing small samples down on a work surface to analyze them is that you may get readings from the work surface that interfere with analytical results. A test stand is an effective way of analyzing small samples accurately and safely. Never hold samples during analysis or look into the path of the primary beam.

Irregularly Shaped Samples

Irregularly shaped samples may not allow the proximity button to be depressed, or they may not entirely cover the primary beam and cause additional scattering. A back scatter shield is a safe way of reducing your radiation exposure while effectively analyzing an irregularly shaped sample.

Low Density Materials (such as plastics)

X-rays are attenuated more through denser materials and less through low density materials such as plastic. This causes higher dose rates in the scattered radiation. If you are frequently handling low density samples, you should consider the use of test stands, backscatter shields, or the equivalent.

Radiation Profile

Table 3-4, Table 3-5, Table 3-6 and Table 3-7 below describes the external radiation dose rates that are present at various points in space around the NITON XL3t analyzer when it is being used. Figure 3-4 illustrates where these dose rate points are relative to the analyzer.

Table 3-4. Primary Beam Dose Rates in mSv/hr

Max Power Settings	Max Power Settings		Window Contact Deep	Window Contact Shallow	5 cm Deep	30 cm Deep
kVp	µA	Max in Following Modes* (Filter)	(mSv/hr)	(mSv/hr)	(mSv/hr)	(mSv/hr)
40	50	G, D, E, A, P, F, M, J (Main Filter)	1,410	1,410	50.00	6.3
40	50	B (Main Filter)	750	2,250	40.00	5.4
50	40	H (Main Filter), D, E, M, J (High Filter)	1,090	4,060	84.0	12.2
20	100	D, H, E, M, J (Low Filter)	1,450	31,717	5.2	0.5
15	100	A, B (Low Filter)	133	10,567	4.3	0.42

Table 3-5. Primary Beam Dose Rates in Rem/hr

Max Power Settings	Max Power Settings		Window Contact Deep	Window Contact Shallow	5 cm Deep	30 cm Deep
kVp	µA	Max in Following Modes* (Filter)	(Rem/hr)	(Rem/hr)	(Rem/hr)	(Rem/hr)
40	50	G, D, E, A, P, F, M, J (Main Filter)	141	141	5.00	0.63
40	50	B (Main Filter)	75	225	4.00	0.54
50	40	H (Main Filter), D, E, M, J (High Filter)	109	406	8.4	1.22
20	100	D, H, E, M, J (Low Filter)	145	3,171.7	0.52	0.05
15	100	A, B (Low Filter)	13.3	1,056.7	0.43	0.042

* G = Alloy, B = Alloy Electronics, F = Dental Alloy, P = Precious Metals, M = Mining, D = Soil, J = Exploration, A = Lead Paint, E = Thin Sample, H = Plastic

Table 3-6. Secondary (Scatter) Dose Rates (μSv/hr)

kVp	μA	Max in Following Modes* (Filter)	Substrate	Max @ 5cm (μSv/hr) Point A	Max @ 30 cm (μSv/hr) Point A'	Max @ Trigger (μSv/hr) Point B
40	50	G, D, E, A, P, F, M, J (Main Filter)	Aluminum	25	2	0.5
40	50	G, D, E, A, P, F, M, J (Main Filter)	Stainless	16	1.2	0.1
40	50	B (Main Filter)	Aluminum	4	0.4	0.1
40	50	B (Main Filter)	Stainless	1.4	0.1	0.1
50	40	H (Main Filter), D, E, M, J (High Filter)	Plastic	400	35	20
50	40	H (Main Filter), D, E, M, J (High Filter)	Soil	80	4	0.7
20	100	D, H, E, M, J (Low Filter)	Aluminum	0.15	0.1	0.1
20	100	D, H, E, M, J (Low Filter)	Stainless	0.15	0.1	0.1
20	100	D, H, E, M, J (Low Filter)	Plastic	1.3	0.15	0.15
20	100	D, H, E, M, J (Low Filter)	Soil	0.15	0.15	0.15
15	100	A, B (Low Filter)	Aluminum	0.15	0.15	0.15
15	100	A, B (Low Filter)	Stainless	0.15	0.15	0.15

* G = Alloy, B = Alloy Electronics, F = Dental Alloy, P = Precious Metals, M = Mining, D = Soil, J = Exploration, A = Lead Paint, E = Thin Sample, H = Plastic.

Table 3-7. Secondary (Scatter) Dose Rates (mRem/hr)

kVp	uA	Max in Following Modes* (Filter)	Substrate	Max @ 5cm (mRem/hr) Point A	Max @ 30 cm (mRem/hr) Point A'	Max @ Trigger (mRem/hr) Point B
40	50	G, D, E, H, A, P, F, M, J (Main Filter)	Aluminum	2.5	0.2	0.05
40	50	G, D, E, H, A, P, F, M, J (Main Filter)	Stainless	1.6	0.12	0.01
40	50	B (Main Filter)	Aluminum	0.4	0.04	0.01
40	50	B (Main Filter)	Stainless	0.14	0.01	0.01
50	40	H (Main Filter), D, E, M, S, J (High Filter)	Plastic	40	3.5	2
50	40	H (Main Filter), D, E, M, S, J (High Filter)	Soil	8	0.4	0.7
20	100	D, H, E, M, S, J (Low Filter)	Aluminum	0.015	0.01	0.01
20	100	D, H, E, M, S, J (Low Filter)	Stainless	0.015	0.01	0.01
20	100	D, H, E, M, S, J (Low Filter)	Plastic	0.13	0.015	0.015
20	100	D, H, E, M, S, J (Low Filter)	Soil	0.015	0.015	0.015
15	100	A, B (Low Filter)	Aluminum	0.015	0.015	0.015
15	100	A, B (Low Filter)	Stainless	0.015	0.015	0.015

* G = Alloy, B = Alloy Electronics, F = Dental Alloy, P = Precious Metals, M = Mining, D = Soil, J = Exploration, A = Lead Paint, E = Thin Sample, H = Plastic.

