Safe Method of Use
HSNO Class 3.1 - Flammable Liquids

HSNO Class 3
Flammable Liquids

	3.1 Flammable liquids	3.1A Highly flammable Flash point < 23°C and initial boiling point ⩽ 35°C 3.1B Flash point < 23°C and initial boiling point > 35°C	3.1C Moderate to mildly flammable Flash Point ⩾ 23°C but ⩽ 60°C 3.1D Flash Point > 60°C but ⩽ 93°C
	3.2 Liquid desensitisers, explosives	3.2 A & B Highly sensitive	3.2 C Moderately sensitive
	Tracked Substances	3.1A, 3.2A	

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A. CLASSIFICATION

HSNO Class 3.1 flammable liquids are categorised according to their flashpoints:

HSNO Category 3.1A

Flammable Liquids with a flashpoint below 23 degrees Celsius and an Initial Boiling Point below or equal to 35 degrees Celsius

HSNO Category 3.1B

Flammable Liquids with a flashpoint below 23 degrees Celsius and an Initial Boiling Point above 35 degrees Celsius

HSNO Category 3.1C

Flammable Liquids with a flashpoint between 23 and 65 degrees Celsius

NB. Halogenated organic compounds generally have much higher flashpoints than unsubstituted compounds. Chlorinated solvents such as chloroform do not pose a fire safety hazard although they are still toxic.

HSNO Category 3.1D

Flammable Liquids with a flashpoint great than 60^0C, but less than or equal to 93^0C

B. INCOMPATIBILITIES

- HSNO Class 3.1 Flammable Liquids ***shall*** NOT be stored with HSNO Class 4 Reactive solids, HSNO Class 5.1 Oxidising agents or HSNO Class 5.2 Organic Peroxides or HSNO Class 8 Corrosives.

- HSNO Class 3.1 Flammable Liquids ***shall*** NOT be stored or used near any sources of ignition.

C. STORAGE

- HSNO Class 3.1 Flammable Liquids (especially HSNO 3.1A Flammable Liquids - those with a flash point below 23 degrees Celsius) ***shall*** be stored in a flame-proof cabinet.

- Minimum quantities of working stocks of HSNO Class 3.1 Flammable liquids may be stored in the laboratory outside a flame-proof cabinet.

- NO MORE THAN 10 litres of flammable liquid ***shall*** be kept in a laboratory outside a flame-proof cabinet.

- All storage ***shall*** be within cabinet/cupboard fitted with secondary containment capable of retaining at least half the volume of flammable goods stored.

- NO MORE THAN 100 litres of solvent may be stored within a flame-proof cabinet.

- Bulk solvents MUST always be kept inside a licensed Dangerous Goods store.

D. STORAGE OF ETHERS - SPECIAL PRECAUTIONS

- Ethers that have been exposed to the atmosphere for any length of time almost invariably contain peroxides. Di-isopropyl ether, diethyl ether and tetrahydrofuran are especially prone to generate peroxides - see Safe Method of Use – Storage and Testing for Peroxide Forming Chemicals

- Peroxides are hazardous because they are unstable and decompose violently at elevated temperatures.

- Ethers should not be stored for longer than 12 months, if the presence of peroxides has not been tested.

E. USE OF HSNO CLASS 3.1 FLAMMABLE LIQUIDS

- Use of low flashpoint solvents (HSNO 3.1A Flammable liquids) ***shall*** be restricted to fume hoods.

- Safety glasses ***shall*** be worn when handling these liquids.

- Minimal quantities of solvent ***shall*** be kept in the laboratory at any one time.

- Ensure that these solvents are always placed in flame-proof storage cabinets after use.

- Sources of ignition ***shall*** be kept well away from the area in which these solvents are being used.

- HSNO 3.1A flammable liquids ***shall*** NOT be stored in refrigerators unless the refrigerator has been extensively modified by installation of spark-proof thermostatic switch and other components.

- Ethers should NEVER be distilled to dryness.

