Appendix G: High Hazard Chemicals

Section 1: Carcinogens, Reproductive Toxins or Highly Toxic Chemicals used in Biomedical Research

The chemicals listed below are extremely hazardous due to their toxic effects. This is not an exclusive list. Workers must have knowledge of the dangers of these chemicals prior to use, and documentation of training in safe working procedures.

Biologically active compounds:

DNA synthesis inhibitors (e.g. hydroxyurea, nucleotide analogs, dideoxy nucleotides, actinomycin D, acidicolin)
kinase inhibitors (e.g. NaF)
mitogenic compounds (e.g. concanavalin A)
mitogenic inhibitors (e.g. colcemid)
phosphatase inhibitors (e.g. okadaic acid)
protease inhibitors (e.g. PMSF, Aprotin, Pepstatin A, Leopeptin – use safer alternatives like Pefabloc™)
protein synthesis inhibitors (e.g. cycloheximide, Puromycin)
respiratory chain inhibitors (e.g. sodium azide)
transcriptional inhibitors (e.g. a-amanitin and actinomycin D)

BRDU, 5- bromo–2'–deoxyuridine (CAS# 59-14-3) – mutagen, reproductive toxin, potential carcinogen, used as an alternative to tritium (H3) in labeling replicating cells/DNA.

Diisopropyl fluorophosphate: highly toxic cholinesterase inhibitor; the antidote, atropine sulfate and 2-PAM (2-pyridinealdoxime methiodide) must be readily available

MPTP, 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridne hydrochloride (CAS# 23007-85-4) – potent neurotoxin at low doses, producing irreversible parkinsons like symptoms, lethal at high doses

N-methyl-N'-nitro-N-nitrosoguanidine: carcinogen (this chemical also forms explosive compounds upon degradation)
Phalloidin from Amanita Phalloides: used for staining actin filaments
Retinoids: potential human teratogens
Streptozotocin: potential human carcinogen
Urethane (ethyl carbamate): an anesthetic agent, potent carcinogen and strong teratogen, volatile at room temperature

Other compounds used in biomedical research:

5-fluoracil
alpha-Ammanatin
Ethylene Oxide
Hydrofluoric Acid

Osmium Tetroxide
Perchloric Acid
Thimerosol (organic mercury compound)

Section 2: Toxins of Biological Origin
(adapted from the University of Florida website)

Biological toxins are produced by certain bacteria, fungi, protozoa, plants, reptiles, amphibians, fish, echinoderma (spiny urchins and starfish), mollusks, and insects.

Biological toxins with a mammalian LD_{50} of $\leq$ 100 ug/kg body weight are called "Acute Toxins". Additional precautions, training and supervision are required for work with these materials

The following table lists LD_{50} values for some biological toxins.

Toxin	LD50 (ug/kg)*
Abrin	0.7
Aerolysin	7.0
Botulinin toxin A	0.0012
Botulinin toxin B	0.0012
Botulinin toxin C1	0.0011
Botulinin toxin C2	0.0012
Botulinin toxin D	0.0004
Botulinin toxin E	0.0011
Botulinin toxin F	0.0025
b-bungarotoxin	14.0
Caeruleotoxin	53
Cereolysin	40-80
Cholera toxin	250
Clostridium difficile enterotoxin A	0.5
Clostridium difficile cytotoxin B	220
Clostridium perfringens lecithinase	3
Clostridium perfringens kappa toxin	1500
Clostridium perfringens perfringolysin O	13-16
Clostridium perfringens enterotoxin	81
Clostridium perfringens beta toxin	0.4
Clostridium perfringens delta toxin	5
Clostridium perfringens epsilon toxin	0.1
Conotoxin	12-30
Crotoxin	82
Diphtheria toxin	0.1
Listeriolysin	3-12

Leucocidin	50
Modeccin	1-10
Nematocyst toxins	33-70
Notexin	25
Pertussis toxin	15
Pneumolysin	1.5
Pseudomonas aeruginosa toxin A	3
Ricin	2.7
Saxitoxin	8
Shiga toxin	20
Shigella dysenteriae neurotoxin	1.3
Streptolysin O	8
Staphylococcus enterotoxin B	25
Staphylococcus enterotoxin F	2-10
Streptolysin S	25
Taipoxin	2
Tetanus toxin	0.001
Tetrodotoxin	8
Viscumin	2.4-80
Volkensin	1.4
Yersinia pestis murine toxin	10

*Please note that the LD50 values are from a number of sources. For specifics on route of application (i.v., i.p., s.c.), animal used, and variations on the listed toxins, please go to the references listed below.

