Material Identification System

Developed for

The United States Department of Defense and Customs Service

Developed by

Pacific Northwest National Laboratory
Operated by Battelle for the US Department of Energy

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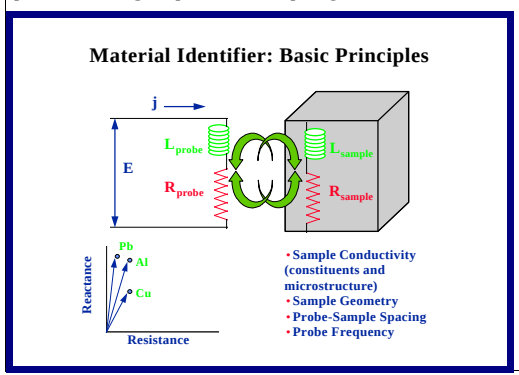
Introduction

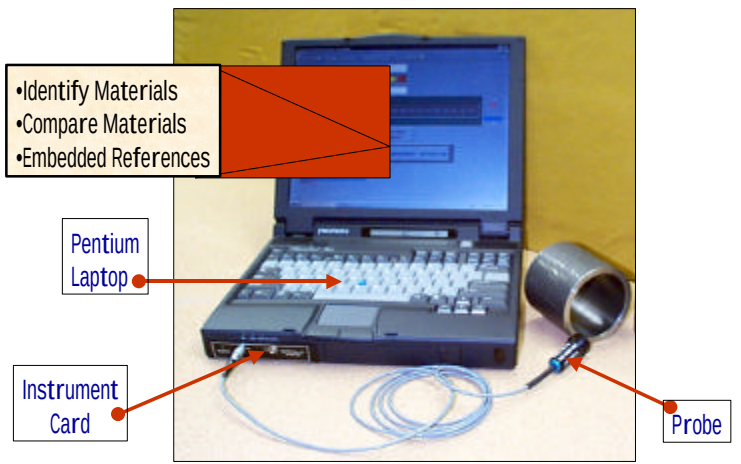
The material identification system rapidly and nonintrusively identifies high value, strategic, or nuclear dual-use materials. The material identification system employs eddy current technologies to make noncontact electrical conductivity measurements. The instrument enables a single inspector to interrogate and identify a strategic material in the field in less than 5 seconds. As a screening tool, this technology augments the expensive and time consuming process entailing on-site sample collection and off-site laboratory sample analysis. The instrument provides a simple text/graphics display for immediate results and the storage facility for archiving the material electronic signatures, and accessing tariffs and regulations.



Step by Step
Hardware Installation

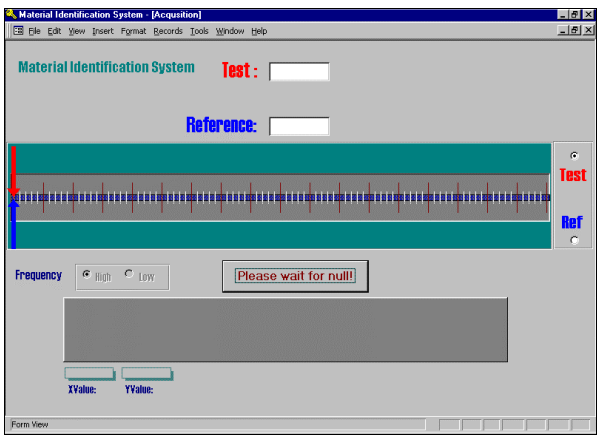
1. **Select Probe to be used. The Low Frequency Probe is marked with a PSU-xxxx-60 and has a 4-pin LEMO connector. The High Frequency Probe is marked with a PSU-xxxx-390 and has a 3-pin LEMO connector.**
2. **Verify that the power to the instrument module is off. The computer can be powered up but the red LED on the instrument module should be off.**
3. **Connect the selected probe to the appropriate socket on the instrument module. The Low Frequency socket is marked "Lo" and the High Frequency socket is marked "Hi". Only one probe can be connected at a time. The power to the instrument module should off when connecting and disconnecting probes.**

No attempt should ever be made to remove the instrument module from its bay in the computer. For service, please contact the agency deploying the equipment. The system allows for the use of a CD ROM or battery pack in the other computer bay. A floppy drive will not work in this second computer bay



