

HazMatID™ Chemical Identifier

Training Course:

Infrared Spectroscopy for Hazardous Materials Identification

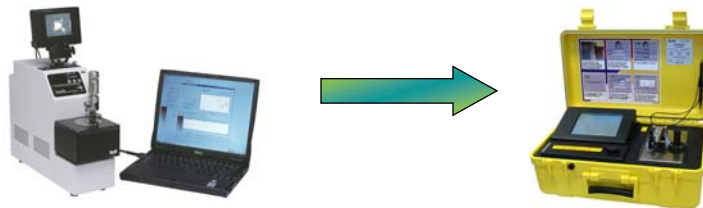


HazMatID Training Course – Outline

1. Basics
 - a. Intro
 - b. What it can and cannot identify?
 - c. How does it identify chemicals?
 - d. Wireless operation
 - e. Measurement Procedure
 - f. Recognizing Good Data
 - g. Mixtures
 - h. Support
 - i. Methods
 - j. Libraries
 - k. Reports
 - l. Maintenance
2. Practical Operation
3. Exam
4. Evaluation

History of HazMatID

- In 2001, SensIR Technologies introduced the TravelIR, the first portable FT-IR spectrometer
 - Widely used for the identification of unknown materials including: WMD's, TICS, Common Chemicals, Explosives, Narcotics, etc.
- In 2003, SensIR developed the HazMatID based on feedback from First Responders and the U.S. Military
- Hazardous Material Identifier (*HazMatID*) is an entirely new concept for in field-based Fourier Transform Infrared (FT-IR) spectroscopy

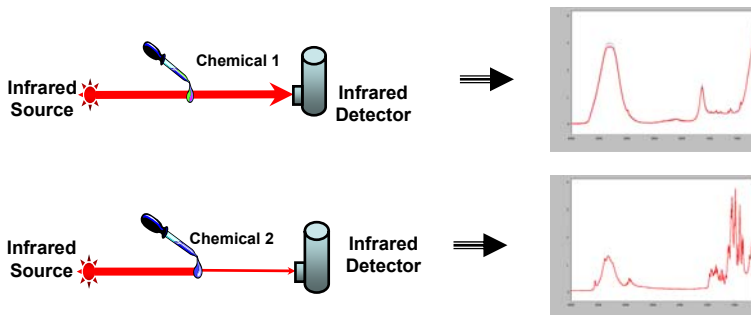


“What is Infrared Spectroscopy” ?

- Spectroscopy is
 - *The study of how electromagnetic radiation interacts with the atoms and molecules that make up matter*
- A Spectrum is
 - *A graph of how much infrared light is absorbed by molecules at each frequency*

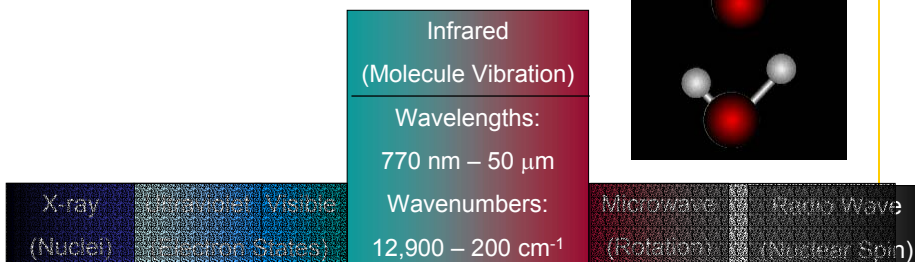
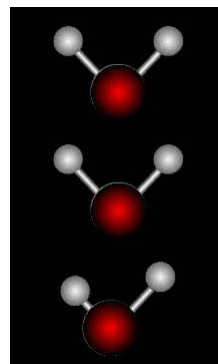
"Infrared Spectroscopy"

- Chemicals absorb infrared light.
- The pattern of absorption is unique to a chemical.
 - Pattern is called a Spectrum.
- HazMatID will match the spectrum of the sample to a library.



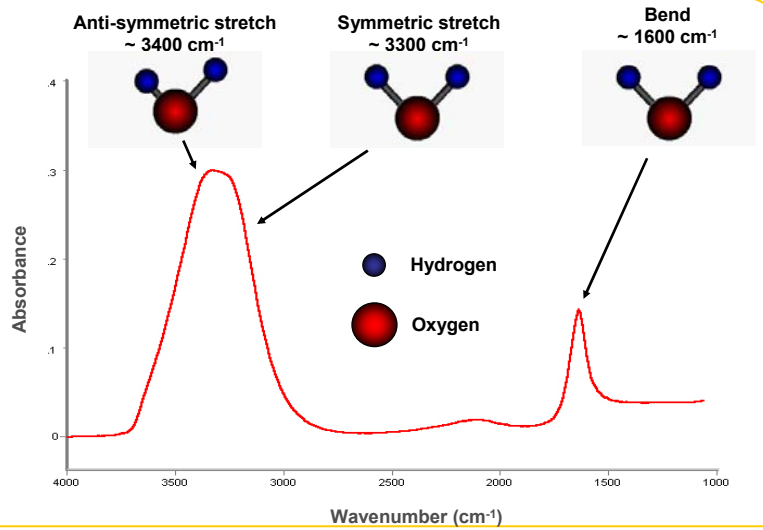
Infrared Radiation

- Wavelengths of light in the infrared (heat) region have energies that are on the same order of magnitude as *vibrating bonds* in molecules



Infrared Spectrum of Water (H_2O)

smiths



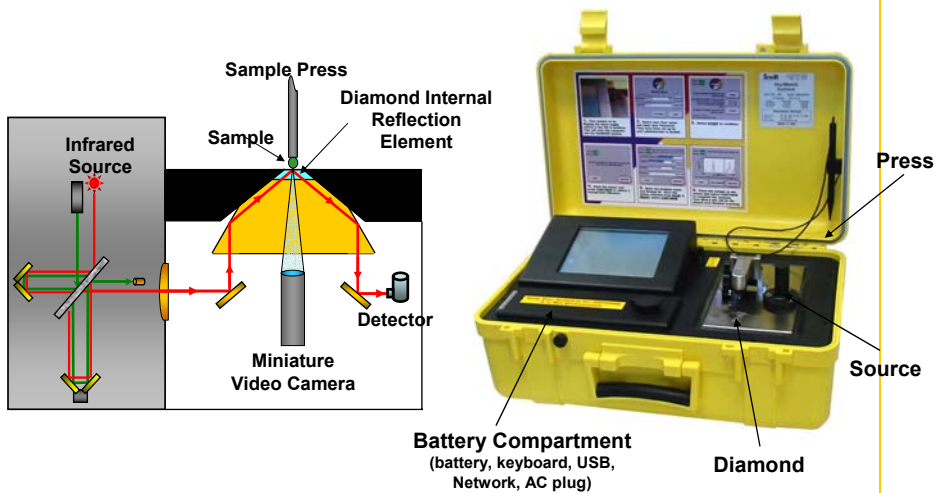
Smiths Detection

November 3, 2004

7

HazMatID Main Components

smiths



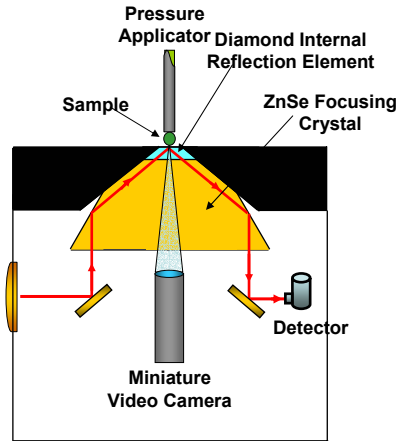
Smiths Detection

November 3, 2004

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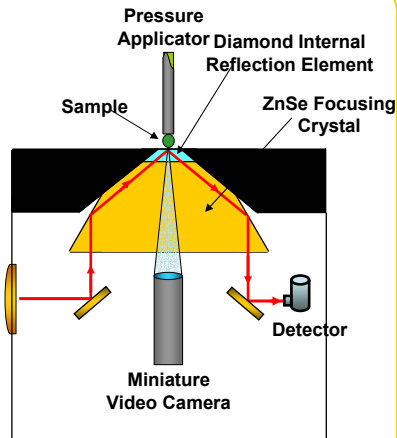
Diamond ATR Advantages

- **Easy sampling**
 - Solids, liquids, paste
- **Consistent sampling**
 - Path length controlled by ATR crystal
- **Easy clean up**
- **Diamond**
 - Chemical resistant
 - Scratch proof
 - Strong (10,000 psi applied pressure)



Diamond ATR Features

- **IR penetrates sample very small amount**
 - 0.0015mm for most chemicals
 - Sample thickness doesn't matter
- **Liquids coat the surface**
- **Solids must be pressed against the surface**



What can the HazMatID Identify ?

- Solids, liquids, and pastes
- Must have a COVALENT CHEMICAL BOND
 - Organic compounds
 - Petroleum products, Pesticides, Fertilizers, Plastics, Plant materials
 - Many inorganic compounds
 - Water
 - Mineral acids (sulfuric, nitric, etc.)
 - Inorganic oxides (rust, talc, etc.)
 - Nitrates, Chlorates and Phosphates.