Reference:

1. Gill, D. Michael; 1982; Bacterial toxins: a table of lethal amounts; Microbiological Reviews; 46: 86-94
2. Stirpe, F.; Luigi Barbieri; Maria Giulia Battelli, Marco Soria and Douglas A. Lappi; 1992; Ribosome-inactivating proteins from plants: present status and future prospects; Biotechnology; 10: 405-412
3. Registry of toxic effects of chemical substances (RTECS): comprehensive guide to the RTECS. 1997. Doris V. Sweet, ed., U.S. Dept of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health; Cincinnati, Ohio

Other Biological Toxins:

Aflatoxins
Amanitin
Amphibian venoms
Anatoxin A
Anthrax toxin
Aspergillus sp toxins
Bacillus sp. toxins - all
Bordetella sp. toxins
Botulinum toxins - all
Brevetoxins
Bungarotoxins
Cardiotoxin
Charybdotoxin
Cholera toxins - all
Ciguatera toxin
Clostridia species toxins - all
Cluepeotoxins
Cobra venous and all derived toxins
Cobratoxin
Conotoxins - all
Crotamine
Dendrodotoxins
Dinoflagellate neurotoxins
Diphtheria toxins
Domoic acid
DTX-1 (Dinophysistoxin-1)
Echinoderm venoms - all
Endotoxins - all
Enterobacteriaciae toxins - all
Enterotoxins - all
Escherichia coli toxins - all
Exotoxin A
Fish venoms - all
Fusarium sp. toxins
Gliotoxin
Joco Spider Toxin JSTX-3
Lappaconitines
Leiurotoxins
Lipid A - all types
Lipopolysaccharides from all species
Maitotoxin
Medamine
Microcystins
Mojave toxin
Mycotoxins - all
Myotoxins
Neurotoxins - all
Notexin
Nodularin
Ochratoxin
Palytoxin
Paradoxin
Pertussis toxins - all
Phalloidin
Psilocybine
Pseudomonas sp. toxins
Reptile venoms - all
Resiniferatoxin
Ricin toxins - all
Sapintoxin
Sarafotoxin
Saxitoxin
Short Neurotoxins
Snake venoms - all
Stable toxins
Staphylococcus sp. toxins
Streptonigrin
Taipoxin
Tetanus toxins - all
Tetrodotoxins - all
Textilotoxin
Thymeleatoxin
Tinyatoxin
Toxin II - all types

Section 3: Working with and Disposing of Biological Toxins

Adapted from the University of Pennsylvania EH&S website

Because they can be extremely hazardous, even in minute quantities, biological toxins require strict safeguards against their inhalation, absorption through skin or mucous membranes (typically due to a splash), ingestion, or percutaneous injury.

Key points of the guidelines are:

1. Written safety **protocols** to cover the use of the specific toxin(s) in use
2. **Security measures** in place to protect against unauthorized access to toxin(s)
3. **Inventory control** system in place; all entries in a hardbound book, in ink
4. Written **plan for** toxin-related **emergencies** (spill, exposure, etc) posted
5. **BSL-2 or BSL-3** containment and practices in use

Some toxins are quite resistant to conventional methods of inactivation. **These agents cannot be simply placed in the biomedical or hazardous waste that is picked up by EH&S**.

Toxins may be destroyed by several methods as shown in the table below. Some toxins are inactivated by autoclaving for one hour at 121°C. Others are inactivated by exposure to sodium hypochlorite and/or sodium hydroxide.

Chemical destruction of toxins:

When using sodium hypochlorite and / or sodium hydroxide to destroy toxin, the procedure(s) must be performed in a laboratory fume hood or a biological safety cabinet. At a minimum, personal protective equipment for all procedures should include:

Long sleeved protective clothing (lab coat, gown)
Gloves and eye protection

1. If the toxin is classified as a select agent, even in exempt amounts, document destruction of the toxin and notify EHS.

2. Work in a fume hood or biosafety cabinet with the sash at the lowest reasonable sash height for safe and effective work.