System Software

The Material ID System software is composed of custom code running through a user's interface developed on the Microsoft ACCESS database platform. Two versions of the users interface code are provided with the system. One version is an uncompiled copy that serves as a backup. Any code modifications are made at the user's risk and is strongly discouraged. Both versions of the code are called "matid98v1_compiled" and are found in the subdirectory



Step by Step

System Start-up

1. **Exit all other programs that may be running.**
2. **Verify that the proper probe has been connected to the instrument module**
3. **Double click on the "globe" icon labelled Material ID System.**
4. **The Material ID System software takes several seconds to load. The operator sees an entry display with the current date followed by the instrument's main screen.**
5. **Wait until central button display changes from "Please Wait !" to "Click to Start Measure". This may take 5 to 10 seconds.**

Please note that on the initial startup of the laptop and Windows 95 a DOS window may appear and need to be closed by the operator. This does not indicate an instrument error.

System Operation

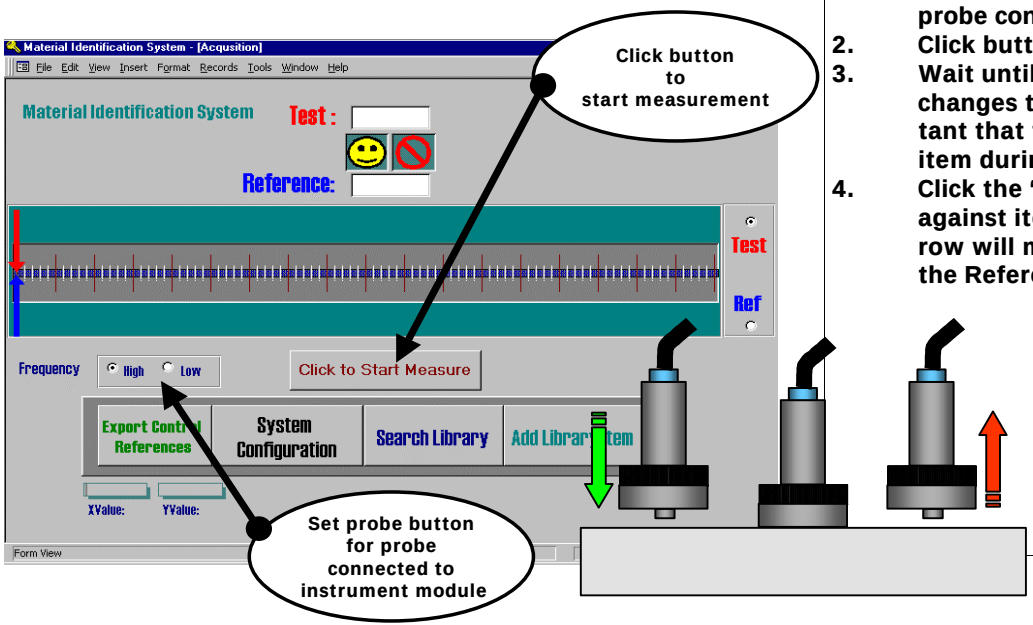
The Material ID System operates in three modes:

- **Comparison:** sort items into groups of like/unlike
- **Verification:** check library entries with items
- **Identification:** check item against library entries