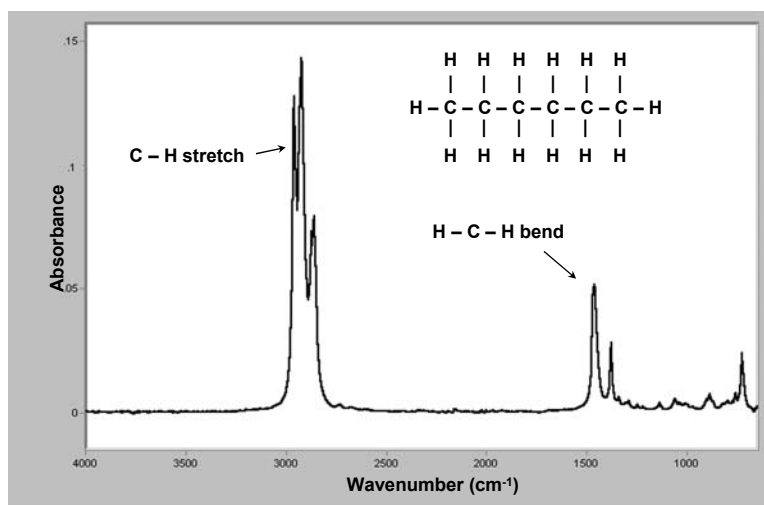
What can the HazMatID NOT Identify ?

- Elemental substances
 - Metals (iron, aluminum, etc.)
 - Non-metals (sulfur, phosphorus, etc.)
- Ionic salts (sodium chloride, calcium chloride)
- Dilute aqueous (water-based) solutions, or individual components of any mixture
 - Less than 10% concentration
- Biological Agents
 - Infrared Spectroscopy as a field based portable analytical technique (HazMatID) can NOT definitively identify biological agents.

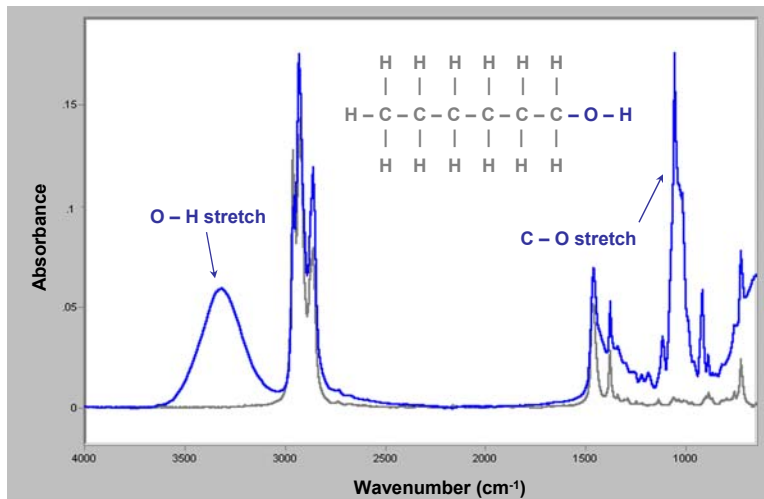
How does it identify chemicals?

- Recall that an infrared spectrum has peaks where light energy is absorbed by molecular bonds
- Bonds between particular atoms (functional groups) occur at characteristic wavenumbers
- Let's look at the effects some functional groups have on infrared spectra ...

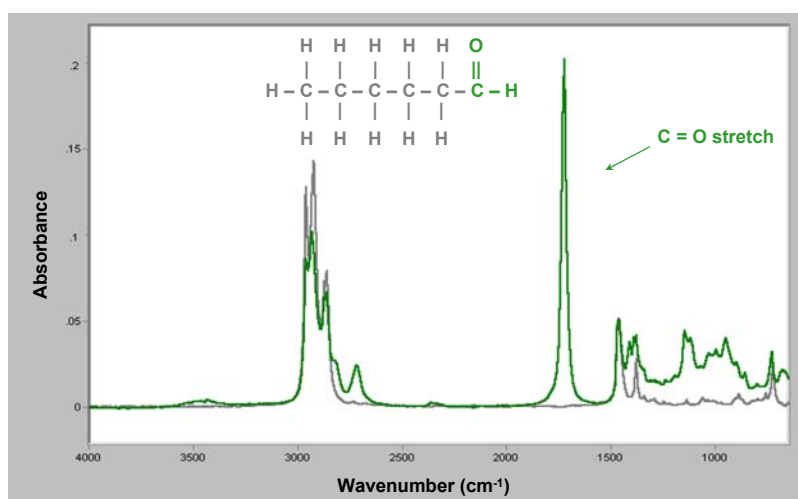
Hexane



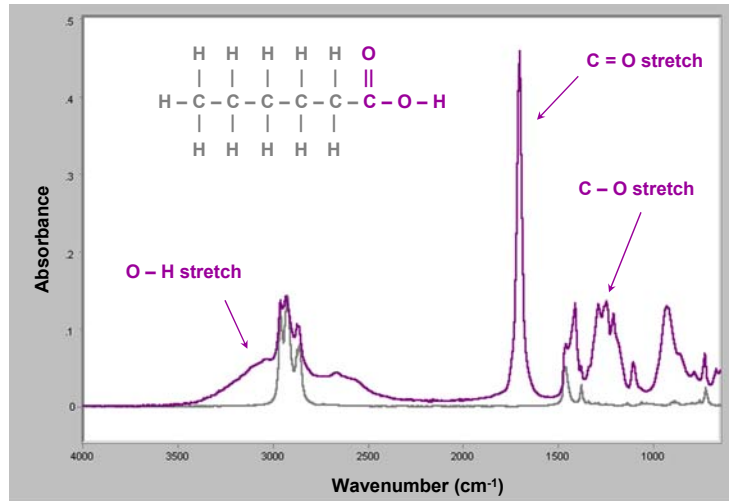
Hexanol



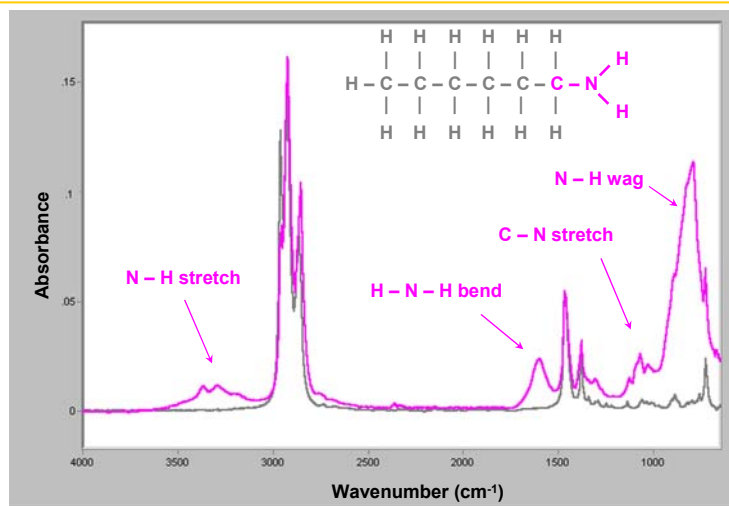
Hexanal



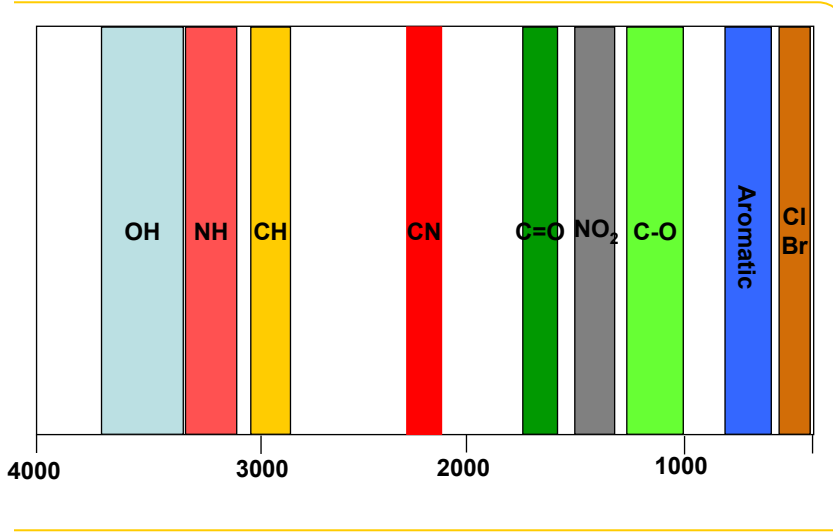
Hexanoic acid



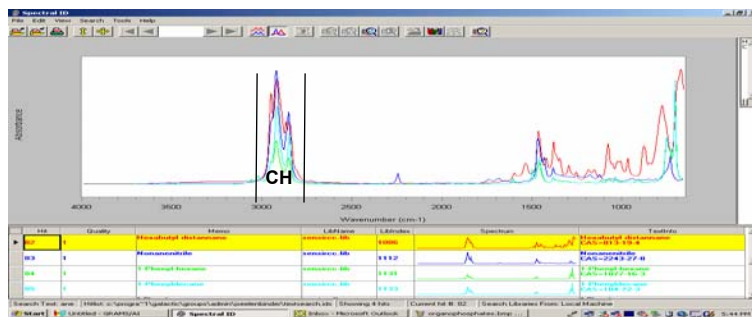
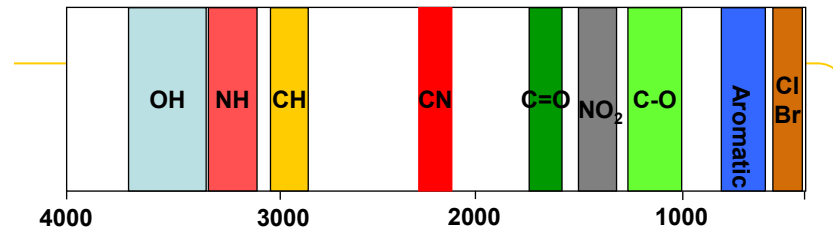
Hexyl amine



