EXPLOSIVES

AccuStandard

Technical Update

Standards including TATP, HMTD, HNS & others.

EPA Method 8330
&
EPA Method 8095

Custom Standards & Synthesis

Revision

Detection of Explosives by Chemical Monitoring

The ability to detect the presence of explosives from a distance of a few millimeters to several meters serves several different purposes, such as:

• Training dogs and other animals to detect bombs & landmines.
• Automated Explosive Detection Systems at airports to electronically "sniff" baggage and people to detect bombs (3).
• Analysis to aid the remediation of contaminated soil and water at ordinance sites (10).

Actual precise and certified reference standards are required in order to calibrate an animal or an "electronic nose" so that the detection will not be obstructed by false negatives and positives (1,2).

The future in Explosives detection may belong to the bees. Government funded projects have developed electronic 'backpacks' for bees which will allow for the training and tracing of bees to landmines and other explosive devices (11). The training involves the lacing of sugar with a target chemical (12). The University of Montana study (11) showed that the bees can detect 2,4-DNT (residue of TNT) at a PBB and PPT level with a 97-99% detection probability and a 1.0-2.5% probability of false positive and a less than 1% of a false negative (13).

Incidents involving TATP, HMTD, and PETN

To the 2002 List of Explosive Material, the Bureau of Alcohol, Tobacco and Firearms (ATF) has added explosives such as TATP (Triacetonetriperoxide) and HMTD (Hexamethylenetriperoxidediamine) (4). The reason for these additions is the frequency with which they show up in global occurrences such as:

• In 2003, the "Shoe Bomber", whose weapon was a wedge of plastic explosive in his shoe with a trigger of a highly unstable component known as TATP, combined with PETN (Pentaerythritol tetranitrate) (4,5), boarded an airplane and attempted to light the fuse (6).
• The Philippine Airlines explosion in 1994 also was caused by TATP (6).
• Car bombs in London outside the Israeli Embassy in 1994 used TATP (6).
• A sixteen-year-old in Oregon was arrested in 2003 after he was selling vials of TATP near his school. The boy was making this explosive in his apartment (7).

It is quite easy for a non-chemist to get the information and raw materials to make these terror-producing substances (4,5,7,8). The recipe for HMTD is easily found on several web pages including descriptions such as: "HMTD is a very unstable primary explosive compound that can be made from hexamine, hydrogen peroxide, and citric acid." (9). The article even describes where the raw materials can be legally purchased and the production procedure. PETN is also described in similar fashion (5). The fact that these compounds can be readily synthesized by individuals searching the internet leads to many other concerns such as the motives behind those posting them on the internet, the availability of this information to those who have no purpose for it, and the repercussions of its presence. The available readiness of this material strikes moral nerves and security concerns. Because this information is so easily accessible, governments across the globe must be prepared to combat acts of terrorism.

Users of Reference Material

AccuStandard synthesizes the important explosives and their metabolites, raw materials and degradates and makes them available in usable forms to government agencies, instrument manufacturers, research facilities, and monitoring labs.

Government Agencies

The Transportation Security Agency (TSA) formerly the FAA, has the responsibility for safety of air travel and embassies, a concern shared by all nations. The FBI use the reference standards to confirm the presence of particular compounds when screening objects and people (9).

Instrument Manufacturers

Instruments that are used in airports and embassies require documented reference materials to maintain their performance in generating reliable data.

Research Facilities

There is a need for constant development of procedures and reference standards to combat new terrorist threats.

Monitoring Labs

Remediation of contaminated soil and water from the storage and use of explosives at ordinance sites has been ongoing for the last thirty years. The US EPA developed its own method, Method 8330, to define the procedure which is used globally.

AccuStandard

AccuStandard is a leading company in the Explosive Standards area offering about sixty explosives, degradates and metabolites (most synthesized in-house) in addition to the many special formulations for customer-specific applications and EPA method-specific formulations. AccuStandard is the only commercial source for TATP, HNS, and HMTD due to the excellent work of its Synthesis Department.

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Explosive Standards

- **EPA Method 8330 & Second Source Mixes**
- **EPA Method 8095**
- **Custom Standards & Synthesis**

