

Supplement 1. Safe Handling of Hazardous Substances

Appendix 3-2 Hazardous Substances (Fire Services Law)

Table 1. Hazardous Substances (Fire Services Law)

Type	Property	Substance Name
Type 1	Oxidizing solid substances	1 Chlorates
		2 Perchlorates
		3 Inorganic peroxides
		4 Chlorites
		5 Bromates
		6 Nitrates
		7 Iodates
		8 Permanganates
		9 Dichromates
		10 Any substance designated by a separate ordinance (Periodates, Periodic acid, Oxides of chromium, lead and iodine, Nitrites, Hypochlorites, Chlorinated isocyanuric acid, Peroxodisulfates, and Peroxoborates)
		11 Substances including any of above items
Type 2	Combustible solid substances	1 Phosphorus sulfide
		2 Red phosphorus
		3 Sulfur
		4 Iron powder
		5 Metal powder
		6 Magnesium
		7 Any substance designated by a separate ordinance
		8 Substances including any of above items
		9 Flammable solids
Type 3	Substances ignitable spontaneously, or reactive with water	1 Potassium
		2 Sodium
		3 Alkylaluminums
		4 Alkylolithiums

		5 Yellow phosphorus
		6 Alkaline metals (excluding potassium and sodium), and alkaline earth metals
		7 Organometallic compounds (excluding alkylaluminum and alkyllithium)
		8 Metal hydrides
		9 Metal phosphides
		10 Calcium carbide or Aluminum carbide
		11 Any substance designated by a separate ordinance (Chlorinated silicon compounds)
		12 Substances including any of above items
Type 4	Flammable liquid substances	1 Special flammables
		2 Petroleum Class 1
		3 Alcohols
		4 Petroleum Class 2
		5 Petroleum Class 3
		6 Petroleum Class 4
		7 Animal & vegetable oils
Type 5	Self-reactive substances	1 Organic peroxides
		2 Nitric esters
		3 Nitro compounds
		4 Nitroso compounds
		5 Azo compounds
		6 Diazo compounds
		7 Hydrazine derivatives
		8 Any substance designated by a separate ordinance (Metal azides, Guanidinium nitrate)
		9 Substances including any of above items
Type 6	Oxidizing liquid substances	1 Perchloric acid
		2 Hydrogen peroxide
		3 Nitric acid
		4 Any substance designated by a separate ordinance (Halogen-halogen compounds)
		5 Substances including any of above items

- (1) Oxidizing solids are solids (substances other than liquids (substances are in liquid form at 20 °C under 1 atmosphere or become in liquid form between 20 °C and 40 °C), or gasses (substances are in gas state at 20 °C under 1 atmosphere), possessing the property designated by an ordinance in a test designated by an ordinance to judge its potential oxidizing ability.
- (2) Combustible solids are solids that indicate the form designated by an ordinance in a test designated by an ordinance to judge its ignition potentiality by fire or show inflammability in a test designated by an ordinance to judge its inflammable hazard.
- (3) Iron powder is a powder of iron, and powder size designated by a self-government ministerial ordinance is excluded.
- (4) Phosphorus sulfide, red phosphorus, sulfur and iron powder are recognized to show the form ruled in (2).
- (5) Metal powder is powder of metals other than alkali metals, alkali-earth metals, iron, and magnesium, and powder size designated by a self-government ministerial ordinance is excluded.
- (6) Magnesium and substances including magnesium among substances shown in Type 2, Clause 8, and substances designated by a self-government ministerial ordinance considering the form etc. are excluded.
- (7) Ignitable solids are solid alcohols or substances with the flash point below 40 °C under 1 atmosphere.
- (8) Substances ignitable spontaneously, or reactive with water are solids or liquids that show the property designated by an ordinance in a test designated by an ordinance to judge its ignition hazard in the air or catch fire upon contacting water or show the property designated by an ordinance in a test designated by an ordinance to judge its hazard to generate a combustible gas.
- (9) Potassium, sodium, alkylaluminums, alkylolithiums and yellow phosphorus are recognized to show the property given in (8).
- (10) Flammable liquids are liquids (among Petroleum Class 3, Petroleum Class 4 and animal and vegetable oils (only substances that are in liquid state at 20 °C under 1 atmosphere) that show inflammability in a test designated by an ordinance to judge its inflammable hazard.
- (11) Special flammables are diethyl ether, carbon disulfide and other substances with the ignition point below 100 °C or with the flash point below -20 °C and the boiling point below 40 °C under 1 atmosphere.
- (12) Petroleum Class 1 includes acetone, gasoline and other substances with the flash point below 21 °C under 1 atmosphere.
- (13) Alcohols are saturated mono alcohols with 1-3 carbon atoms in a molecule (including denatured alcohol), and alcohols designated by a self-government ministerial ordinance considering the composition are excluded.
- (14) Petroleum Class 2 includes kerosene, light oil and other materials with the flash point between

