

# Explosives



# AccuStandard Europe



## **Technical Update**



**Standards including  
TATP, HMTD, HNS &  
others**



**EPA Method 8330  
&  
EPA Method 8095**



**Custom Standards &  
Synthesis**

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## 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 (Triacetoneperoxide) and HMTD (Hexamethylenetriperoxidodiamine) (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.

Explosive analysis and detection becomes less of a problem with the new AccuStandard Explosive Certified Reference Materials, including TATP and HMTD. AccuStandard now offers the most comprehensive line of in house synthesized explosives in the industry including RDX, PETN, Tetryl, HNS, TNT, TNT metabolites, the highly reactive and unstable TATP and HMTD, and many others. Single solutions and custom mixes can be provided in a wide range of concentrations and solvents.

Many of the explosive standards, like the TATP and HMTD, are synthesized exclusively by AccuStandard, and are therefore not otherwise available.

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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".

<b>M-8330A</b> 1 x 1 mL <i>0.1 mg/mL each in AcCN:MeOH (1:1)</i> <b>M-8330A-10X</b> 1 x 1 mL <i>1.0 mg/mL each in AcCN:MeOH (1:1)</i> 1,3-Dinitrobenzene 7 comps. 2,4-Dinitrotoluene RDX HMX 1,3,5-Trinitrobenzene Nitrobenzene TNT	<b>M-8330B</b> 1 x 1 mL <i>0.1 mg/mL each in AcCN:MeOH (1:1)</i> <b>M-8330B-10X</b> 1 x 1 mL <i>1.0 mg/mL each in AcCN:MeOH (1:1)</i> Tetryl 5 comps. 2,6-Dinitrotoluene 3-Nitrotoluene 2-Nitrotoluene 4-Nitrotoluene	<b>M-8330B-R2</b> 1 x 1 mL <i>0.1 mg/mL each in AcCN:MeOH(1:1)</i> <b>M-8330B-R2-10X</b> 1 x 1 mL <i>1.0 mg/mL each in AcCN:MeOH(1:1)</i> 6 comps. 4-Amino-2,6-dinitrotoluene Tetryl 2,6-Dinitrotoluene 2-Nitrotoluene 3-Nitrotoluene 4-Nitrotoluene	<b>Surrogate Standard</b> <b>M-8330-SS</b> 1 x 1 mL <i>1.0 mg/mL in MeOH</i> 1,2-Dinitrobenzene
<b>M-8330A-R</b> 1 x 1 mL <i>0.1 mg/mL each in AcCN:MeOH (1:1)</i> <b>M-8330A-R-10X</b> 1 x 1 mL <i>1.0 mg/mL each in AcCN:MeOH (1:1)</i> 8 comps. 2-Amino-4,6-dinitrotoluene Nitrobenzene 1,3-Dinitrobenzene RDX 2,4-Dinitrotoluene 1,3,5-Trinitrobenzene HMX TNT	<b>M-8330B-R</b> 1 x 1 mL <i>0.1 mg/mL each in AcCN:MeOH (1:1)</i> <b>M-8330B-R-10X</b> 1 x 1 mL <i>1.0 mg/mL each in AcCN:MeOH (1:1)</i> 7 comps. 2-Amino-4,6-dinitrotoluene 4-Amino-2,6-dinitrotoluene 2-Nitrotoluene Tetryl 3-Nitrotoluene 2,6-Dinitrotoluene 4-Nitrotoluene	<b>Internal Standard</b> <b>M-8330-IS</b> 1 x 1 mL <b>M-8330-IS-PAK</b> 5 x 1 mL <i>1.0 mg/mL in MeOH</i> 3,4-Dinitrotoluene	<b>Composite Explosive Mix</b> <b>M-8330-R</b> 1 x 1 mL <i>1.0 mg/mL each in MeOH:AcCN (1:1)</i> 14 comps. 1,3-Dinitrobenzene 3-Nitrotoluene 2,4-Dinitrotoluene 4-Nitrotoluene 2,6-Dinitrotoluene Tetryl HMX TNT RDX 1,3,5-Trinitrobenzene Nitrobenzene 2-Amino-4,6-dinitrotoluene 2-Nitrotoluene 4-Amino-2,6-dinitrotoluene

- Widest selection of Explosives and their Metabolites
- Unlimited choice in concentration and analyte configuration
- Choice from a number of appropriate solvents

## 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

<b>M-8095-SSA-100X</b> 1 x 1 mL	
<b>M-8095-SSA-100X-PAK</b> 5 x 1 mL	
<i>100 µg/mL each in AcCN:MeOH (1:1) 10 comps.</i>	
2-Amino-4,6-dinitrotoluene	1,3,5-Trinitrobenzene
4-Amino-2,6-dinitrotoluene	TNT
1,3-Dinitrobenzene	RDX
2,6-Dinitrotoluene	Tetryl
2,4-Dinitrotoluene	HMX

