12 – Inspector 1000 Topics

SAND2011-2082P
Defense Nuclear Nonproliferation

- Uses
- External Controls/Buttons
- Standard Features
- Specifications
- Operational Checks
- Operations
- Exercise

Use of the Inspector 1000 in Search and Secure

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- When do you use the Inspector 1000?
- When do you use an Inspector 1000 with neutron probe option
- Why and When to use a Sodium-Iodide (NaI) detector?

Use of the Inspector 1000 in Search and Secure

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- Use the Inspector 1000 for:
  - General area or grid survey to identify the presence of gamma activity significantly above background
  - After an observance of activity significantly above background (2 or 3 times), use the Inspector to localize or pinpoint the location of a gamma source (interferences may confuse things)
  - Use to find and secure source and then evaluate
- Use the Inspector 1000 Neutron Option:
  - When a neutron source is suspected
  - The presence of neutrons may indicate
    - Special Nuclear Material (Pu or U)
    - Density Gauges
    - Other Reasons?
- Use a NaI
  - Very efficient for gamma rays (compare background count rates)
  - Most isotopes emit a gamma signature
  - Let the gamma rays and neutrons travel to the inspector first!

Inspector 1000 Control Buttons in Easy Mode

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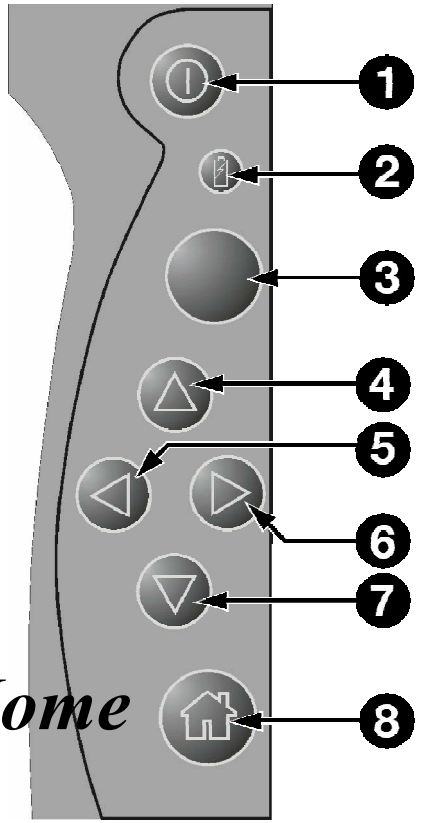

1. *On/Off*
2. *Battery Charge Light (lit while charging and off when fully charged)*
3. **Save/New/Resume/Clear/Stop**
4. *No function*
5. *Slow Data Locate View Rate Display*
6. *Increase the Data Locate View Rate Display*
7. *No function*
8. *Toggles Between Source Locate Display and Nuclide Identification (NID) Display*

Home

Easy Mode Only Provides Locate, NID, and CAL Functions with Dose Rate bar graph on NID Screen

Inspector 1000 Standard Features

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- Powerful field instrument that is fully customizable
- Digital handheld multichannel analyzer (MCA) for isotope identification
- Easy to Use
  - High Resolution Color Touchscreen &/or buttons
  - NaI Probe Stabilized for temperature and light conversion
  - Flexible cord
- Versatile alarming setpoints, for dose, dose rate, and specific nuclide
- Multiple nuclide libraries and analysis options
- USB device interface to the host computer for single point access to all setup screens and data download or transfer
- Automatically recognizes probes and loads operating parameters and any existing calibration

Inspector 1000 Standard Features

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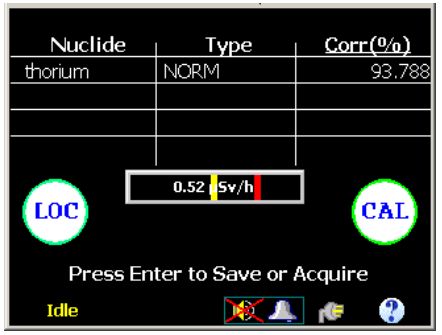
- NID with quantitative results: Calculates the activity of all identified nuclides but only valid for the default geometry of point sources at 25 cm
- Nuclide Identification (NID) associates a nuclide type to each activity such as **Waste, Fission, Natural, NORM, SNM or User-defined**.
- Allows for two independent activity alarm levels per nuclide (setup in nuclide library)
- Performs dose-by-isotope calculations
- User may load in efficiencies for other geometries for automatic calculation and display of activity
- Provides easy access to results
- Can be decontaminated and is spill-proof



Inspector 1000 Standard Features

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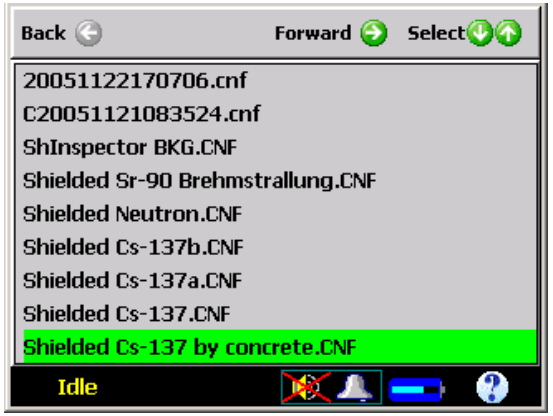
- Full Spectrometry mode available
- Spectral files may be saved automatically
- Date and time stamp data file name format
- User-defined nuclide library (up to 32 nuclide libraries, each isotope can be described by up to 50 lines)
- CAM file format for use in conjunction with the host software (Genie-2000) for data storage and more sophisticated analysis and reporting
- Multi-Language Support
- Microsoft CE compliance
- Optional Neutron Probe
- (Moderated 3He tube)