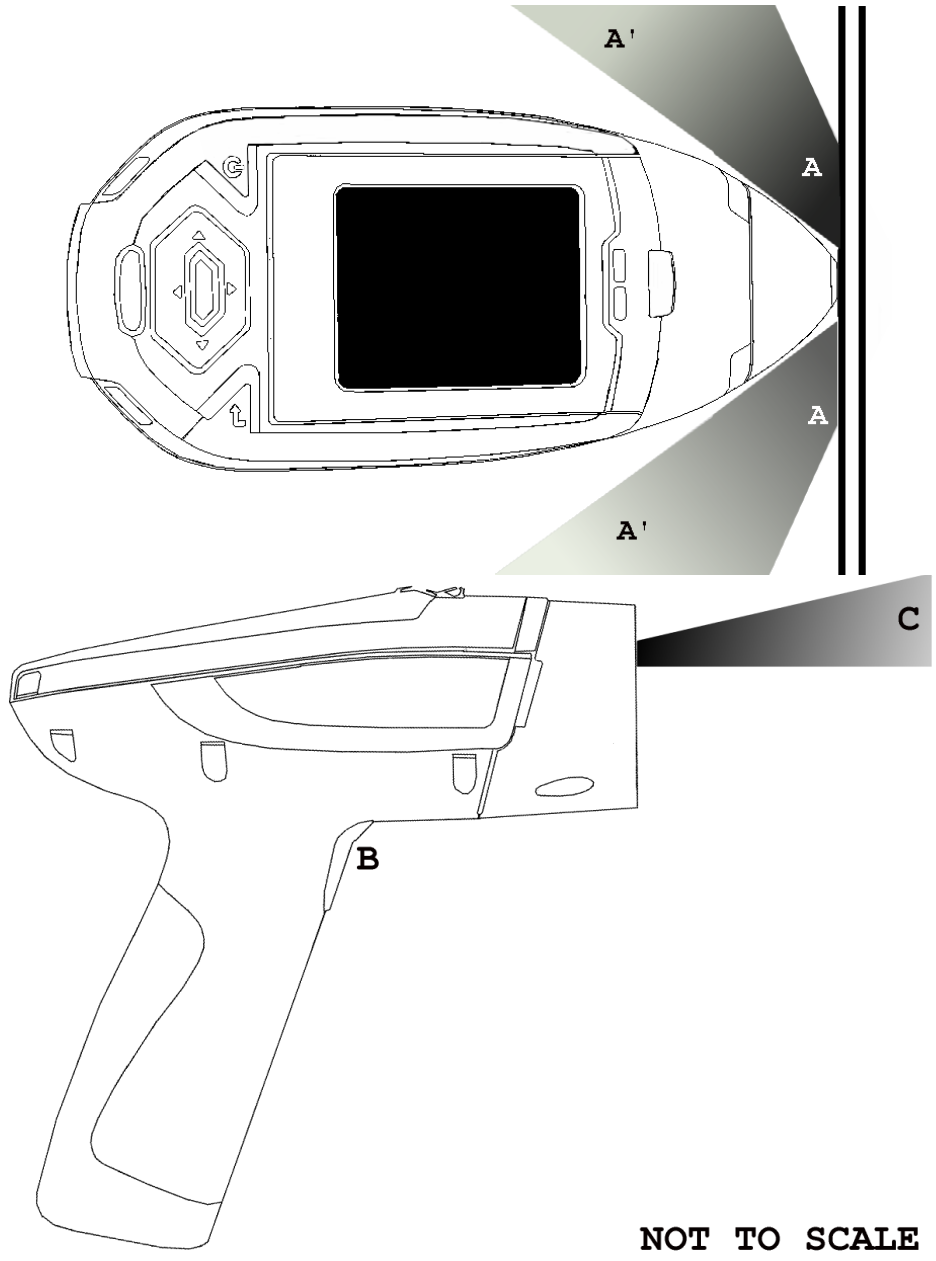


Figure 3-4. Primary & Secondary Dose Rate Locations

Primary Radiation

Primary radiation is radiation that is produced by the analyzer and emitted out through the kapton measurement window. Individuals should never place any part of their body in the primary beam path when the x-ray tube is on. There should always be a sample in contact with the measurement window when the x-ray tube is on. The sample will absorb most of the primary-beam radiation unless it is smaller than the instrument's

measurement window or of low density and/or thickness. Caution should be taken when analyzing samples that are small, thin, and/or low in density as they may allow much more of the primary beam to escape. In-beam primary radiation dose rates are listed in Table 3-4 and Table 3-5 and their location identified relative to the analyzer in Figure 3-4 as Dose Point C.

Secondary Radiation

Under conditions of normal and proper use, individuals can be exposed to secondary (or "scattered") radiation. Secondary radiation is low-level radiation that emanates from the sample being analyzed as a result of primary beam radiation scattering in the sample or primary beam radiation inducing fluorescent x-rays in the sample. Dose points A, A' and B in Figure 3-4 are examples of where you can encounter secondary radiation. The magnitude of this secondary radiation is sample dependent. Higher density samples such as steel will emit the lowest levels as they absorb most primary and secondary radiations. Lower density samples such as aluminum, wood, and especially plastic, will produce higher levels of secondary radiation. Secondary radiation dose rates are listed in Table 3-6 and Table 3-7 for a few common sample types over a wide range of densities.

The operator is reminded that one should never hold samples during analysis, doing so will result in higher than necessary exposure to secondary radiation and could expose the operator directly to the much higher primary-beam dose rates.

Deep and Shallow Dose

You will find in Table 3-4 and Table 3-5 that shallow dose rates are listed for some dose points. All dose rates listed in Table 3-4 and Table 3-5 are deep dose unless they are specifically identified as shallow dose. Deep dose is dose from penetrating radiation that is delivered to both skin and underlying tissues and organs and is the type most commonly referred to when describing external radiation hazards. Occupational deep dose is limited to a maximum of 5 rem (50 mSv) per year in the United States and most countries internationally. Deep dose is measured at 1.0 cm below the skin surface.

Shallow dose is often referred to as "skin dose" because it is a result of low penetrating radiation that only interacts with the skin. Shallow dose is limited to a maximum of 50 rem (500 mSv) per year in the United States and most countries internationally. Shallow dose is listed below for primary in-beam dose points only because the low penetrating radiation that causes shallow dose is nearly all absorbed by a sample and does not produce any significant secondary radiation. Shallow dose is measured at a point 0.007 cm below the surface.