### Stock Solution B

<b>M-8095-SSB-100X</b> 1 x 1 mL	
<b>M-8095-SSB-100X-PAK</b> 5 x 1 mL	
<i>At stated conc. in AcCN:MeOH (1:1) 7 comps.</i>	
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

<b>M-8095-SS-01</b> 1 x 1 mL	
<b>M-8095-SS-01-PAK</b> 5 x 1 mL	
<i>100 µg/mL in AcCN</i>	
3,4-Dinitrotoluene	
<b>M-8095-SS-02</b> 1 x 1 mL	
<b>M-8095-SS-02-PAK</b> 5 x 1 mL	
<i>100 µg/mL in AcCN</i>	
2-Methyl-4-nitroaniline	
<b>M-8095-SS-03</b> 1 x 1 mL	
<b>M-8095-SS-03-PAK</b> 5 x 1 mL	
<i>10 µg/mL in AcCN</i>	
2,5-Dinitrotoluene	



Explosive Standards are listed as follows:

- Single Solutions
- International Methods
- USEPA Mixtures



COMPOUND	CAS NO.	QTY./CONC.	MATRIX	CAT. NO.
4-Amino-2,6-dinitrotoluene	19406-51-0	1 mg/mL	MeOH:AcCN (1:1)	M-8330-13
		0.1 mg/mL	MeOH:AcCN (1:1)	M-8330-14-0.1X
		1 mg/mL	MeOH:AcCN (1:1)	M-8330-14
Ammonium picrate		0.1 mg/mL	AcCN	M-8330-ADD-27
1,2-Diaminopropane	78-90-0	0.1 mg/mL	MeOH	M-8330-ADD-9
1,2-Dinitrobenzene	528-29-0	1 mg/mL	MeOH	M-8330-SS
1,3-Dinitrobenzene	99-65-0	0.1 mg/mL	MeOH:AcCN (1:1)	M-8330-01-0.1X
		1 mg/mL	MeOH:AcCN (1:1)	M-8330-01
2,3-Dimethyl-2,3-dinitrobutane	3964-18-9	100 µg/mL	AcCN	M-8330-ADD-21
2,4-Diamino-6-nitrotoluene	6629-29-4	0.1 mg/mL	AcCN	M-8330-ADD-12
2,4-Dinitrotoluene	121-14-2	0.1 mg/mL	MeOH:AcCN (1:1)	M-8330-02-0.1X
		1 mg/mL	MeOH:AcCN (1:1)	M-8330-02
2,6-Diamino-4-nitrotoluene	59229-75-3	0.1 mg/mL	AcCN	M-8330-ADD-13
2,5-Dinitrotoluene	619-15-8	100 µg/mL	AcCN	M-8095-SS-03
2,6-Dinitrotoluene	606-20-2	0.1 mg/mL	MeOH:AcCN (1:1)	M-8330-03-0.1X
		1 mg/mL	MeOH:AcCN (1:1)	M-8330-03
3,4-Dinitrotoluene	610-39-9	100 µg/mL	AcCN	M-8095-SS-01
		1 mg/mL	MeOH	M-8330-IS
EGDN	628-96-6	0.1 mg/mL	AcCN	M-8330-ADD-5
Guanidine nitrate	506-93-7	0.1 mg/mL	MeOH	M-8330-ADD-10
Hexanitrostilbene (HNS)		0.1 mg/mL	AcCN	M-8330-ADD-26
HMX	2691-41-0	0.1 mg/mL	MeOH:AcCN (1:1)	M-8330-04-0.1X
		1 mg/mL	MeOH:AcCN (1:1)	M-8330-04
HMTD		0.1 mg/mL	AcCN	M-8330-ADD-25
2-Hydroxylamino-4,6-dinitrotoluene		0.1 mg/mL	AcCN	M-8330-ADD-18
4-Hydroxylamino-2,6-dinitrotoluene		0.1 mg/mL	AcCN	M-8330-ADD-20
Hydrazine	302-01-2	0.1 mg/mL	MeOH	M-8330-ADD-8
Nitrobenzene	98-95-3	0.1 mg/mL	MeOH:AcCN (1:1)	M-8330-06-0.1X
		1 mg/mL	MeOH:AcCN (1:1)	M-8330-06
Nitroglycerin	55-63-0	0.1 mg/mL	EtOH	M-8330-ADD-1
Nitroguanidine	556-88-7	0.1 mg/mL	MeOH	M-8330-ADD-6
Nitromethane	75-52-5	0.1 mg/mL	MeOH	M-8330-ADD-7
2-Nitrotoluene	88-72-2	0.1 mg/mL	MeOH:AcCN (1:1)	M-8330-07-0.1X
		1 mg/mL	MeOH:AcCN (1:1)	M-8330-07
3-Nitrotoluene	99-08-1	0.1 mg/mL	MeOH:AcCN (1:1)	M-8330-08-0.1X
		1 mg/mL	MeOH:AcCN (1:1)	M-8330-08
4-Nitrotoluene	99-99-0	0.1 mg/mL	MeOH:AcCN (1:1)	M-8330-09-0.1X
		1 mg/mL	MeOH:AcCN (1:1)	M-8330-09
PETN	78-11-5	0.1 mg/mL	MeOH	M-8330-ADD-2
Picramic acid	831-52-7	100 µg/mL	AcCN:MeOH	M-8330-ADD-22
Picric acid	88-89-1	0.1 mg/mL	AcCN:MeOH	M-8330-ADD-3
Propyleneglycol dinitrate		0.1 mg/mL	MeOH	M-8330-ADD-35
PYX	38082-89-2	0.1 mg/mL	AcCN	M-8330-ADD-11
RDX	121-82-4	0.1 mg/mL	MeOH:AcCN (1:1)	M-8330-05-0.1X
		1 mg/mL	MeOH:AcCN (1:1)	M-8330-05
TATP		0.1 mg/mL	AcCN	M-8330-ADD-24
Tetryl	479-45-8	0.1 mg/mL	MeOH:AcCN (1:1)	M-8330-10-0.1X
		1 mg/mL	MeOH:AcCN (1:1)	M-8330-10
2,2',6,6'-Tetranitro-4,4'-azoxytoluene		0.1 mg/mL	AcCN	M-8330-ADD-15

