

The State of Data in Explosives and Ignitable Liquids

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- 3. The Prevention of and Fight against Crime Programme of the European Union. This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the European Commission cannot be held responsible for any use which may be made of the information contained therein.*

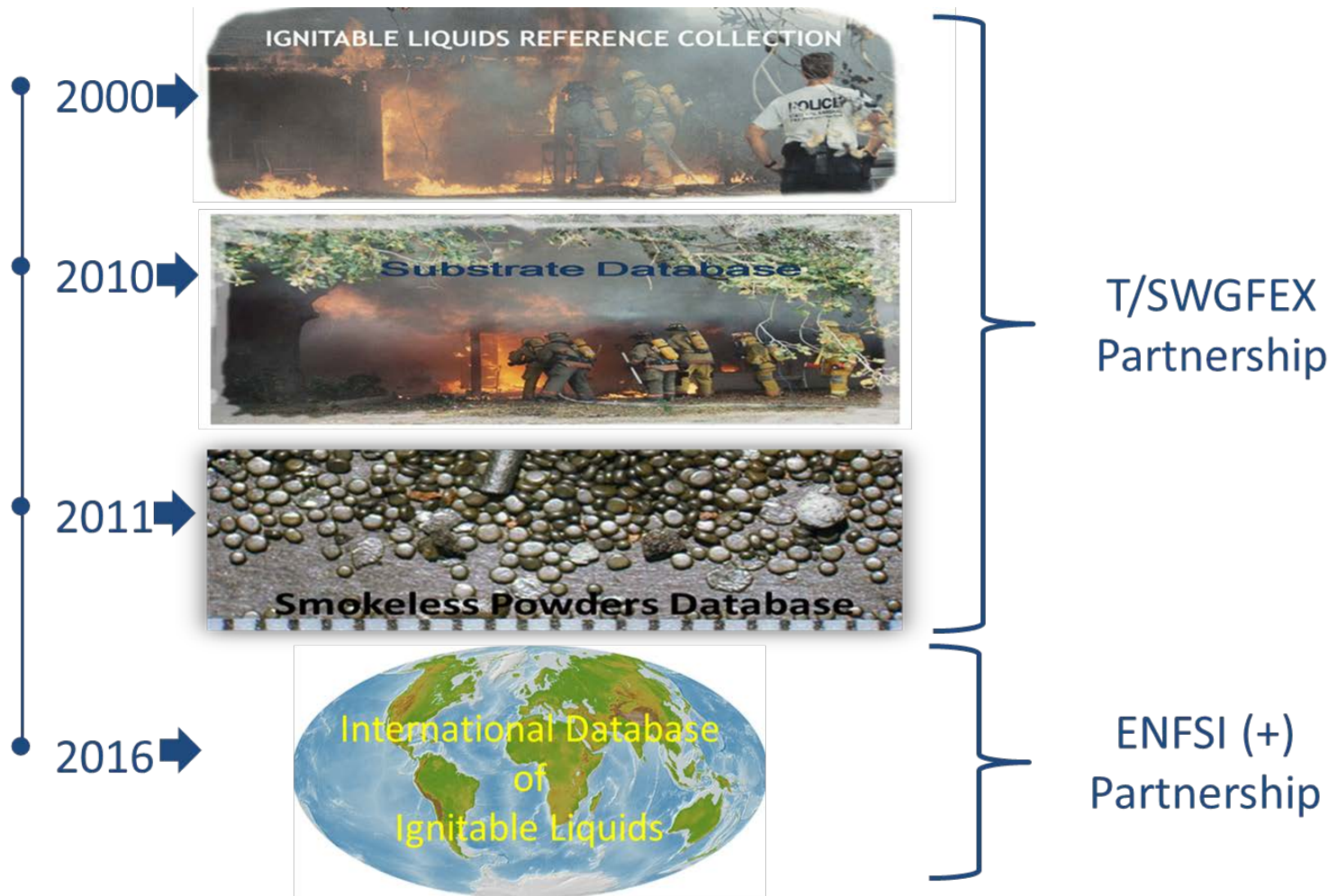


Presentation Outline

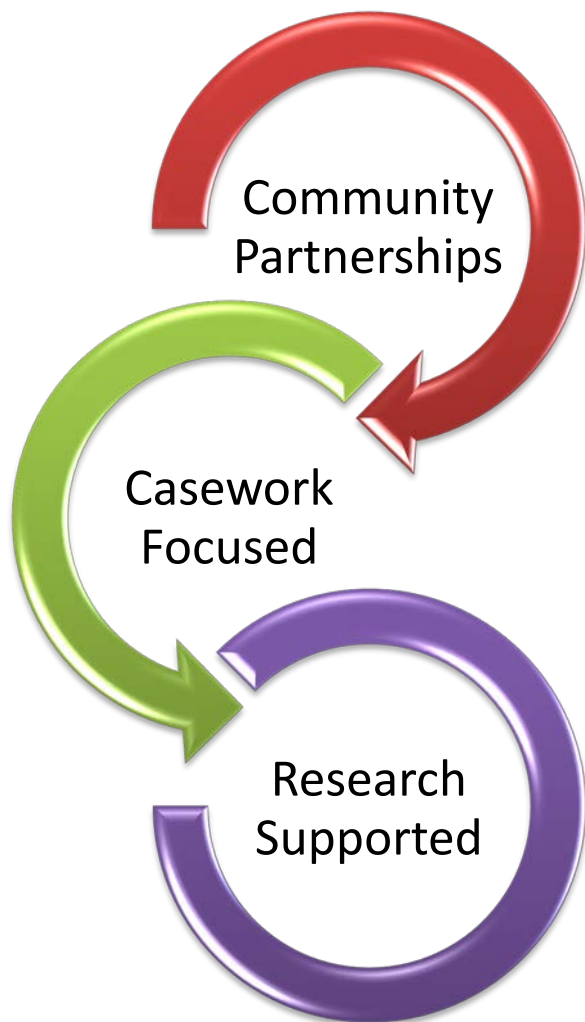
- Overview of NCFS databases and partnerships
- Detailed Descriptions
 - Ignitable Liquids Reference Collection Database
 - International Database of Ignitable Liquids
 - Substrates Database
 - Smokeless Powders Database
- Future needs and directions
- Summary



NCFS Database Time Line



NCFS Database Development



Database projects are driven by needs of the forensic science community and conducted as partnerships with the community.

Databases are designed to meet the daily needs of analysts performing casework. Database growth to answer new questions and meet new casework needs is anticipated.

Combining Community Partnerships and Casework Focus with literature and community driven research support is a strong basis for obtaining competitive funding.



Ignitable Liquids Database

Substrate Database



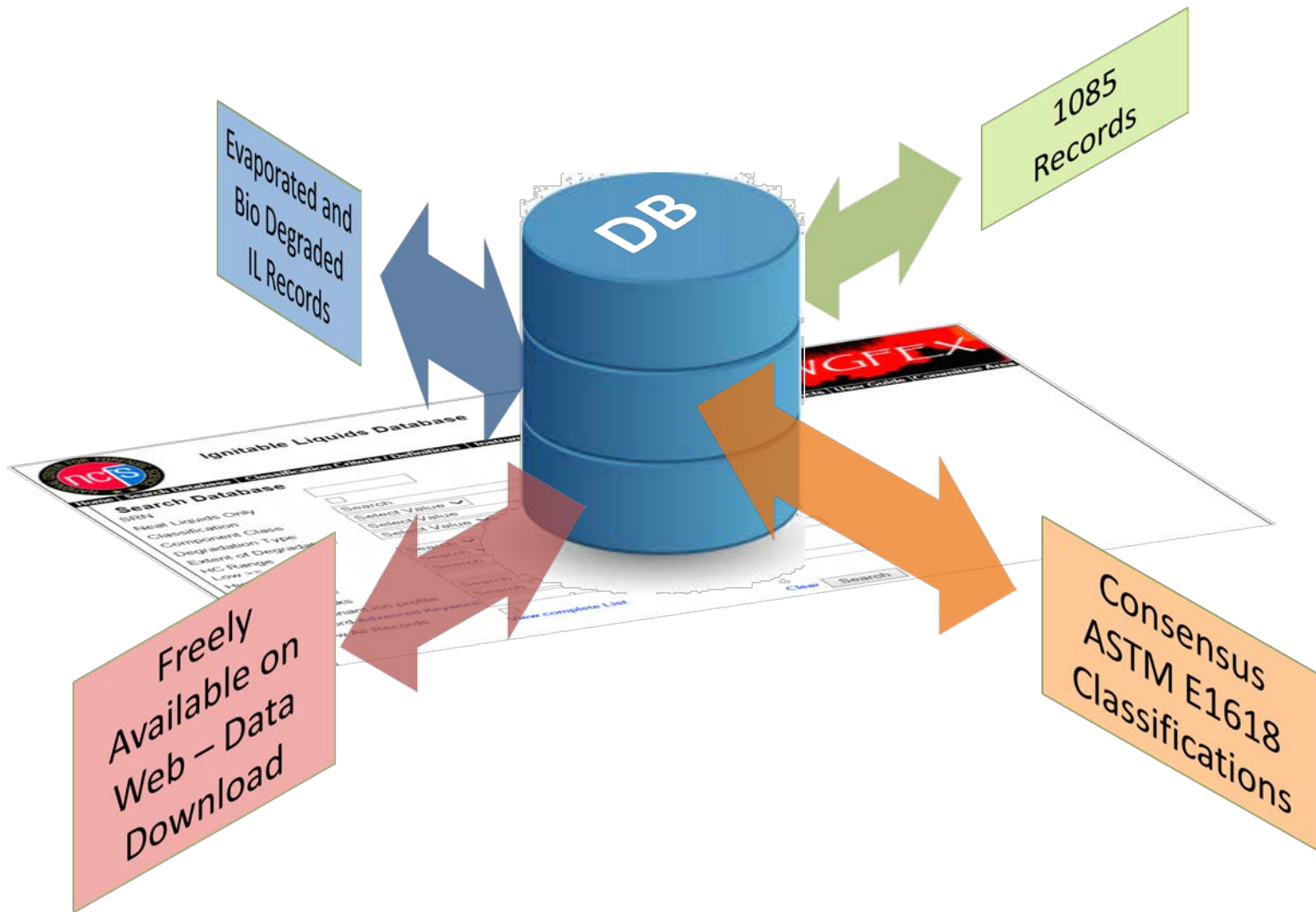
Home | Search Database | Classification Criteria / Definitions | Instrument Parameters | Download All | Contacts | Help | Committee Area