Storage & Transportation

Storage

Regulations in nearly all locations will require that you store your analyzer locked in a secured area to prevent access, use, and/or removal by unauthorized individuals. Storage requirements will vary by location, particularly with regard to storage at temporary job sites or away from your primary storage location such as hotels and motels and in vehicles. You should contact your local Radiation Control Authority to identify the specific storage requirements in your jurisdiction.

Transportation

There are no specific US Department of Transportation (DOT) or International Air Transport Association (IATA) radiation regulations regarding shipping the NITON XL3t analyzer. It is recommended that you ship the XL3t in its carrying case and an over-pack to protect the sensitive measuring equipment inside the analyzer.

Do NOT ship the analyzer with the battery pack connected to the analyzer.

EMERGENCY PROCEDURES

THIS PAGE CONTAINS EMERGENCY CONTACT INFORMATION THAT SHOULD BE AVAILABLE TO THE OPERATOR AT ALL TIMES.

Lost or Stolen Instrument

If the NITON XL3t analyzer is lost or stolen, notify your Radiation Safety Officer (RSO) or the equivalent responsible individual at your company or institution immediately. Your company's RSO, as well as other important emergency contacts, are listed below. Your company RSO may need to notify the x-ray tube regulatory authority and the local police. It is also recommended that a notification is made to Thermo Fisher Scientific.

Damaged Instrument

Minor Damage

If the instrument is intact but there is indication of an unsafe condition such as a cracked case, a shutter mechanism failure, or the lights remain flashing after a measurement is terminated, follow these steps:

1. **Stop using the instrument**

2. **Remove the battery, the x-ray tube can not produce radiation when the battery is disconnected. The instrument is now safe to handle.**

3. **Place the instrument securely in the holster**

4. **Place the instrument in the carrying case that came with the instrument.**

5. **Notify your Radiation Safety Officer (RSO) or the equivalent responsible individual at your company or institution immediately.**

6. **You or your RSO should call Thermo Fisher Scientific at one of their contact numbers listed below for additional instructions and guidance.**

Major damage

If the instrument is severely damaged:

1. **Perform the same steps as described above for minor damage. There will be no radiation hazard as long as the battery is removed from the instrument.**

2. **Place all components in a plastic bag and contact Thermo Fisher Scientific.**

Emergency Response Information

Please Complete the Following Emergency Response Information and Keep with the Analyzer at All Times

NITON ANALYZER EMERGENCY CONTACT INFORMATION

The Company RSO is:_____

RSO Telephone Number:_____

Regulatory Agency Emergency Number:_____

Local Fire Department:_____

Local or State Police Department:_____

Thermo Fisher Scientific's NITON Analyzer Contact Numbers

Main Number (USA): (800) 875-1578

Additional Radiation Emergency #'s: (978) 790-8269 or (617) 901-3125

Outside the USA - Local NITON Service Center:_____

For assistance with your NITON XL3t analyzer outside the United States, please contact your nearest manufacturer's service center identified below:

Europe

NITON Analyzers Europe

Munich, Germany

Phone: +49 89 3681 380

Fax: +49 89 3681 3830

Email: niton.eur@thermo.com

Asia NITON Analyzers Asia

Hong Kong

Phone: +852 2869-6669

Fax: +852 2869-6665

Email: niton.asia@thermo.com

Registration and Licensing

As a user of a NITON XL3t analyzer, you may be required to register or obtain a license with your local radiation control authority. In the US, if you intend to do work with your XL3t in states other than your own, you may be required to register there as well. Below is a list of commonly asked questions that come up when filling out registration forms.

FAQ

What is the max mA, max kVp, and max power?

Maximum mA is 0.1 mA

Maximum kVp is 50 kVp

Maximum power: 2 watts

What is the accelerator voltage or MeV?

This should be filled out as not applicable N/A as it does not apply to XL3t analyzers.

What is the radioisotope?

There are no radioactive isotopes in XL3t analyzers.

What category is the XL3t?

States differ greatly in their categories; the following is a list of common categories:

- o X-Ray Fluorescence
- o Analytical or Analytical XRF
- o Open Beam or Open Beam Analytical
- o Portable Gauge or Portable XRF
- o Industrial Analytical or Non-Destructive Testing

When selecting the category make sure that you don't select medical or radiographic.

How many tubes are in the XL3t?

One.

What is the analyzer serial number?

The serial number is a 5 digit number located on the yellow sticker on the underside of your analyzer.

What is the tube serial number?

The serial number on the tube is different from the serial number on the analyzer itself. If your jurisdiction asks for this number please call us at 1-800-875-1578 and ask to speak with someone regarding X-Ray tube registrations and we can look this number up for you.

What is the type of X-Ray Processing?

None. XL3t analyzers do not use film.

How often do I need to perform leak tests on the XL3t?

Never. Leak tests are only required for analyzers with radioactive isotopes. XL3t analyzers do not have radioactive isotopes.

Regarding Safety Devices for the Open Beam Configuration:

In the US, you may be required to file for an exemption, "variance letter", with your state if there is a requirement for a safety device that would prevent entry of an extremity into the primary beam. If you need assistance with the exemption letter, you may contact the radiation safety group.

Contact Information

If you have additional questions, please feel free to contact the Radiation Safety Group. If you have questions about regulatory requirements, we recommend that you contact your local radiation control authority. Contact information is listed below.