Absorption Landmarks

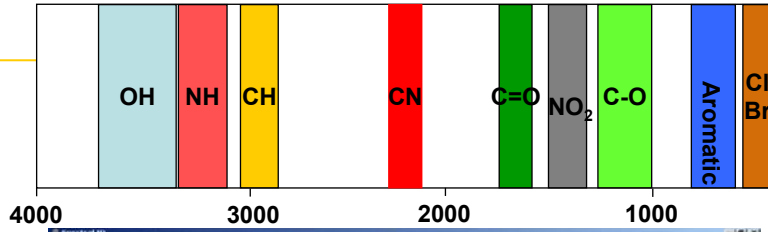


Hydrocarbon



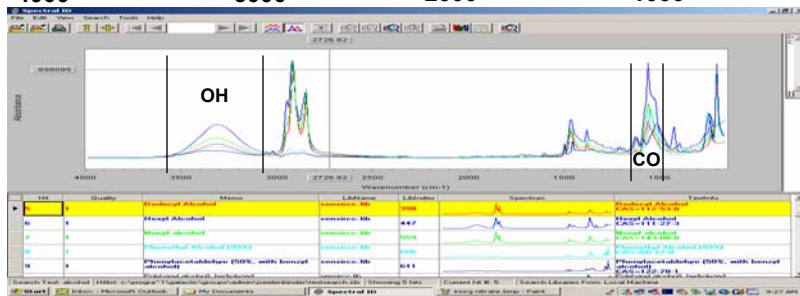
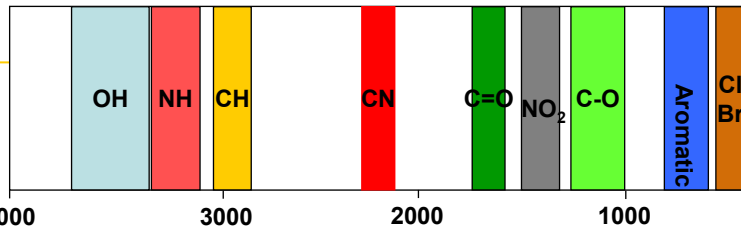
Alkane (CH, hydrocarbon)

Aromatic (xylene)



Aromatic (xylene)

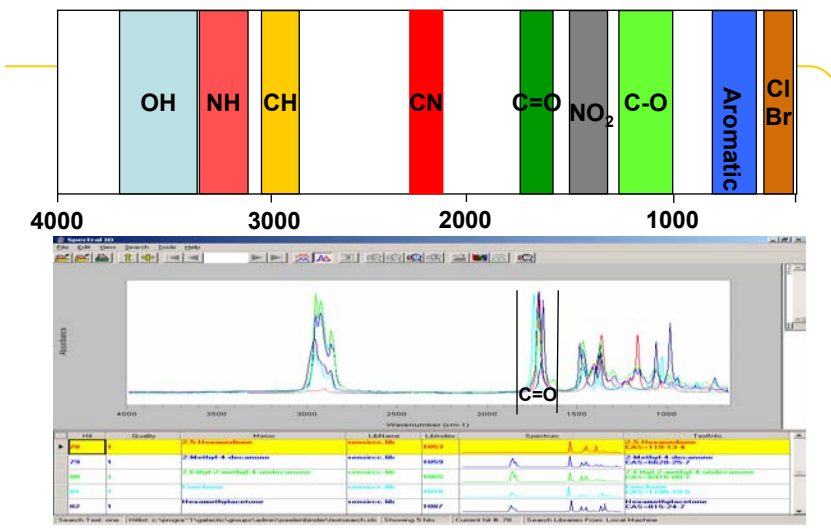
Alcohol



Alcohol (C-O, OH)

Carbonyl

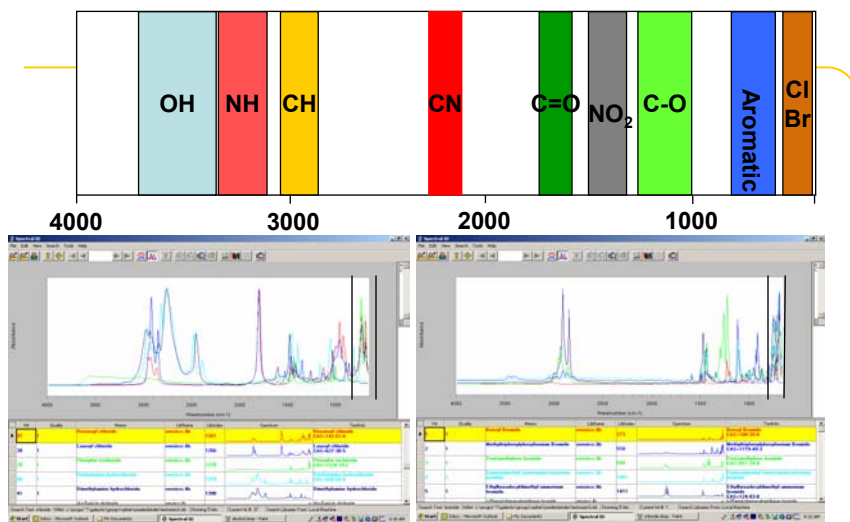
smths



Ketone (C=O)

Halogens

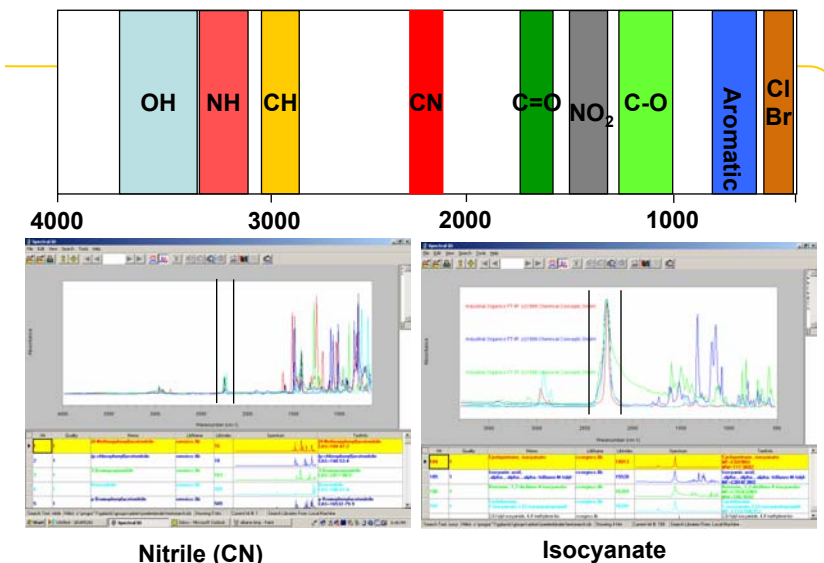
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Chloride (C-Cl)

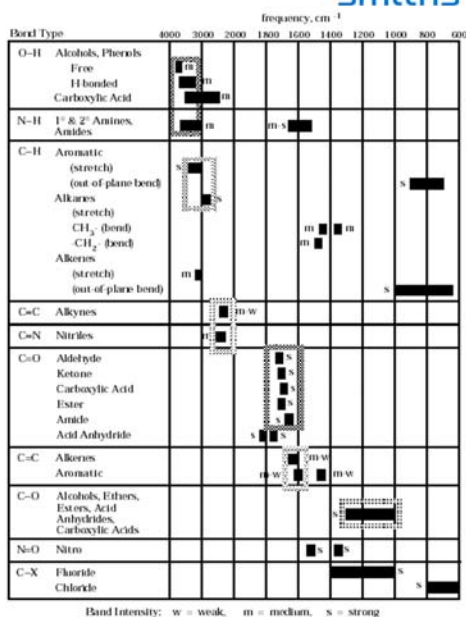
Bromide (C-Br)

Nitrile, Isocyanate



Correlation Chart

- Chemical bonds have absorption bands at very characteristic wavenumbers (cm^{-1})
- With practice, one can classify a chemical just by looking at its spectrum



Band Intensity: w = weak, m = medium, s = strong

Molecular “Fingerprinting”