Inspector 1000 Standard Features

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- For simplicity of operation, menus, sub-menus, functions and parameters may be “hidden” within the instrument (selectable by the host software) to limit access to sensitive operations
- May be setup to target isotopes that are primarily environmental, medical, industrial, military, or other.
- Customize your instrument in the field or at your desk with a host computer
- Use the Inspector 1000 Maintenance Software to lock out access to certain functions

Inspector 1000 Specifications

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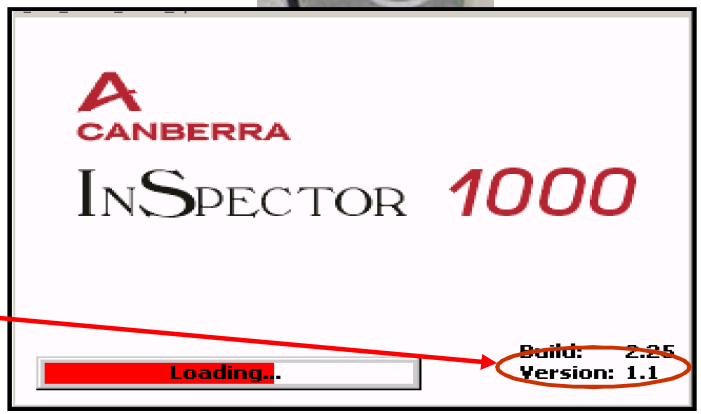
- Dose rate always monitored either by NaI probe or with GM tube in base (0.01 µSv/hr – 10 mSv/hr)
- 50 keV - 3 MeV energy range
- IPROS-2: Stabilized 2” x 2” NaI probe*; 13 000 cps/mrem/h ±3.5%.
- Up to 4096 channels spectrum size
- Storage of > 500 files of 1K spectra in the instrument
- Small, light weight package:
  - Approximately 2.0 kg with 2” x 2” probe
  - -10°C to +50°C operating temperature
  - Re-chargeable Li-ion battery lasts years
  - Approximately 9 hour useful battery life between charges

Operational Checks

- PUSH the POWER button to power ON
  - To turn the unit OFF, hold down the power button for a few seconds. Release when software Unload screen appears (similar to Load screen)
- When the InSpector 1000 boots-up, the internal version is displayed
- Be patient. The start-up will take a little time
- Current version is 1.4



Operational Checks

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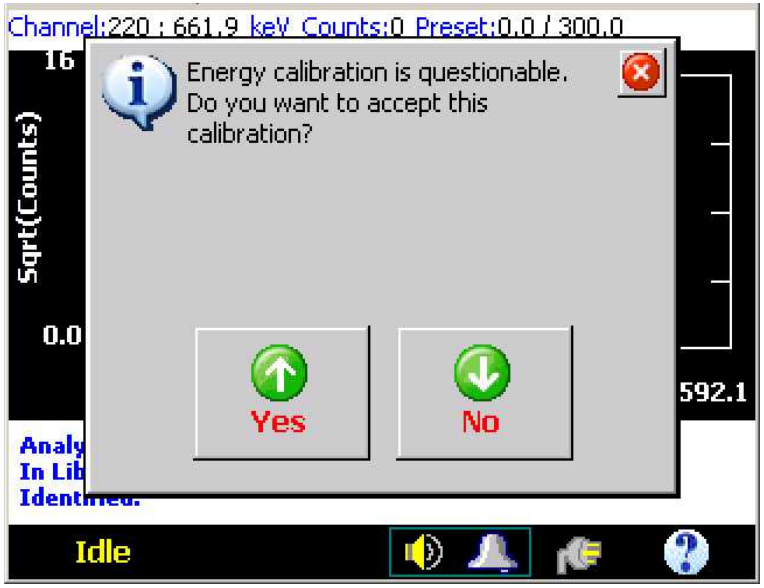
- The startup cycle takes about 30 seconds
- Probe may be hot plugged
- The message “No Probe” will be displayed until full communication with the probe is established



- Energy Calibration warning issued if wrong or new probe attached.
- Choose “Yes” and then perform energy calibration

Operational Checks

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- Additional start-up time is needed to stabilize the probe
- Takes about 1 minute to stabilize the probe
- Blue Light Emitting Diode (LED) at back of the probe is blinking during stabilization
- LED is steady blue when stabilized

