

Appendix 8.1

TABLE 8.1 - Main chemical classes of explosives, categorized as mandatory and elective; including examples of commercial materials containing explosives

EXPLOSIVE CLASSES	MANDATORY		ELECTIVE ¹	
	MANDATORY EXPLOSIVES ²	COMMERCIAL TYPES OF MANDATORY EXPLOSIVE MATERIALS	ELECTIVE EXPLOSIVES	COMMERCIAL TYPES OF ELECTIVE EXPLOSIVE MATERIALS
NITRO ALKANES (C-NO ₂)	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Nitromethane (NM) 2,3-Ddimethyldinitrobutane (DMNB) 	<ul style="list-style-type: none"> Kine-Pak and Kine-Stick (AN+ N M) Tagged Plasticized explosives (DMNB)³
NITRO AROMATICS (Ar-NO ₂)	<ul style="list-style-type: none"> 2,4,6-trinitrotoluene (TNT) 	<ul style="list-style-type: none"> TNT "Flake" TNT Demilled Military "Flake" Nitropel (TNT) 	<ul style="list-style-type: none"> Dinitrotoluene (DNT) Picric acid (PA) Tetranitro-N-methylaniline (Tetryl) 	<ul style="list-style-type: none"> DNT in most TNT containing explosives and selected brands of smokeless powders PA and Tetryl in some cast explosives
NITRATE ESTER (C-O-NO ₂)	<ul style="list-style-type: none"> Pentaerythritol tetranitrate (PETN) 	<ul style="list-style-type: none"> PETN (Unadulterated)⁴ Detasheet A (85% PETN + binder) red commercial form PETN Detonating Cord (100% PETN) cross section usually White in color (<i>PIMALINE, PRIMACORD, PRIMASHEAR, OPTICORD, GEOSEIS, LOW FLEX, FIRELINE CORD</i>) Primasheet 1000 (PETN + Plasticizers) SEMTEX A (PETN + Plasticizers) 	<ul style="list-style-type: none"> Methyl nitrate (MN) Nitroglycerin (NG)⁵ Ethylene glycol dinitrate (EGDN) Diethylene glycol dinitrate (DEGN) Nitrocellulose (NC) Nitroguanidine. (GN) 	<ul style="list-style-type: none"> Dynamite (EGDN + NG) Single Based Smokeless powder (NC+DNT depending on brand) Double Based Smokeless Powder (NC + NG) Triple Based Smokeless powder (NC+NG+GN)
NITRAMINES (C-N-NO ₂)	<ul style="list-style-type: none"> Trinitro-triazacyclohexane (cyclonite or RDX) 	<ul style="list-style-type: none"> RDX (Unadulterated) RDX Det Cord Composition C-4 (RDX + Plasticizers) Datasheet (Flex -X) (RDX + Plasticizers) Demex 200 (RDX + plasticizer) PE-4 (RDX + Plasticizer) Primasheet 2000 (RDX + Plasticizers) 	<ul style="list-style-type: none"> Methylamine nitrate (MAN) Tetranitro-tetrazacyclooctane (Octogen or HMX) Hexanitroisowurtzitane (CL20). specialty military explosive. 	<ul style="list-style-type: none"> HMX Detonating Cord (Fireline 17/80 HMX LS Exposed, Fireline 8/40 HMX LS Ribbon) PAX11/PAX29 (79/77% CL20+Al+plasticizers, cellulose acetate butyrate) DLE -C038 (90% CL-20, 10% HTPB plasticizer)
ACID SALTS (NH ⁴⁺ , NO ₃ ⁻)	<ul style="list-style-type: none"> Ammonium nitrate (AN) Potassium Nitrate (PN)⁶ 	<ul style="list-style-type: none"> Black Powder (PN+charcoal+sulfur) PN (Pure) Procured from Chemical Supply Kine-Pak and Kine-Stick solid component (AN) 34-0-0 agricultural fertilizers (pure AN) 	<ul style="list-style-type: none"> Ammonium perchlorate (AP) Potassium chlorate (PC) Potassium perchlorate (PP) Urea nitrate (UN) 	<ul style="list-style-type: none"> AP, PC, PP procured from Chemical or Fireworks Supply UN must be prepared by qualified chemist
PEROXIDES⁶ (C-O-O-C)	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Triacetone triperoxide (TATP) Hexamethylene triperoxide diamine (HMTD). 	<ul style="list-style-type: none"> TATP & HMTD must be prepared by a qualified chemist.

¹ Best practice is to select elective explosives from different chemical classes .

² The mandatory scents do not represent all six explosive chemical classes .

³ Plastic explosives manufactured in the U.S. after 1997 are tagged with DMNB..