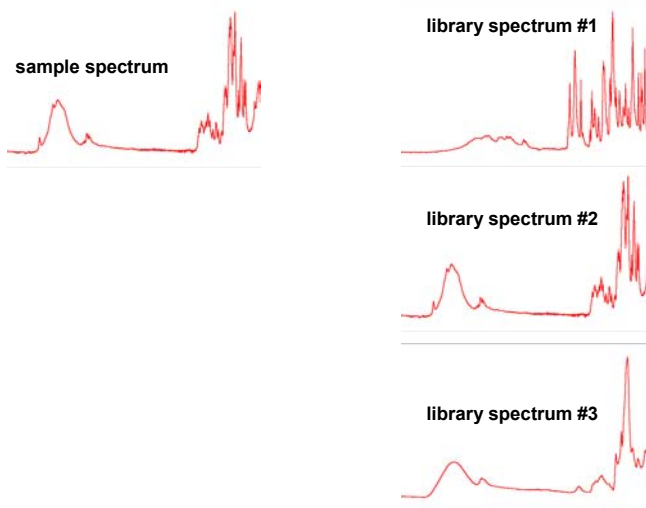


smiths

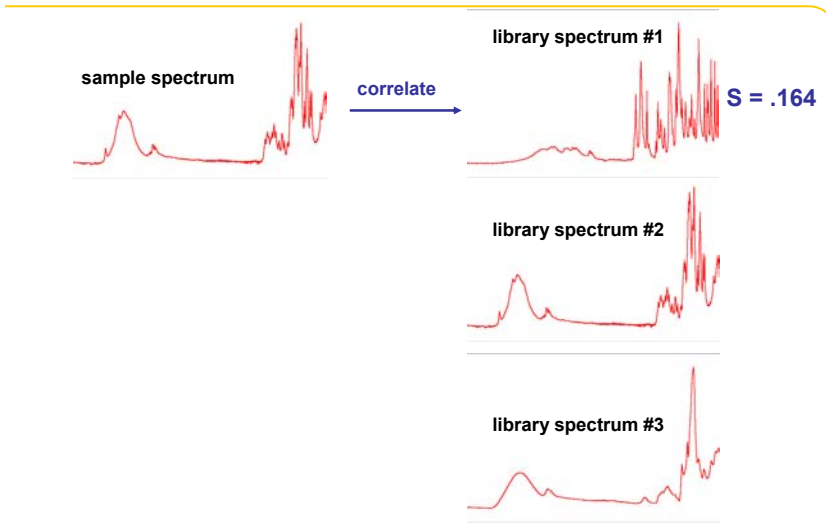
- Because chemicals have unique chemical structures, they also have *unique infrared spectra*
- Just like criminals are identified by searching human fingerprints in databases, chemicals are identified by matching infrared spectra
- This matching is done automatically by the HazMatID software

Molecular “Fingerprinting”

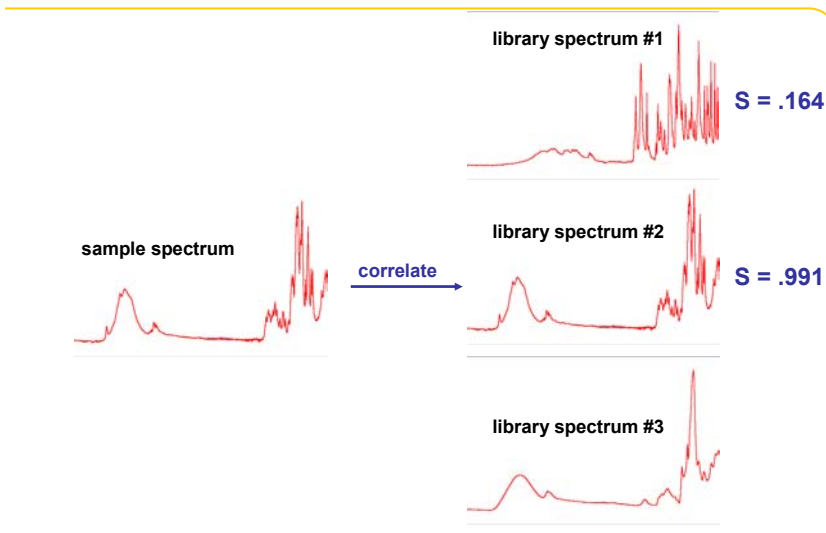
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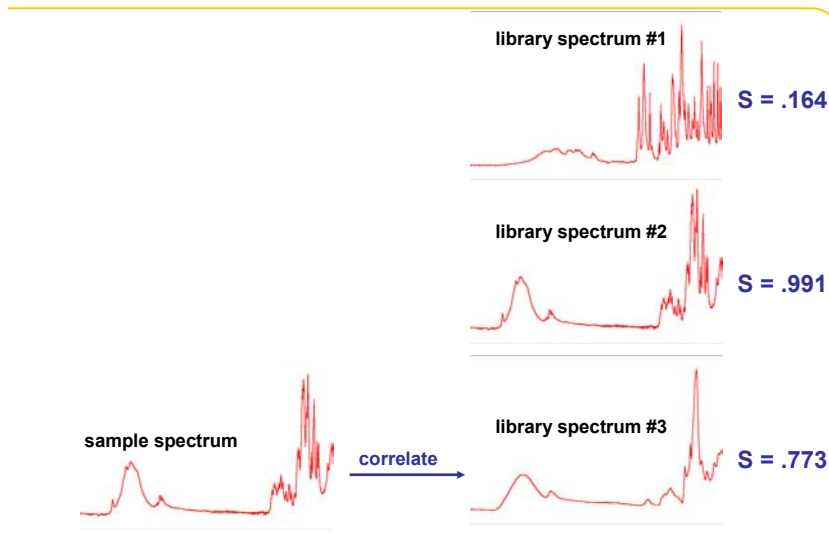
Molecular "Fingerprinting"



Molecular "Fingerprinting"



Molecular "Fingerprinting"



Molecular "Fingerprinting"

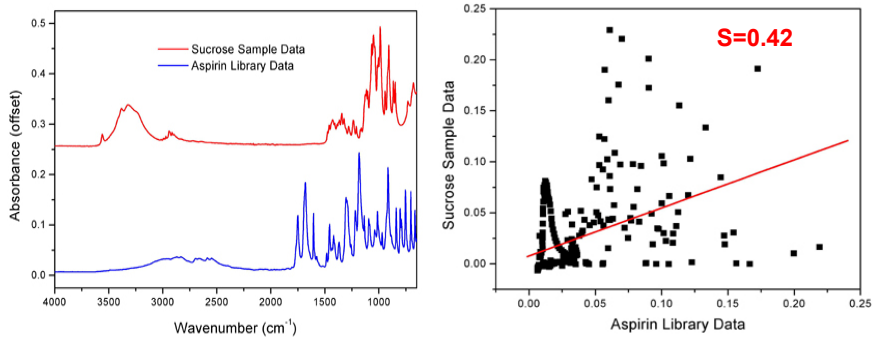
- Once the "unknown" sample spectrum is compared to all available library spectra, the results are ranked:

| Library Spectrum # | Correlation Value (Similarity) |
|--------------------|--------------------------------|
| 2 | .991 |
| 3 | .773 |
| 1 | .164 |

The library spectrum with the *highest* correlation value is the *most likely* identity of the unknown

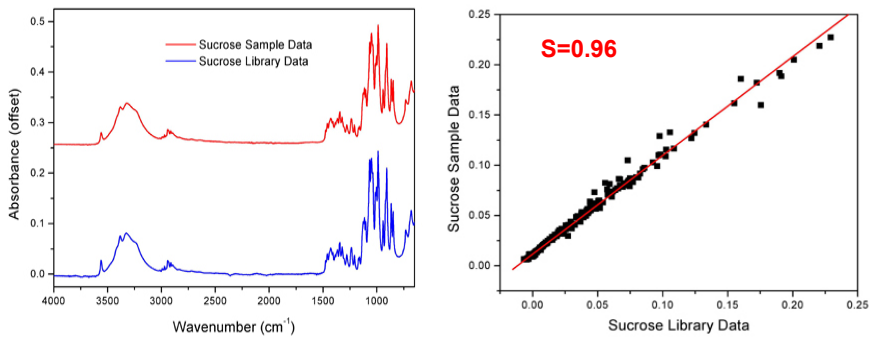
What is "Correlation" ?

Different Substances = Poor Correlation = Low S Value

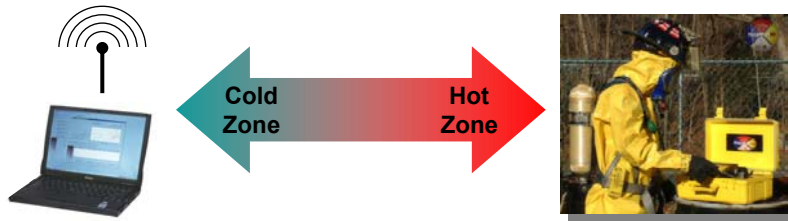


What is "Correlation" ?