Operational Checks

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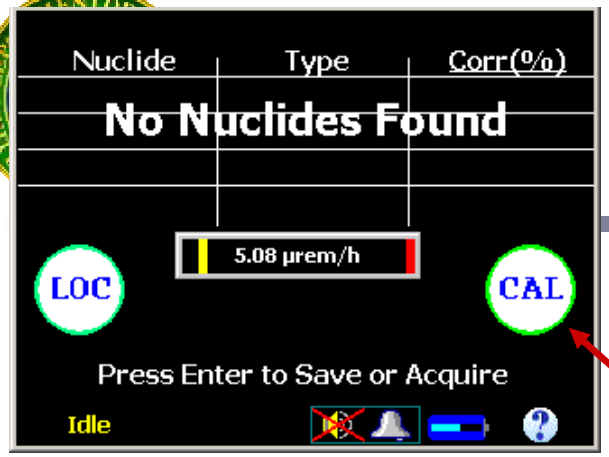
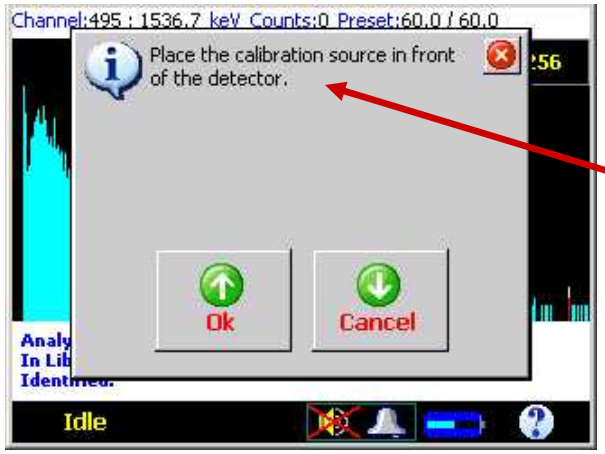
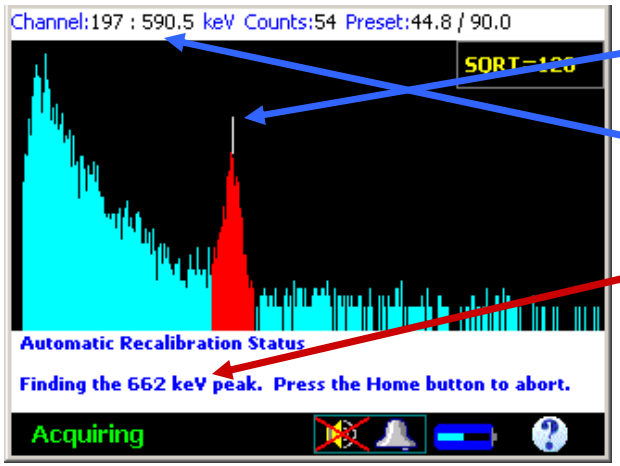


- At a minumum, energy calibration should be performed quarterly or any time it has drifted 5-10 keV or cannot identify a known Cs-137 or other known source.
- To calibrate in easy mode, select the CAL button from the NID page and follow the on screen instructions

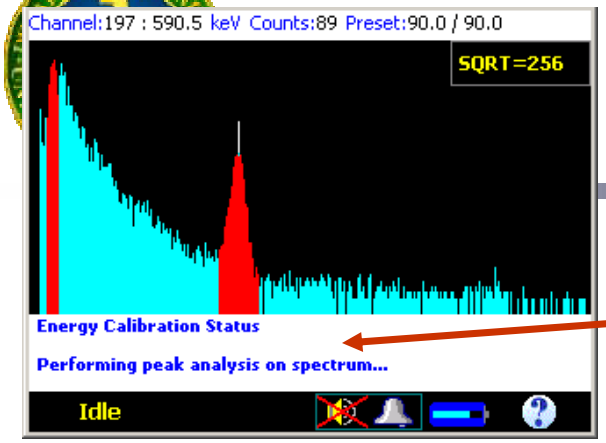


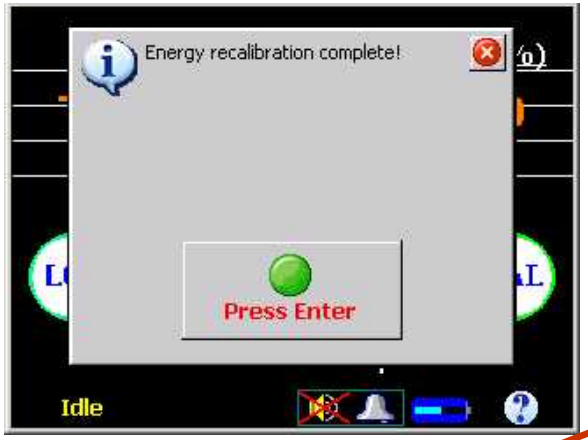
- Cs-137 must be used for the calibration unless a different source energy is designated in the Inspector 1000 Setup (Home + Enter => Spec Setup=>Page 3)
- Cs-137 emits a 662 keV energy line which is a good midpoint energy for typical spectra

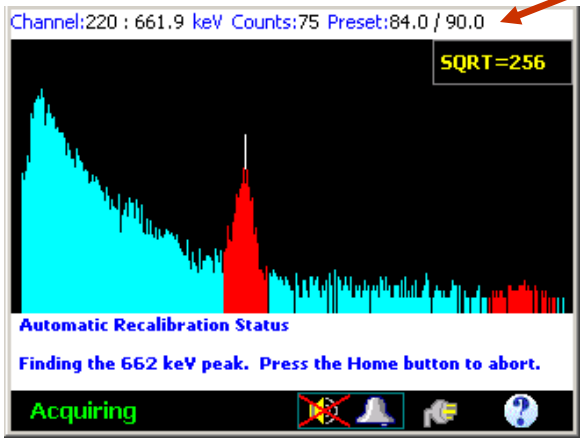


- To note the current Cs-137 energy, the cursor may be placed in the center of the peak (touch screen to get near and then use the side arrows to move by channel)
- This unit had drifted over 70 keV which is very unusual (intentional for the example)
- The inspector has been setup to look for the 662 keV peak during this process and will adjust the gain until the peak falls very near 662 keV.