3. Place plastic backed absorbent paper (bench diaper) on the work surface of the fume hood or biosafety cabinet.

4. CAREFULLY put the Select Agent toxin into solution in the primary container. DO NOT USE A GLASS CONTAINER.

5. Place the primary container in a secondary container, such as a beaker or rack.
6. Slowly dispense an equal volume of the concentrations of sodium hypochlorite and/or sodium hydroxide designated in table 1 below into the primary container of toxin solution to be destroyed.
7. Do not replace the cap on primary container.
8. Place a "WARNING / DO NOT USE" sign on the hood/cabinet.
9. Allow a minimum 60 minutes exposure time. (See table 1 below for additional exposure time recommendations.)
10. Document the destruction of the toxin in the laboratory inventory logbook.
11. Secure the cap on the primary container. DOUBLE BAG the material in zip-lock plastic bags and label it "Inactivated/denatured (TOXIN NAME)".
12. Contact EH&S for disposal

Steam Sterilization (Autoclaving) of Toxins

If acceptable as a method in table 1 below, destroy toxins by autoclaving them using the procedure outlined below:

1. If the toxin is classified as a select agent, even in exempt amounts, notify EH&S prior to destruction of the agent.
2. In a fume hood or biological safety cabinet, loosen the cap of the primary toxin container to allow steam penetration.
3. Place the primary container into a secondary biohazard sharps container.
4. Place the sharps container in a loosely closed biohazard bag.
5. Place the bag in a autoclavable pan.
6. Autoclave at 121° C for 1 hour on liquid cycle (slow exhaust).
7. Document the destruction of the toxin the laboratory inventory logbook.
8. After autoclaving, allow time for materials to cool before handling.
9. Discard the biobag and its containers as biological waste.

DO NOT use steam sterilization for destruction of any of the low molecular weight toxins (i.e. mycotoxins, marine and reptile venoms).

All waste from toxins that is not disposed as infectious waste must be collected by EH&S for disposal as hazardous waste.

Toxins classified as select agents, even if in exempt amounts, require documentation of destruction with witnesses. Contact EHS and refer to the Select Agent policy.

Table 1 - Inactivation Procedures for Selected Toxins

Allow at least a 60-minute chemical contact time for complete inactivation of toxin. Any procedure labeled "yes" is an approved procedure for inactivation of the toxin specified.

Toxin	**Autoclave** (**1 hour** @ 121° C, liquid exhaust)	**2.5% NaOCL + 0.25 N NaOH**	**1.0% NaOCl**	**2.5% NaOCl**
Abrin (1)(8)	Yes	N/A	N/A	N/A
Botulinum Neurotoxin (1) (7)	Yes	Yes	Yes	Yes
Clostridium perfringens epsilon toxin (2)	Yes	N/A	N/A	N/A
Conotoxin(3)	**CALL EH&S**			
Diacetoxyscirpenol(5)	No	Yes	No	Yes (3-5%)
Ricin (1)(7)	Yes	Yes	Yes	Yes
Saxitoxin (1)(7)	No	Yes	Yes	Yes
Shigatoxin & Shiga-like ribosome inactivating proteins(4)	Yes	Yes	Yes	Yes
Staphylococcal Enterotoxins (1)(7)	Yes	Yes	Yes	Yes
Tetrodotoxin (1)(7)	No	Yes	Yes	Yes
T-2 Toxin (1)(6)(5)	No	Yes	No	No

1. Wannemacher R.W. 1989. Procedures for Inactivation and Safety Containment of Toxins. Proc. Symposium on Agents of Biological Origin, U.S. Army Research, Dev. and Engineering Center, Aberdeen proving Ground, MD. pp. 115-122

2. Factsheets on Chemical and Biological Warfare, http://www.cbwinfo.com/Biological/Toxins/Cper.html

3. Factsheets on Chemical and Biological Warfare, http://www.cbwinfo.com/Biological/Toxins/Conotox.html

4. Factsheets on Chemical and Biological Warfare, http://www.cbwinfo.com/Biological/Toxins/Verotox.html

5. Factsheets on Chemical and Biological Warfare, http://www.cbwinfo.com/Biological/Toxins/mycotoxins.html

6. For complete inactivation of T-2 mycotoxin extend exposure time for liquid samples, spills, and non-burnable waste in 2.5% sodium hypoclorite and 0.25 N sodium hydroxide to 4 hr. Expose cages/bedding from animals exposed to T-2 mycotoxin to 0.25% sodium hypochlorite and 0.025 N sodium hydroxide for 4 hrs.