F. DECANTING CLASS 3.1 FLAMMABLE LIQUIDS

- The opening and decanting of all flammable liquids ***should*** be carried out in a suitable fume cupboard.

- HSNO 3.1A flammable liquids ***shall*** only be opened and poured:
    - in a suitable fume cupboard, or
    - at a location where flammable vapours ***will*** not accumulate and local ventilation ***will*** ensure that the concentration of flammable vapour does not exceed 10% of the Lower Explosive Limit (LEL) at any actual or potential ignition source.

- When pouring, decanting or pumping any flammable liquid from one metal container to another precautions to prevent the build up of static should be taken.

    - **Note:** Static can be generated by swirling, splashing, high flow rates, venturi effects, turbulence, cavitation or micofiltration. Minimising these effects ***will*** reduce the static generated. Before pouring, decanting pumping or micro-filtering from a metal container into another metal container the containers ***shall*** be efficiently bonded together and connected to a common earth. The resistance between earth and any container ***shall*** not exceed 10 ohms.

- The refilling or "topping up" of containers that contain, or have contained, flammable liquids, with a flash point less than 10°C above ambient temperature ***shall***:
    - be carried out in a fume cupboard; or
    - at a location where flammable vapours ***will*** not accumulate and local ventilation ***will*** ensure that the concentration of flammable vapour does not exceed 10% of the LEL at any actual or potential ignition source.

    - **Note:** Less than 0.5 ml of residual ethanol in a 2.5 litre Winchester can produce a saturated air/ethanol vapour mixture. Refilling a 2.5 litre Winchester which has held ethanol at 190C will release 2.5 litres of a saturated ethanol vapour/air mixture. This can result in over 42 litres of flammable vapour.

    - Liquids with a higher vapour pressure and /or lower explosive limit will produce a larger flammable zone.

- Where opening and pouring operations cannot be carried out in a fume cupboard and the laboratory is well ventilated, the following will apply:
    - Containers ***should*** be opened for as short a time as possible and never near any source of ignition (including operating cell phones).

    - In any one place, the duration that any container of flammable liquid is opened ***shall*** not exceed 10 minutes and the volume ***should*** not exceed:

a. 1500 ml decanted volume of any flammable liquid with a flashpoint less than or equal to 10°C above ambient temperature; or

b. 5000 ml decanted volume of any flammable liquid with a flashpoint greater than 10°C above ambient temperature.

G. PERSONAL PROTECTIVE EQUIPMENT FOR HANDLING HSNO CLASS 3.1 FLAMMABLE LIQUIDS

- The primary barrier will be the use of a tested and certified fume hood to extract solvent vapours away from laboratory worker - reducing the chance of fire and explosion and reducing the possibility of exposure to toxic solvents.

- Nitrile gloves should be used when handling these solvents where the risk of prolonged contact is minimal.

- Where prolonged contact with solvent is likely gloves of the correct material must be used – always consult SDS for correct type of gloves.

H. TOXICITY OF HSNO CLASS 3.1 FLAMMABLE LIQUIDS

SDS Database should be consulted for more specific information. See Chemwatch database http://www.otago.ac.nz/healthandsafety/hazardmanagement/index.html

General Observations

The high vapour pressure of commonly used solvents means that the most likely pathway of absorption is inhalation, but dermal absorption can also occur. Compounds dissolved in these solvents will often be absorbed by the skin much more freely, bypassing the body's first line of defence - the skin.

Aliphatic hydrocarbons

C6 to C8 aliphatic hydrocarbons (hexanes to octane's) can be responsible for contact dermatitis as well as damage the central nervous systems.

n-alkanes are neurotoxic by virtue of the fact that their oxidised metabolites are potent neurotoxins.

Aromatic solvents

- Benzene attacks the haemopoietic system and at higher exposures have been linked to aplastic anaemia and leukemia – the metabolites of benzene are thought to have a major role in suspected genetic damage. Safe exposure levels have been revised downward in the last 20 years to less than 0.1 ppm.