Thermo Fisher Scientific Contact Information

Radiation Safety Group

By phone: +1 978-670-7460

By fax: +1 978-670-7430

By e-mail: Radsafety.Billerica@thermofisher.com

Radiation Emergency Numbers (Call only if there is a radiation emergency)

Phone: +1 617-901-3125

Phone: +1 978-790-8269

Service Departments

USA Phone:+1 800-875-1578

Fax: +1 978-215-6127

Germany Phone:+49 89 368138-0

Fax:+49 89 368138-30

Hong Kong Phone:+852 2869-6669

Fax:+852 2869-6665

United States Regulatory Authority Contact Information

A list of states and their contacts can be found at the following website:

http://www.hsrd.ornl.gov/nrc/asdirectr.htm

Appendices

Appendix A: X-ray Emission Energies Arranged by Element, by Increasing Atomic Number, in KeV

Table Appendices-1. X-ray Emission Energies Arranged by Element, by Increasing Atomic Number, in KeV

Element	Symbol	Atomic Number	Atomic Weight	Ka1	Kb1	La1	Lb1	Lg1	Ma
magnesium	Mg	12	24.30	1.254	1.30				
aluminum	Al	13	26.48	1.487	1.557				
silicon	Si	14	28.08	1.74	1.84				
phosphorus	P	15	30.97	2.01	2.14				
sulphur	S	16	32.07	2.31	2.46				
chlorine	Cl	17	35.45	2.62	2.82				
argon	Ar	18	39.95	2.96	3.19				
potassium	K	19	39.10	3.3	3.6				
calcium	Ca	20	40.08	3.7	4.0				
scandium	Sc	21	44.96	4.1	4.5				
titanium	Ti	22	47.87	4.5	4.9				
vanadium	V	23	50.94	4.9	5.4				
chromium	Cr	24	52.00	5.4	5.9				
manganese	Mn	25	54.94	5.9	6.5				
iron	Fe	26	55.85	6.4	7.1				
cobalt	Co	27	58.93	6.9	7.6				
nickel	Ni	28	58.69	7.5	8.3				
copper	Cu	29	63.55	8.0	8.9				
zinc	Zn	30	65.41	8.6	9.6				
gallium	Ga	31	69.72	9.2	10.3				
germanium	Ge	32	72.64	9.9	11.0				
arsenic	As	33	74.92	10.5	11.7				
selenium	Se	34	78.96	11.2	12.5				
bromine	Br	35	79.90	11.9	13.3				
krypton	Kr	36	83.80	12.6	14.1				
rubidium	Rb	37	85.47	13.4	15.0				

Table Appendices-1. X-ray Emission Energies Arranged by Element, by Increasing Atomic Number, in KeV

Element	Symbol	Atomic Number	Atomic Weight	Ka1	Kb1	La1	Lb1	Lg1	Ma
strontium	Sr	38	87.62	14.2	15.8				
yttrium	Y	39	88.91	15.0	16.7				
zirconium	Zr	40	91.22	15.8	17.7				
niobium	Nb	41	92.91	16.6	18.6				
molybdenum	Mo	42	95.94	17.5	19.6				
technetium	Tc	43	98.00	18.4	20.6	2.4	2.5	2.8	
ruthenium	Ru	44	101.07	19.3	21.7	2.6	2.6	3.0	
rhodium	Rh	45	102.91	20.2	22.7	2.7	2.8	3.1	
palladium	Pd	46	106.42	21.2	23.8	2.8	3.0	3.3	
silver	Ag	47	107.87	22.2	25.0	3.0	3.2	3.5	
cadmium	Cd	48	112.41	23.2	26.1	3.1	3.3	3.7	
indium	In	49	114.82	24.2	27.3	3.3	3.5	3.9	
tin	Sn	50	118.71	25.3	28.5	3.4	3.7	4.1	
antimony	Sb	51	121.76	26.4	29.7	3.6	3.8	4.3	
tellurium	Te	52	127.60	27.5	31.0	3.8	4.0	4.6	
iodine	I	53	126.90	28.6	32.3	3.9	4.2	4.8	
xenon	Xe	54	131.29	29.8	33.6	4.1	4.4	5.0	
cesium	Cs	55	132.91	31.0	35.0	4.3	4.6	5.3	
barium	Ba	56	137.33	32.2	36.4	4.5	4.8	5.5	
lanthanum	La	57	138.91	33.4	37.8	4.7	5.0	5.8	
cerium	Ce	58	140.12	34.7	39.3	4.8	5.3	6.0	
praseodymium	Pr	59	140.91	36.0	40.7	5.0	5.5	6.3	
neodymium	Nd	60	144.24	37.4	42.3	5.2	5.7	6.6	
promethium	Pm	61	145.00	38.6	44.0	5.4	6.0	6.9	
samarium	Sm	62	150.36	40.1	45.4	5.6	6.2	7.2	
europium	Eu	63	151.96	41.5	47.0	5.8	6.5	7.5	
gadolinium	Gd	64	157.25	43.0	48.7	6.1	6.7	7.8	1.18
terbium	Tb	65	158.92	44.5	50.4	6.3	7.0	8.1	1.24
dysprosium	Dy	66	162.50	46.0	52.2	6.5	7.3	8.4	1.29
holmium	Ho	67	164.93	47.5	53.9	6.7	7.5	8.7	1.34
erbium	Er	68	167.26	49.1	55.7	6.9	7.8	9.1	1.41
thulium	Tm	69	168.93	50.7	57.6	7.2	8.1	9.4	1.46
ytterbium	Yb	70	173.04	52.4	59.4	7.4	8.4	9.8	1.52

Table Appendices-1. X-ray Emission Energies Arranged by Element, by Increasing Atomic Number, in KeV

Element	Symbol	Atomic Number	Atomic Weight	Ka1	Kb1	La1	Lb1	Lg1	Ma
lutetium	Lu	71	174.97	54.1	61.3	7.7	8.7	10.1	1.58
hafnium	Hf	72	178.49	55.8	63.2	7.9	9.0	10.5	1.64
tantalum	Ta	73	180.95	57.5	65.2	8.1	9.3	10.9	1.71
tungsten	W	74	183.84	59.3	67.2	8.4	9.7	11.3	1.77
rhenium	Re	75	186.20	61.1	69.3	8.7	10.0	11.7	1.84
osmium	Os	76	190.23	63.0	71.4	8.9	10.4	12.1	1.91
iridium	Ir	77	192.22	64.9	73.6	9.2	10.7	12.5	1.98
platinum	Pt	78	195.09	66.8	75.7	9.4	11.1	12.9	2.05
gold	Au	79	196.97	68.8	78.0	9.7	11.4	13.4	2.12
mercury	Hg	80	200.59	70.8	80.3	10.0	11.8	13.8	2.19
thallium	Tl	81	204.38	72.9	82.6	10.3	12.2	14.3	2.27
lead	Pb	82	207.20	75.0	85.9	10.5	12.6	14.8	2.34
bismuth	Bi	83	208.98	77.1	87.3	10.8	13.0	15.2	2.42
polonium	Po	84	(209.0)	79.3	89.8	11.1	13.4	15.7	
astatine	At	85	(210.0)	81.5	92.3	11.4	13.9	16.2	
radon	Rn	86	(222.0)			11.7	14.3	16.8	
francium	Fr	87	(223.0)			12.0	14.8	17.3	
radium	Ra	88	(226.0)			12.3	15.2	17.8	
actinium	Ac	89	(227.0)			12.7	15.7	18.4	
thorium	Th	90	232.04			13.0	16.2	19.0	
protactinium	Pa	91	(231.0)			13.3	16.7	19.6	
uranium	U	92	238.03			13.6	17.2	20.2	
neptunium	Np	93	237.00			13.9	17.7	20.8	
plutonium	Pu	94	244.00			14.3	18.3	21.4	

