Reference Material 3. Related Information about Hazardous Materials

Table 1 Classification of hazardous materials in the Fire Service Act
(source: Fire Service Act, Appended Table 3 of the Cabinet Order Regarding Regulation of Hazardous Materials, etc.)

Type	Properties	Product name	Classification	Designation Quantity	Examples of applicable substances (They vary depending on the manufacturer.)
Type 1	Oxidizing solids	1. Chlorates 2. Perchlorates 3. Inorganic peroxides 4. Chlorites 5. Nitrates 6. Bromates 7. Iodites 8. Permanganates 9. Dichromates 10. Other chemical substances specified by the Cabinet Order (periodates; periodic acid; chromium, lead or iodine oxides; nitrites; hypochlorites; chlorinated isocyanuric acid; peroxoborates; sodium carbonate peroxyhydrate) 11. Oxidizing solids containing any of the chemical substances listed in the preceding items	Class I oxidizing solids	50 kg	Potassium perchlorate, magnesium perchlorate, barium peroxide, ammonium perchlorate
			Class II oxidizing solids	300 kg	
			Class III oxidizing solids	1,000 kg	Ammonium nitrate, potassium dichromate
Type 2	Combustible solids	1. Phosphorus sulfide		100 kg	
		2. Red phosphorus		100 kg	
		3. Sulfur		100 kg	
		4. Iron powder		500 kg	
		5. Metal powder 6. Magnesium 7. Other combustible solids specified by the Cabinet Order 8. Combustible solids containing any of the chemical substances listed in the preceding items	Class I combustible solids	100 kg	
			Class 2 combustible solids	500 kg	

Type	Properties	Product name	Classification	Designation Quantity	Examples of applicable substances (They vary depending on the manufacturer.)
Type 3	Spontaneously combustible substances and water-reactive substances	1. Potassium		10 kg	
		2. Sodium		10 kg	
		3. Alkyl aluminum		10 kg	
		4. Alkyl lithium		10 kg	
		5. Yellow phosphorus		20 kg	
		6. Alkali metals (excluding potassium and sodium) and alkaline earth metals 7. Organometallic compounds (excluding alkyl aluminum and alkyl lithium) 8. Metal hydrides 9. Metal phosphides 10. Calcium and aluminum carbides 11. Other spontaneously combustible substances and water-reactive substances specified by the Cabinet Order (silicon chloride compounds) 12. Other spontaneously combustible substances and water-reactive substances containing any of the chemical substances listed in the preceding items	Class I spontaneously combustible substances and water-reactive substances	10 kg	
			Class II spontaneously combustible substances and water-reactive substances	50 kg	
			Class III spontaneously combustible substances and water-reactive substances	300 kg	
Type 4	Flammable liquids	1. Special inflammable materials		50 L	Diethyl ether, carbon disulfide, acetaldehyde, propylene oxide
		2. Class I petroleums	Water-insoluble liquids	200 L	Toluene, ethyl acetate/hexane, benzene
			Water-soluble liquids	400 L	Acetone, acetonitrile, tetrahydrofuran, 1,4-dioxane
		3. Alcohols		400 L	Methanol, ethanol, isopropanol
		4. Class II petroleums	Water-insoluble liquids	1,000 L	Xylene, styrene, butyl acetate
			Water-soluble liquids	2,000 L	Acetic acid, N,N-dimethylformamide, acrylic acid
		5. Class III petroleums	Water-insoluble liquids	2,000 L	Cresol, aniline
			Water-soluble liquids	4,000 L	Glycerin, butyric acid, dimethyl sulfoxide
		6. Class IV petroleums		6,000 L	Polyoxyethylene sorbitan monooleate
		7. Animal and vegetable fats and oils		10,000 L	Palm oil, linseed oil, coconut oil

Type	Properties	Product name	Classification	Designation Quantity	Examples of applicable substances (They vary depending on the manufacturer.)
Type 5	Self-reactive substances	1. Organic peroxides 2. Nitrate esters 3. Nitro compounds 4. Nitroso compounds 5. Azo compounds 6. Diazo compounds 7. Hydrazine derivatives 8. Hydroxylamine 9. Hydroxylamine salts 10. Other Self-reactive substances specified by the Cabinet Order Metal azides Guanidine nitrate 1-Allyloxy-2,3-epoxypropane 4-methylideneoxetane-2-one 11. Self-reactive substances containing any of the chemical substances listed in the preceding items	Class I self-reactive substances	10 kg	
			Class II self-reactive substances	100 kg	Sodium azide, benzoyl peroxide, nitromethane, hydrazine sulfate
Type 6	Oxidizing liquids	1. Perchloric acid 2. Hydrogen peroxide 3. Nitric acid 4. Other oxidizing liquids specified by the Cabinet Order (interhalogen compounds) 5. Oxidizing liquids containing any of the chemical substances listed in the preceding items		300 kg	Perchloric acid, hydrogen peroxide, sulfuric acid and nitric acid mixed (1:1), concentrated nitric acid

Table 2 Properties of hazardous materials and appropriate fire extinguishing methods
(source: Appended Table 5 of the Cabinet Order Regarding Regulation of Hazardous Materials, To ensure safety in experiments (new edition) (No. 5 in References), etc.)