- Alkylbenzenes (Toluene and xylene) are not as toxic as benzene, but at higher concentrations can result in headaches and nausea.

Alcohols and Aldehydes

Alcohols are metabolised into aldehydes which are considerably more toxic than their parent alcohol reacting with proteins and amine neurotransmitters.

I. STORAGE - MAXIMUM QUANTITIES

- NO MORE THAN 100 litres of solvent may be stored within a flame-proof cabinet

- Bulk solvents MUST always be kept inside a licensed hazardous substances location facility (Dangerous Goods) store

J. STORAGE - LIMITS ON STORAGE TIME

- Ethers should not be stored for longer than 12 months, if the presence of peroxides has not been tested.

- See also the Safe Method of Use –Peroxide Forming Substances.

K. DISPOSAL

- With the exception of small quantities of ethanol, methanol and acetonitrile all HSNO 3.1 flammable liquids must be disposed by a licensed chemical waste contractor. Contact the health and safety office for disposal arrangements (twice yearly collections).

- Class 3 Flammable waste liquids must be stored in flame-proof cabinets or in Dangerous Goods stores. They MUST NOT be stored in the open laboratory.

- All HSNO Class 3 waste must be packed separately and packaged labelled clearly as: “HSNO Class 3 - Flammable Liquids”

L. SMALL SPILLS (less that 2.5 litres)

- Extinguish all sources of ignition

- Use correct gloves

- Use absorbent material in spill kits to wipe up solvent – wiping from outside of spill toward centre

- Place used absorbent material in impermeable/airtight container, label with classifications, concentrations and date of incident. Store in flammable cabinet or DG store.

- Inform Laboratory Manager and arrange for disposal.

M. LARGE SPILLS (greater than 2.5 litres or any amount of spill involving a tracked substance)

- Assess the situation, if you the substance and are comfortable with cleaning up the spill, continue to do so as above. Spills of this volume or nature must be reported immediately to the response team through 5000.

- If you are unsure what to do, then follow these instructions:

    - Extinguish all sources of ignition immediately

    - Evacuate laboratory immediately

    - Close all doors to laboratory and prevent re-entry until 'all-clear' given

    - Call Fire Service immediately 1 – 111 from an internal phone. Also call security on 5000 and report a chemical spill (nature of substance, amount and location).

    - Inform Laboratory Manager and/or arrange for SDS to be made available.

    - Prepare to evacuate building

APPENDIX 1: REPRESENTATIVE LIST OF HSNO 3.1 FLAMMABLE LIQUIDS WITH FLASHPOINTS

Substance	HSNO Class	Tracked?	Flash point	WES Monitoring
Acetaldehyde	**3.1A** 6.1D 6.4A 6.6A 6.7B 6.8B 6.9B 9.1D 9.2D 9.3C	Y	-40	
Acetic Acid	3.1C 6.1D 6.9B 8.1A 8.2B 8.3A 9.1D 9.3C	N	40	
Acetone	**3.1B**, 6.1E, 6.3B, 8.3A	N	-17	TWA 500 ppm : 1185 mg/m^3 STEL 1000 ppm : 2375 mg/m^3 Biological Indices Measurement Possible
Acetonitrile	**3.1B**, 6.1B, 6.4A, 9.2D, 9.3A	N	5	TWA 40 ppm : 67 mg/m^3 STEL 60 ppm : 101mg/m^3
Anisole	3.1C 6.1C 6.3B 6.4A 9.1D 9.2D	N	51	
n-Amyl acetate (1-pental acetate)	3.1C 6.3B 6.4A 9.		23	NIL
Benzene	**3.1D**, 6.1B, 6.3A, 6.4A, 6.6A, 6.7A, 6.8A, 6.9A, 9.1D, 9.3C	Y	-11	TWA 5 ppm : 16 mg/m^3 A1 Carcinogen
Butanol	3.1C, 6.XA, 6.YA	N	35	
Butyl acrylate	3.1C 6.1C 6.3A 6.4A 6.5B 6.8B 6.9B 9.1D 9.3C	N	39	
2-Butanol	3.1C 6.1E 6.4A	N	26	