TNT Metabolites

Analyte	Concentration (mg/mL)	Solvent	Catalog Number (1 mL)
1,3-Dinitrobenzene	0.1	AcCN : MeOH (1:1)	M-8330-01-0.1X
2,4-Dinitrotoluene	0.1	AcCN : MeOH (1:1)	M-8330-02-0.1X
2,6-Dinitrotoluene	0.1	AcCN : MeOH (1:1)	M-8330-03-0.1X
Nitrobenzene	0.1	AcCN : MeOH (1:1)	M-8330-06-0.1X
2-Nitrotoluene	0.1	AcCN : MeOH (1:1)	M-8330-07-0.1X
3-Nitrotoluene	0.1	AcCN : MeOH (1:1)	M-8330-08-0.1X
4-Nitrotoluene	0.1	AcCN : MeOH (1:1)	M-8330-09-0.1X
TNT	0.1	AcCN : MeOH (1:1)	M-8330-11-0.1X
1,3,5-Trinitrobenzene	0.1	AcCN : MeOH (1:1)	M-8330-12-0.1X
2-Amino-4,6-dinitrotoluene	0.1	AcCN : MeOH (1:1)	M-8330-13-0.1X
4-Amino-2,6-dinitrotoluene	0.1	AcCN : MeOH (1:1)	M-8330-14-0.1X
2,4-Diamino-6-nitrotoluene	0.1	AcCN	M-8330-ADD-12
2,4-Diamino-4-nitrotoluene	0.1	AcCN	M-8330-ADD-13
1,3,5-Triamino-2,4,6-trinitrobenzene (TATB)	0.04	Dimethyl formamide	M-8330-ADD-14-DMF
2,2',6,6'-Tetranitro-4,4'-azoxytoluene	0.1	AcCN : MeOH (1:1)	M-8330-ADD-15
4,4',6,6'-Tetranitro-2,2'-azoxytoluene	0.1	AcCN : MeOH (1:1)	M-8330-ADD-16
2,2',6,6'-Tetranitro-4,4'-azotoluene	0.1	AcCN	M-8330-ADD-17
4,4',6,6'-Tetranitro-2,2'-azotoluene	0.1	AcCN	M-8330-ADD-19
2-Hydroxylamino-4,6-dinitrotoluene *	0.1	AcCN	M-8330-ADD-18
4-Hydroxylamino-2,6-dinitrotoluene *	0.1	AcCN	M-8330-ADD-20
Hexanitrostilbene (HNS) *NEW*	0.1	AcCN	M-8330-ADD-26

* (3 month stability)

Additional Explosives by HPLC

Analyte	Concentration (mg/mL)	Solvent	Catalog Number (1 mL)
1,3-Dinitrobenzene	0.1	AcCN : MeOH (1:1)	M-8330-01-0.1X
HMX	0.1	AcCN : MeOH (1:1)	M-8330-04-0.1X
RDX	0.1	AcCN : MeOH (1:1)	M-8330-05-0.1X
Tetryl	0.1	AcCN : MeOH (1:1)	M-8330-10-0.1X
Nitroglycerin	0.1	EtOH	M-8330-ADD-1
PETN	0.1	MeOH	M-8330-ADD-2
Picric acid	0.1	AcCN : MeOH (1:1)	M-8330-ADD-3
3,5-Dinitroaniline	0.1	AcCN : MeOH (1:1)	M-8330-ADD-4
EGDN	0.1	AcCN	M-8330-ADD-5
Nitroguanidine	0.1	MeOH	M-8330-ADD-6
Nitromethane	0.1	MeOH	M-8330-ADD-7
Hydrazine	0.1	MeOH	M-8330-ADD-8
1,2-Diaminopropane	0.1	MeOH	M-8330-ADD-9
Guanidine nitrate	0.1	MeOH	M-8330-ADD-10
PYX(2,6-bis,bis-(pricrylamine)-3,5-dinitropyridine	0.1	AcCN	M-8330-ADD-11
1,3,5-Triamino-2,4,6-trinitrobenzene (TATB)	0.04	Dimethyl formamide	M-8330-ADD-14-DMF
2,3-Dimethyl-2,3-dinitrobutane *NEW*	0.1	AcCN	M-8330-ADD-21
Picramic acid *NEW*	0.1	AcCN : MeOH (1:1)	M-8330-ADD-22
2,4,6-Triaminotoluene trihydrochloride *NEW*	N/A	10 mg	M-8330-ADD-23N
Triacetone triperoxide (TATP) *NEW*	0.1	AcCN	M-8330-ADD-24
Hexamethylene triperoxide (HMTD) *NEW*	0.1	AcCN	M-8330-ADD-25
Hexanitrostilbene (HNS) *NEW*	0.1	AcCN	M-8330-ADD-26
Ammonium picrate *NEW*	0.1	AcCN	M-8330-ADD-27
Trimethylolethane trinitrate *NEW*	0.1	AcCN : MeOH (1:1)	M-8330-ADD-28

Explosives by HPLC Set

M-8330R-SET **set of 14 x 1 mL**
Each at 0.1 mg/mL in MeOH:AcCN (1:1)

M-8330R-SET-10X **set of 14 x 1 mL**
Each at 1.0 mg/mL in MeOH:AcCN (1:1)

1,3-Dinitrobenzene (01)	3-Nitrotoluene (08)
2,4-Dinitrotoluene (02)	4-Nitrotoluene (09)
2,6-Dinitrotoluene (03)	Tetryl (10)
HMX (04)	TNT (11)
RDX (05)	1,3,5-Trinitrobenzene (12)
Nitrobenzene (06)	2-Amino-4,6-dinitrotoluene (13)
2-Nitrotoluene (07)	4-Amino-2,6-dinitrotoluene (14)

Synthesis Department

We developed the procedures and synthesized these Explosives and Metabolites in response to customer requirements.