7. For inactivation of saxitoxin, tetrodotoxin, ricin, botulinum toxin, or staphylococcal enterotoxins, expose work surfaces, solutions, equipment, animal cages, spills to 10% sodium hypochlorite for 60 minutes.

8. http://www.inchem.org/documents/pims/plant/abruspre.htm

Section 4: Poisonous Gasses and Compressed Liquids

Arsine
Boron Trichloride
Bromine Pentafluoride
Chlorine Trifluoride
Cyanogen
Diborane
Dinitrogen tetroxide
Fluorine
Germane
Hydrogen Selenide
Nitric Oxide
Nitrogen Dioxide
Nitrogen Trioxide
Nitrosyl Chloride
Oxygen Difluoride
Phosgene
Phosphine
Phosphorous Pentafluoride
Selenium Hexafluoride
Stibine
Sulfur Tetrafluoride
Tellurium Hexafluoride
Tetraethyldithiopyrophosphate
Tetraethylpyrophosphate

Other unique compressed gas hazards:
Hydrogen Fluoride (cylinders can fail over time due to corrosion and/or overpressurization from HF degradation)
Tetrafluoroethylene (flammable and unstable over time due to peroxide formation)

Section 5: OSHA regulated carcinogens

These chemicals, with their unique Chemical Abstract Service (CAS) numbers in parentheses, are:

- Acrylonitirle (107-13-1)
- Arsenic (7440-38-2) and inorganic arsenic compounds
- Asbestos (1332-21-4), including Amosite (12172-73-5),
- Chrysotile (12001-29-5), and Crocidolite (12001-28-4)
- Benzene (71-43-2)
- Cadmium (7440-43-9) and cadmium compounds
- Coal tar pitch volatiles (8007-4-2)
- Coke oven emissions
- 1,2-Dibromo-3-chloropropane (96-12-8)
- Ethylene dibromide (106-93-4)
- Ethylene oxide (75-21-8)
- Formaldehyde (50-00-0) (including paraformaldehyde [30525-89-41])
- 4,4'-Methylenebis(2-chloroaniline) (101-14-4)
- 4,4'-Methylenedianiline (107-77-9)
- Vinyl chloride (75-01-4)
- Carcinogens with specific laboratory activity regulations:
    - 2-Acetylaminofluorene (53-96-3)
    - 2-Aminodiphenyl (92-67-1)
    - Benzidine (92-87-2) (and its salts)
    - bis-Chloromethyl ether (542-88-1)
    - 3,3'-Dichlorobenzidine (91-94-1) (and its salts)
    - 4-Dimethylaminoazobenzene (60-11-7)
    - Ethyeneimine (151-56-4)
    - Methyl chloromethyl ether (107-30-2)
    - alpha-Naphthylamine (134-32-7)
    - beta-Naphthylamine (91-59-8)
    - 4-Nitrobiphenyl (92-93-3)
    - N-Nitrosodimethylamine (62-75-9)
    - beta-Propiolactone (57-57-8)

Section 6: Shock Sensitive and Peroxide forming Chemicals

(From Sigma Aldrich http://www.sigmaaldrich.com/chemistry/solvents/learning-center/peroxide-formation.html accessed on 5/2/2012)

Peroxide Forming Solvents

A significant number of laboratory solvents can undergo autoxidation under normal storage conditions to form unstable and potentially dangerous peroxide by-products. This process is catalyzed by light and heat and occurs when susceptible materials are exposed to atmospheric oxygen. Molecular structure is the primary factor relating to a material's potential for hazardous peroxide formation.

Most overviews of potential peroxide-forming chemicals classify various materials into three categories, on the basis of peroxide formation susceptibility, each with general handling and use guidelines.1 The two categories relevant to solvents are defined as solvents that pose a peroxide related safety risk without having to be pre-concentration (see Group A, next section) and solvents that necessitate pre-concentration in order to form peroxides (see Group B, next section). Storage time guidelines for perviously opened containers is provided in the section following this paragraph (Potential Peroxide-Forming Solvents*). Please note that the storage time indicated below are based on these solvents continually being stored in opaque containers and under inert atmospheric gases.

Potential Peroxide-Forming Solvents*

Group A: Chemicals that form explosive levels of peroxides without concentration

Severe peroxide hazard after prolonged storage, especially after exposure to air.
Test for peroxide formation before using or discard after 3 months.