Step by Step

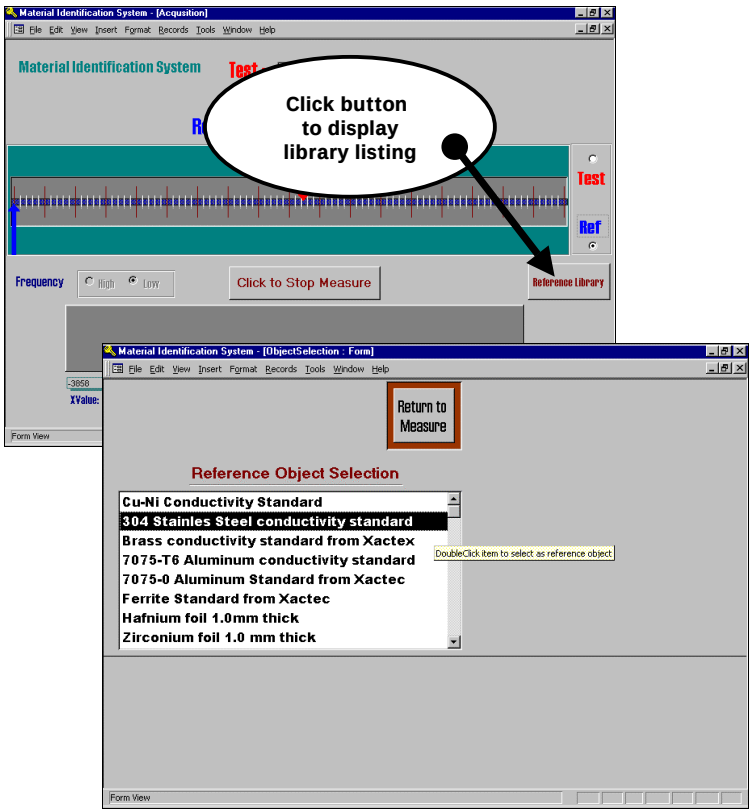
Start Measurement

Comparison



1. Set "Frequency" software button to match the probe connected to the instrument module.
2. Click button marked "Click to Start Measurement".
3. Wait until button display "Please wait for null" changes to "Click to Stop Measure". It is important that the probe is NOT pressed against any item during this time.
4. Click the "Ref" button and press/release probe against item to be used as reference. The blue arrow will move and a number will be displayed in the Reference window. REPEAT measurement to check precision. The displayed numbers can be used as a gauge of measurement repeatability
5. Click the "Test" button and press/release probe against other items. Arrows' alignment and yellow "happy face" indicate that item is the same material as the reference.

System Operation, continued



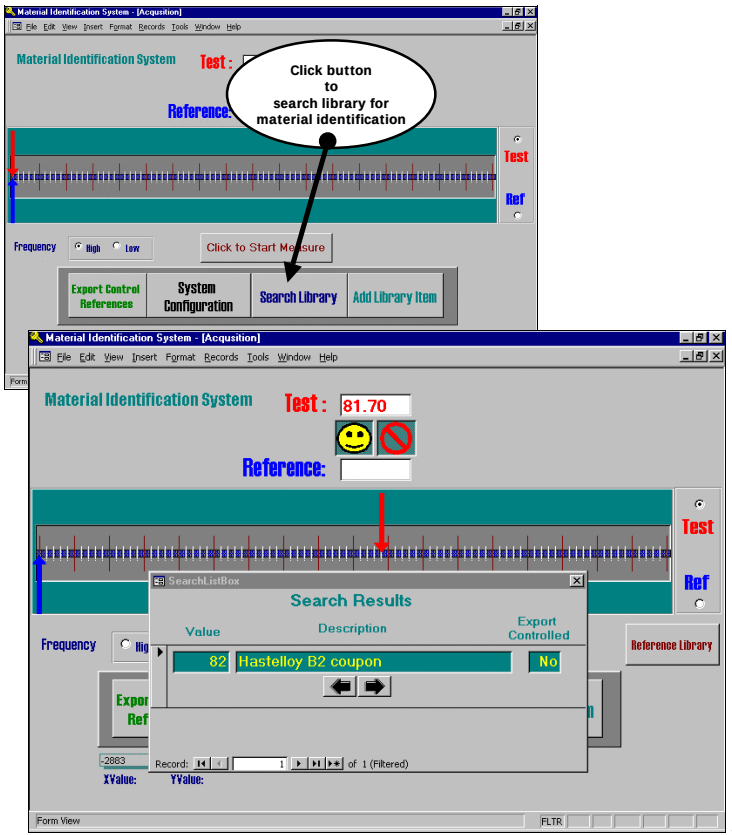
Step by Step

Start Measurement

Verification

1. Set “Frequency” software button to match the probe connected to the instrument module.
2. Click button marked “Click to Start Measurement”.
3. Wait until button display “Please wait for null” changes to “Click to Stop Measure”. It is important that the probe is NOT pressed against any item during this time.
4. Click the “Ref” button and then the “Reference Library” button to display window listing items in library.
5. Double click on the listed item of interest. The item description, signal value, and blue arrow are all displayed.
6. Click the “Test” button and press/release probe against other items. Arrows’ alignment and yellow “happy face” indicate that item is the same material as the library reference.