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Explosive Standards

Multi-Component Formulations for Method 8330 Explosive Analysis

The following A & B mixes provide better resolution between possible coeluting analytes. Depending on the way the chemist optimizes the HPLC system, the chemist can choose which A & B mix is finally used. We suggest, when first performing Method 8330 development, to purchase the high concentration 14 x 1 mL set "M-8330R-SET-10X".

M-8330A **1 x 1 mL**
0.1 mg/mL each in AcCN:MeOH (1:1)
M-8330A-10X **1 x 1 mL**
1.0 mg/mL each in AcCN:MeOH (1:1)
7 comps.

- 1,3-Dinitrobenzene
- 2,4-Dinitrotoluene
- HMX
- Nitrobenzene
- RDX
- 1,3,5-Trinitrobenzene
- TNT

M-8330A-R **1 x 1 mL**
0.1 mg/mL each in AcCN:MeOH (1:1)
M-8330A-R-10X **1 x 1 mL**
1.0 mg/mL each in AcCN:MeOH (1:1)
8 comps.

- 2-Amino-4,6-dinitrotoluene
- 1,3-Dinitrobenzene
- 2,4-Dinitrotoluene
- HMX
- Nitrobenzene
- RDX
- 1,3,5-Trinitrobenzene
- TNT

M-8330B **1 x 1 mL**
0.1 mg/mL each in AcCN:MeOH (1:1)
M-8330B-10X **1 x 1 mL**
1.0 mg/mL each in AcCN:MeOH (1:1)
5 comps.

- Tetryl
- 2,6-Dinitrotoluene
- 2-Nitrotoluene
- 3-Nitrotoluene
- 4-Nitrotoluene

M-8330B-R **1 x 1 mL**
0.1 mg/mL each in AcCN:MeOH (1:1)
M-8330B-R-10X **1 x 1 mL**
1.0 mg/mL each in AcCN:MeOH (1:1)
7 comps.

- 2-Amino-4,6-dinitrotoluene
- 4-Amino-2,6-dinitrotoluene
- Tetryl
- 2,6-Dinitrotoluene
- 2-Nitrotoluene
- 3-Nitrotoluene
- 4-Nitrotoluene

M-8330B-R2 **1 x 1 mL**
0.1 mg/mL each in AcCN:MeOH(1:1)
M-8330B-R2-10X **1 x 1 mL**
1.0 mg/mL each in AcCN:MeOH(1:1)
6 comps.

- 4-Amino-2,6-dinitrotoluene
- Tetryl
- 2,6-Dinitrotoluene
- 2-Nitrotoluene
- 3-Nitrotoluene
- 4-Nitrotoluene

Internal Standard

M-8330-IS **1 x 1 mL**
M-8330-IS-PAK **5 x 1 mL**
1.0 mg/mL in MeOH

- 3,4-Dinitrotoluene

Surrogate Standard

M-8330-SS **1 x 1 mL**
1.0 mg/mL in MeOH

- 1,2-Dinitrobenzene

Composite Explosive Mix

M-8330-R **1 x 1 mL**
1.0 mg/mL each in MeOH:AcCN (1:1)
14 comps.

- 1,3-Dinitrobenzene
- 2,4-Dinitrotoluene
- 2,6-Dinitrotoluene
- HMX
- RDX
- Nitrobenzene
- 2-Nitrotoluene
- 3-Nitrotoluene
- 4-Nitrotoluene
- Tetryl
- TNT
- 1,3,5-Trinitrobenzene
- 2-Amino-4,6-dinitrotoluene
- 4-Amino-2,6-dinitrotoluene

Second Source (ACES™) Method 8330

AccuStandard works together with Cerilliant to offer the industry's only true 3rd party certified standards. ACES products are made independently by AccuStandard and Cerilliant and analyzed by both companies. The data from both companies is then reviewed by an independent third party. There are 3 versions: A single ampule tested by both companies, one from each company (Pair of ACES), and Five ACES, 4 from AccuStandard plus 1 from Cerilliant.