Appendix B: X-ray Emission Energies Arranged Alphabetically by Element, by name

Table Appendices-2. X-ray Emission Energies Arranged Alphabetically by Element, by Name

Element	Symbol	Atomic Number	Atomic Weight	Ka1	Kb1	La1	Lb1	Lg1	Ma
actinium	Ac	89	(227.0)			12.7	15.7	18.4	
aluminum	Al	13	26.48	1.487	1.557				
antimony	Sb	51	121.76	26.4	29.7	3.6	3.8	4.3	
argon	Ar	18	39.95	2.96	3.19				
arsenic	As	33	74.92	10.5	11.7				
astatine	At	85	(210.0)	81.5	92.3	11.4	13.9	16.2	
barium	Ba	56	137.33	32.2	36.4	4.5	4.8	5.5	
bismuth	Bi	83	208.98	77.1	87.3	10.8	13.0	15.2	2.42
bromine	Br	35	79.90	11.9	13.3				
cadmium	Cd	48	112.41	23.2	26.1	3.1	3.3	3.7	
calcium	Ca	20	40.08	3.7	4.0				
cerium	Ce	58	140.12	34.7	39.3	4.8	5.3	6.0	
cesium	Cs	55	132.91	31.0	35.0	4.3	4.6	5.3	
chlorine	Cl	17	35.45	2.62	2.82				
chromium	Cr	24	52.00	5.4	5.9				
cobalt	Co	27	58.93	6.9	7.6				
copper	Cu	29	63.55	8.0	8.9				
dysprosium	Dy	66	162.50	46.0	52.2	6.5	7.3	8.4	1.29
erbium	Er	68	167.26	49.1	55.7	6.9	7.8	9.1	1.41
europium	Eu	63	151.96	41.5	47.0	5.8	6.5	7.5	
francium	Fr	87	(223.0)			12.0	14.8	17.3	
gadolinium	Gd	64	157.25	43.0	48.7	6.1	6.7	7.8	1.18
gallium	Ga	31	69.72	9.2	10.3				
germanium	Ge	32	72.64	9.9	11.0				
gold	Au	79	196.97	68.8	78.0	9.7	11.4	13.4	2.12
hafnium	Hf	72	178.49	55.8	63.2	7.9	9.0	10.5	1.64
holmium	Ho	67	164.93	47.5	53.9	6.7	7.5	8.7	1.34
indium	In	49	114.82	24.2	27.3	3.3	3.5	3.9	
iodine	I	53	126.90	28.6	32.3	3.9	4.2	4.8	
iridium	Ir	77	192.22	64.9	73.6	9.2	10.7	12.5	1.98
iron	Fe	26	55.85	6.4	7.1				
krypton	Kr	36	83.80	12.6	14.1				

Table Appendices-2. X-ray Emission Energies Arranged Alphabetically by Element, by Name

Element	Symbol	Atomic Number	Atomic Weight	Ka1	Kb1	La1	Lb1	Lg1	Ma
lanthanum	La	57	138.91	33.4	37.8	4.7	5.0	5.8	
lead	Pb	82	207.20	75.0	85.9	10.5	12.6	14.8	2.34
lutetium	Lu	71	174.97	54.1	61.3	7.7	8.7	10.1	1.58
magnesium	Mg	12	24.30	1.254	1.30				
manganese	Mn	25	54.94	5.9	6.5				
mercury	Hg	80	200.59	70.8	80.3	10.0	11.8	13.8	2.19
molybdenum	Mo	42	95.94	17.5	19.6				
neodymium	Nd	60	144.24	37.4	42.3	5.2	5.7	6.6	
neptunium	Np	93	237.00			13.9	17.7	20.8	
nickel	Ni	28	58.69	7.5	8.3				
niobium	Nb	41	92.91	16.6	18.6				
osmium	Os	76	190.23	63.0	71.4	8.9	10.4	12.1	1.91
palladium	Pd	46	106.42	21.2	23.8	2.8	3.0	3.3	
phosphorus	P	15	30.97	2.01	2.14				
platinum	Pt	78	195.09	66.8	75.7	9.4	11.1	12.9	2.05
plutonium	Pu	94	244.00			14.3	18.3	21.4	
polonium	Po	84	(209.0)	79.3	89.8	11.1	13.4	15.7	
potassium	K	19	39.10	3.3	3.6				
praseodymium	Pr	59	140.91	36.0	40.7	5.0	5.5	6.3	
promethium	Pm	61	145.00	38.6	44.0	5.4	6.0	6.9	
protactinium	Pa	91	(231.0)			13.3	16.7	19.6	
radium	Ra	88	(226.0)			12.3	15.2	17.8	
radon	Rn	86	(222.0)			11.7	14.3	16.8	
rhenium	Re	75	186.20	61.1	69.3	8.7	10.0	11.7	1.84
rhodium	Rh	45	102.91	20.2	22.7	2.7	2.8	3.1	
rubidium	Rb	37	85.47	13.4	15.0				
ruthenium	Ru	44	101.07	19.3	21.7	2.6	2.6	3.0	
samarium	Sm	62	150.36	40.1	45.4	5.6	6.2	7.2	
scandium	Sc	21	44.96	4.1	4.5				
selenium	Se	34	78.96	11.2	12.5				
silicon	Si	14	28.08	1.74	1.84				
silver	Ag	47	107.87	22.2	25.0	3.0	3.2	3.5	
strontium	Sr	38	87.62	14.2	15.8				