Isopropyl ether

Group B: Peroxide hazards on concentration

Test for peroxide formation before distillation or evaporation. Test for peroxide formation or discard after 1 year.

Acetal

Acetaldehyde

Benzyl Alcohol

2-Butanol

Dioxanes

Chlorofluoroethylene

Cumene(isopropylbenzene)

Cyclohexene

2-Cyclohexen-1-ol

Cyclopentene

Decahydronapthalene(decalin)

Diacetylene(butadiyne)

Dicyclopentadiene

Diglyme

Diethyl ether

Ethylene glycol ether acetates

Furan

4-Heptanol

2-Hexanol

Methyl Acetylene

3-Methyl-1-butanol

Methyl-isobutyl ketone

4-Methyl-2-pentanol

2-Pentanol

4-Penten-1-ol

1-Phenylethanol

Tetrahydrofuran

Tetrahydronapthalene

Vinyl Ethers

Sec. Alcohols

* Materials other than those listed may form peroxides. Applies only to pure materials.

Use and Storage of Peroxide-Forming Solvents

The solvents most commonly used in the laboratory solvents, such as diethyl ether, tetrahydrofuran, cyclohexene, glycol ethers, decalin and 2-propanol are shown in Group B of the previous section. These compounds produce organic peroxides that are significantly less volatile than the solvent in which they are formed, as a result, evaporative concentration or distillation can produce dangerous levels of peroxides. In fact, most Group B solvents are sufficiently volatile that multiple openings of a single container can result in significant and dangerous peroxide concentration. The next section contains a list of key aspects to consider when handling peroxide-forming solvents.

General Handling Considerations for Peroxidizeable Solvents:

- All peroxide-forming solvents should be checked for the presence of any peroxides prior to distillation or evaporation.
- Solvents containing low levels of free radical scavengers such as BHT should be used whenever the presence of the stabilizing species does not interfere with intended application.
- Uninhibited materials should be stored with care and frequently checked for peroxide formation.
- Peroxide-forming solvents should be purchased in limited quantities and older material in inventory should be preferentially selected for use.
- Materials should be stored away from light and heat with tightly secured caps and labeled with dates of receipt and opening.
- Periodic testing to detect peroxides should be performed and recorded on previously opened material. For more information, it is recommended that the reader review the articles referenced below by Kelly2 and/or Clark3

Peroxide Detection

A variety of methods are available to test for the presence of peroxides in organic solvents with the two most common tests described below. At present, 100 ppm is widely used as a general control point with respect to minimum hazardous peroxide concentration in a solvent, however, this value lacks scientific validation and is likely too liberal or conservative depending on the solvent in question and intended application.2 If there are visible crystals, visible precipitate or an oily viscous layer present in the material, these are visual indicators of dangerous high peroxide levels, immediately contact your company's EH&S (Environmental, Health and Safety) department or its equivalent, to manage this hazardous situation and to dispose of this material.

Quantofix® Peroxide Test Strips (Sigma-Aldrich Part # 37206)

In the presence of hydrogen peroxide the test paper turns blue. Quantofix® Peroxide test sticks can also be used for the determination of peracetic acid and other organic and inorganic hydroperoxides. To test for hydroperoxides in organic solvents, the test zone is wetted with one drop of water after evaporation of the solvent.

Interferences: In the pH range of 2-9, the accuracy of the determination is independent of the pH of the test solution. Buffer strongly acidic solutions with sodium acetate and adjust alkaline solutions to about pH 5-7 with citric acid. Falsely positive results can only be caused by strong oxidizing agents.

Storage: Avoid exposing the sticks to sunlight and moisture. Store unopened packs in refrigerator (+2 °C to +8 °C). Opened packs: store container in a cool and dry place.

Potassium Iodide Indicator

Add 0.5-1.0 ml of the sample solvent to an equal volume of glacial acetic acid containing about 0.1 g of sodium iodide or potassium iodide crystals. A yellow color indicates iodine formation via iodide oxidation by sample peroxide; a brown color indicates high concentration. A blank determination should be made particularly when color development is faint since iodide/acetic acid mixtures will, over time, turn a yellow - brown color due to air oxidation.

A more sensitive variation of the above method adds one drop of a saturated, aqueous starch solution to the sample solution. Starch and iodine combine to form a bright blue complex that is more easily visualized than the yellow color generated by iodine alone. Dark blue solution color would be indicative of high peroxide concentrations.