<http://ilrc.ucf.edu/>




Ignitable Liquids Reference Collection Database



ILRC Database: Search Page

 **Ignitable Liquids Database** Substrate Database



[Home](#) | [Search Database](#) | [Classification Criteria / Definitions](#) | [Instrument Parameters](#) | [Sample Preparation](#) | [Contacts](#) | [User Guide](#) | [Committee Area](#)

Search Database

SRN

Neat Liquids Only

Classification

Component Class

Degradation Type

Extent of Degradation

HC Range

Low >=

High <=

Product Use

Brand Name

Major Peaks

Predominant ion profile

Keyword [Advanced Keyword](#)

Show All Records

[View complete List](#)

[Clear](#)

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ILRC Database: Search Results

Ignitable Liquids Reference Collection

Total Records: 34
 Certain browsers scale the image. Please click on the image to zoom in/out

SRN	Brand Name	HC Range	Predominant ion profile	Classification	Major Peaks
0096	BP Regular Unleaded Gasoline	C 6-C 14	Aromatics	Gasoline	1,2,4-trimethylbenzene m,p-ethyltoluene m,p-xylene toluene
0097	BP Regular Unleaded Gasoline	C 6-C 14	Aromatics	Gasoline	1,2,4-trimethylbenzene m,p-ethyltoluene m,p-xylene toluene

TIC: 0096

Abundance

Time (s) -> 4.00 6.00 8.00 10.00 12.00 14.00

Alkanes -> C6 C7 C8 C9 C10 C11 C12 C13

SRN 0096

Brand Name BP Regular Unleaded Gasoline

HC Range C 6-C 14

Predominant ion profile Aromatics

Classification Gasoline

Major Peaks 1,2,4-trimethylbenzene m,p-ethyltoluene m,p-xylene toluene

[Sample detail & download section](#)

TIC: 0097

Abundance

Time (s) -> 4.00 6.00 8.00 10.00 12.00 14.00

Alkanes -> C6 C7 C8 C9 C10 C11 C12 C13

SRN 0097

Brand Name BP Regular Unleaded Gasoline

HC Range C 6-C 14

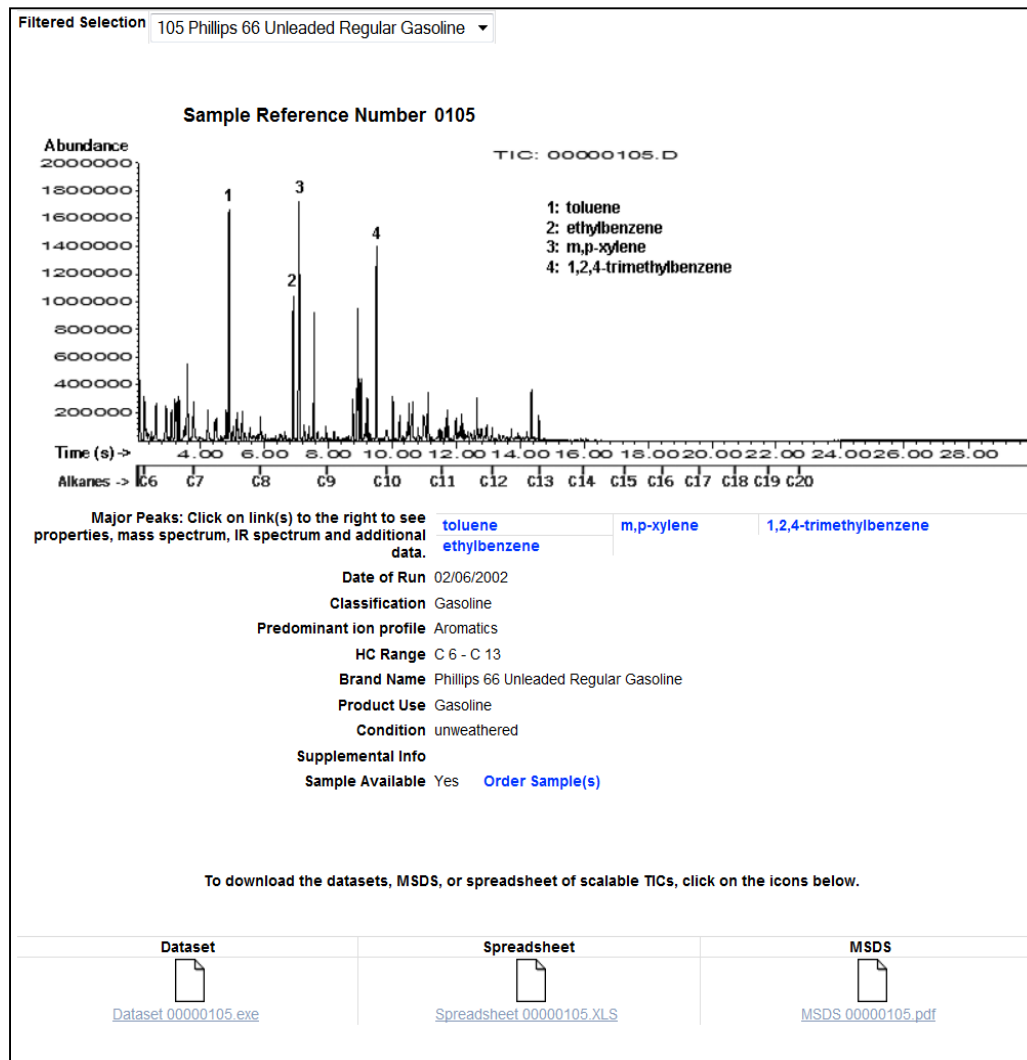
Predominant ion profile Aromatics

Classification Gasoline

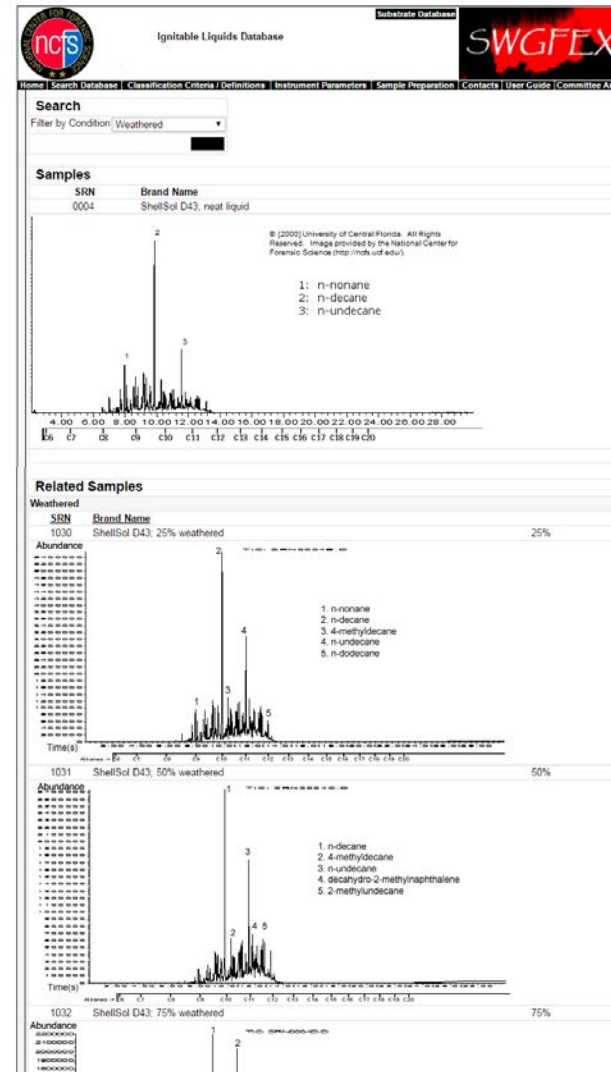
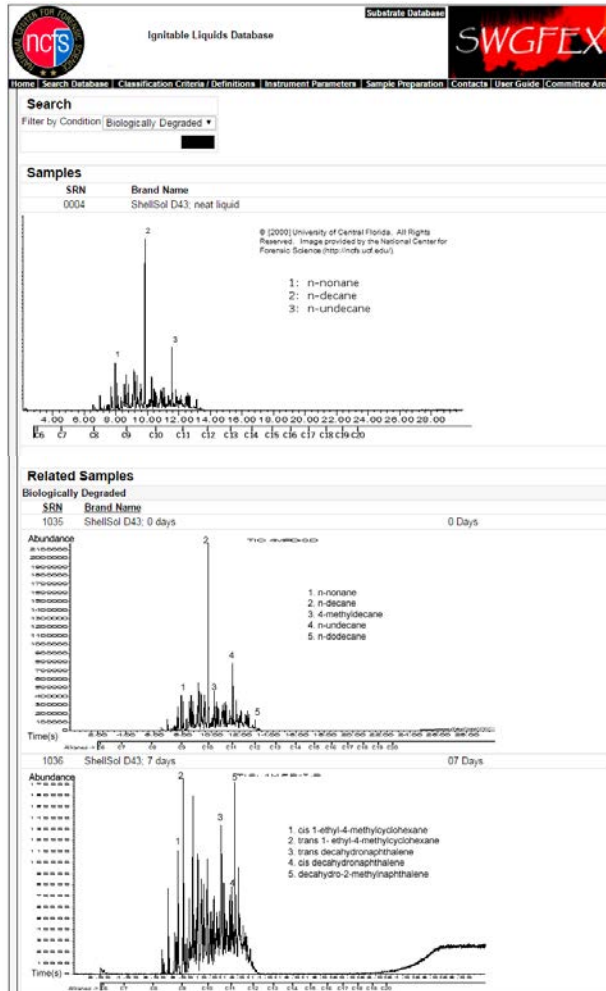
Major Peaks 1,2,4-trimethylbenzene m,p-ethyltoluene m,p-xylene toluene