Table Appendices-2. X-ray Emission Energies Arranged Alphabetically by Element, by Name

Element	Symbol	Atomic Number	Atomic Weight	Ka1	Kb1	La1	Lb1	Lg1	Ma
sulphur	S	16	32.07	2.31	2.46				
tantalum	Ta	73	180.95	57.5	65.2	8.1	9.3	10.9	1.71
technetium	Tc	43	98.00	18.4	20.6	2.4	2.5	2.8	
tellurium	Te	52	127.60	27.5	31.0	3.8	4.0	4.6	
terbium	Tb	65	158.92	44.5	50.4	6.3	7.0	8.1	1.24
thallium	Tl	81	204.38	72.9	82.6	10.3	12.2	14.3	2.27
thorium	Th	90	232.04			13.0	16.2	19.0	
thulium	Tm	69	168.93	50.7	57.6	7.2	8.1	9.4	1.46
tin	Sn	50	118.71	25.3	28.5	3.4	3.7	4.1	
titanium	Ti	22	47.87	4.5	4.9				
tungsten	W	74	183.84	59.3	67.2	8.4	9.7	11.3	1.77
uranium	U	92	238.03			13.6	17.2	20.2	
vanadium	V	23	50.94	4.9	5.4				
xenon	Xe	54	131.29	29.8	33.6	4.1	4.4	5.0	
ytterbium	Yb	70	173.04	52.4	59.4	7.4	8.4	9.8	1.52
yttrium	Y	39	88.91	15.0	16.7				
zinc	Zn	30	65.41	8.6	9.6				
zirconium	Zr	40	91.22	15.8	17.7				

Appendix C: SpectraView

SpectraView enables you to qualitatively analyze the fluorescent x-rays of most of the elements in the periodic table from potassium (element 19) through plutonium (element 94) in a given sample. For a complete list of elements and their fluorescent x-rays see Appendix A. In SpectraView Mode, the spectrum is displayed in a linear scale, autoscaled logarithmically so that the highest peak on the screen reaches the top of the scale.

How to Use SpectraView

You can access the SpectraView screen after taking a measurement in any mode, or while viewing a previous measurement, by selecting Spectra from the NAV Menu. Once you are in SpectraView, you can use the up and down positions of the 4-way touch pad to scroll through the spectrum, or you can tap on the spectrum display with the stylus to place the cursor at the point you tapped. The vertical cursor line indicates the current position along the spectrum.

Viewing the Information in SpectraView Mode

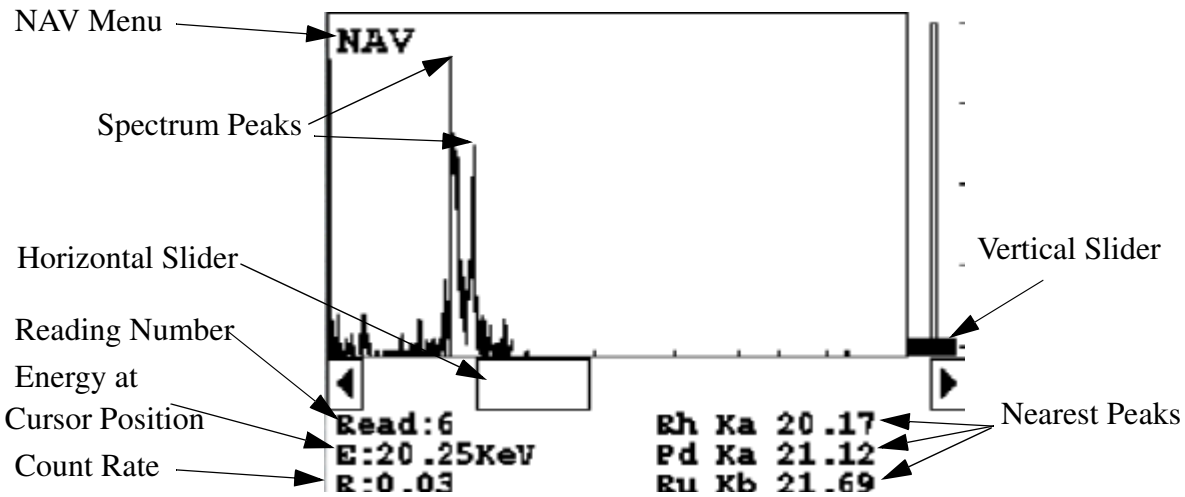


Figure Appendices-1. The SpectraView Screen

By default, the following information is shown along with the spectrum:

The Reading number (Bottom Left) in the form "Read:x", where x is the Reading number.

The position of the cursor on the energy scale (Bottom Left, under the Reading number), in the form "E: x.xx KeV", where KeV is thousands of electron volts.

The **count rate** (Bottom Left, under the energy position), in the form “R:x.xx”.

Ka, **Kb**, **La,** Lb, and/or Lg peaks of the three elements closest to where your cursor is positioned on the energy scale (Bottom Right). This information is written with the element symbol first, followed by either Ka (K shell alpha peak), Kb (K shell beta peak), La (L shell alpha peak), La (L shell beta peak), or Lg (L shell gamma peak). An example would be "Al Ka 1.5." To determine if a given element is present, look at the count rate at that cursor position.

SpectraView cannot be used to determine exact element percentages in a sample.

Multiple Spectra

SpectraView can display the reading spectra from multiple filter settings if your analysis uses more than one filter. Use the NAV Menu to select which spectrum to view.

The “Spectra1” choice will display the display the spectrum produced by excitation with the first filter setting.

The “Spectra2” choice will display the display the spectrum produced by excitation with the second filter setting.

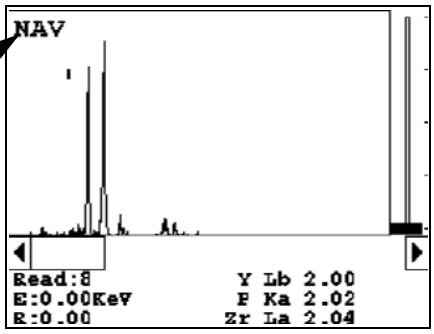
The “Spectra3” choice will display the display the spectrum produced by excitation with the third filter setting.