System Operation, continued



Step by Step

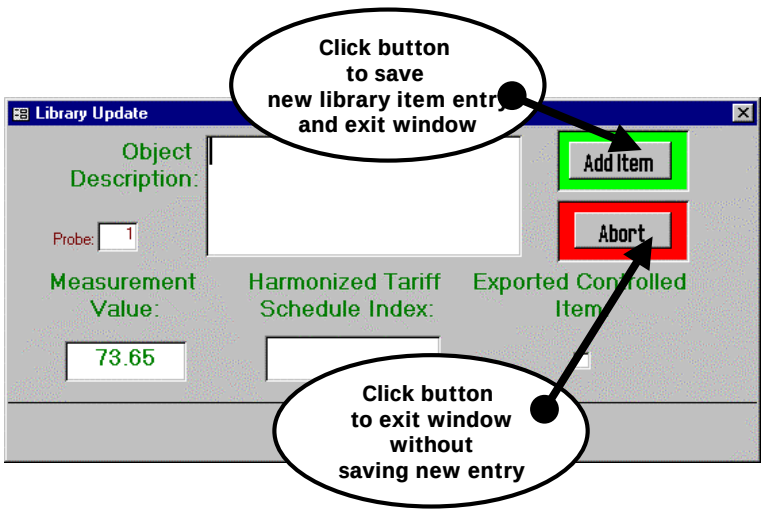
Start Measurement

Identification

1. Set “Frequency” software button to match the probe connected to the instrument module.
2. Click button marked “Click to Start Measurement”.
3. Wait until “Please wait for null” changes to “Click to Stop Measure”. It is important that the probe is NOT pressed against any item during this time.
4. Click the “Ref” or the “Test” button and press/release probe against item to be used as reference. The blue (red) arrow will move and a number will be displayed in the Reference window. REPEAT measurement to check precision.
5. Click the “Click to Stop Measure” button followed by the “Search Library” button. Any library entries close to the measured value will be displayed. More than one entry may be found similar to the measured value.

Data Library Maintenance

The Material ID System data library is easy to update with new item entries. The operator needs to carefully regulate new entries to prevent the library from becoming cluttered.



Step by Step

Add Library Item

1. **Set "Frequency" software button to match the probe connected to the instrument module.**
2. **Click button "Click to Start Measurement".**
3. **Wait until button display "Please wait for null" changes to "Click to Stop Measure". It is important that the probe is NOT pressed against any item during this time.**
4. **Click the "Ref" button or "Test" button and press/release probe against item to be used as reference. The blue (red) arrow will move and a number will be displayed in the Reference window. REPEAT measurement to check precision. The displayed numbers can be used as a gauge of measurement repeatability**
5. **Click the "Add Libray Item" to display a new window. The most recently measured value is displayed in the new window. The operator enters a description of the item and, if desired, the HTSUSA heading and export control flag.**
6. **Click "Add Item" button to save new entry and exit. Click "Abort" button to exit without saving.**