Similar Substances = Good Correlation = High S Value



HazMatID Wireless Communication



- Transfer files to Laptop or Desktop over wireless network, or Control HazMatID software remotely with PC Anywhere™
- 128 bit WEP encryption security capable
- Compliant with 802.11b standards
- Operating Range depends on connection speed and environmental conditions
 - Outdoors up to 150 feet

Smiths/SensIR: Libraries

| | Included | |
|---|-----------------|------------------|
| • Common Laboratory Chemicals | | 3302 spectra |
| • Common Household White Powders | | 41 spectra |
| • Regulated Drug Precursors (Meth Lab) | | 43 spectra |
| • Toxic Industrial Chemicals (NIOSH Guide) | | 383 spectra |
| • Forensic Drugs (IL State Police) | | 454 spectra |
| • Explosives (CO State Forensic Lab) | | 31 spectra |
| • Chemical Warfare Agents (4 th WMD CST) | | <u>7 spectra</u> |
| | | 4261 spectra |
| Additional Available Libraries | | |
| • Sigma-Aldrich™ ATR Library | | 18,513 spectra |
| • Pesticide Active Ingredients | | 273 spectra |
| • IChem™ ATR Library | | 12,706 spectra |
| • IChem/Aldrich Combined Library | | 26,221 spectra |

Powering Up the HazMatID System

- Insert a battery or connect the system to AC power using the AC adapter.
- After the system boots up, the login screen will appear.
- The default login screen name is: Admin with no password
- Approx. 1 minute after this screen appears the wireless is available

Measurement Procedure

- Clean diamond
 - Last rinse with methanol, rubbing alcohol or acetone
 - Make sure diamond is dry before continuing
- Measure Background
 - Should be as close to sample measurement as possible
- Apply Sample
 - Observe flat baseline
 - Add sample
 - Pressure if solid, cover if liquid
- Record Sample

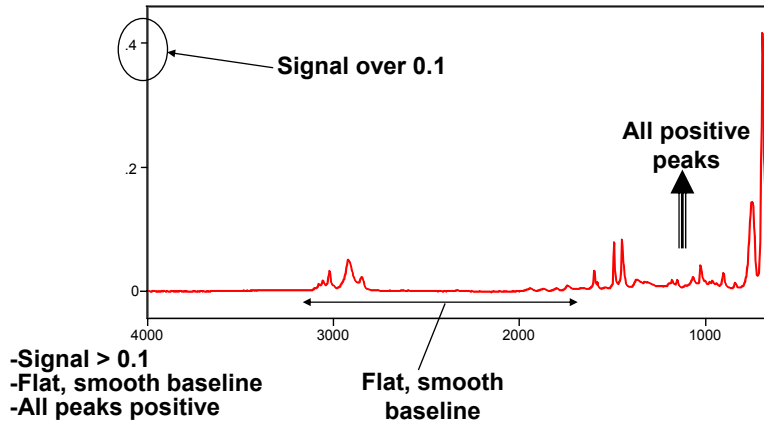
What is a good match?

- 3 criteria for a positive identification
 - Quality (correlation) over 0.95
 - Sample and library match **VISUALLY**
 - **PHYSICAL** properties match

What If I Don't Get a Match ?

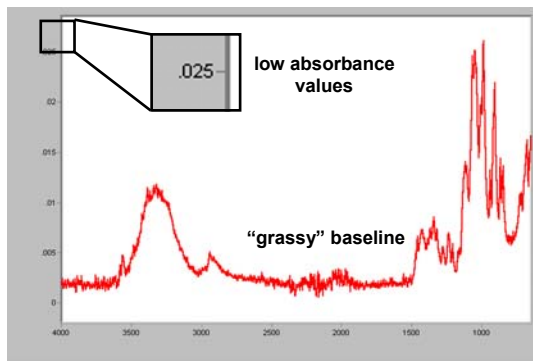
- Most matching problems fall into 2 categories
 - Spectral Artifacts
 - Baseline problems
 - Easily recognized
 - Minimized by proper procedure
 - Mixtures
 - Primary component match
 - Mathematical subtraction
 - Mixture in the library

What does a good spectrum look like?



Spectral Artifacts – Poor Contact

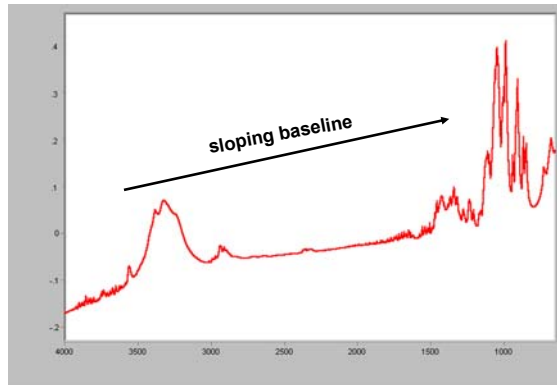
Problem: Lot of “grass” or “noise” in spectrum, and maximum absorbance value is much less than 0.1



Solution: Insufficient amount of sample and/or applied pressure. Make sure sample covers diamond area, and apply more pressure.

Spectral Artifacts – Bad Baseline

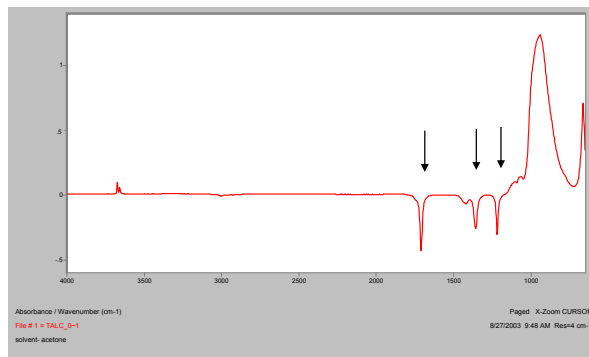
Problem: Spectrum appears “tilted” at an angle



Solution: Background is old. Usually occurs when system has been on for less than 1 hour. Record new background and repeat analysis.

Spectral Artifacts – Negative Peaks

Problem: Spectrum has “downward” peaks



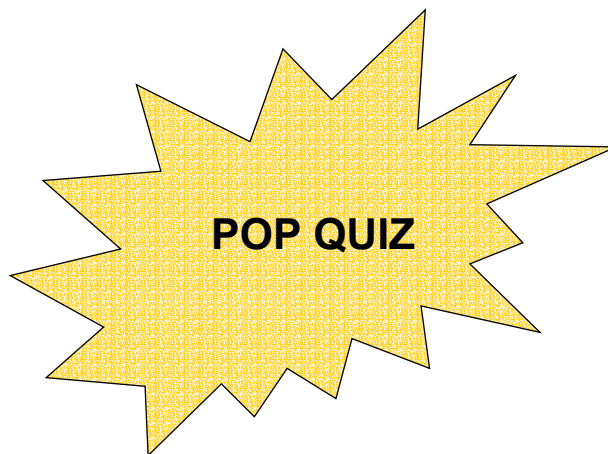
Solution: Solvent not evaporated from diamond before background measurement. Dry diamond and collect a new background.

Effect of Artifacts on Library Search

| Quality of Sample Sugar Spectrum | Correlation Value to Library Sugar Spectrum |
|----------------------------------|---|
| Excellent | S = .997 |
| Poor Contact | S = .989 |
| Bad Baseline | S = .797 |
| Negative Peaks | S = .750 |

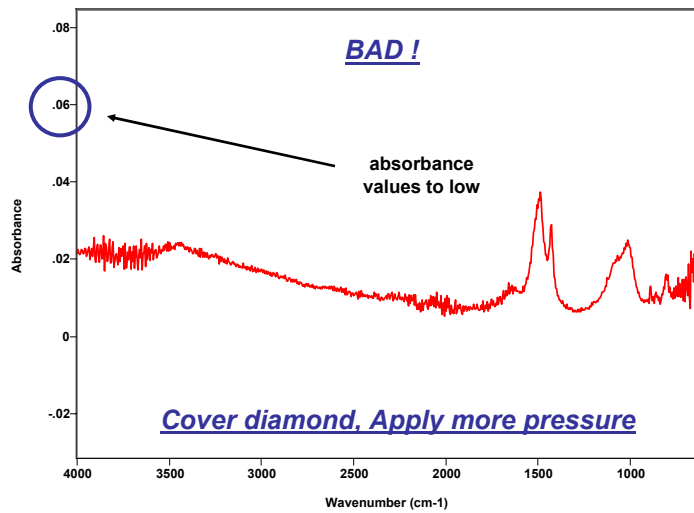
The likelihood of a *positive identification* depends on the *quality* of the data !!!

HazMatID Advanced Topics



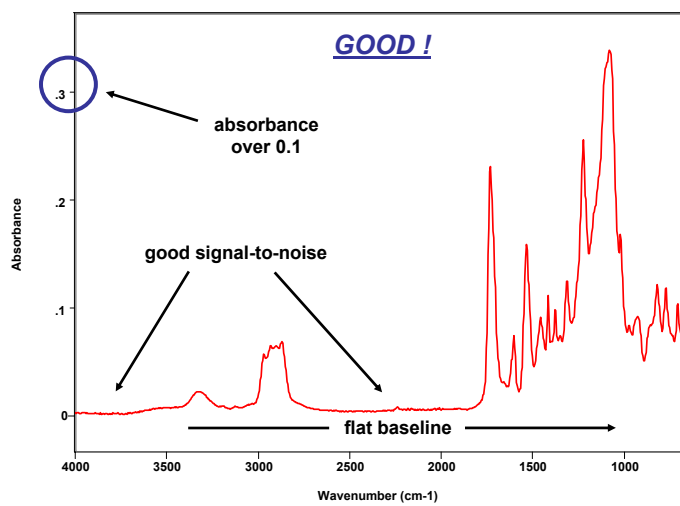
Good or Bad ?

smiths

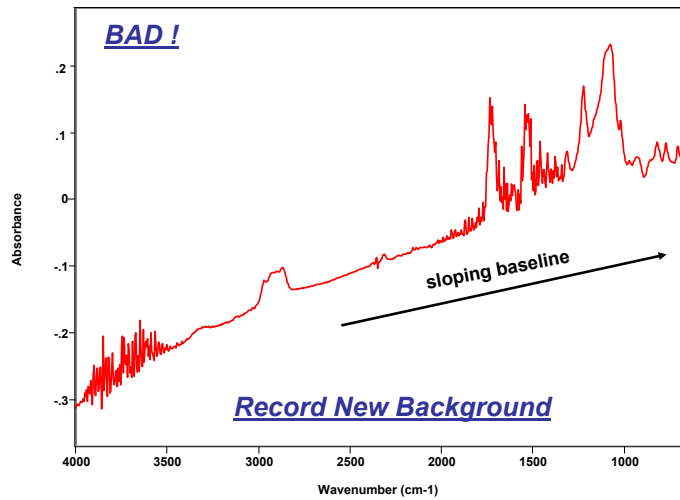


Good or Bad ?