References

Jackson, H.L., McCormack, W.B., Rondestvedt, C.S., Smeltz, K.C., and Viele, I.E. Control of Peroxidizable Compounds, J. Chem. Educ., 1970, 46 (3), A175.

Kelly, R.J, Review of Safety Guidelines for Peroxidizable Organic Compounds, Chemical Health and Safety, 1996, 3 (5), 28-36.

Clark, D.E., Peroxides and Peroxide - Forming Compounds, Chemical Health and Safety, 2001, 8 (5), 12-21.

B. Shock, Temperature or Friction Sensitive

Acetyl acetone peroxide with more than 9% wt active oxygen
Acetyl benzoyl peroxide (solid or more than 40% in solution)
Acetyl cyclohexanesulphonyl peroxide (> 82% with <12% water)
Acetyl peroxide, solid, or more than 27% in solution
Aceytlene (liquid), Ethyne (liquid) acetylene
Acetylene silver nitrate
Aluminum dross, wet or hot
Ammonium azide
Ammonium bromate
Ammonium chlorate
Ammonium fulminate
Ammonium nitrite
Ammonium permanganate
Antimony sulfide and a chlorate, mixture of
Arsenic sulfide and a chlorate, mixtures of
Ascaridole (organic peroxide) epidioxy-2-p-menthene
Azaurolic acid (salt of) (dry)
3-Azido guanidine picrate (dry)
Azido-1,2-propylene glycol dinitrate
Azidodithiocarbonic acid
Azidoethyl nitrate
Azotetrazole (dry)
Benzene tirozonide
Benzenediazonium chloride (dry)
Benzenediazonium nitrate (dry)
Benzoxidiazoles (dry)
Benzoyl azide
Benzazide, benzoic acid azide
Biphenyl triozonide
Bromine azide
4-Bromo-1,2-dinitrobenzene
Bromo silane
Butanetriol trinitrate
tert-butoxycarbonyl azide
Butyl azidoformate
tert-Butyl hydroperoxide, more than 90% with water

- Hydroperoxide, 1,1-dimethylethyl (more than 90% with water)

tert-Butyl peroxyisobutyrate, 77% or more
Chlorine azide
Chlorine dioxide (not hydrated)
Chloroprene, uninhibited
Copper amine azide
Copper tetramine nitrate
Cyanuric triazide
Cyclotetramethylene tetranitramine (dry)
  Octogen (dry)
  HMX (dry)
Di(beta-nitroxyethyl)ammonium nitrate
A,A-Di(nitroxy)methyl ether
Di(1-hydroxy tetrazole) (dry)
Di(1-naphthoyl) peroxide
Diacetone alcohol peroxide >57% in solution, >9% hydrogen peroxide,<26% diacetone alcohol, <9% water; total active
Diazidobenzene
1,2-Diazidoethane
1,1-Diazoaminonaphthalene
Diazoaminotetrazole (dry)
Diazodinitrophenol (dry)
  Dinol (dry)
  Diazol (dry)
  DDNP (dry)
  Diazo-4,6-dinitrobenzene-1-oxide (dry)
  Dinitro-1,2,3-benzoxadiazole (dry)
Diazodiphenyl methane
Diazomethane
Azimethylene
Diazonium nitrates (dry)
Diazonium perchlorates (dry)
Diazopropane
Dibenzyl peroxydicarbonate, >87% with water
Dibromoacetylene
Dibromomethyne
N,N'-dichlorazodicarbonamidine (salts of) (dry)
  Chloroazodin (salts of) (dry)
  Azochloramide (salts of) (dry)
Dichloroacetylene
  Dichloroethyne
2,4 dichlorobenzoyl peroxide (>77% with water)
Diethanol nitrosamine dinitrate
Diethyl peroxydicarbonate more than 27% in solution
Diethylene glycol dinitrate
  DEGN

- Digylcol nitrate
- Dinitroglycol

Diethylgold bromide
1,8-dihydroxy-2,4,5,7-tetranitroanthraquinone
- chrysamminic acid

Diiodoacetylene
- Diiodoethyne

Diisopropylbenzene hydroperoxide (>72% in solution)
- Isopropylcumyl hydroperoxide (>72% in solution)