⁴ "Unadulterated" is the near pure substance with minimal binders, plasticizers, etc

⁵ **Highly volatile explosives such as NG and EGDN are prone to contaminate other explosives and should be stored separately (e.g. nylon bag, sealed paint can).**

⁶ Training on explosives from the peroxide family (TATP and HMTD) should only be conducted under the proper supervision of a qualified chemist and trainer following a training objective.

TABLE 8.2 - Examples of products containing the explosive compounds listed in Table 8.1.

COMPOUNDS	ELECTIVE COMPOSITE MATERIALS CONTAINING THE EXPLOSIVE COMPOUNDS LISTED IN TABLE 8.1.	NOTES
AN - Ammonium nitrate:	<ul style="list-style-type: none"> • Amatol (Ammonium Nitrate + TNT) • Ammonal (Ammonium Nitrate + TNT + Al) • ANFO [Amex or Amite] (Ammonium Nitrate + Fuel Oil [Diesel]) • Kinepak [solid] (Ammonium Nitrate) • Water Gel / Slurry [powermex] (Ammonium Nitrate + Sodium Nitrate + EGMN) • Water Gel / Slurry [tovex] (Ammonium Nitrate + Sodium Nitrate + MMAN) • Emulsion (Ammonium Nitrate in water, Oil, Oleic Acid, Sodium Hydroxide) • Emulsion explosive DYN0 GOLD, TITAN1000 (AN+Sodium nitrate+calcium nitrate+fuel oil+mineral oil) • Emulsion explosive DYN0 AP, DYNOSPLIT (AN+Sodium nitrate+Aluminum+mineral oil) • Emulsion explosive BLASTEX, DYNOTEX (AN+sodium nitrate+Aluminum+mineral oil+kerosene) • Emulsion explosive BLASTGEL (AN+calcium nitrate+mineral oil) 	
AP - Ammonium perchlorate:	<ul style="list-style-type: none"> • 	
CL20 - Hexanitroisowurztitane	<ul style="list-style-type: none"> • PAX11/PAX29 (79/77% CL20+Al+plasticizers, cellulose acetate butyrate) • DLE-C038 (90% CL-20, 10% HTPB plasticizer) 	
DMNB - 2,3-dimethyldinitrobutane:	<ul style="list-style-type: none"> • SEMTEX H (RDX + PETN + Plasticizers) • Common plasticizer chemical 2-ethyl-1-hexanol. 	
DEGN - Diethylene glycol dinitrate:	<ul style="list-style-type: none"> • 	
EGDN - Ethylene glycol dinitrate:	<ul style="list-style-type: none"> • Straight Dynamite (NG+EGDN) • Ammonia Dynamite (NG+EGDN+AN) • Ammonia Gelatin Dynamite (NG+EGDN+AN+NC) • Red Diamond (NG + EGDN + Sodium Nitrate + Ammonium Nitrate). 	
GN - Nitroguanidine:	<ul style="list-style-type: none"> • Triple based smokeless powder (NC + NG + Nitroguanidine / TNT) 	
HMX - Tetranitro-tetrazacylooctane:	<ul style="list-style-type: none"> • HMX Detonating Cord ((Fireline 17/80 HMX LS Exposed, Fireline 8/40 HMX LS Ribbon) 	
HMTD - Hexamethylene triperoxide diamine:	<ul style="list-style-type: none"> • prepared by qualified chemist/trainer 	
MAN - Methylamine nitrate:	<ul style="list-style-type: none"> • 	
MN - Methyl nitrate:	<ul style="list-style-type: none"> • 	
NB - Nitrobenzene:	<ul style="list-style-type: none"> • Many TNT explosive mixtures 	
NC - Nitrocellulose:	<ul style="list-style-type: none"> • single, double and triple based smokeless powders 	