Type	Properties	Overview of properties	Product name	Fire extinguishing method
Type 1	Oxidizing solids (Incombustibles)	Solids that generate oxygen and cause extremely intense combustion due to decomposition by heat, etc. when mixed with combustibles	Chlorates Perchloric peroxides Chlorites Bromates Iodates Permanganates Dichromates and others	Fire extinguishing method: watering (Cooling) Use powder fire extinguishers and dry sand (smothering) for alkali metal salts.
Type 2	Combustible solids	Solids that are easily ignited by flames or solids that easily catch fire at relatively low temperatures	Phosphorus sulfide Red phosphorus Sulfur Iron powder Metal powder Magnesium and others	Fire extinguishing method for phosphorus and sulfur: watering (cooling) Use powder fire extinguishers and dry sand (smothering) for metal powders.
Type 3	Spontaneously combustible substances and water-reactive substances	Substances that are likely to ignite spontaneously when exposed to air Or substances that ignite in contact with water or generate combustible gases	Potassium Sodium Alkali metals Alkaline earth metals Yellow phosphorus Alkyl aluminum Metal hydrides Calcium and aluminum carbides and others	Use powder fire extinguishers and dry sand (smothering) for water-reactive substances. Fire extinguishing method for spontaneously combustible substances only (cooling)
Type 4	Flammable liquids	Flammable liquids	Special inflammable materials Class I petroleums Alcohols Class II petroleums Class III petroleums Class IV petroleums Animal and vegetable fats and oils	Foam fire extinguishers, powder fire extinguishers, carbon dioxide fire extinguishers, dry sand (smothering)

Type 5	Self-reactive substances (combustibility)	Substances that cause explosive reaction (e.g., generation of a large amount of heat, ignition, explosion) due to self-reaction (e.g., decomposition) triggered by heat, impact, etc.	Organic peroxides Nitric esters Nitro compounds Nitroso compounds Azo compounds Diazo compounds Hydrazine derivatives Hydroxylamine Hydroxylamine salts and others	Fire extinguishing method: watering (cooling) However, the fire fighting method cannot extinguish fire quickly enough in most cases. Thus, evacuation is also necessary.
Type 6	Oxidizing liquids (Incombustibles)	Liquids that cause extremely intense combustion through reaction with combustibles	Perchloric acid Hydrogen peroxide Nitric acid and others	Fire extinguishing method: watering (cooling) Foam fire extinguishers (smothering)

Table 3 Combinations of chemical substances that may explode when mixed (A + B)
(source: Waste disposal guide for universities (No. 16 in References), etc.)

Chemical substance A	Chemical substance B	Chemical substance A	Chemical substance B
Alkali metals, powdered aluminum or magnesium, etc. (reaction)	Carbon tetrachloride, other carbon chlorides, carbon disulfide, and halogen	Hydrogen peroxide (rapid decomposition reaction)	Copper, chromium, iron, many metals or their salts, alcohols, acetone, organic substances, aniline, combustible materials, flammable liquids, nitromethane
Potassium, sodium (reaction)	Carbon tetrachloride, carbon dioxide, water		
Copper (generation/decomposition reaction of acetylide)	Acetylene, hydrogen peroxide	Ammonia (anhydrous) (generation of mercury/silver azides, intense exothermic reaction, decomposition of products)	Mercury (e.g., mercury used in manometers), chlorine, calcium hypochlorite, iodine, bromine, anhydrous hydrofluoric acid
Silver (generation/decomposition reaction of acetylide, generation of silver fulminate/silver azides)	Acetylene, oxalic acid, tartaric acid, fulminic acid, ammonium compounds		
Mercury (generation of acetylide, fulminic acid, mercury, and azides)	Acetylene, fulminic acid, ammonia	Chromic acid (oxidation reaction, generation of oxygen)	Acetic acid, naphthalene, camphor, glycerin, turpentine oil, alcohols, general oxidized substances
Chlorine (intense exothermic reaction, decomposition of products)	Ammonia, acetylene, butadiene, butane, methane, propane (other petroleum gases), hydrogen, sodium, carbide, terebic acid, benzene, pulverized metals	Anhydrous hydrofluoric acid (intense exothermic reaction)	Ammonia (hydrous or anhydrous)
		Concentrated nitric acid (oxidation reaction, exothermic reaction)	Acetic acid, aniline, chromic acid, cyanic acid, hydrogen sulfide, flammable liquids, flammable gases
Bromine (intense exothermic reaction, decomposition of products)	The same as chlorine.	Sulfuric acid (generation and decomposition of free chloric acid and permanganic acid, oxidation reaction)	Potassium chlorate, potassium perchlorate, potassium permanganate or permanganates of light metals, such as sodium, potassium, and lithium
Iodine (intense exothermic reaction, decomposition of products)	Acetylene, ammonia (solution or anhydrous), hydrogen		
Fluorine (the same as above, highly exothermic reaction due to large bond energy in particular)	Reactivity is significantly high for all compounds.		
Chlorine dioxide (intense exothermic reaction, decomposition of products)	Ammonia, methane, phosphine, hydrogen sulfide	Hydrocarbons (intense exothermic reaction and oxidation reaction, generation of peroxides)	Fluorine, bromine, chromic acid, sodium peroxide
Chlorates (explosives derived from explosive mixtures, similar to explosion)	Ammonium salts, acids, metal powders, sulfur, generally pulverized organic substances or combustibles	Acetylene (intense exothermic reaction, decomposition of products, generation of acetylide)	Chlorine, bromine, fluorine, copper, silver, mercury
Perchloric acid (rapid oxidation reaction)	Acetic anhydride, bismuth and their alloys, alcohols, paper, wood	Aniline acid (oxidation reaction)	Nitric acid, hydrogen peroxide
Potassium permanganate (rapid oxidation reaction)	Ethanol or methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural	Oxalic acid (rapid decomposition)	Silver, mercury
		Cumene hydroperoxide (rapid decomposition)	Acids (organic or inorganic)
		Flammable liquids (oxidation reaction, generation of peroxides, rapid reaction)	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, and halogen