SpectraView Navigation

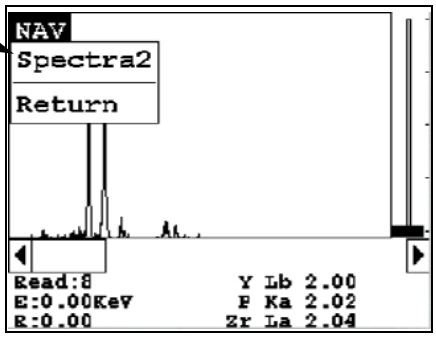
Use the left button on the 4-way touch pad to expand the spectrum, centered on the position of the cursor.

Use the right button on the 4-way touch pad to contract the spectrum, centered on the position of the cursor.

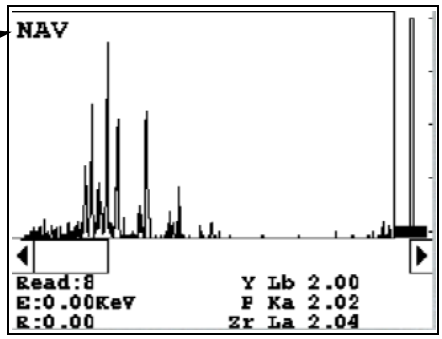
Select NAV to access the NAV Menu while viewing the first source spectrum.



Select Spectra2 to view the second source spectrum



Select NAV to access the NAV Menu.



Select Spectra1 to return to the first source spectrum.

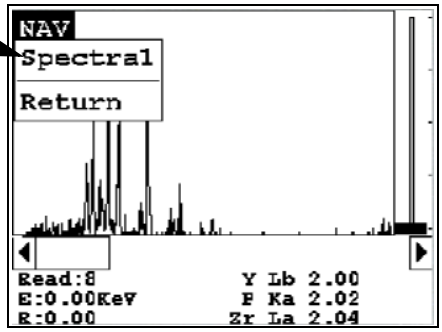


Figure Appendices-2. Viewing Multiple Spectra

Appendix D: Summary of Warnings

WARNING! Do not attempt to use this instrument without first reading and understanding the entire User's Guide! ♦

WARNING! Always treat radiation with respect. Do not hold your instrument near the Kapton window during testing. Never point your instrument at yourself or anyone else when the shutter is open. ♦

WARNING! The preconditions for operation must be continued for the duration of the reading. If the preconditions are violated, the x-ray tube will turn off, the calibration shutter will close, and the measurement will end. The four LED lights will stop blinking when the measurement is ended. The flashing of the LED lights is not synchronized to minimize power consumption. ♦

WARNING! When the four LED lights are blinking, the x-ray tube is on. This should only occur during a measurement, while the preconditions for operation are met. If the LED lights blink at any other time, disconnect the battery pack and call Thermo Scientific's Service Department in the United States, toll free, at (800) 875-1578, or outside the United States, at +1-978-670-7460, or your local Authorized NITON Service Center. ♦

WARNING! Tampering with the 5,500 ppm (lead high) lead-in-soil standard may cause exposure to lead dust. Keep all standards out of the reach of children. ♦

WARNING! Do not attempt to take measurements while downloading readings! This will generate an error requiring a system reset, and may corrupt your stored readings, requiring all stored readings to be erased. ♦

WARNING! Grinding and sifting dried samples produces dust. Even clean soil contains silica, which may be hazardous when airborne. Prepare all samples in a ventilated area; wear a mask, gloves, and an apron; and spread a drop cloth. ♦

WARNING! All Service, except exterior cleaning and Kapton window replacement, must be performed by Thermo Scientific or an Authorized NITON Analyzers Service Center. Do not attempt to make repairs yourself. Opening the case of your NITON will void the analyzer Warranty in its entirety. ♦

WARNING! In the highly unlikely event that the x-ray tube remains on when the trigger is not depressed, disconnect the battery pack immediately to turn off the x-ray tube, and call Thermo Fisher Scientific's Service Department in the United States, toll free, at (800) 875-1578, or outside the United States at +1-978-670-7460, or your local Authorized NITON Analyzers Service Center. ♦

Appendix E: Summary of Cautions

CAUTION NITON Analyzers are not intrinsically safe instruments in regard to sparking. All pertinent Hot Work procedures should be followed in areas of concern. ♦

CAUTION All test equipment must be kept clean to prevent contamination of samples. ♦

CAUTION Never tamper with Test Standards. They should not be used unless they are completely intact. ♦

CAUTION Never turn off the instrument while data is being erased! ♦

CAUTION Do not leave the battery pack connected to the charger for excessive periods of time. Overnight recharging is recommended. ♦

CAUTION Store the instrument and the spare battery packs in a cool place, away from direct sunlight. ♦

CAUTION Always obtain a Return Authorization (RA) number from Thermo Scientific's Service Department in the United States, toll free, at (800) 875-1578, or outside the United States, at +1-978-670-7460 before returning your instrument to the NITON Service Department or local Authorized NITON Analyzers Service Center. ♦

CAUTION Do not store battery packs or charger in direct sunlight. ♦

CAUTION Do not let the battery pack recharge for excessive periods of time. ♦

CAUTION Always transport the unit in its padded carrying case, and store the NITON Analyzer in its case whenever it is not being used. ♦

CAUTION In most cases, no notification is required if transporting within state boundaries. This may not be the case when entering federal properties. ♦

CAUTION Always follow all pertinent local and national regulations and guidelines, wherever your analyzer is transported or used. ♦

CAUTION If you return your NITON instrument without the carrying case, you will void your analyzer's warranty in its entirety. You will be billed for a replacement case plus any repairs resulting from improper shipping. ♦

CAUTION Always remove the battery pack when transporting or storing your instrument. ♦

CAUTION Avoid any vibration, loud noise, strong electronice fields, or other possible interference when your analyzer is calibrating its detector. ♦

CAUTION Within the United States, always keep a copy of the US DOT compliance statement in your NITON analyzer case at all times. A copy is included with your analyzer. ♦

CAUTION Whenever you turn on your NITON Analyzer after it has been off for more than 30 minutes, you should measure your check sample to assure proper operation. If the instrument is not reading properly, you should re-calibrate your NITON Analyzer's sample analysis electronics before you start to take readings. When the instrument is turned on after being off for more than 30 minutes, your NITON analyzer will require a 10 minute warm-up period before the instrument can be calibrated, unless this 10 minute warm-up period is manually overridden.