[Sample detail & download section](#)

ILRC Database: Sample Detail & Download

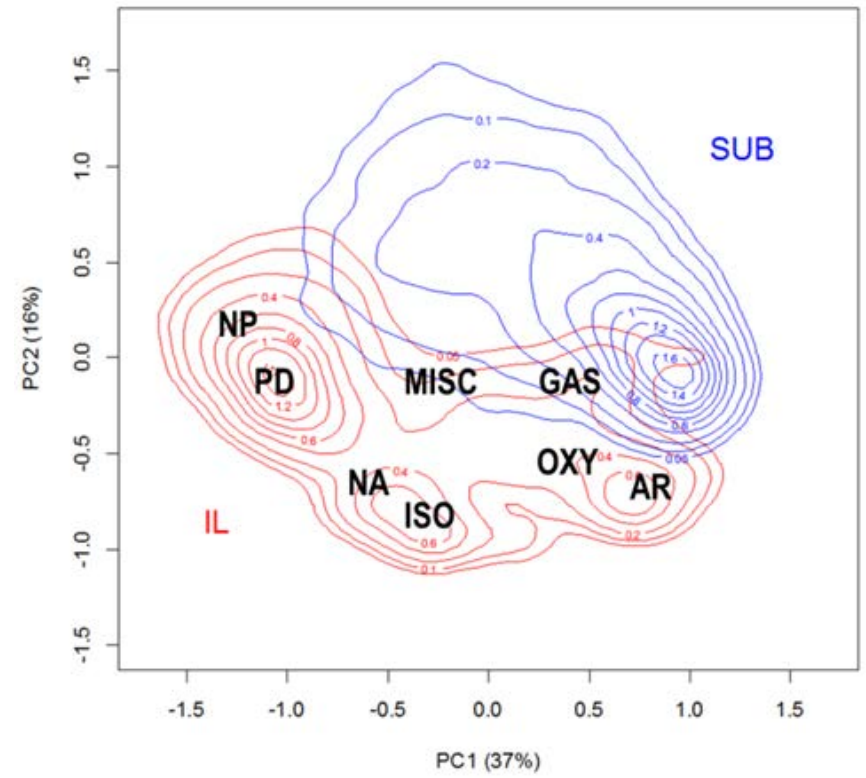
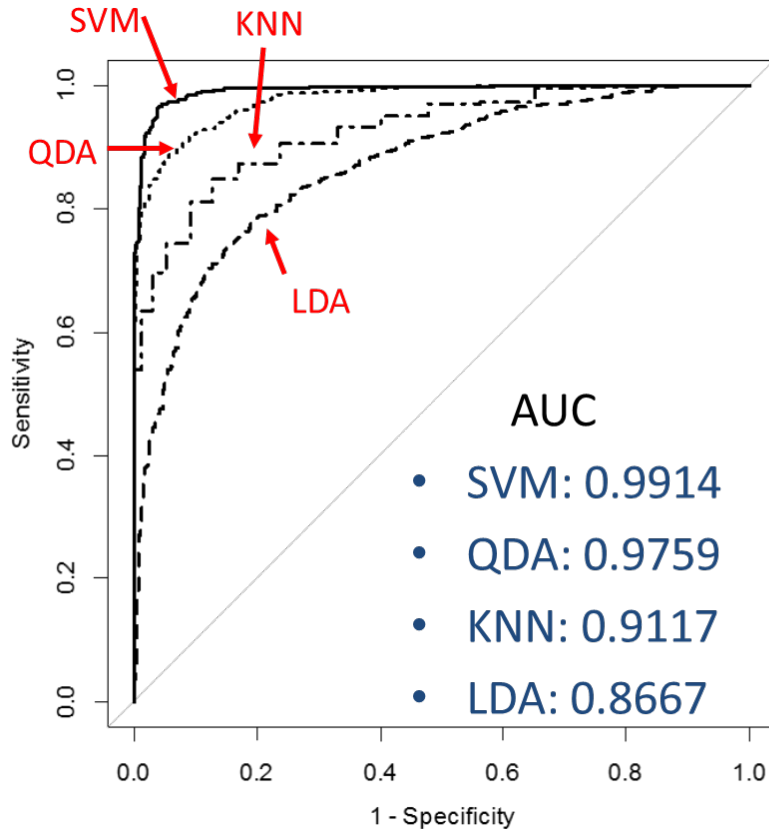


ILRC Database: Related Samples



Modeling Fire Debris: Classification Models

Fire Debris 0 – 100% SUB, Validation Data

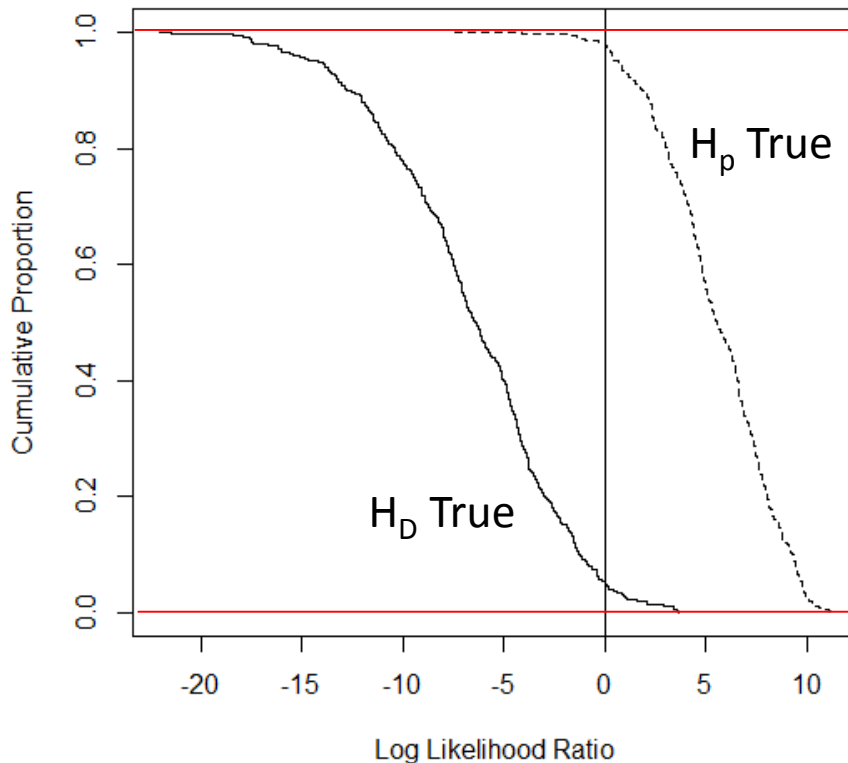
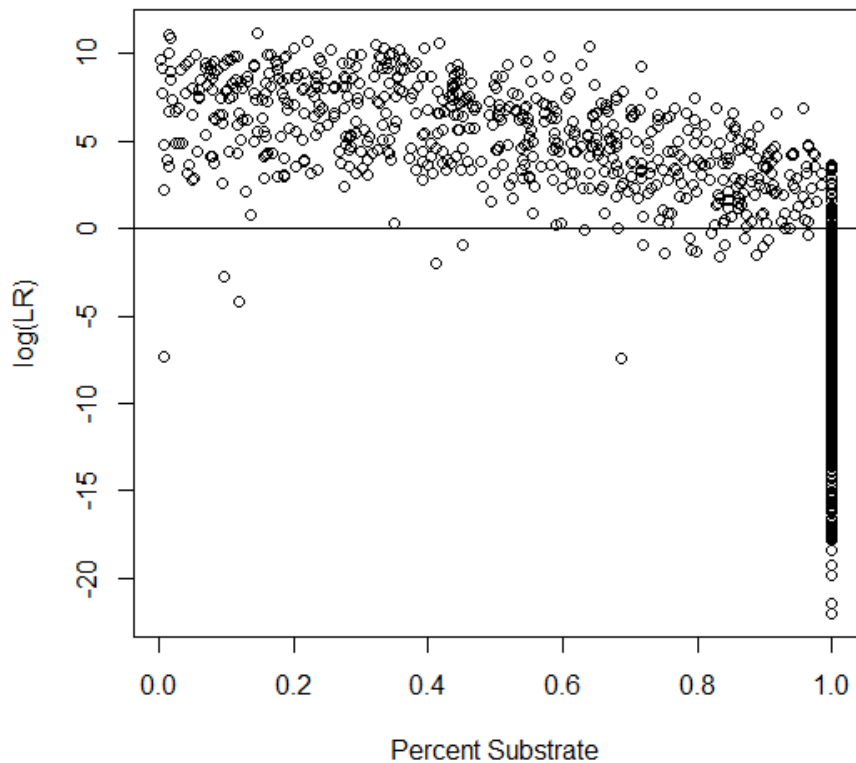


Sigman, M. E.; Williams, M. R., "Assessing Evidentiary Value in Fire Debris Analysis by Chemometric Approaches", Forensic Sci. International, (2016) 264, 113 – 121.