Operational Checks







- The calibration routine gives the current operation and status as it progresses
- When finished, "Energy recalibration complete" message is displayed.
- Another recalibration can be performed to verify the Cs-137 energy indeed falls near the 662 keV value +/- 10 keV or so. If the "Energy Recalibration Failed" message is displayed the preset time is automatically increased by a factor of 3 and the recalibration continued. The recalibration screen should look very similar to the last screen when the recalibration is progressing well. The Cs-137 peak should not be more than 100 keV off (562 kev to 762 keV)
- Call Canberra Service if the energy recalibration fails a second attempt and the Cs-137 energy is off by more than 100 keV

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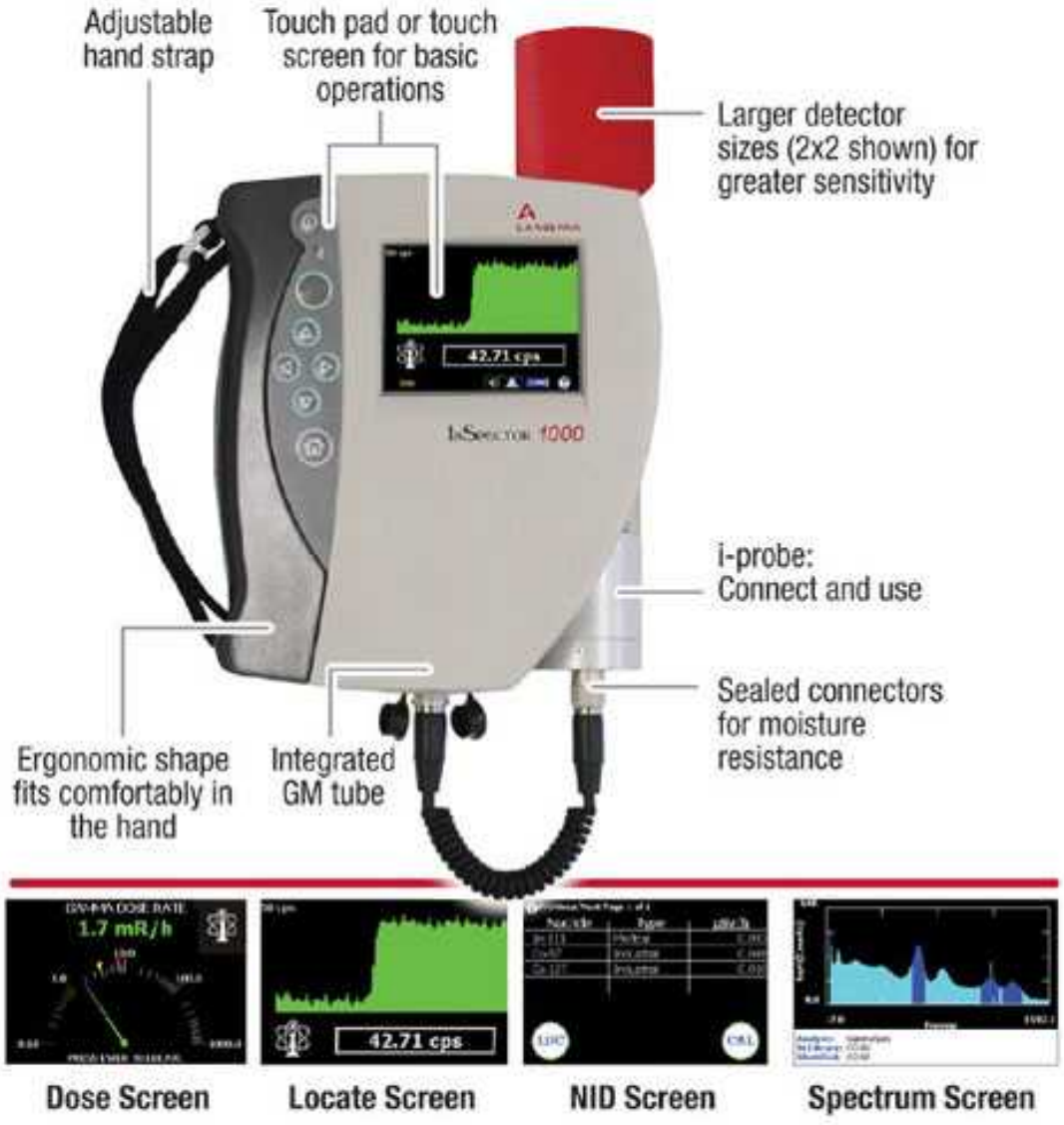

Inspector 1000 Operations

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- Two modes of operation, four primary functions:
  - I. Easy Mode
    1. Source Locating
    2. Nuclide Identification with Activity & Dose Rate by Isotope
  - II. Expert Mode (Easy Mode Functions Plus the Following)
    3. Dose and Dose Rate measurements
    4. Spectroscopy mode
- Single point energy Auto re-calibration and full energy and shape (FWHM) calibration
- The basic functions need to be mastered first in order to accomplish the source locate and secure mission
- As experience is gained advanced features may be incorported for sophisticated analysis and more complex tasks