2,5-dimethyl-2,5-dihydroperoxy hexane, more than 82% with water
Dimethylhexane dihydroperoxide (dry)
1,4-dinitro-1,14,4-tetramethylolbutanetetranitrate (dry)
2,4-dinitro-1,3,5-trimethylbenzene
1,3-dinitro-4,5-dinitrosobenzene
1,3-dinitro-5,5-dimethylhydantoin
Dinitor-7,8-dimethylglycouril (dry)
1,2-dinitroethane
1,1-dinitroethane (dry)
Dinitroethane
Dinitropropyleneglycol
4,6-dinitroresorcinol (heavy metal salts of) (dry)
2,4-dinitroresorcinol (heavy metal salts of) (dry)
3,5-dinitrosalicylic acid (lead salt) (dry)
Dinitrosobenxylamide and salts of (dry)
2,2-Dinitrostilbene
1,9-dinitroxypentanamethylene-2,4,6,8-tetramine (dry)
t-butyl peroxyacetate, >77% in solution
Ethanolamine dinitrate
Ethyl hydroperoxide
Ethyl perchlorate
Ethylene diamine diperchlorate
Ethylene glycol dinitrate
- EGDN
- Nitrogylcol

Fulminating gold
Fulminating platinum
Fulminating silver
Fulminic acid
Galactsan trinitrate
Glycerol monogluconate trinitrate
Glycerol monolactate trinitrate
Glycerol-1,3-dinitrate
Guanyl nitrosaminoguanylidine hydrazine (dry)
Hexamethylene triperoxide diamine (dry)
- HMTD (dry)

Hexamethylol benzene hexanitrate

- 2,2,4,4,6-Hexanitro-3,3'-dihydroxyazobenzene (dry)
- Hexanitroazoxy benzene
- 2,3,4,4,6-Hexanitrophenyl ether
  - Hexanitrodiphenyloxide
- N,N'-Hexanitrodiphenyl ethylene dinitramine (dry)
- Hexanitrodiphenyl urea
- 2,2,3,4,4-Hexanitrodiphenylamine (2,2,3,4,4,6)
- Hexanitroethane
- Hexanitoroxanilide
- Hydrazine azide
- Hydrazine chlorate
- Hydrazine dicarbonic acid diazide
- Hydrazine perchlorate
- Hydrazine selenate
- Hydrocyanic acid (prussic), unstabilized
- Hydroxylamine iodide
- Hyponitrous acid
- Lead nitroresorcinate (dry)
- Lead monoresorcinate (dry)
- Guanyl nitrosamineogyanyltetrazene (dry)
  - Tetrazene (dry)
- Lead styphnate (dry)
  - Lead trinitroresorcinate (dry)
- Inositol hexanitrate (dry)
- Inulin trinitrate (dry)
- Iodide Azide (dry)
- Iodoxy compounds (dry)
- Iridium nitratopentamine iridium nitrate
- Isothiocyanic acid (polymerization hazard)
  - Thiocyanic acid (polymerization hazard)
  - Hydrogen thiocyanate (polymerization hazard)
- Lead azide (dry)
- Lead picrate (dry)
- Magnesium dross (wet or dry)
- Mannitan tetranitrate
- Mercurous azide
- Mercury acetylide
- Mercury fulminate (dry)
- Mercuric cyanate (dry)
  - Fulminic acid, mercury(2+) salt (dry)
  - Fulminate of mercury (dry)
  - Fulminating mercury (dry)
- Mercury iodide aquabasic ammonbasic
  - Iodide of millon's base
- Mercury nitride
- Di-n-Butyl peroxydicarbonate, >52% in solution

Metal salts of methyl nitramine (dry)
Methazoic acid
Methyl ethyl ketone peroxide, in solution with >9% by weight active oxygen
Methyl isobutyl ketone peroxide, in solution with >9% by weight active oxygen
Methyl nitrate
    Nitric acid methyl ester (less than 10% with ethanol)
Methyl picric acid (heavy metal salts of)
Methyl trimethylol methane trinitrate
Methylamine dinitramine and drys salts of
Methylamine nitroform
Methylamine perchlorate (dry)
Methylene glycol dinitrate
alpha-methylglucoside tetranitrate
alpha-methylglycerol trinitrate
Chloroacetone, unstabilized
    Chloro-2-propanone, unstabilized
Naphthalene diozonide
Naphthyl amineperchlorate
Nickel picrate
Nitrated paper (unstable)
Nitrates of diazonium compounds
Nitrohydantoin
Nitro isobutane triol trinitrate
Nitro-n-methylglycolamide nitrate
2-Nitro-2-methylpropanol nitrate
6-Nitro-4-diazotoluene-3-sulfonic acid (dry)
M-Nitrobenzene diazonium perchlorate
Nitroethyl nitrate
Nitroethylene polymer
Nitrogen trichloride
Nitrogen triiodide
Nitrogen triiodide monoamine
Nitroguanidine nitrate
Mannitol hexanitrate (dry)
Cabazide
Nitrophenyldinitro methane
Nitrosugars (dry)
1,7-octadiene-3,5-diyne-1,8-dimethoxy-9-octadecynoic acid
Pentaerythrite tetranitrate (dry)
Pentaerythritol tetranitrate (dry)
    PETN (dry)
    Baritrate (dry)
    Angicap (dry)
    Angitet (dry)
    Antora (dry)
    Arcotrate (dry)