Tippett Plot

Fire Debris 0 – 100% SUB, Validation Data



H_p : The sample is positive for ILR
 H_D : The sample is not positive for ILR



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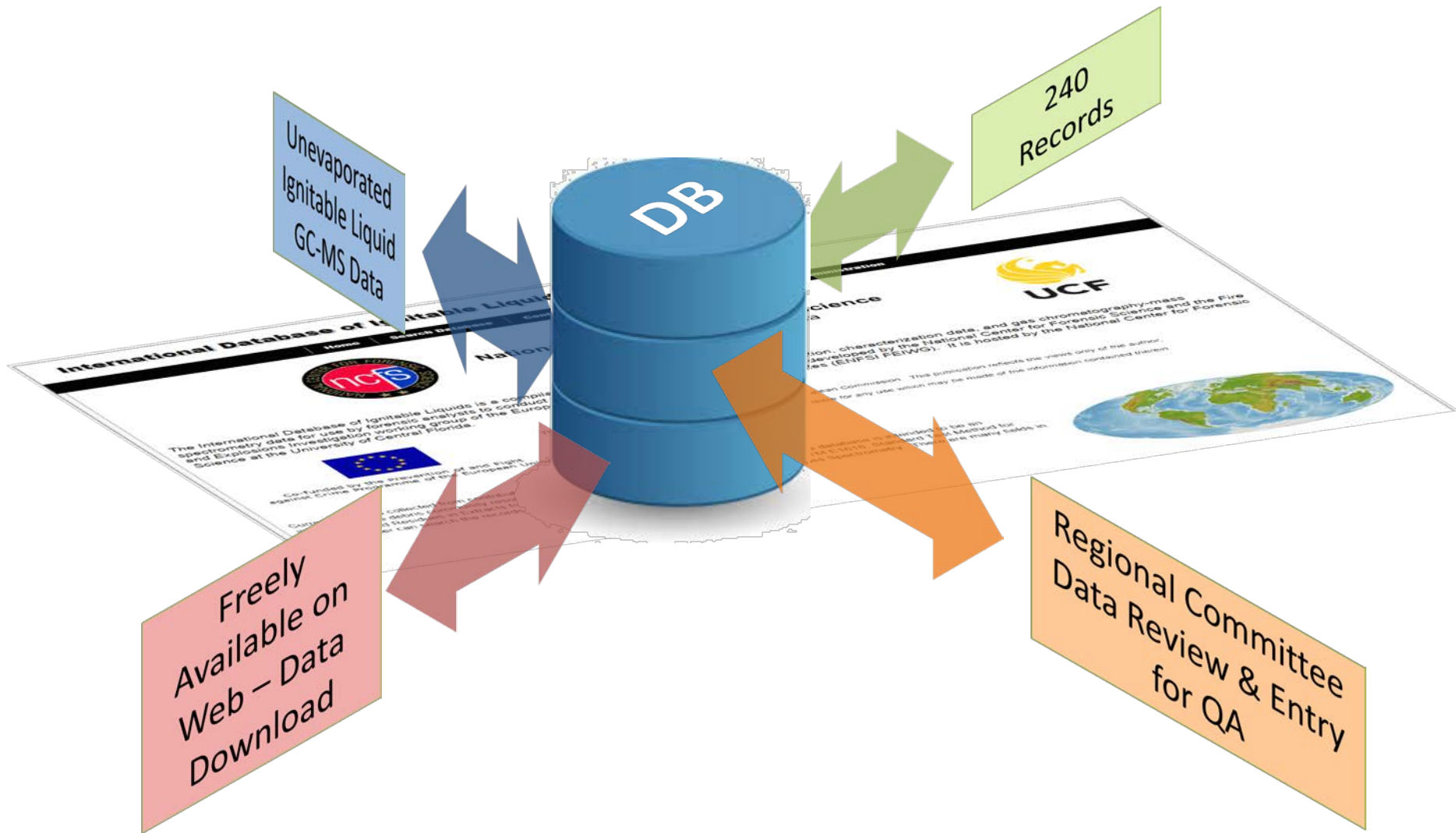
Co-funded by the Prevention of and Fight
against Crime Programme of the European Union



<http://ncfs.ucf.edu/internationaldb/>



International Database of IL



International Database of IL: Search Page

International Database of Ignitable Liquids

[Home](#)[Search Database](#)[Contacts](#)[User Guide](#)[Download](#)[Administration](#)

Search Database

Ignitable Liquid Information		Classification Information	
SRN	<input type="text"/>	HC Range	<input type="text"/>
Brand Name	<input type="text"/>	Low >=	<input type="text" value="Search"/>
Country Purchased	<input type="text" value="Select Value"/>	High <=	<input type="text" value="Search"/>
Product Use	<input type="text" value="Search"/>	Predominant ion profile	<input type="text" value="Search"/>
Date Purchased	<input type="text"/>	Classification	<input type="text" value="Search"/>
Data Source	<input type="text" value="Select Value"/>	Major Peaks	<input type="text" value="Search Peak Name"/>
Data Source SRN	<input type="text"/>	CAS #	<input type="text" value="Search Abstract"/>
Country of Data Source	<input type="text" value="Select Value"/>	TIC Image width	<input type="text" value="800 Pixel"/>
Region	<input type="text" value="All Regions"/>		
Keyword	<input type="text"/>		
Advanced Keyword			

Show All Liquids

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International Database of IL: Search Results

Released Samples

Total Records: 7

SRN	Brand Name	HC Range	Predominant ion profile	Classification	Major Peaks
0032	Diesel, Shell	C 6-C 23	Alkanes	Heavy petroleum distillate (HPD)	<ol style="list-style-type: none"> 1. methylcyclohexane 2. toluene 3. n-heptadecane 4. n-octadecane 5. n-nonadecane
<p>SRN: 0032 Country Purchased: Netherlands Brand Name: Diesel, Shell HC Range: C 6-C 23 Predominant ion profile: Alkanes Classification: Heavy petroleum distillate (HPD) Major Peaks: methylcyclohexane 0000108-87-2 n-heptadecane 0000629-78-7 n-hexadecane 0000544-76-3 n-nonadecane 0000629-92-5 toluene 0000108-88-3</p> <p>Sample detail & download section</p>					
0037	Gasoline, BP Ultimate	C 6-C 12	Aromatics	Gasoline	<ol style="list-style-type: none"> 1. 2-ethoxy-2-methylpropane (ETBE) 2. 2,2,4-trimethylpentane 3. toluene 4. m/p-xylene 5. 1,2,4-trimethylbenzene
<p>SRN: 0037 Country Purchased: Netherlands Brand Name: Gasoline, BP Ultimate HC Range: C 6-C 12 Predominant ion profile: Aromatics Classification: Gasoline Major Peaks: 1,2,4-trimethylbenzene 0000095-63-6 2,2,4-trimethylpentane 0000540-84-1 2-ethoxy-2-methylpropane (ETBE) 0000637-92-3 m,p-xylene 0000108-38-3 toluene 0000108-88-3</p> <p>Sample detail & download section</p>					

International Database of IL: Sample Detail & Download

International Database of Ignitable Liquids

Home Search Database Contacts User Guide Download Administration

Filtered Selection: 32 Diesel, Shell

Sample Reference Number 0032

TIC: NL_NFI_0001.D\data.ms

1. methylcyclohexane
2. toluene
3. n-heptadecane
4. n-octadecane
5. n-nonadecane

Brand Name Diesel, Shell
Sample Preparation Dilution
Product Use Automotive Fuel
Date Purchased 4/1/2015
Country Purchased Netherlands
Country of Data Source Netherlands
Region Europe
Data Source Netherlands Forensic Institute
Data Source SRN NL_NFI_0001
Date Released 8/4/2015

Date of Run 4/1/2015
HC Range C 6 - C 23
Predominant ion profile Alkanes
Classification Heavy petroleum distillate (HPD)
Supplemental Information
Major Peaks
methylcyclohexane 0000108-87-2
n-heptadecane 0000629-78-7
n-hexadecane 0000544-76-3
n-nonadecane 0000929-92-6
toluene 0000108-88-3

GC-MS Dataset.pdf
Sample Preparation & Instrument Parameters

NL_NFI_0001.CDF
NFI_liquid_Institute_and_method_description.doc

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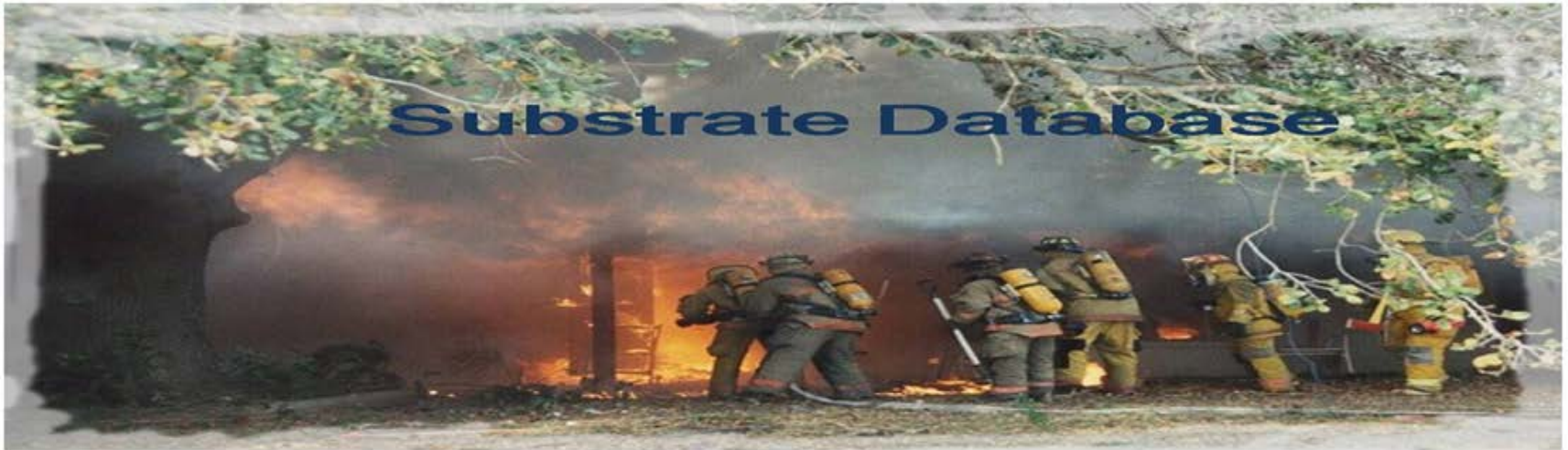