## Explosives (in 1 mL of solvent, unless otherwise noted)

COMPOUND	CAS NO.	QTY./CONC.	MATRIX	CAT. NO.
2,2',6,6'-Tetranitro-4,4'-azotoluene		0.1 mg/mL	AcCN	M-8330-ADD-17
4,4',6,6'-Tetranitro-2,2'-azotoluene		0.1 mg/mL	AcCN	M-8330-ADD-19
TNT	118-96-7	0.1 mg/mL	MeOH:AcCN (1:1)	M-8330-11-0.1X
		1 mg/mL	MeOH:AcCN (1:1)	M-8330-11
1,3,5-Trinitrobenzene	99-35-4	0.1 mg/mL	MeOH:AcCN (1:1)	M-8330-12-0.1X
		1 mg/mL	MeOH:AcCN (1:1)	M-8330-12
		100 µg/mL	MeOH	APP-9-210
		2 mg/mL	MeOH	M-8270-10
1,3,5-Triamino-2,4,6-trinitrobenzene		mg/mL	Dimethylformamide	M-8330-ADD-14-DMF
2,4,6-Triaminotoluene trihydrochloride	634-87-7	10 mg	Neat	M-8330-ADD-23N
Trimethylolethane trinitrate		100 µg/mL	AcCN:MeOH	M-8330-ADD-28

## Explosives by HPLC Set

### M-8330-R-SET

Each at 0.1 mg/mL in MeOH:AcCN (1:1)

set of 14 x 1 mL

### M-8330-R-SET-10X

Each at 1.0 mg/mL in MeOH:AcCN (1:1)

set of 14 x 1 mL

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

## Synthesis Department

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

## EU Formulations

### DIN 38407-21 Explosives

Scope: Examination of water, wastewater, and sludge for determination of selected explosives and related compounds by HPLC with UV detection

#### DIN38407-21-A

10 µg/mL each in MeOH

1 x 1 mL

12 comps.

Picric acid  
HMX  
RDX  
Tetryl  
EGDN  
DEGDN  
Nitroglycerin  
TNT  
2-Nitrotoluene  
PETN  
4-Nitrotoluene  
3-Nitrotoluene

### DIN-38407-17 Nitroaromatic Compounds

Scope: Examination of water, wastewater, and sludge for the determination of selected nitroaromatic compounds by Gas-Liquid Chromatography

#### DIN38407-17

500 µg/mL each in MeOH

1 x 1 mL

12 comps.