Second Source (ACES) for Explosive Analysis

ACE-8330A-R **1 x 1 mL**
PR-ACES-8330A-R **2 x 1 mL**
(includes AccuStandard Cat# ACE-8330A-R & Cerilliant equivalent)
5-ACES-8330A-R **5 x 1 mL**
(includes 4 AccuStandard Cat# ACE-8330A-R & 1 Cerilliant equivalent)
0.1 mg/mL each in AcCN:MeOH (1:1) 8 comps.

- 2-Amino-4,6-dinitrotoluene
- 1,3-Dinitrobenzene
- 2,4-Dinitrotoluene
- HMX
- Nitrobenzene
- RDX
- 1,3,5-Trinitrobenzene
- TNT

ACE-8330B-R2 **1 x 1 mL**
PR-ACES-8330B-R2 **2 x 1 mL**
(includes AccuStandard Cat# ACE-8330B-R2 & Cerilliant equivalent)
5-ACES-8330B-R2 **5 x 1 mL**
(includes 4 AccuStandard Cat# ACE-8330B-R2 & 1 Cerilliant equivalent)
0.1 mg/mL each in AcCN:MeOH (1:1) 6 comps.

- 4-Amino-2,6-dinitrotoluene
- Tetryl
- 2,6-Dinitrotoluene
- 2-Nitrotoluene
- 3-Nitrotoluene
- 4-Nitrotoluene

Internal Standard

ACE-8330-IS **1 x 1 mL**
PR-ACES-8330-IS **2 x 1 mL**
(includes AccuStandard Cat# ACE-8330-IS & Cerilliant equivalent)
5-ACES-8330-IS **5 x 1 mL**
(includes 4 AccuStandard Cat# ACE-8330-IS & 1 Cerilliant equivalent)
1.0 mg/mL in MeOH

- 3,4-Dinitrotoluene

Surrogate Standard

ACE-8330-SS **1 x 1 mL**
PR-ACES-8330-SS **2 x 1 mL**
(includes AccuStandard Cat# ACE-8330-SS & Cerilliant equivalent)
5-ACES-8330-SS **5 x 1 mL**
(includes 4 AccuStandard Cat# ACE-8330-SS & 1 Cerilliant equivalent)
1.0 mg/mL in MeOH

- 1,2-Dinitrobenzene

ACES Documentation Package Includes:

1. **Certificate of Product Data shows component purity, gravimetric concentrations, and analyte concentration.**
2. **3rd party Analytical Data review**
3. **Chromatograms of both products with elution order and analytical parameters.**
4. **Each analyte is tested for concentration and homogeneity by both companies.**

Explosive Intermediate for EPA Method 8095 by GC/ECD

This set of standards for EPA Method 8095 is outlined below. This method is a companion to EPA Method 8330. Utilizing the sensitivity and selectivity of the ECD as well as resolution capabilities of capillary columns allows the chemist to quantitatively analyze for the typical explosives. Use of this new method expands the laboratory's capability to pursue and fulfill contracts involving explosives analysis. The method uses familiar extraction techniques which reduce sample preparation time. It also has the benefit of GC/ECD instrument reproducibility.

Stock Solution A

M-8095-SSA-100X **1 x 1 mL**
M-8095-SSA-100X-PAK **5 x 1 mL**
100 µg/mL each in AcCN:MeOH (1:1) 10 comps.

- 2-Amino-4,6-dinitrotoluene
- 4-Amino-2,6-dinitrotoluene
- 1,3-Dinitrobenzene
- 2,6-Dinitrotoluene
- 2,4-Dinitrotoluene
- 1,3,5-Trinitrobenzene
- TNT
- RDX
- Tetryl
- HMX

Stock Solution B

M-8095-SSB-100X **1 x 1 mL**
M-8095-SSB-100X-PAK **5 x 1 mL**
At stated conc. in AcCN:MeOH (1:1) 7 comps.

Nitrobenzene	(500 µg/mL)	Nitroglycerin	(500 µg/mL)
3-Nitrotoluene	(500 µg/mL)	PETN	(500 µg/mL)
2-Nitrotoluene	(500 µg/mL)	3,5-Dinitroaniline	(100 µg/mL)
4-Nitrotoluene	(500 µg/mL)		

Explosive Surrogate Standards

M-8095-SS-01 **1 x 1 mL**
M-8095-SS-01-PAK **5 x 1 mL**
100 µg/mL in AcCN

- 3,4-Dinitrotoluene

M-8095-SS-02 **1 x 1 mL**
M-8095-SS-02-PAK **5 x 1 mL**
100 µg/mL in AcCN

- 2-Methyl-4-nitroaniline

M-8095-SS-03 **1 x 1 mL**
M-8095-SS-03-PAK **5 x 1 mL**
10 µg/mL in AcCN

- 2,5-Dintrotoluene