Substrate Database

ILRC Database



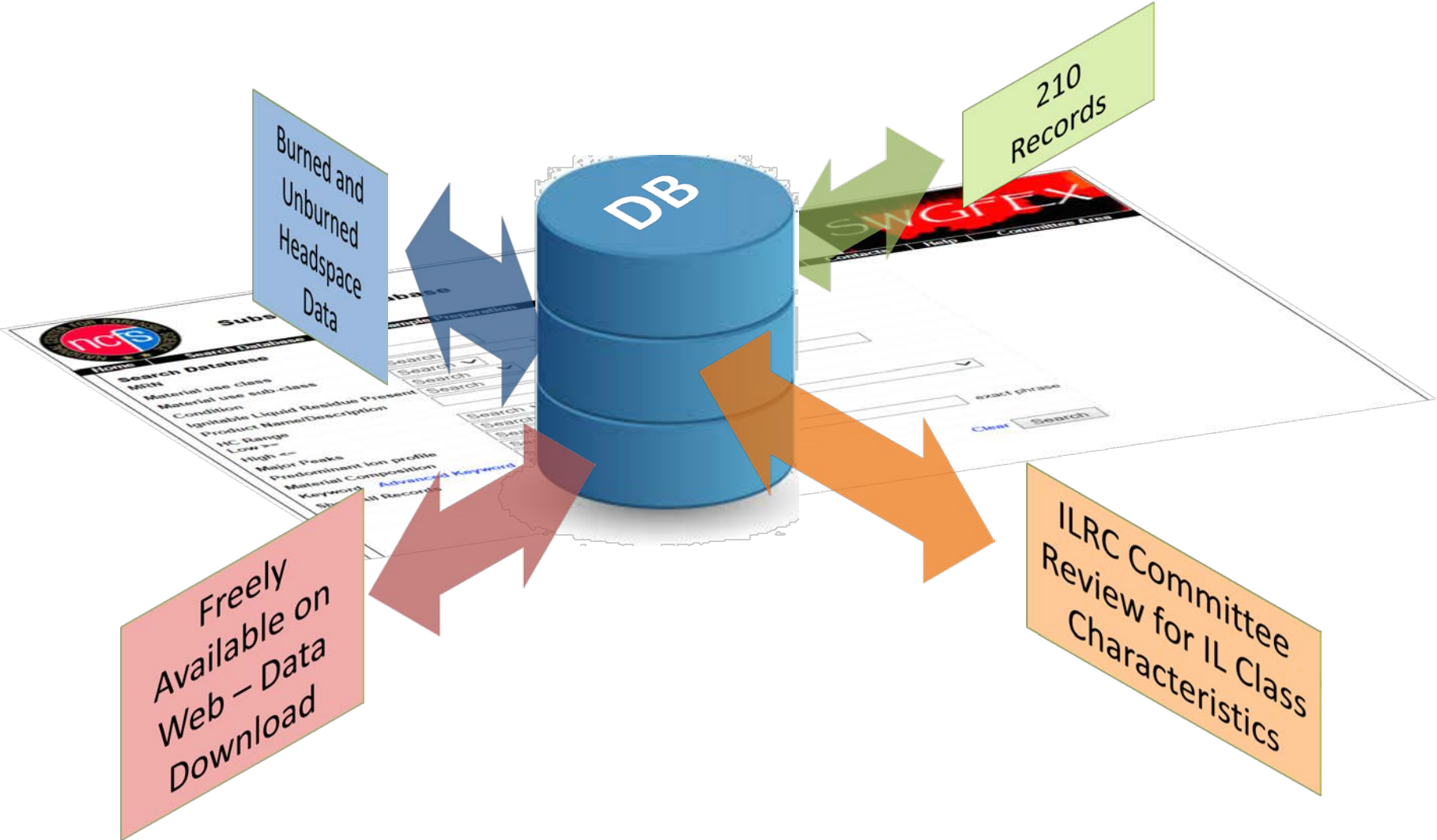
Home | Search Database | Sample Preparation | Instrument Parameters | Download All | Contacts | Help | Committee Area



<http://ilrc.ucf.edu/substrate/>



Substrate Database



Substrate Database: Search Page

Search Database	
MRN	<input type="text"/>
Material use class	Search ▾
Material use sub-class	Search ▾
Condition	Search ▾
Ignitable Liquid Residue Present	Search ▾
Product Name/Description	<input type="text"/>
HC Range	
Low >=	Search ▾
High <=	Search ▾
Major Peaks	Search ▾
Predominant ion profile	Search ▾
Material Composition	Search ▾
Keyword Advanced Keyword	<input type="text"/> exact phrase
Show All Records	<input type="checkbox"/>
View complete List	
Clear <input type="button" value="Search"/>	

Substrate Database: Search Results

Total Records: 14
 Certain browsers scale the image. Please click on the image to zoom in/out

MRN	Product Name/Description	HC Range	Condition	Material use class	Major Peaks
0007	1. styrene 2. benzaldehyde	C 7-C 19	Burned	Flooring Carpet Olefin Carpet	benzaldehyde styrene
0008		C 10-C 18	Unburned	Flooring Carpet Olefin Carpet	Peaks not identified

Abundance vs Time (s) chromatogram for MRN 0007. The y-axis ranges from 0 to 1,500,000. The x-axis ranges from 4.00 to 20.00 seconds. Two major peaks are labeled: peak 1 at approximately 8.5 minutes and peak 2 at approximately 10.5 minutes. The plot title is 'TIC: 40907.H.D\data.ms'.

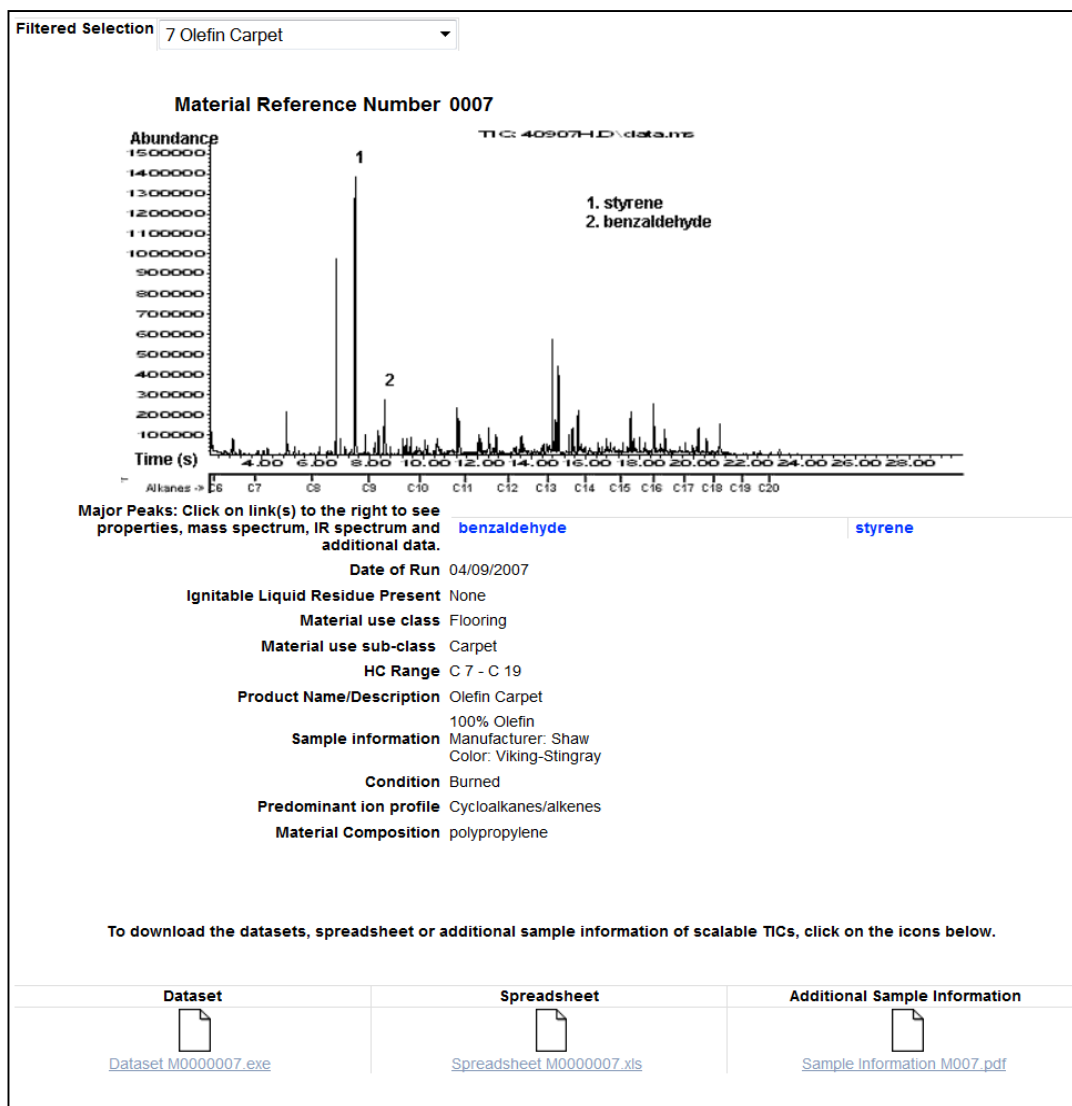
MRN: 0007
 HC Range: C 7-C 19
 Material use class: Flooring
 Material use sub-class: Carpet
 Product Name/Description: Olefin Carpet
 Ignitable Liquid Residue Present: None
 Condition: Burned
 Major Peaks: benzaldehyde styrene

Predominant Profile: Cycloalkanes/alkenes
 Material Composition: polypropylene
[Sample detail & download section](#)

Abundance vs Time (s) chromatogram for MRN 0008. The y-axis ranges from 0 to 450,000. The x-axis ranges from 4.00 to 26.00 seconds. A single major peak is visible at approximately 16.5 minutes. The plot title is 'TIC: 40907A.D\data.ms'.