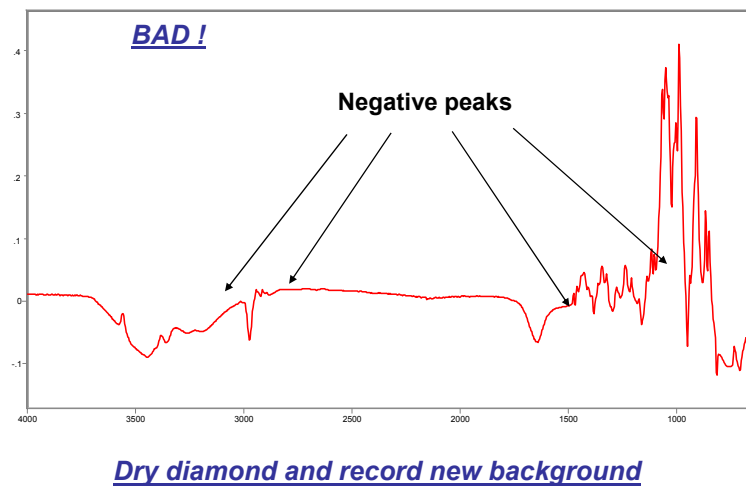
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Good or Bad ?



Good or Bad ?



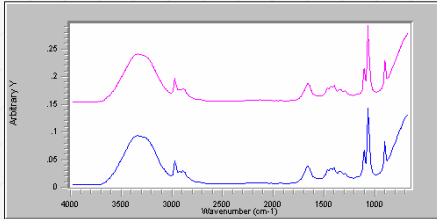
HazMatID - Mixtures

- Unlike GC/MS, Infrared as a technique does **NOT** separate and identify individual components
- Mixtures can be identified with infrared
 - The spectrum of a mixture is characteristic of that mixture
 - If the mixture is in the library, it will match well
 - Simple mixtures can also be identified by primary component identification and residual mathematical subtraction.

HazMatID: Mixture Example

Mixture in library

Similarity: 9999 SampleID: mixture3 09-11-2003 at 9h51m32s
 Name: Ethanol Water mixture 50/50 (testing)



OVERLAY
 SEARCH RESIDUAL
 NIOSH Information

| # | Compound Name(s) | Similarity |
|---|-----------------------------------|------------|
| 1 | Ethanol Water mixture 50/50 | 0.999904 |
| 2 | Gluconic acid | 0.903518 |
| 3 | Water | 0.853453 |
| 4 | Betadine (TM) Antiseptic Solution | 0.853185 |
| 5 | Distilled Water | 0.846202 |

Mixture in library

High similarity

DONE

HazMatID - Mixture Example

Mixture not in library

Similarity: .85192 SampleID: mixture 09-11-2003 at 9h5m48s
Name: Water (SensIRcc)

Main component matched but with low similarity

| # | Compound Name(s) | Similarity |
|---|-----------------------------------|------------|
| 1 | Gluconic acid | 0.903779 |
| 2 | Water | 0.851920 |
| 3 | Betadine (TM) Antiseptic Solution | 0.851831 |
| 4 | Distilled Water | 0.844776 |
| 5 | Astromid 18 | 0.837781 |

08

HazMatID: Mixture Example – 50/50 Water, Ethanol

Similarity: .85192 SampleID: mixture 09-11-2003 at 9h5m48s
Name: Water (SensIRcc)

Shape of water seen in sample

Water in top 5 hits

Sample has more peaks than water

| # | Compound Name(s) | Similarity |
|---|-----------------------------------|------------|
| 1 | Gluconic acid | 0.903779 |
| 2 | Water | 0.851920 |
| 3 | Betadine (TM) Antiseptic Solution | 0.851831 |
| 4 | Distilled Water | 0.844776 |
| 5 | Astromid 18 | 0.837781 |

08

HazMatID: Mixture Example – 50/50 Water, Ethanol

Residual = Sample - (LibraryHit * ScaleFactor)

Sample in green Library in blue Residual in red Scale factor: 0.78389

Keyboard
APPLY SCALE

Quality for Residual Hit: 0.8108 SEARCH RESIDUAL

Best Residual Hit: Ethyl Alcohol

SAVE RESIDUAL CANCEL

Result

Automatic

HazMatID: Mixture Example

Similarity: .81083 SampleID: mixture 09-11-2003 at 9h5m48s_residual0002
Name: Ethyl Alcohol (SensIRdemo)

STACK
SEARCH RESIDUAL
NIOSH Information

| # | Compound Name(s) | Similarity |
|---|----------------------------|------------|
| 1 | Ethyl Alcohol | 0.810829 |
| 2 | Triethyl orthoacetate | 0.804554 |
| 3 | Ethyl Alcohol | 0.795475 |
| 4 | Ethanol | 0.765716 |
| 5 | N-(n-Propyl)diethanolamine | 0.753283 |

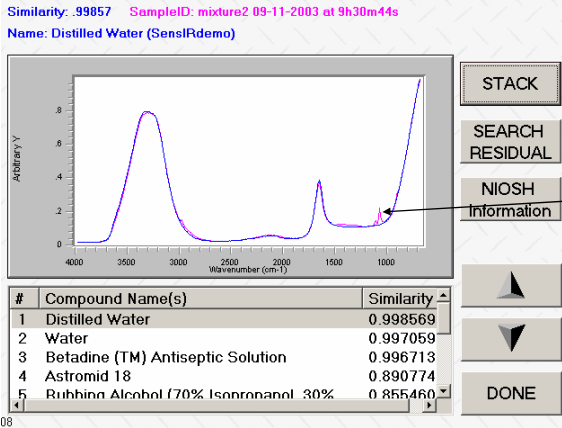
DONE

Top 10 hits shown after "Save".

Visual compare needed to confirm

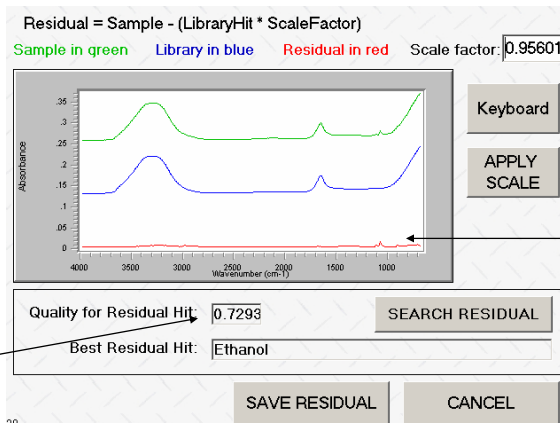
Similarity low after subtraction

HazMatID: Mixture Example – 90/10 Water, Ethanol



Only small difference noted

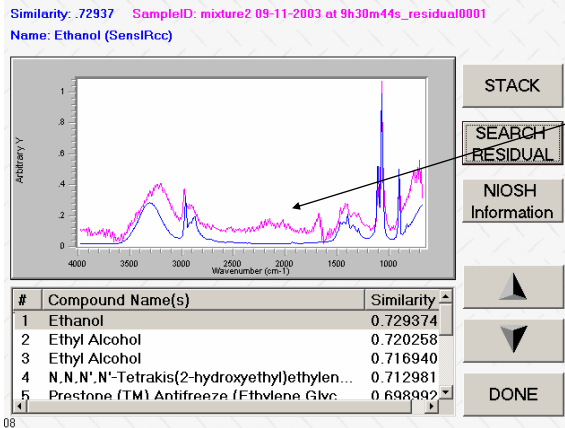
HazMatID: Mixture Example – 90/10 Water, Ethanol



Similarity value lower than 50/50 example 0.70 or greater

Very little information remaining

HazMatID: Mixture Example – 90/10 Water, Ethanol



Minimum concentration for HazMatID: 10%

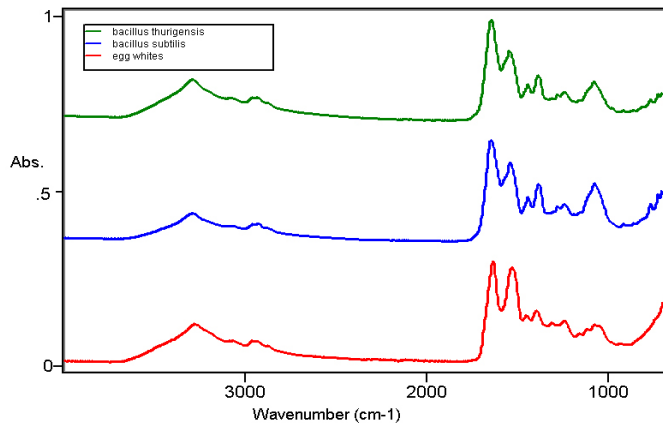
Biological Agents

- Infrared Spectroscopy as a field based portable analytical technique (HazMatID) can **NOT** definitively identify biological agents.
- Why not?