- 21 °C and 70 °C under 1 atmosphere. Paint and other materials designated by a self-government ministerial ordinance considering the composition are excluded.
- (15) Petroleum Class 3 includes heavy oil, creosote oil and other materials with the flash point between 70 °C and 200 °C under 1 atmosphere. Paint and other materials designated by a self-government ministerial ordinance considering the composition are excluded.
- (16) Petroleum Class 4 includes gear oil, cylinder oil and other materials with the flash point over 200 °C under 1 atmosphere. Paint and other materials designated by a self-government ministerial ordinance considering the composition are excluded.
- (17) Animal vegetable oils that are substances extracted from animal meat and fat etc. or seeds or pulp of vegetables and stored and kept substances designated by a self-government ministerial ordinance are excluded.
- (18) Self-reactive substances are solids or liquids that show the property designated by an ordinance in a test designated by an ordinance to judge its explosion hazard or in a test designated by an ordinance to judge its violence of thermal decomposition.
- (19) In substances shown in Type 5, Clause 9, substances including organic peroxides substances including inactive solids designated by a self-government ministerial ordinance are excluded.
- (20) Oxidizing liquids are liquids that show the property designated by an ordinance in a test designated by an ordinance to judge its potential hazard of oxidizing ability.
- (21) Names of substances that have the properties other than the two shown in the property column of this table are designated by a self-government ministerial ordinance.

Table 2 Substances designated by an ordinance (Fire Services Law)

Type	Name of Substances
Type 1	Salts of periodic acid, Periodic acid, Chromium, Lead or iodine oxides, Salts of nitrous acid, Salts of chlorous acid, Chlorinated isocyanuric acids, Salts of peroxydisulfuric acid, Salts of peroxyboric acid
Type 3	Chlorinated silicon compounds
Type 5	Metal azides, guanidinium nitrate
Type 6	Halogen compounds

Procedures for Calculating Hazardous Factors

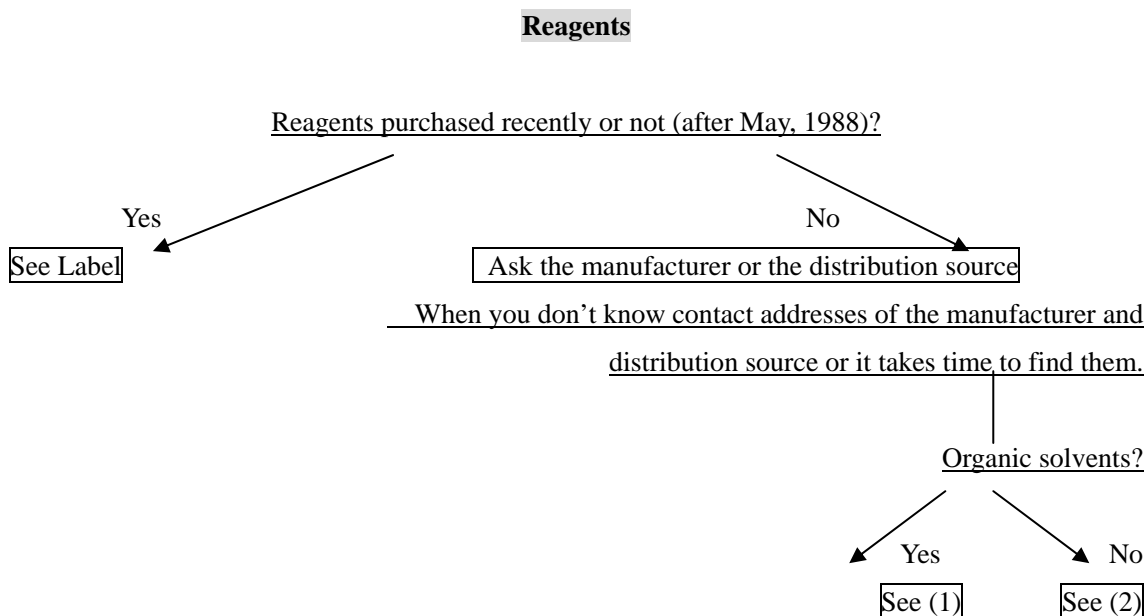
Hazardous substances:

According to Article 2, Clause 7 in Fire Services Law, hazardous substances are defined to be substances that are presented in the Name section of Table 1 and have the property shown in the Property section in the table depending on Types in the table.