MRN: 0008
 HC Range: C 10-C 18
 Material use class: Flooring
 Material use sub-class: Carpet
 Product Name/Description: Olefin Carpet
 Ignitable Liquid Residue Present: None
 Condition: Unburned
 Major Peaks: Peaks not identified
 Predominant Profile: Cycloalkanes/alkenes
 Material Composition: polypropylene
[Sample detail & download section](#)

Substrate Database: Sample Detail & Download



Substrate Database: Current Expansion Work

- Addition of 1350 new records
- Multiple burn methods
- Tabulation of frequency of occurrence of 255 major compounds in each ILRC and Substrates Database record
- Investigation of improved modeling of fire debris using new substrate pyrolysis data



2015-DN-BX-K051 awarded by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice

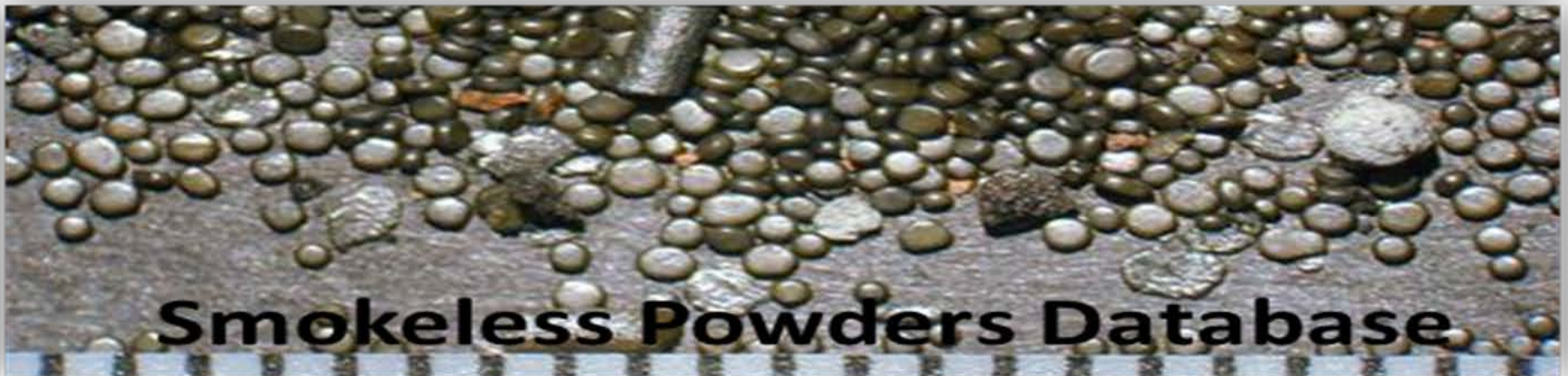




Smokeless Powders Database



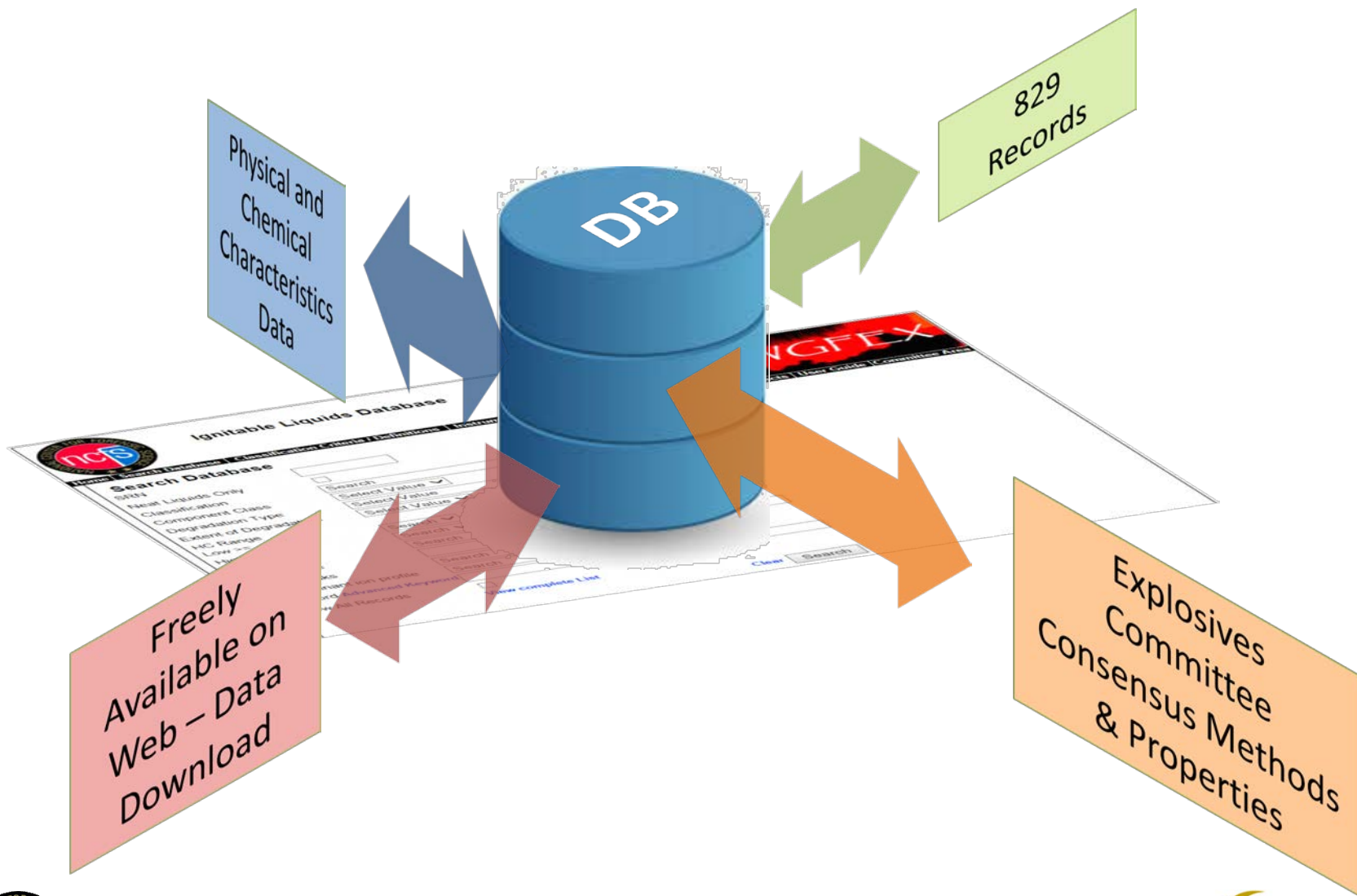
Home | Search Database | Sample Preparation and Instrument Parameters | Definitions | Contacts | Help | Committee Area



<http://www.ilrc.ucf.edu/powders/>



Smokeless Powders Database



Smokeless Powders Database: Search Page

Search Database

[Powder Information](#) | [Physical Description](#) | [Chemistry](#) | [Result Layout](#)

SRN	<input type="text"/>	Help
Data Source	Select Value <input type="button" value="v"/>	Help
Data Source SRN	Select Value	Help
Product use	Federal Bureau of Investigation National Center for Forensic Science	Help
Distributor Name	Netherlands Forensic Institute	Help
Product Name	<input type="text"/>	Help
Date Obtained	<input type="text"/> <input type="button" value="Calendar"/>	Help
Lot Number	<input type="text"/>	Help
Date of Analysis	<input type="text"/> <input type="button" value="Calendar"/>	
Manufacturer	Select Value <input type="button" value="v"/>	Help
Date Manufactured	<input type="text"/> <input type="button" value="Calendar"/>	Help
Comments	<input type="text"/>	

[Clear Parameters](#)



Smokeless Powders Database: Search Page

Search Database							
Powder Information		Physical Description		Chemistry	Result Layout		
Shape	Select Value ▾			Help			
Perforation	<input type="checkbox"/> Yes <input type="checkbox"/> No			Help			
Distinguishing Features	<input type="checkbox"/> teardrops <input type="checkbox"/> dumb bells <input type="checkbox"/> agglomerates <input type="checkbox"/> bias cut <input type="checkbox"/> striation <input type="checkbox"/> Oblongs			Help			
Color	Select Value ▾			Help			
Luster	Select Value ▾			Help			
Marker Color	<input type="checkbox"/> Green <input type="checkbox"/> Red <input type="checkbox"/> Blue <input type="checkbox"/> Yellow <input type="checkbox"/> Purple <input type="checkbox"/> Orange <input type="checkbox"/> White			Help			
Diameter	min.	<input type="text"/>	mm	max.	<input type="text"/>	mm	Help
	Average	<input type="text"/>	mm	+ / -	<input type="text"/>	mm	
Length/thickness	min.	<input type="text"/>	mm	max.	<input type="text"/>	mm	Help
	Average	<input type="text"/>	mm	+ / -	<input type="text"/>	mm	
Clear Parameters				<input type="button" value="Search"/>			