- Duotrate (dry)
  - Erinit (dry)
  - Hasethrol (dry)
  - Martrate-45 (dry)
  - Methranil (dry)
  - Mycardol (dry)
  - Niperyt (dry)
  - Niperyth (dry)
  - Nitropenta (dry)
  - Pencard (dry)
  - Pentafin (dry)
  - Pentestan-80 (dry)
  - Pentrate (dry)
  - Pentriol (dry)
  - Peritrate (dry)
- Pentanitroaniline (dry)
- Perchloric acid, exceeding 72% strength
- Peroxyacetic acid >43% and with more than 6% hydrogen peroxide
- Phenylene diaminediperchlorate (dry)
- Phosphorous (white or red) and a chlorate mix
- Pyridine perchlorate
- Quebrachitol pentanitrate
- Selenium nitride
- Silver acetylide (dry)
- Silver azide (dry)
- Silver chlorite (dry)
- Silver fulminate (dry)
- Silver oxalate (dry)
- Silver picrate (dry)
- Sodium picryl peroxide
- Sodium tetranitride
- Sucrose octanitrate (dry)
- Sulfur and chlorate (loose mixtures of)
- Tetraazido benzene quinone
- Tetraethylammonium perchlorate (dry)
- Tetramethylene diperoxide dicarbimide
- Tetranitrodiglycerin
- 2,3,4,6-Tetranitrophenol
- 2,3,4,6-Tetranitrophenyl methyl nitramine
- 2,3,4,6-Tetranitrophenylnitramine
- Tetranitroresorcinol (dry)
- 2,3,5,6-Tetranitroso nitrobenzene (dry)
- 2,3,5,6-tetranitroso-1,4-dinitrobenzene
- Tetrazine (dry)
- Tetrazoyl azide (dry)
- Tri-(B-nitroxyethyl)ammonium nitrate

Trichloromethyl perchlorate
Triformoxine trinitrate
Trimethylene glycol diperchlorate
Trimethylol nitromethane trinitrate
Trinitro-1,3-diazobenzene
Trinitroacetic acid
Trinitroacetonitrile
Trinitroamine cobalt
Trinitroethanol
Trinitroethyl nitrate
Trinitromethane
Nitroform
1,3,5-Trinitronaphthalene (alpha)
2,4,6-Trinitrophenyl guanidine (dry)
2,4,6-Tirnitrophenyl nitramine
2,4,6-Trinitrophenyl trimethylol methylnitramine trinitrate (dry)
2,4,6-Trinitroso-3-methyl nitraminoanisole
Trinitrotetramine cobalt nitrate
Vinyl nitrate polymer
1-Bromo-3-nitrobenzene
n-Butyl peroxydicarbonate >52%
2,2-Di-(tert-butylperoxy) butane, >55% in solution
Di-(tert-butylperoxy) phthalate, >55% in solution
2,2-Di-(4,4-di-tert-butylperoxycyclohexyl)propane, >42% with inert solid
Di-2,4-dichlorobenzoyl peroxide, >72% with water
Di(chlorethyl) sulfide
Mustard gas
    Dichlorodiethylsulfide
    Bis(2-chloroethyl) sulfide
Dichlorovinylchloroarsine
Dipropionyl peroxide, >28% in solution
Methyl nitramine
Methyl nitrite
Nitroglycerin, liquid not desensitized
P-Xylyl diazide
Dess-Martin periodinane
    Periodinane
5-Azido-1-hydroxy tetrazole
Azido hydroxy tetrazole (mercury and silver salts)