Appendix F Glossary

Calibration factors numbers, calculated from sample readings, that are used to adjust for consistently high or consistently low readings from the XRF Analyzer

Matrix a substance in which things are embedded or suspended.

In mining, the earthy or stony substance in which metallic ores or crystalized minerals are found (source: Webster's Revised Unabridged Dictionary, via dictionary.com)

Pearson correlation coefficient a dimensionless index that ranges from -1.0 to 1.0 inclusive and reflects the extent of a linear relationship between two data sets.

R^2 the square of the Pearson correlation coefficient.

RMS error root-mean-squared error, the square root of the arithmetic mean of squared deviations from the mean. This number ells you how good your approximation is. The lower the number, the better the approximation.

Appendix F: Warranty

Seller warrants that the Products will operate or perform substantially in conformance with Seller's published specifications and be free from defects in material and workmanship, when subjected to normal, proper and intended usage by properly trained personnel, for the period of time set forth in the product documentation, published specifications or package inserts. If a period of time is not specified in Seller's product documentation, published specifications or package inserts, the warranty period shall be **Two (2) years** from the date of shipment to Buyer in the country of purchase. Seller agrees during the Warranty Period, to repair or replace, at Seller's option, defective Products so as to cause the same to operate in substantial conformance with said published specifications; provided that Buyer shall (a) promptly notify Seller in writing upon the discovery of any defect, which notice shall include the product model and serial number (if applicable) and details of the warranty claim; and (b) after Seller's review, Seller will provide Buyer with service data and/or a Return Material Authorization ("RMA"), which may include biohazard or other Radiation safety decontamination procedures and other product-specific handling instructions, then, if applicable, Buyer may return and receive the defective Products to Seller with all costs of freight and insurance prepaid by Buyer. Replacement parts may be new or refurbished, at the election of Seller, the warranty of these parts expire with the instrument warranty. All replaced parts shall become the property of Seller. Shipment to Buyer of repaired or replacement Products shall be made in accordance with the Delivery provisions of the Seller's Terms and Conditions of Sale. Accessories and Consumables are expressly excluded from this warranty (see list A for details).

Notwithstanding the foregoing, Products supplied by Seller that are obtained by Seller from an original manufacturer or third party supplier are not warranted by Seller, but Seller agrees to assign to Buyer any warranty rights in such Product that Seller may have from the original manufacturer or third party supplier, to the extent such assignment is allowed by such original manufacturer or third party supplier. In no event shall Seller have any obligation to make repairs, replacements or corrections required, in whole or in part, as the result of:

i. normal wear and tear,

ii. accident, disaster or event of force majeure,

iii. misuse, fault or negligence of or by Buyer,

iv. use of the Products in a manner for which they were not designed,

v. causes external to the Products such as, but not limited to, power failure or electrical power surges,

vi. improper storage and handling of the Products,

vii. use of the Products in combination with equipment or software not supplied by Seller,

viii. moderately heavy or excessive impact against any object, including but not limited to floors, walls, furniture, sample or other objects. A shock sensor is fitted inside of the instrumentation; warranty is void if this shock sensor is activated,

ix. excessive water, moisture or condensing humidity that breaches the instrument seals,

x. excessive or extreme ambient or direct temperature or

xi. Heavy vibrations directly to the instrument for extended periods of time.

If Seller determines that Products for which Buyer has requested warranty services are not covered by the warranty hereunder, Buyer shall pay or reimburse Seller for all costs of investigating and responding to such request at Seller's then prevailing time and materials rates. If Seller provides repair services or replacement parts that are not covered by this warranty, Buyer shall pay Seller therefore at Seller's then prevailing time and materials rates.

ANY INSTALLATION, MAINTENANCE, REPAIR, SERVICE, RELOCATION OR ALTERATION TO OR OF, OR OTHER TAMPERING WITH, THE PRODUCTS PERFORMED BY ANY PERSON OR ENTITY OTHER THAN SELLER WITHOUT SELLER'S PRIOR WRITTEN APPROVAL, OR ANY USE OF REPLACEMENT PARTS NOT SUPPLIED BY SELLER, SHALL IMMEDIATELY VOID AND CANCEL ALL WARRANTIES WITH RESPECT TO THE AFFECTED PRODUCTS.

THE OBLIGATIONS CREATED BY THIS WARRANTY STATEMENT TO REPAIR OR REPLACE A DEFECTIVE PRODUCT SHALL BE THE SOLE REMEDY OF BUYER IN THE EVENT OF A DEFECTIVE PRODUCT. EXCEPT AS EXPRESSLY PROVIDED IN THIS WARRANTY STATEMENT, SELLER DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS OR

IMPLIED, ORAL OR WRITTEN, WITH RESPECT TO THE PRODUCTS AND INCLUDING WITHOUT LIMITATION ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS

FOR ANY PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE PRODUCTS ARE ERROR-FREE OR WILL ACCOMPLISH ANY PARTICULAR RESULT.

Accessories, Spares and Consumables - exclusions

(List A)

Specific warranties of some common accessories:

- Battery Charger and batteries - 12 months
- Instrument accessories - 12 months
- Consumable - no warranty
- Soil Grinder - no warranty
- Single-stage or two stage helium tank regulator - 12 months
- Test stands, extend-a-poles and docking stations – 12 months
- Parts or spares sold, installed or supplied outside of the product warranty period and not listed above – 12 months

Thermo Fisher Scientific shall not be liable for delays, deprivation of use, or any other damages, direct or indirect, which may result to the purchaser because of defects in the product or because of the purchaser's inability to operate it or use it to his satisfaction. Thermo Fisher will not be liable to anyone for special or consequential damages of any kind. Thermo Fisher neither assumes nor authorizes any person to assume for it, any other obligation or liability with respect to Thermo Fisher products..

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