Inspector 1000 Operations

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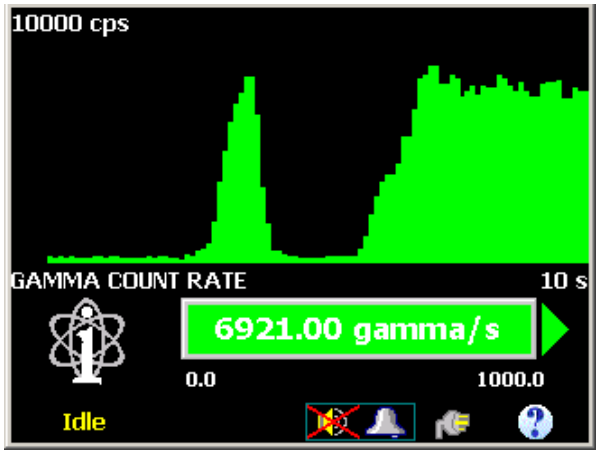
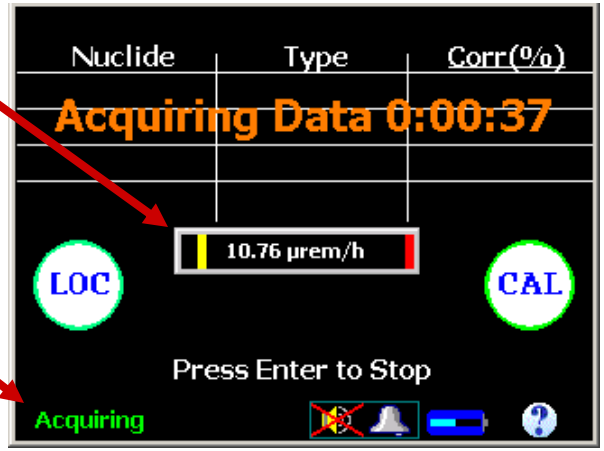
- Use the Locate function to look for activity significantly above background and use the Inspector 1000 to pinpoint the location of a gamma source
- Move the inspector up/down/forward/backward looking for the highest count-rate (without alarming) Don't assume the source is where you first see a rise in count rate or an increase in the audible response
- If the inspector begins alarming, back away until the alarming stops but still detects counts significantly above background.



- Touch the  from the touch pad or press enter (green button)
- Monitor the Dose Rate to keep below warning and alarm levels
- Press Enter to Acquire (green button)
- Verify the unit changed from Idle to Acquiring. Set the unit down if able and back away while the count and analysis is performed
- Respond appropriately to alarms
- When "Analyzing" is complete, evaluate the NID report
- When a neutron source is suspected and optional neutron probe is available the presence of neutrons may indicate a Soil Density Guage or Special Nuclear Material (SNM) such as Plutonium or enriched U-235



Inspector 1000 Operations

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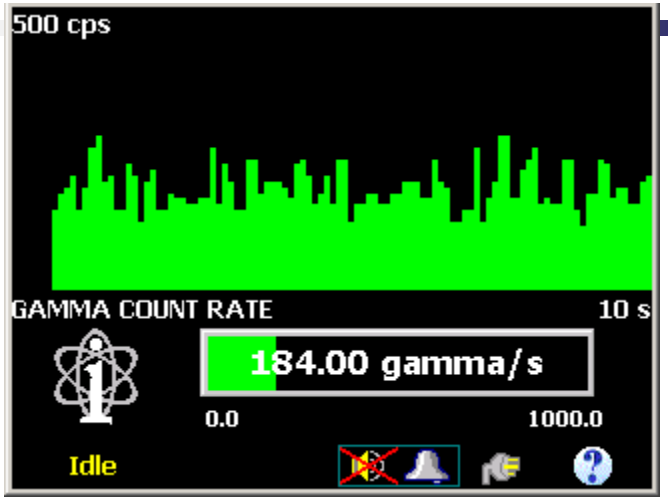
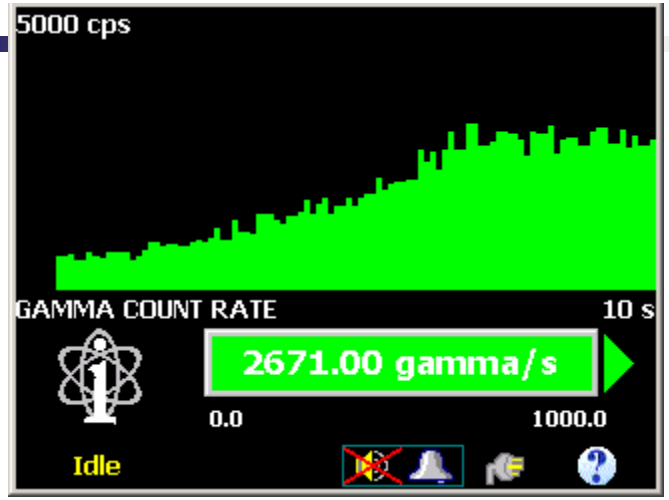
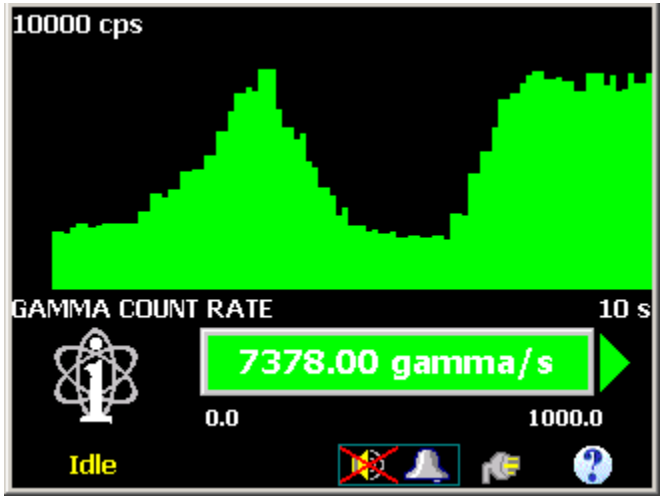


