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 ($C\text{-}NO_2$)	• None	• None	• Nitromethane (NM) • 2,3-Ddimethyldinitrobutane (DMNB)	• Kine-Pak and Kine-Stick (AN+ NM) • Tagged Plasticized explosives (DMNB)[3] •
NITRO AROMATICS ($Ar\text{-}NO_2$)	• 2,4,6-trinitrotoluene (TNT)	• TNT "Flake" • TNT Demilled Military "Flake" • Nitropel (TNT)	• Dinitrotoluene (DNT) • Picric acid (PA) • Tetranitro-N-methyaniline (Tetryl)	• DNT in most TNT contaning explosives and selected brands of smokeless powders • PA and Tetryl in some cast explosives
NITRATE ESTER ($C\text{-}O\text{-}NO_2$)	• Pentaerythitol tetranitrate (PETN)	• PETN (Unadulterated)[4] • Detasheet A (85% PETN + binder) red commercial form • PETN Detonating Cord (100% PETN) cross section usually White in color *(PIMALINE, PRIMACORD, PRIMASHEAR, OPTICORD, GEOSEIS, LOW FLEX, FIRELINE CORD)* • Primasheet 1000 (PETN + Plasticizers) • SEMTEX A (PETN + Plasticizers)	• Methyl nitrate (MN) • Nitroglycerin (NG)[5] • Ethylene glycol dinitrate (EGDN) • Diethylene glycol dinitrate (DEGN) • Nitrocellulose (NC) • Nitroguanidine. (GN)	• 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 ($C\text{-}N\text{-}NO_2$)	• Trinitro-triazacylohexane (cyclonite or RDX)	• 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)	• Methylamine nitrate (MAN) • Tetranitro-tetrazacylooctane (Octogen or HMX) • Hexanitroisowurztitane (CL20). specialty military explosive.	• HMX Detonating Cord (Fireline 17/80 HMX LS Exposed, Fireline 8/40 HMX LS Ribbon) • PAX11/PAX29 (79/77% CL20+Al+plasticzers, cellulose acetate butyrate) • DLE-C038 (90% CL-20, 10% HTPB plasticizer)
ACID SALTS (NH^{4+}, NO^{3-})	• Ammonium nitrate (AN) • Potassium Nitrate (PN)[1]	• 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)	• Ammonium perchlorate (AP) • Potassium chlorate (PC) • Potassium perchlorate (PP) • Urea nitrate (UN)	• AP, PC, PP procured from Chemical or Fireworks Supply • UN must be prepared by qualified chemist
PEROXIDES[6] (C-O-O-C)	• None	• None	• Triacetone triperoxide (TATP) • Hexamethylene triperoxide diamine (HMTD).	• 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:	• 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 DYNO GOLD, TITAN1000 (AN+Sodium nitrate+calcium nitrate+fuel oil+mineral oil) • Emulsion explosive DYNO 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:	•	
CL20 - Hexanitroisowurztitane	• PAX11/PAX29 (79/77% CL20+Al+plasticzers, cellulose acetate butyrate) • DLE-C038 (90% CL-20, 10% HTPB plasticizer)	
DMNB - 2,3-dimethyldinitrobutane:	• SEMTEX H (RDX + PETN + Plasticizers) • Common plasticizer chemical 2-ethyl-1-hexanol.	
DEGN - Diethylene glycol dinitrate:	•	
EGDN - Ethylene glycol dinitrate:	• 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:	• Triple based smokeless powder (NC + NG + Nitroguanidine / TNT)	
HMX - Tetranitro-tetrazacylooctane:	• HMX Detonating Cord ((Fireline 17/80 HMX LS Exposed, Fireline 8/40 HMX LS Ribbon)	
HMTD - Hexamethylene triperoxide diamine:	• prepared by qualified chemist/trainer	
MAN - Methylamine nitrate:	•	
MN - Methyl nitrate:	•	
NB – Nitrobenzene:	• Many TNT explosive mixtures	
NC - Nitrocellulose:	• single, double and triple based smokeless powders	

NG - Nitroglycerine:	• Straight Dynamite (NG+EGDN) • Ammonia Dynamite (NG+EGDN+AN) • Ammonia Gelatin Dynami te (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	•	
PA - Picric acid:	• Specialty chemical company	
PC - Potassium chlorate:	• Potassium chlorate often mixed with petroleum jelly, paraffin.	
PN - Potassium nitrate:	• 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:	• 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 Barium Nitrate, Potassium Chlorate, Sodium Chlorate, and Potassium Permanganate).	
PETN - Pentaerythitol tetranitrate :	• 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	• 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, $C_6H_5CO_2K$; Sulphur, S; and Titanium, Ti. Oxidizers include Ammonium Nitrate, NH_4NO_3, Ammonium perchlorate, NH_4ClO_4, Potassium chlorate, $KClO_3$ (being phased out due to its sensitivity), perchlorate, Potassium nitrate, KNO_3 and Potassium perchlorate, $KClO_4$. • Coloring Agents include barium salts (green), copper salts (green and blue), sodium salts (yellow/orange), strontium salts (red), cryolite, Na_3AlF_6, (yellow), lithium carbonate, Li_2CO_3 (red). • Stabilizers include boric acid, H_3BO_3, calcium carbonate, $CaCO_3$, linseed oil, petroleum jelly. • Binders including dextrin, gum Arabic and shellac. Smoke agents include anthracene, $C_{14}H_{10}$, hexachloroethane, C_2Cl_6, and Zinc, Zn.	

RDX - Trinitro-triazacylohexane (cyclonite, hexogen, T4)	• 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	• PA and Tetryl in some cast explosives	
TATP – Tiacetone triperoxide	• Prepared by qualified chemist/trainer	
TNB/NT/DNB/DNT – Trinitrobenzene/Nitrotoluene/Dinitrobenzene/Dinitrotoluene:	• Many TNT explosive mixtures. DNT (Dinitrotoluene) found in selected brands of double based smokeless powder	
UN – Urea Nitrate	• prepared by qualified chemist/trainer	
TNT - 2,4,6-trinitrotoluene:	• 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)	