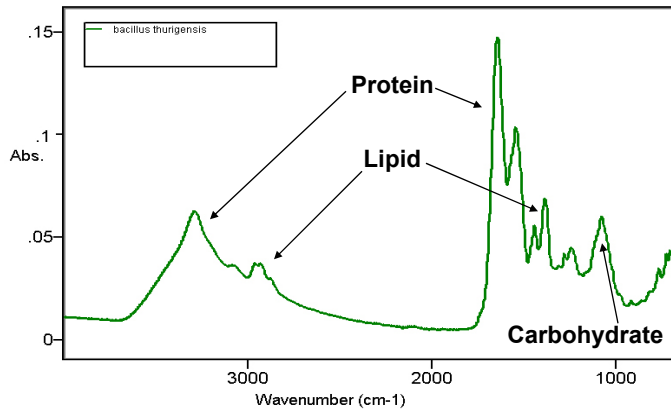
Biological Agents

- Chemistry of bacteria and microorganisms
 - Three main components
 - Protein
 - Lipids
 - Carbohydrate
 - The majority of chemicals (> 80%) in microorganisms are protein.
- Spectra of proteins are too similar to distinguish using library matching
 - Spectra more dependant on protein preparation than identity
 - Moisture content, media for growth, etc.

Bacterium Comparison



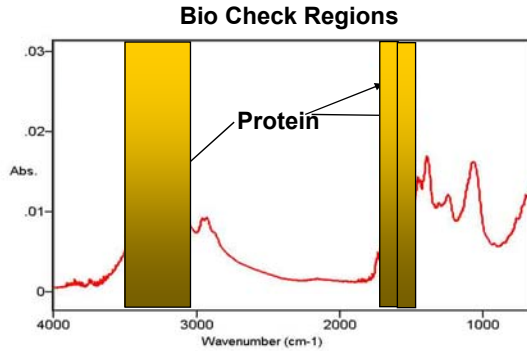
Bacteria Components



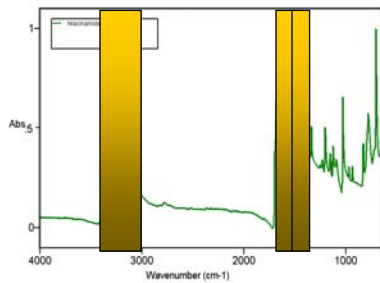
Biological Agents

- IR spectroscopy can NOT currently positively identify biological agents
 - Several Universities researching possibilities
- We can detect proteins
 - 80% of biological agents consist of proteins
 - Still limited by the 10% concentration limit
- HazMatID has a “Bio Check” with looks for the presence of proteins
 - 3300 cm⁻¹
 - 1640 cm⁻¹
 - 1540 cm⁻¹

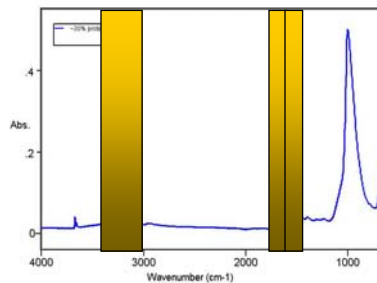
If peaks are found in all three of the bio check regions, a “protein warning” is displayed



- Why do I get false positives?
 - False positives are erring on the side of caution
 - “Bio Check” is set sensitive to find proteins in a mixture



Niacinamide – vitamin supplement



~ 30% Protein in Talc

Biological Agents

- HazMatID is only an INITIAL screening tool for biological agents.
- False positive are possible with the “Bio Check”.
- To confirm a protein, look for 3 peaks
 - 3300 cm^{-1}
 - 1640 cm^{-1}
 - 1540 cm^{-1}
- **Remember the 10% concentration limit**

ExtractIR

- Physically separate mixtures using Solid Phase Extraction (SPE)
- Separate non-volatile organic compounds from water in about 10 minutes
- Designed for Hot Zone use
- Increase detection limits by about 3 orders of magnitude (from 10% to 0.01%)



24/7 ReachBack

- Chemists, Spectroscopists, Engineers, and technicians are on call 24 hours a day, 7 days a week for urgent assistance.
- If no close match is possible, or other system related problems are incurred, contact Smiths Detection/SensIR ReachBack number:
 - 1-866-442-0628 or 1-866-777-8880
 - Provide the Operator with the following information
 - Name
 - Location of Incident
 - Environmental conditions (weather, temperature etc.)
 - Urgency of Matter
 - Sample description – be specific
 - Problems (Spectral interpretation assistance, software or equipment, etc.)
 - If the inquiry pertains to Spectral interpretation assistance, the service rep will ask you to email the spectrum to: reachback@smithsdetection.com

Support

- www.HazMatID.com
- Web based support for up to 3 users per unit
- Download
 - User libraries
 - Updated Smiths/SensIR libraries and software
- Users forum
- Educational corner – FAQ
- ReachBack procedures

Methods

- **Methods contain all of the information the instrument needs to analyze and identify a sample**
- **Selecting libraries is important if new libraries are added**
- **Why edit methods?**
 - **Shorten measurement time**
 - **Reduce noise for difficult samples**
 - **Search different libraries**
 - **Display results with lower match quality (subtraction)**

View/Edit Methods - HazMatID

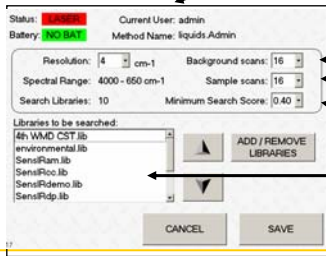
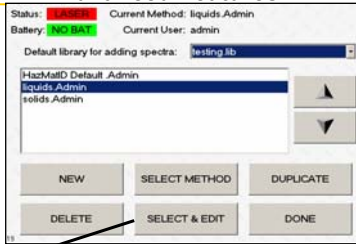
Advanced Features

All Methods

The screenshot displays the 'Method Manager' interface. At the top, it shows 'Status: ASHA', 'Current Method: liquids Admin', 'Battery: NO BATT', and 'Current User: admin'. Below this, there are several buttons: 'METHOD MANAGER' (circled in red), 'DIAGNOSTICS', 'VIEW / EDIT CURRENT METHOD', 'AUTOMATIC ALIGNMENT', 'VIEW PREVIOUS RESULTS', and 'HOME'. An arrow labeled 'All Methods' points to the 'METHOD MANAGER' button. Below the main interface, a detailed view of the 'Method Manager' is shown. It includes a dropdown menu for 'Default library for adding spectra:' with 'testing.lib' selected. Below the dropdown is a list of methods: 'HazMatID Default Admin', 'liquids Admin' (highlighted), and 'solids Admin'. Below the list are buttons for 'NEW', 'SELECT METHOD', 'DUPLICATE', 'DELETE', 'SELECT & EDIT', and 'DONE'. Arrows point from text labels to these elements: 'User library to add to.' points to the dropdown, 'Available methods' points to the list, and 'Select or edit options' points to the bottom buttons.

View/Edit Methods - HazMatID

Advanced Features



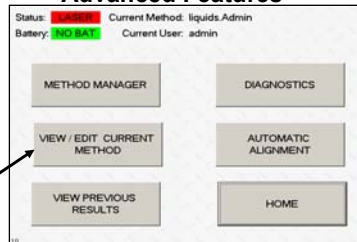
~ 1 second / scan

Minimum score to report

Libraries to search

View/Edit Methods - HazMatID

Advanced Features



Shortcut to current method

Previous Results - HazMatID

Status: **LASER**
Battery: **NO BAT** Incident: test

1 08-29-2003 at 14h52m27s SIR
1 08-29-2003 at 14h55m44s SIR
1 08-29-2003 at 14h55m44s_residual0001 SIR
2 08-29-2003 at 15h0m13s SIR
2 08-29-2003 at 15h11m39s SIR
2 08-29-2003 at 15h11m39s_newsearch0001.sir
2 08-29-2003 at 15h11m39s_residual0001.sir
lexan 09-11-2003 at 10h56m43s SIR
lexan 09-11-2003 at 10h56m43s_newsearch0001.sir
mixture 09-11-2003 at 9h56m5s SIR
mixture 09-11-2003 at 9h5m48s_residual0002 SIR
mixture2 09-11-2003 at 9h30m44s SIR

EXPORT TO DISK VIEW SELECTED DONE

Status: **LASER**
Battery: **NO BAT**

Your data will be saved in the root of the drive you select. For example, if you select drive C: the data files will be stored in the directory C:\

Select which drive to export data to:
d:

Selected Incident: test
Selected Sample: 1 08-29-2003 at 14h52m27s SIR

EXPORT ENTIRE INCIDENT EXPORT SAMPLE DATA FILE CANCEL

Similarity: 99575 SampleID: lexan 09-11-2003 at 10h56m43s
Name: Lexan (TM) Poly(bisphenol A carbonate) (Cisloc)

ADD TO LIBRARY
OVERLAY
SEARCH RESIDUAL
NIOSH Information
DONE

| # | Compound Name(s) | Similarity |
|---|--|------------|
| 1 | Lexan (TM) Poly(bisphenol-A carbonate) | 0.996751 |
| 2 | Lexan (TM) Poly(bisphenol A carbonate) | 0.995757 |
| 3 | Poly(bisphenol A carbonate) | 0.984224 |
| 4 | Polycarbonate Plastic | 0.945483 |
| 5 | Common Floor Material (Polycarbonate) | 0.847960 |

Libraries

- Libraries contain the spectral information that is required to identify a material.
- Library information needs to be completely trusted as we are relying on the quality to insure quality identification.
- A User's library is created in the factory: "UserLibrary.lib"
 - All Smiths/SensIR libraries are write protected to prevent corruption.
- Editing/Adding libraries
 - Add local substances to library
 - Oils, fuels, maintenance materials, known chemical sites
 - Customize libraries for different local companies, or situations like training.