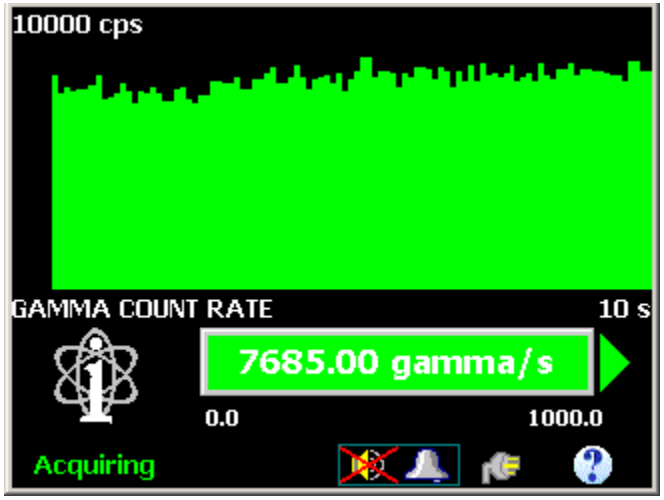
- Typical background for a 2X2 NaI in Grand Rapids, MI



- Approaching a source



- Going past the source and then returning. May be forward, backwards, up or down



- Locate Screen while Acquiring a spectrum

Inspector 1000 Operations

- The Inspector 1000 will generally identify the strongest isotope first
- Extend the assay if additional isotopes are suspected from the same source or location
- Press Enter to Acquire and then Extend to continue the same spectrum collection. New will clear out the spectrum and start again. Use New when identifying a different source location.
- If finished, the spectrum may be saved to a file, downloaded to a PC and emailed for expert analysis for example

Inspector 1000 Operations

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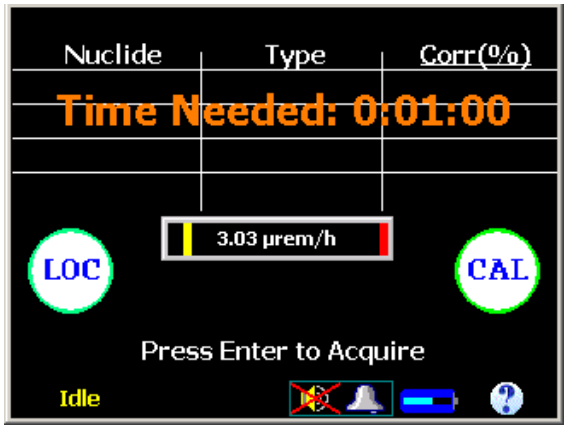
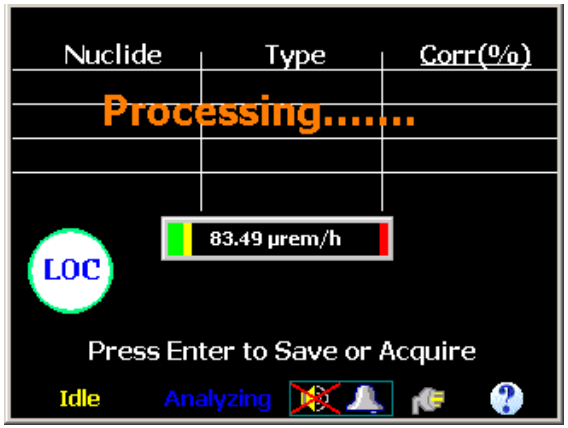
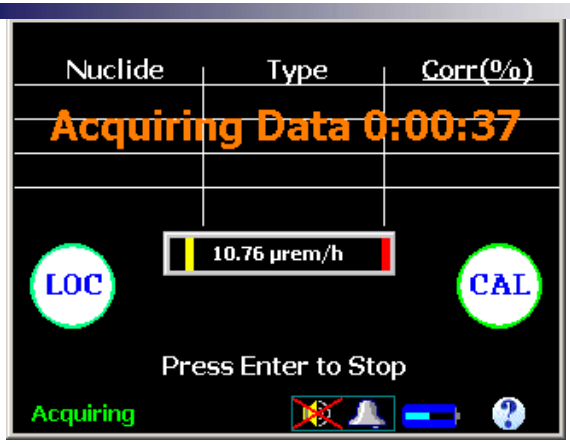


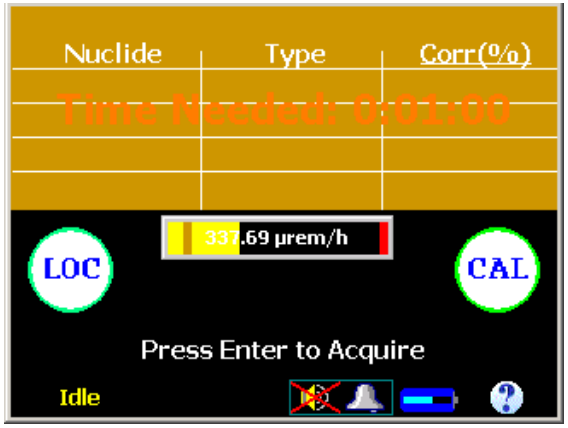
- Not collecting a spectrum (Idle)