Procedures for calculating hazardous factors:

1. Determine whether the materials in one's possession are hazardous or not, and classify them.

The concrete names of reagents are hardly presented in Table 1 (Fire Services Law). The following method is effective to determine whether the reagents in one's possession are hazardous or not and to know to what type they are classified.



(1) Organic solvents

Organic solvents other than ones classified to Type 5 (nitro compounds etc.) are considered to be Type 4. Examine water-solubility, water insolubility, the flash point, ignition point, flash point, and boiling point. (These data can be found in Appendix 3-5 Fire and Explosion Hazard of Combustible Materials) Compare these data with Footnotes (11)-(17) in Table 1 (Fire Services Law) as shown in the following example.

Example 1 Pentane: the flash point; below $-40\text{ }^{\circ}\text{C}$, the ignition point; $260\text{ }^{\circ}\text{C}$, the boiling point; $36\text{ }^{\circ}\text{C}$

In Footnote (11) in Table 1 ((Fire Services Law), there is the description “Special flammables are diethyl ether, carbon disulfide and other substances with the ignition point below $100\text{ }^{\circ}\text{C}$ or with the flash point below $-20\text{ }^{\circ}\text{C}$ and the boiling point below $40\text{ }^{\circ}\text{C}$ under 1 atmosphere.” Pentane agrees with these conditions, and is thus classified to special flammables.

Example 2 Hexane: the flash point; below $-22\text{ }^{\circ}\text{C}$, the ignition point; $223\text{ }^{\circ}\text{C}$, the boiling point; $69\text{ }^{\circ}\text{C}$, water-insoluble

In Footnote (12) in Table 1 ((Fire Services Law), there is the description “Petroleum Class 1 includes acetone, gasoline and other substances with the flash point below $21\text{ }^{\circ}\text{C}$ under 1 atmosphere.” Hexane agrees with this, so it is classified to Petroleum Class 1, water-insoluble liquids.

Example 3 Acetic acid (Glacial acetic acid): the flash point; below $39\text{ }^{\circ}\text{C}$, the ignition point; $463\text{ }^{\circ}\text{C}$, the boiling point; $118\text{ }^{\circ}\text{C}$, water-soluble

In Footnote (14) in Table 1 ((Fire Services Law), there is the description: “Petroleum Class 2 includes kerosene, light oil and other materials with the flash point between $21\text{ }^{\circ}\text{C}$ and $70\text{ }^{\circ}\text{C}$ under 1 atmosphere. Paint and other materials designated by a self-government ministerial ordinance considering the composition are excluded.” Acetic acid agrees with this, so it is classified to Petroleum Class 2, water-soluble liquids.

(2) Other reagents

Ask Hazardous Materials Safety Techniques Association (Charged) Tel: 03-3436-2353 Fax: 03-3436-2251

2. Examine specified quantities

See Table 3 of an ordinance about regulation for hazardous materials (Safety Instruction for Hazardous Materials Appendix 3-1) and examine specified quantities for each reagent.

Table Example			
Hazardous Materials	Type	Class	Specified Quantity
Pentane	Type 4	Special flammables	50 L
Hexane	Type 4	Petroleum Class 1 Water-insoluble liquids	200 L
Acetic acid	Type 4	Petroleum Class 2 Water-soluble liquids	2000 L
Concd HNO ₃ (>90%)	Type 6		300 kg

3. Calculating a multiple

Calculate each multiple for the relevant hazardous materials by the following method and add each number up.

About hazardous materials A, B, and C

a) When specified quantities are the same for A, B, and C

Multiple = (A + B + C + ... (possessing quantity)/specified quantity for A (=B=C)

For example: When pentane 5 L, diethyl ether 10 L, carbon disulfide 3 L (all specified quantities are 50 L) are stored.

$(5 + 10 + 3)/50 = 0.36$. Thus, the multiple is 0.36.

b) When specified quantities of A, B, C, ... are different each other.

Multiple = A/specified quantity of A + B/specified quantity of B + C/specified quantity of C + ...

For example: When pentane 5 L (specified quantity 50 L), hexane 10 L (specified quantity 200 L), acetic acid 10 L (specified quantity 2000 L), HNO₃ 5 kg (specified quantity 300 kg) are stored.

$5/50 + 10/200 + 10/2000 + 5/300 = 0.172$. Thus, the multiple is 0.172

Keep the sum of the multiple less than 0.2 in each fire prevention division. If the value is over 0.2, keep it lower than 0.2 by using a storehouse for hazardous materials.