Nitrobenzene  
2-Nitrotoluene  
4-Nitrotoluene  
1,3-Dinitrobenzene  
2,6-Dinitrotoluene  
2,4-Dinitrotoluene  
3,4-Dinitrotoluene  
2-Amino-6-nitrotoluene  
4-Amino-2-nitrotoluene  
4-Amino-2,6-dinitrotoluene  
2-Amino-4,6-dinitrotoluene  
2,4,6-Trinitrotoluene

### DIN 38407-21 Related Compounds

Scope: Examination of water, wastewater, and sludge for determination of selected explosives and related compounds by HPLC with UV detection

#### DIN38407-21-B

10 µg/mL each in MeOH

1 x 1 mL

8 comps.

1,3,5-Trinitrobenzene  
1,3-Dinitrobenzene  
4-Amino-2,6-dinitrotoluene  
2,2',4,4',6,6'-Hexanitrodiphenylamine  
2-Amino-4,6-dinitrotoluene  
2,6-Dinitrotoluene  
2,4-Dinitrotoluene  
Diphenylamine

If you do not find the mixture you need, please inquire at your local Distributor for a competitive price.

## Method 529 Explosive & Related Compounds by SPE & Capillary Column GC/MS

### Method 529 Calibration Curve

All in Ethyl acetate

M-529-	01	02	03	04	05	06	07	08	09
2-Amino-4,6-dinitrotoluene	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10
4-Amino-2,6-dinitrotoluene	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10
3,5-Dinitroaniline	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10
1,3-Dinitrobenzene	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10
2,4-Dinitrotoluene	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10
2,6-Dinitrotoluene	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10
RDX	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10
Nitrobenzene	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10
2-Nitrotoluene	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10
3-Nitrotoluene	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10
4-Nitrotoluene	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10
1,3,5-Trinitrobenzene	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10
Tetryl	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10
TNT	0.025	0.05	0.10	0.25	0.50	1.0	2.0	5.0	10

### Full Scan MS Calibration Set

M-529-MS-SET                      6 x 1 mL      M-529-03, M-529-05, M-529-06, M-529-07, M-529-08, M-529-09

### SIM Calibration Set

M-529-SIM-SET                      7 x 1 mL      M-529-01, M-529-02, M-529-03, M-529-04, M-529-05, M-529-06, M-529-07

### Internal Standard Stock Solution **New**

M-529-IS    1 x 1 mL  
 2.0 mg/mL in Ethyl acetate  
  
 3,4-Dinitrololuene

### Surrogate Analyte Stock Solutions **New**

M-529-SS1    1 x 1 mL  
M-529-SS1-PAK                                      5 x 1 mL  
 100 µg/mL each in MeOH                      2 comps.  
  
 1,3,5-Trimethyl-2-nitrobenzene

<b>Internal Standard Fortification Solution <u>New</u></b>		1,2,4-Trimethyl-5-nitrobenzene	
<b><u>M-529-ISFS</u></b>		1 x 1 mL	
2.0 mg/mL in Ethyl acetate	14 comps.	<b><u>M-529-SS2</u></b>	1 x 1 mL
		<b><u>M-529-SS2-PAK</u></b>	5 x 1 mL
2-Amino-4,6-dinitrotoluene	Nitrobenzene	100 µg/mL each in MeOH	
4-Amino-2,6-dinitrotoluene	2-Nitrotoluene		
3,5-Dinitroaniline	3-Nitrotoluene	Nitrobenzene-d5	
1,3-Dinitrobenzene	4-Nitrotoluene		
2,4-Dinitrotoluene	1,3,5-Trinitrobenzene	<b>Surrogate Analyte Fortification Solution <u>New</u></b>	
2,6-Dinitrotoluene	Tetryl	<b><u>M-529-SAFS</u></b>	1 x 1 mL
RDX	TNT	<b><u>M-521-SAFS-PAK</u></b>	5 x 1 mL
		100 µg/mL each in MeOH	3 comps
		1,3,5-Trimethyl-2-nitrobenzene	
		1,2,4-Trimethyl-5-nitrobenzene	
		Nitrobenzene-d5	

### Gun Surveillance Standard

<b><u>EXP-GSS</u></b>	1 x 1 mL
At stated conc. in AcCN	9 comps.
Dimethyl phthalate	(200 µg/mL)
2,4- $\text{D}_5$ -Dinitrodiphenylamine	(50 µg/mL)
2,4-Dinitrodiphenylamine	(50 µg/mL)
2-Nitrodiphenylamine	(50 µg/mL)
4-Nitrodiphenylamine	(50 µg/mL)
2,2- $\text{D}_5$ -Dinitrodiphenylamine	(50 µg/mL)
4,4- $\text{D}_5$ -Dinitrodiphenylamine	(50 µg/mL)
Diphenylamine	(200 µg/mL)
N-Nitrosodiphenylamine	(75 µg/mL)