- Acquisition complete (now idle) and spectrum being analyzed. May move instrument from sample during analysis

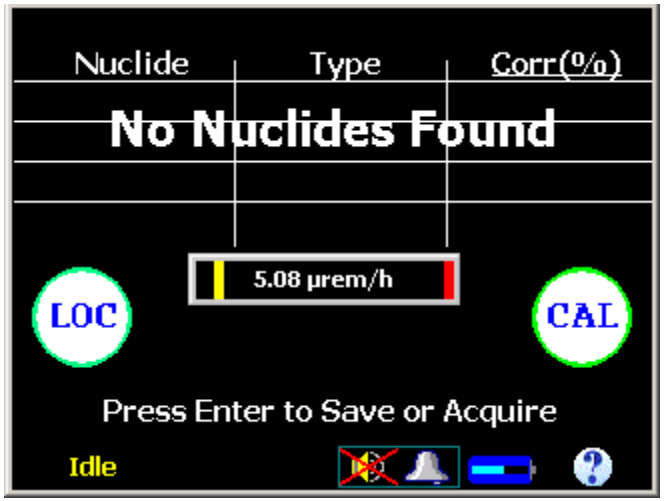


- Dose Rate above background (Source Located), Spectrum Acquiring with 37 seconds remaining before start of Analysis



- Example of dose rate warning. Would hear audible warning also and orange portion would be flashing. Back probe away until warning stops and then begin Acquiring a spectrum

Inspector 1000 Operations



- There could be many reasons why "No Nuclides Found" may be reported
- The source may not emit identifying gamma energies or may be heavily shielded. In this case, you have detected its gamma signature and the unit can measure the dose rate which is important information

- The isotope may be unusual and not contained in the library. Look for labels on the source or package. The library can be edited with a PC and reloaded into the IN1k or the spectral file saved on the inspector and downloaded to the PC for analysis
- The energy calibration may have drifted. Perform the energy calibration using a Cs-137 source.
- Verify calibration peak is within a few keV of the 662 keV energy emitted by Cs-137.

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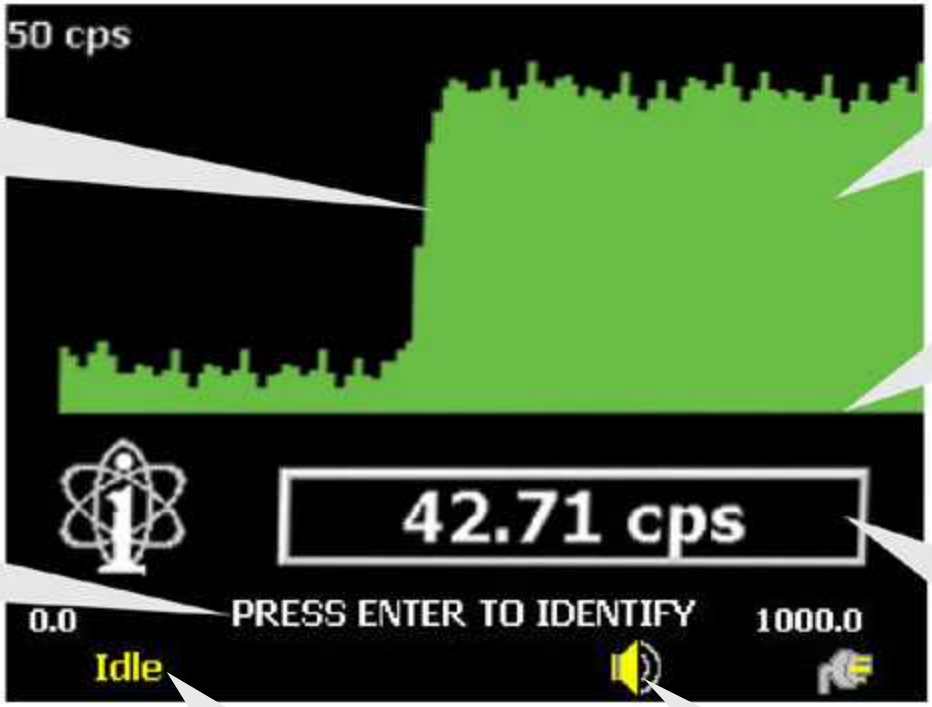
In Easy Mode: Locate Screen Appears After Startup and Probe Stabilization