NG - Nitroglycerine:	<ul style="list-style-type: none"> • Straight Dynamite (NG+EGDN) • Ammonia Dynamite (NG+EGDN+AN) • Ammonia Gelatin Dynamite (NG+EGDN+AN+NC) • Red Diamond (NG + EGDN + Sodium Nitrate + Ammonium Nitrate) • Double based smokeless powder (NC + NG) • Triple based smokeless powder (NC + NG + Nitroguanidine / TNT) • Water Gel / Slurry [aquaspex] (NG) • Solid rocket propellant (NG+NC+stabilizers). 	
NM - nitromethane: "nitro" fuel	<ul style="list-style-type: none"> • 	
PA - Picric acid:	<ul style="list-style-type: none"> • Specialty chemical company 	
PC - Potassium chlorate:	<ul style="list-style-type: none"> • Potassium chlorate often mixed with petroleum jelly, paraffin. 	
PN - Potassium nitrate:	<ul style="list-style-type: none"> • Black powder (potassium nitrate + charcoal + sulfur) • Triple Seven muzzle loading propellant (charcoal + potassium nitrate + potassium perchlorate + graphite) • Pyrodex (Charcoal + Sulfur + Potassium Nitrate + Potassium Perchlorate + Graphite) • Black powder is commonly used in various pyrotechnics. 	
PP - Potassium perchlorate:	<ul style="list-style-type: none"> • Pyrotechnics/Flash powder (any oxidiser/metal fuel often with the addition of other chemicals to modify burn rate and sensitivity. • Standard mixture is 70% Potassium Perchlorate/30% Aluminum Powder. Other oxidizers may include <u>Barium Nitrate</u>, <u>Potassium Chlorate</u>, <u>Sodium Chlorate</u>, and <u>Potassium Permanganate</u>). 	
PETN - Pentaerythitol tetranitrate :	<ul style="list-style-type: none"> • Cast Booster (PETN and TNT) • Detasheet B (65% PETN or RDX) military variety in OD green • Detasheet C or Flex-X (PETN + NC + binder) OD green military form • SEMTEX H (RDX + PETN + Plasticizers) • Pentolite (PETN+TNT) • NONEL delay detonator (PETN+lead azide+silicon) 	
Pyrotechnics	<ul style="list-style-type: none"> • The chemical in Pyrotechnics include fuels, oxidizers, coloring agents, stabilizers and often smoke agents with common examples given below. • Fuels include Aluminum, Al, Antimony, Sb, Carbon black/Lampblack/Charcoal, Iron, Fe, Magnesium, Mg, Phosphorus, P; Potassium benzoate, C₆H₅CO₂K; Sulphur, S; and Titanium, Ti. Oxidizers include Ammonium Nitrate, NH₄NO₃, Ammonium perchlorate, NH₄ClO₄, Potassium chlorate, KClO₃ (being phased out due to its sensitivity), perchlorate, Potassium nitrate, KNO₃ and Potassium perchlorate, KClO₄. • Coloring Agents include barium salts (green), copper salts (green and blue), sodium salts (yellow/orange), strontium salts (red), cryolite, Na₃AlF₆, (yellow), lithium carbonate, Li₂CO₃ (red). • Stabilizers include boric acid, H₃BO₃, calcium carbonate, CaCO₃, linseed oil, petroleum jelly. • Binders including dextrin, gum Arabic and shellac. Smoke agents include anthracene, C₁₄H₁₀, hexachloroethane, C₂Cl₆, and Zinc, Zn. 	

RDX - Trinitro-triazacyclohexane (cyclonite, hexogen, T4)	<ul style="list-style-type: none"> • Composition C-4 (RDX + plasticizers) • Demex (RDX + plasticizers) • Detasheet B (65% PETN or RDX) military variety in OD green • PE-4 (RDX + plasticizers) • Primasheet 2000 (RDX + DMNB + plasticizers) • SEMTEX H (RDX + PETN + Plasticizers OR RDX + plasticizers) • RDX under the name of methenamine is used for the control of urinary tract infections • 	
Tetryl – Trinitrophenyl methylNitramine	<ul style="list-style-type: none"> • PA and Tetryl in some cast explosives 	
TATP – Triacetone triperoxide	<ul style="list-style-type: none"> • Prepared by qualified chemist/trainer 	
TNB/NT/DNB/DNT – Trinitrobenzene/Nitrotoluene/Dinitrobenzene/Dinitrotoluene:	<ul style="list-style-type: none"> • Many TNT explosive mixtures. DNT (Dinitrotoluene) found in selected brands of double based smokeless powder 	
UN – Urea Nitrate	<ul style="list-style-type: none"> • prepared by qualified chemist/trainer 	
TNT - 2,4,6-trinitrotoluene:	<ul style="list-style-type: none"> • Amatol (Ammonium Nitrate + TNT) • Ammonal (Ammonium Nitrate + TNT + Al) • Composition B (RDX + TNT) • Composition C-2 (RDX + TNT + DNT + NC + MNT) • Composition C-3 (RDX + TNT + DNT + Tetryl + NC) • Composition D (RDX + TNT + Al + wax) • Cast Boosters (typically TNT+misc explosives) • Cyclotol (RDX + TNT) • DBX (TNT + RDX + Ammonium Nitrate + Al) • HBX-1 (RDX + TNT + Al) • HTA (HMX + TNT + Al) • Pentolite (PETN + TNT) • Picratol (TNT + Ammonium Picrate) • PTX-1 (RDX + TNT + Tetryl) • PTX-2 (RDX + TNT + PETN) • Tetratol (TNT + Tetryl) • Torpex (TNT + RDX + Al) • Tritonal (TNT + Al) • Military TNT Demolition Blocks used in most aircraft bombs, artillery projectiles, mines, grenades • Cast Boosters/Primers (various combinations of TNT+PETN+RDX+HMX+Al) • Composition B Boosters (RDX+TNT+wax) • Torpex Boosters (RDX+TNT+Al) • Amatol Booster (Pentolite or Composition B + ammonium nitrate) • Sodatol Booster (Pentolite or Composition B + sodium nitrate) 	