Smokeless Powders Database: Search Page

Search Database			
Powder Information	Physical Description	Chemistry	Result Layout
Main Components		<input type="checkbox"/> Nitroglycerin active	Help
		<input type="checkbox"/> 2,4-Dinitrotoluene	
		<input type="checkbox"/> Diethyl phthalate	
		<input type="checkbox"/> Diphenylamine	
		<input type="checkbox"/> Methyl centralite	
		<input type="checkbox"/> Ethyl centralite	
		<input type="checkbox"/> Dibutyl phthalate	
		<input type="checkbox"/> 2-nitrodiphenylamine	
		<input type="checkbox"/> 4-nitrosodiphenylamine	
		<input type="checkbox"/> Amyl phthalate	
		<input type="checkbox"/> 4-nitrodiphenylamine	
		<input type="checkbox"/> Dioctyl phthalate	
		<input type="checkbox"/> 2-nitrosodiphenylamine	
Other components		<input type="checkbox"/> Camphor	Help
Clear Parameters			<input type="button" value="Search"/>

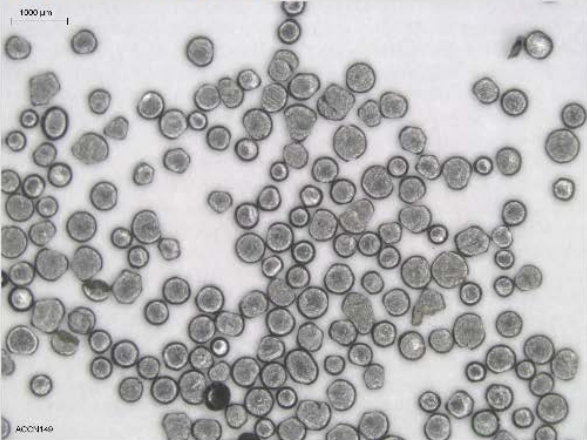

Smokeless Powders Database: Results Layout

Search Database

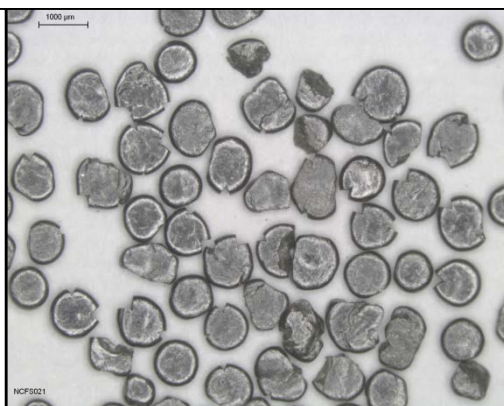
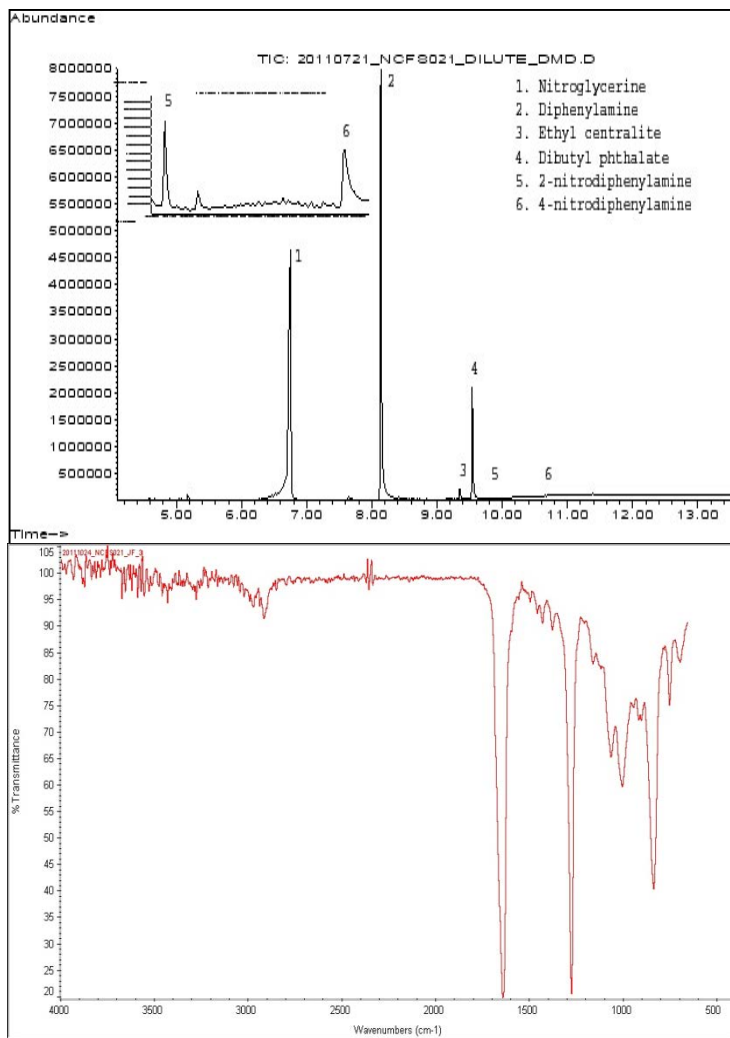
Powder Information	Physical Description	Chemistry	Result Layout
Display Image	<input type="radio"/> GC-MS TIC <input type="radio"/> Powder <input type="radio"/> Canister <input type="radio"/> FTIR Spectrum <input checked="" type="radio"/> None		
Image Size	<input type="radio"/> 400 pixel <input type="radio"/> 600 pixel <input type="radio"/> 800 pixel <input type="radio"/> 1000 pixel		
Clear Parameters	<input type="button" value="Search"/>		

Smokeless Powders Database: Search Results

Total Records: 14

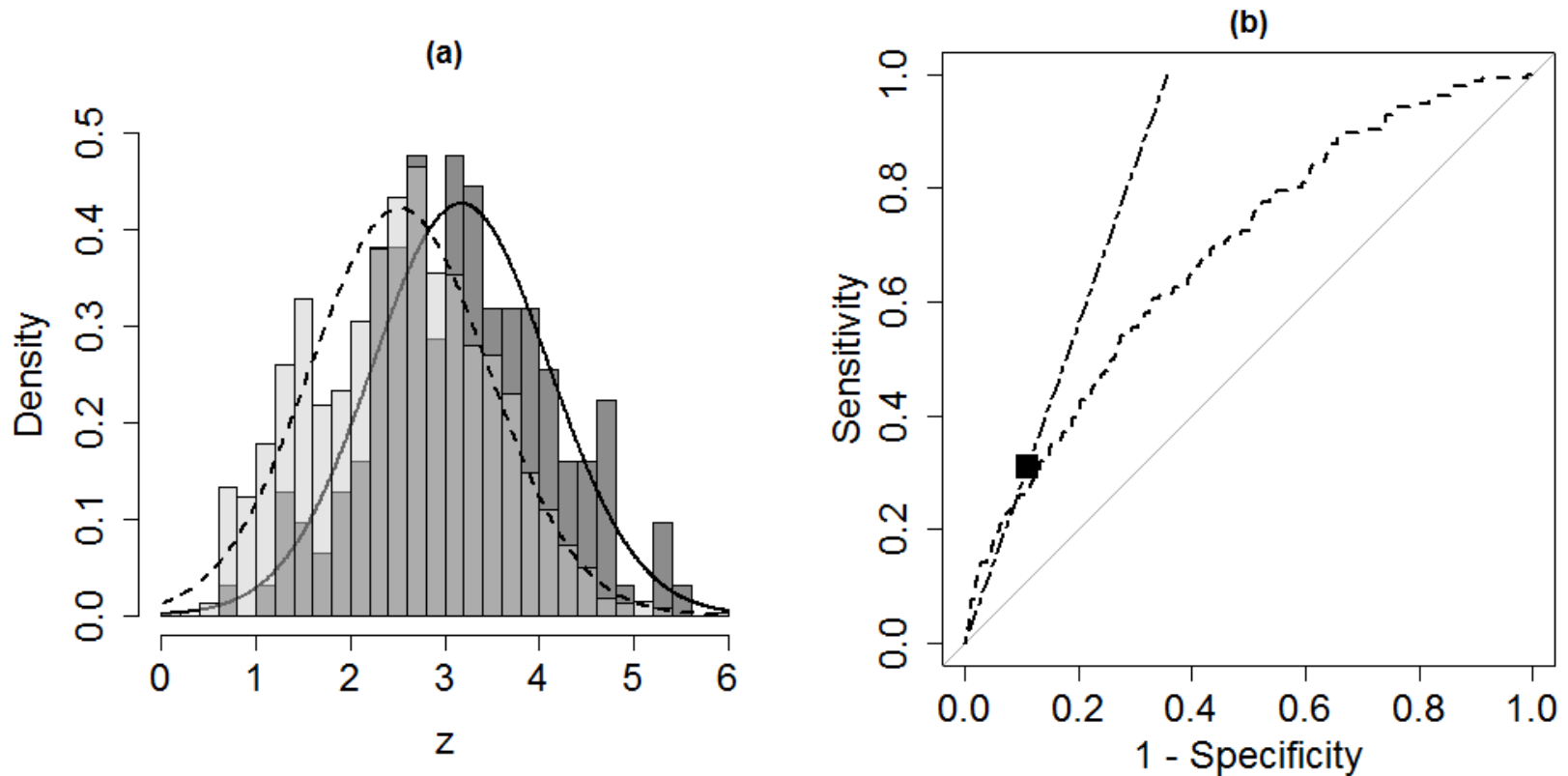
SRN	Distributor	Product Name
0101	Winchester	296
		