System Utilities

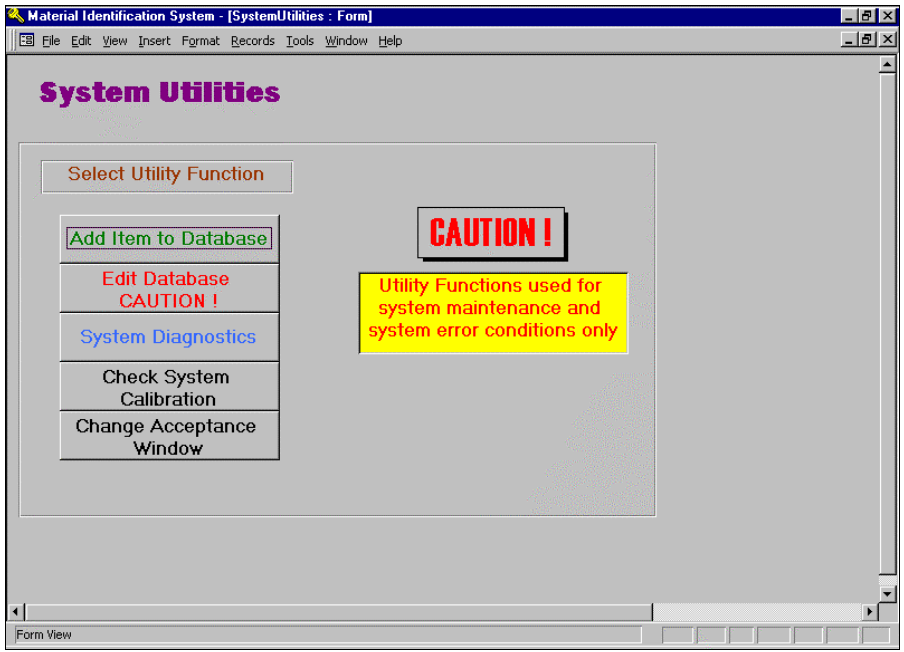
A. Add Item to Database allows the operator to add new library item entries without going through the measurement process.

B. Edit Database allows the operator to edit the system item library. Item descriptions and measurement values of all library entries are available for editing. Care must be taken to avoid corrupting the item library.

C. System Diagnostics allow the operator to access code modules that communicate directly with the instrument module. It is expected that its use is limited to the equipment manufacturer and developer.

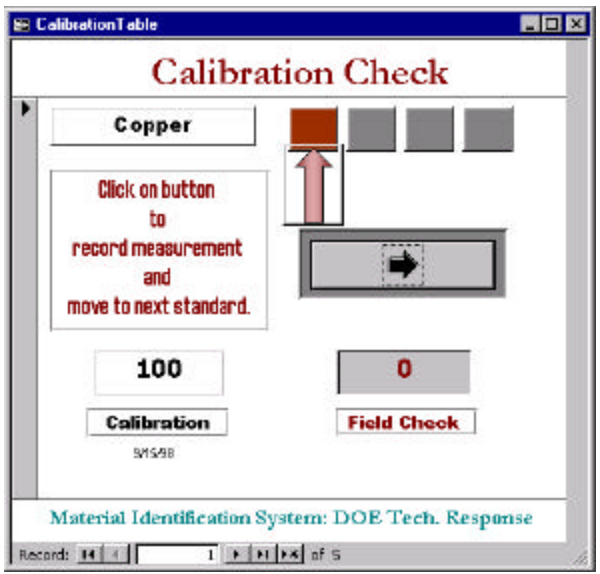
D. Check System Calibration is used to account for temperature effect variations and electronic probe variations.

E. All other System Utilities features are not accessible to the operator.



Check System Calibration

The Material ID System performance precison requires the operator to periodically check system calibration. The system calibration assures that data bases can be shared between systems and that measurement results are temperature independent.



Step by Step

Calibration Check

1. **Let the system come to equilibrium with the ambient temperature where the items are to be tested.**
2. **Make several measurements of the copper calibration coupon (marked CDA110).**
3. **When the measurement results seem to be repeatable, click on the bar with the left arrow. This will record the last measurement and move the vertical arrow to the next metal calibration coupon (marked ZINC).**
4. **Repeat steps 2 and 3 until all four metal calibration coupons have been measured.**
5. **After the last coupon is measured the system will automatically update the system calibration and return the operator to the System Utilities menu.**

System Maintenance

The Material Identification System has been designed to perform in the environment generally encountered at a port-of-entry. It is designed to survive the same shipment, handling, and care that a laptop-PC might experience. There are few serviceable parts on the Material ID System and most repairs will simply involve component replacement. The Material ID System is designed and fabricated at the United States Pacific Northwest National Laboratory (PNNL). PNNL is a Department of Energy laboratory located at the Hanford Site in Richland, Washington. Officials at the United States Customs Service, the United States Department of Defense, and the United States Department of State coordinate distribution of this instrument to the international community.

Design, parts, and software revisions are all keyed to the bar code labels attached to the outside of the instrument and instrument case. This label must be preserved as it serves as the sole reference from which maintenance support can be provided.

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