Locate



Vertical bar graph represents amount in counts or dose rate

Green = no alarm
Yellow = alarm
Red = high alarm

Horizontal position is time
left = oldest
right = newest

Press "ENTER" to go directly to Nuclide Identification

Current reading and alarm levels are always active & displayed

Inspector currently not collecting a spectral file

Touch the screen here to turn off sound AFTER source is located

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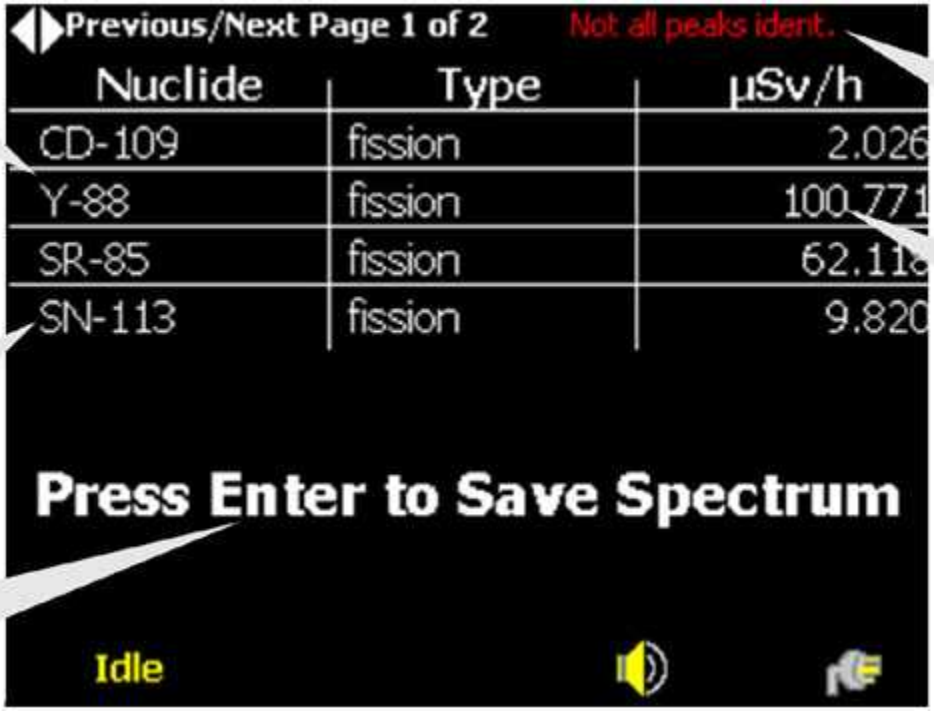
With Easy Mode: Identify & Quantify

Yellow = activity level exceeded

Red = high activity level exceeded

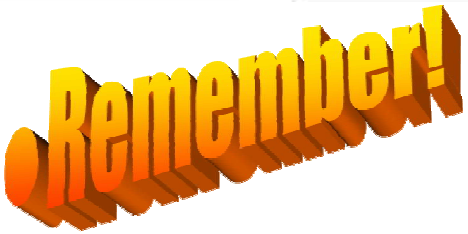
List of identified nuclides

Press "ENTER" to save spectrum after collection is complete



Unidentified peaks found!

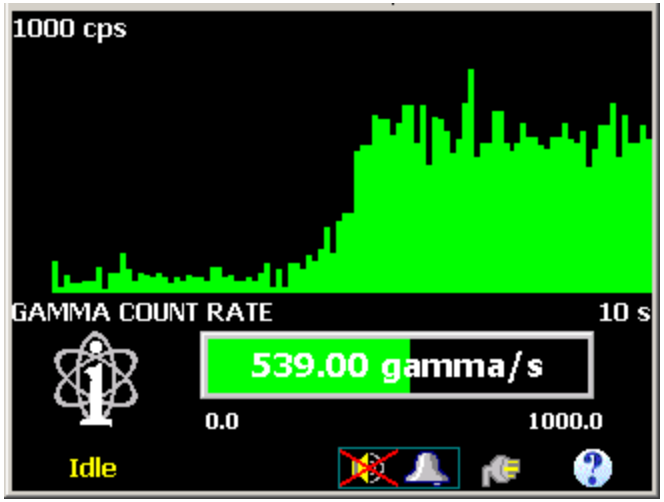
Touch screen to toggle between dose rate & activity

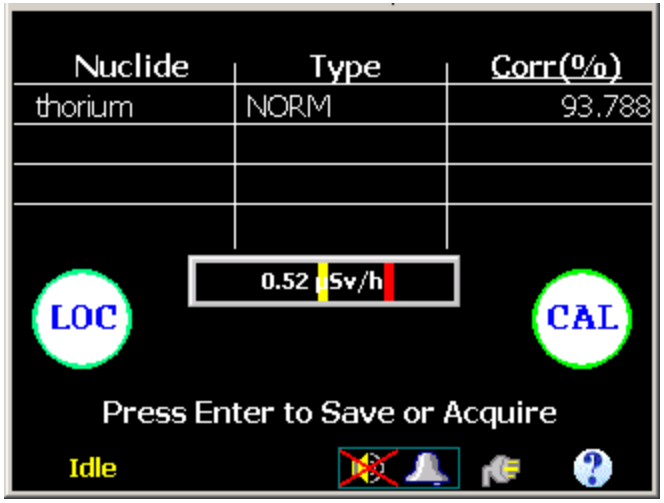


Push the Green enter button to begin collecting a sample and to save when complete (Idle). Default count time is 120 seconds

Exercise: Operating in Easy Mode

- Exercise
  - Power on the unit if not already
  - Use Locate (Audio and Visual) to find source
  - When isotope Is located, Start a New Acquisition
  - Use NID Screen to report the Isotope
- Extra Credit
  - Use instrument to determine Dose Rate on contact and at 25cm
  - Save a file for analysis on host computer





Review of Exercise Results

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- What Isotopes Were Identified?
- Any Isotopes Not Identified? Possible Reasons Why?
- Counting Time Considerations
- Presence of Neutron
- Isotope not in Nuclide Library
- Alternative Analysis Sequence
- Spectral File Save (the assay must finish before the file may be saved)
- Dose Rate results on contact? At 25 cm? Are these sources dangerous?