	SRN	0101
	Distributor	Winchester
	Product Name	296
	Shape	flattened ball
	avg. Diameter	0.50 mm
	avg. Length/thickness	
	List of components	Nitroglycerin Diethyl phthalate Diphenylamine Ethyl centralite Dibutyl phthalate 2-nitrodiphenylamine 4-nitrodiphenylamine
		Sample detail & download section
0139	Hodgdon	HS-6
		
	SRN	0139
	Distributor	Hodgdon
	Product Name	HS-6
	Shape	flattened ball
	avg. Diameter	0.90 mm
	avg. Length/thickness	
	List of components	Nitroglycerin Diphenylamine Ethyl centralite Dibutyl phthalate 2-nitrodiphenylamine 4-nitrodiphenylamine
		Sample detail & download section

Smokeless Powders Database: Sample Detail & Download



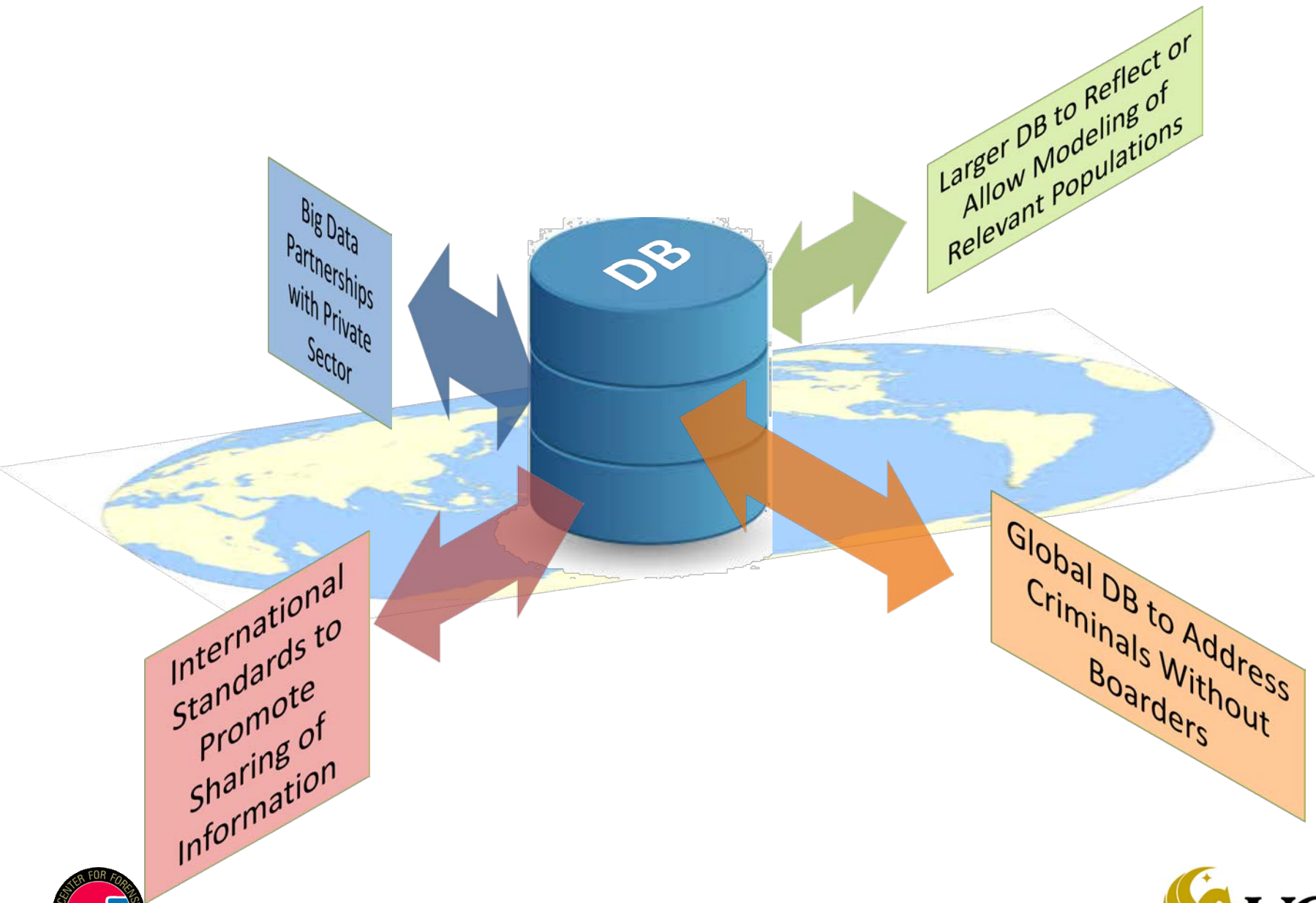
Powder Info	Physical Description	Chemistry
SRN 0139 Distributor Hodgdon Product Name HS-6 Data Source National Center for Forensic Science Source SRN NCF521 Product use Reload Date obtained 7/18/11 Lot Number 041211 2218 Manufacturer USA Date Manufactured Date of Analysis 7/22/11 Comments	Shape flattened ball Color Black Perforation No Distinguishing Features Luster Dull Marker Color Diameter avg. 0.9 mm std. dev. 0.1 min. 0.06 mm max. 1.1 mm Length/thickness avg. std. dev. min. max.	List of components Nitroglycerin Diphenylamine Ethyl centralite Dibutyl phthalate 2-nitrodiphenylamine 4-nitrodiphenylamine Other components
Download GC-MS dataset FTIR dataset MSDS Physical Measurements	GC-MS_0000139.exe ATR-FTIR_0000139.CSV MSDS_Hodgdon_HS6.pdf Measurments_0000139.xlsx	

Evidentiary/Investigative Value of DB Match



Dana-Marie K. Dennis, Mary R. Williams, Michael E. Sigman "Assessing the evidentiary value of smokeless powder comparisons", *Forensic Sci. International* (2016) Vol. 259, p179–187.

Forensic Databases: Future Needs and Directions



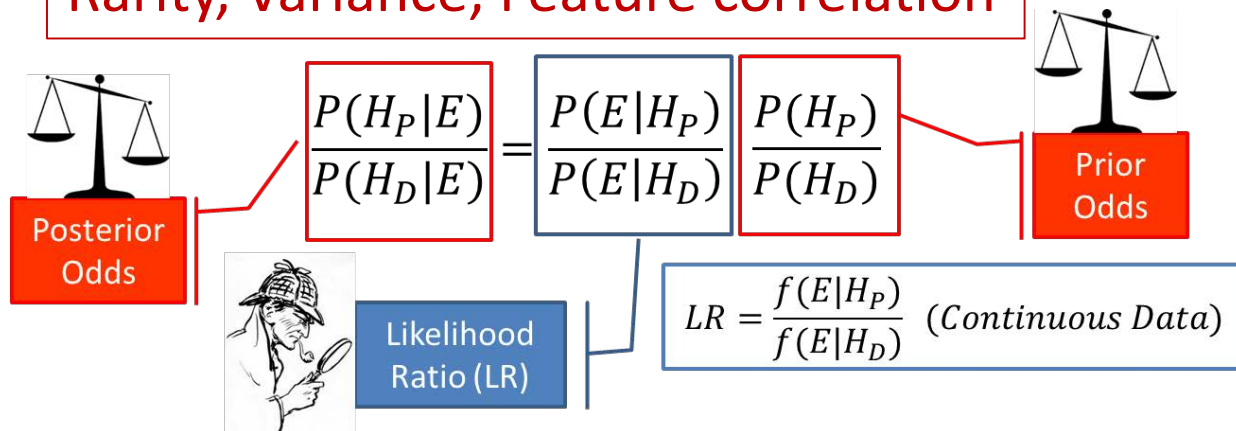
Trace Problems: Comparison & Classification

- **Comparison Problem:** Association between two or more items

C Champod, IW Evett, G Jackson “ Establishing the most appropriate databases for addressing source level propositions”, *Science & Justice*, **2004**, 44, 153 – 164.

- **Classification Problem:** Assign an object into one of several classes

Rarity, Variance, Feature correlation



Zadora et al. “Statistical Analysis in Forensic Science: Evidential Value of Multivariate Physicochemical Data”, Wiley, UK, 2014.

Database vs Relevant Population

FL 1992-2013 (n=70,521)

- AR 331 (0.47%)
- GAS 23,243 (32.96%)
- ISO 219 (0.31%)
- MISC 4,104 (5.82%)
- NA 127 (0.18%)
- NP 233 (0.33%)
- OXY 860 (1.22%)
- PD 4,386 (6.22%)
- SUB 37,016 (52.49%)

ILRC + Substrate (n=1,305)

- AR 74 (5.67%)
- GAS 111 (8.51%)
- ISO 88 (6.74%)
- MISC 203 (15.56%)
- NA 58 (4.44%)
- NP 55 (4.21%)
- OXY 169 (12.95%)
- PD 337 (25.82%)
- SUB 210 (16.09%)

Carl E. Chasteen, B.S., CPM, F-ABC, Chief of Forensic Services, Bureau of Forensic Fire and Explosives Analysis, Division of State Fire Marshal, Department of Financial Services, State of Florida



Summary

- Databases:
 - 2 Ignitable Liquid, 1 Substrate, 1 Smokeless Powders
 - Designed for casework and training as partnerships with forensic community
 - Research applications have been secondary to casework
- Expansion and Future Databases
 - Should consider representation of relevant population
 - Should account for: rarity, variance, feature correlation
 - International databases
 - ANSI/ISO data standards to promote sharing of data
 - i.e., netCDF data files
 - Additional funding/Private sector partnerships

Thank you.



*NCFs Ignitable Liquids and
Explosives Research Group 2016.*