Add to Library

Data View (current or previous results)

ADD TO LIBRARY

Choose Library

Name to appear in library

CAS # for NIOSH Search

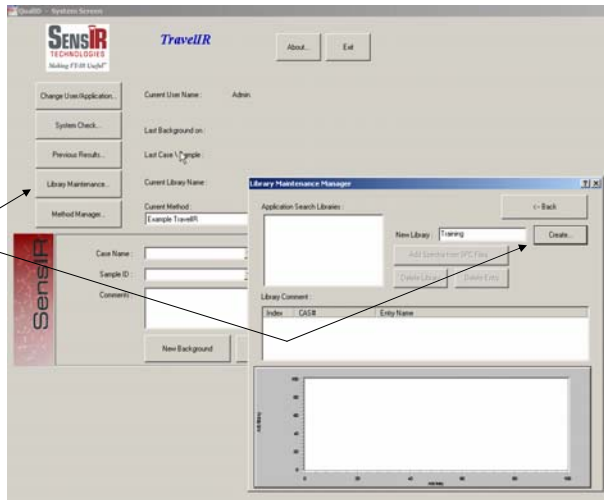
QualID Software

- QualID software is required to create and edit Libraries
 - Operation of QualID is recommended for use on the system laptop.
 - Library maintenance allows the user to remove mistakenly added library entries.
- The QualID icon is located on the laptop desktop and also on the HazMatID desktop.
 - For operation of QualID on the HazMatID you must utilize the "Change Resolution" program also located on the HazMatID desktop. Then the QualID program can be launched.



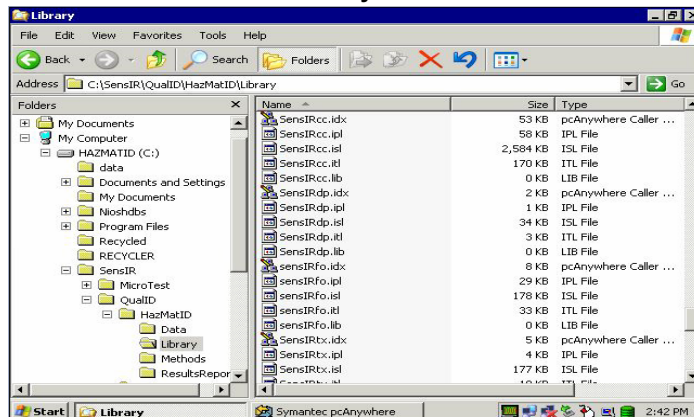
Creating new Libraries

- Select library maintenance and type in the library name



Copying Libraries

- Add a known substance to the new library and then copy the five database files to the HazMatID using Flash Device or wirelessly
- C:\SensiIR\QualID\HazMatID\Library



Reports

- Reports must be generated in QualID
 - Easiest to do on the Laptop
- Report Procedure
 - Transfer data files to laptop w/ PC Anywhere or Flash device
 - File location C:\SensIR\QualID\HazMatID\Data\[Incident]
 - Destination on laptop C:\SensIR\QualID\HazMatID\Data\[incident]
 - 2 files per reading – [name].spc, [name.sir]
 - On laptop, open QualID
 - Select “Previous Results”
 - Select correct case (incident) name
 - Select Print Report
 - Report printed to default printer
 - Copy saved

Reports



Select:
Previous
Results

Reports

The screenshot shows the SensIR software interface. The main window is titled "SensIR - Review Previous Results". It features a "Data Results Folder" field set to "C:\SensIR\QualID\ViaMatID\data". Below this, there are fields for "Case Name" (set to "randolph") and "Sample ID" (set to "Inboards 7, ' allowed"). A date range filter is set to "Only Dated Between: 2/15/2004 and 2/15/2004". A list of cases is displayed, with the selected case being "10/15/2003 test sample 3 10-15-2003 at 10h12m0s". Below the list is a table of search results:

| # | Quality | Library | Name |
|---|---------|---------------------|----------------------|
| 1 | 0.543 | SENSIR(CC-16)(2004) | Acetone |
| 2 | 0.542 | SENSIR(CC-16)(570) | 2,5-Hexanedione |
| 3 | 0.539 | SENSIR(TX-16)(20) | Acetone |
| 4 | 0.539 | SENSIR(DP-16)(36) | Acetone |
| 5 | 0.483 | SENSIR(CC-16)(180) | 4-Hydroxy-2-butanone |
| 6 | 0.452 | SENSIR(DP-16)(40) | Methyl Ethyl ketone |
| 7 | 0.452 | SENSIR(TX-16)(82) | Methyl ethyl ketone |

At the bottom of the main window, there are buttons for "Print Report...", "Compare Spectra & Residual Search...", "Test Search...", "New Search...", "Copy To From...", "Go To Grams...", "Reach Back...", and "Database Lookup: NIOSH Find".

A "Select from existing" dialog box is open on the right, showing a list of cases: "010904", "randolph", "regional training VA", "test", and "training". The "OK" button is highlighted.

Reports

The screenshot shows the "Report options" dialog box. It has two main sections:

Select Report Formatting:

- Landscape mode
- Full Page per Spectrum
- Show library Quality values

Select Optional Report information to be included in Report:

- Logo (BMP): []
- Report Header
- Background Spectrum
- Text Search Results
- Method Information
- Sample Spectrum
- Library Summary Table
- Library Match Spectrum
- Signature (BMP): []

At the bottom of the dialog box are "OK" and "Cancel" buttons.

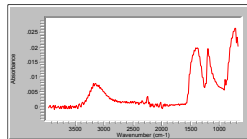
Reports

smiths

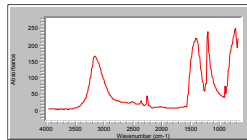
```
RESULTFILE: C:\SensIR\QualID\HazMatID\data\training\BORIC ACID 12-17-2003 at 16h5m49s.SIR  
DATE : 12/17/03 16:07:11  
METHOD : "METHODSCRATCH_PNP"  
USERNAME : ""  
APPLIC : HazMatID Application  
CASE : CANNON
```

```
BKG FILE : CANNON\Bckg.spc  
DATE : <unknown>
```

```
SAMPLE : BORIC ACID 12-17-2003 at 16h5m49s  
DATAFILE : BORIC ACID 12-17-2003 at  
16h5m49s.spc  
DATE : 12/17/03 16:07:04
```



```
LIBRARY :  
C:\SensIR\QualID\HazMatID\LIBRARY\SENSIRCC.lib  
BEST MATCH: Boric Acid Powder
```



Batteries

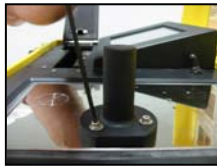
smiths

- **Battery has approx. a 2 hour service life.**
 - Battery life indicator at the top of most screens.
 - Yellow warning with 30 min. remaining.
 - Do not run with less than 15 minutes remaining.
 - AC Power can be applied to replace the installed battery.
- **Batteries should be stored fully charged.**
 - Can remain in charger when not in use.
 - Li-Ion Batteries resist memory effects
- **Do NOT store the battery in the HazMatID**
 - Slow drain of the charge.
 - Battery voltage too low for the battery charger.
 - "Jump start" by inserting in the charger multiple times.
 - Move battery between the charger slots after the red light is displayed.

Maintenance

- **Alignment**
 - **Auto alignment**
 - Anytime “Energy” is low (yellow or red)
15000-19999 – Yellow
20000-32000 - Green
- **Cleaning**
 - Washable, submersible.
 - Keep solvents off of case
 - Dry diamond before use
- **Source Replacement**

Source Replacement, HazMatID



Remove old source with 3 hex bolts.



Remove plastic cover from new source.



Replace source gasket
And screw o-rings.



Align new source with 2 pins and tighten 3 screws.

Two pins

Powering down the HazMatID

The screenshot shows the HazMatID interface. On the left, a status bar indicates 'READY' and 'Battery: 130 min'. Below this are three buttons: 'START', 'ADVANCED FEATURES', and 'LOGOUT'. Text instructions explain the functions of these buttons. The 'LOGOUT' button is highlighted with an arrow from the text 'Select Logout'. Below the buttons, it shows 'Current User: Admin' and 'Current Method: Example HazmatID.Admin'. On the right, a 'Please Log In' screen is shown with a 'User name' dropdown set to 'Admin', a 'Password' field, and 'Keyboard' indicators. At the bottom of the login screen are three buttons: 'TUTORIAL', 'SHUTDOWN', and 'LOGIN'. An arrow from the text 'Select Shutdown on the next two screens' points to the 'SHUTDOWN' button.

Powering down the HazMatID

The screenshot shows a Windows XP desktop with the 'Start' menu open. The 'Turn Off Computer' option is highlighted with an arrow from the text 'Select Turn off computer'. A 'Turn off computer' dialog box is open, showing three options: 'Stand by', 'Turn Off', and 'Restart'. The 'Turn Off' option is selected with a mouse cursor. The 'Cancel' button is also visible at the bottom of the dialog box.

Powering down the HazMatID



- **Wait for the “safe to power off message**
- **Then flip the lever switch to 0**