2-Butanone (MEK)	**3.1B**, 6.1E, 6.3B, 6.4A, 6.9B	N	-3	TWA 150 ppm : 445 mg/m^3 STEL 300 ppm : 890 mg/m^3 Biological Indices Measurement Possible
n-Butyl acetate	**3.1B,** 6.1D, 6.3B, 6.4A, 6.5B, 9.1D.	N	22	TWA 150 ppm : 713 mg/m^3 STEL 200 ppm : 950 mg/m^3
sec-Butyl acetate	**3.1B**, 6.3B, 6.4A, 9.1D	N	16	TWA 200 ppm : 950 mg/m^3
tert-Butyl acetate	**3.1B**, 6.3B, 6.4A	N	15	TWA 200 ppm : 950 mg/m^3
tert-Butyl alcohol (2-methyl-2-propanol)	**3.1B**, 6.1E, 6.3B, 6.4A, 6.9B	N	11	TWA 100 ppm : 303 mg/m^3 STEL 150 ppm : 455 mg/m^3
Carbon disulfide	**3.1B** 6.1C 6.3A 6.4A 6.6B 6.8A 6.9A 9.1D 9.3C	N	-33	
Cyclohexane	**3.1B** 6.1D 6.3B 9.1B 9.3C		-1	
Cyclohexanone	**3.1C** 6.1C 6.4A 9.2B 9.3C		46	
Cyclohexene	**3.1B**, 6.1D, 6.3B, 9.1B, 9.3C	N	-12	TWA 300 ppm : 1010 mg/m^3
p-Cymene	**3.1C** 6.1E 6.3A 6.4A 9.1B	N	47	
n-Decane	**3.1C** 9.1A	N	46	
Di-isopropyl ether	**3.1B**, 6.3B, 9.1C		-12	
Di-isopropylamine	**3.1B**, 6.1C, 6.9A, 8.1A, 8.2B, 8.3A, 9.1B, 9.3B	Y	-6	TWA 5 ppm : 21 mg/m^3
Di-n-butyl ether			25	
Di-n-propyl ether (? Propyl Ether)	3.1B, 6.3B, 9.1D	N	4	

Diethyl ketone	**3.1B**, 6.1E, 6.3B, 6.4A, 9.2D	N	12	TWA 200 ppm : 705 mg/m^3
Diethylamine	**3.1B**, 6.1C, 6.5B, 6.9B, 8.1A, 8.2A, 8.3A, 9.1D, 9.2B, 9.3B	Y	-28	TWA 10 ppm : 18 mg/m^3
Diethylene glycol mono-n-butyl ether			47	
Di-ethylether (ethyl ether)	**3.1A,** 6.1D, 6.3B, 6.4A, 9.3C	Y		
Dimethylamine	**3.1B**, 6.1C, 6.5B, 6.8B, 6.9A, 8.1A, 8.2B, 8.3A, 9.1D, 9.3B	Y	15	
Dimethyldichlorosilane	**3.1B**, 6.1A, 8.2B, 8.3A, 9.1D, 9.3C	Y	-20	
Dimethyl Formamide	**3.1C** 6.1D 6.3B 6.4A 6.8A 6.9A 9.3C		57	
Dioxane	**3.1B**, 6.1D, 6.3B, 6.4A, 6.7A, 6.9B, 9.3C	N	15	
Ethanol	**3.1B**, 6.4A, 9.1D	N	12	TWA 1000 ppm : 1880 mg/m^3
Ethyl acetate	**3.1B**, 6.1C, 6.4A, 6.9B	Y	-3	TWA 200 ppm : 720 mg/m^3
Ethoxyethanol	**3.1C** 6.1C 6.3B 6.4A 6.8A 6.9A 9.3C		42	
Ethyl acrylate	**3.1B**, 6.1C, 6.5B, 6.9B, 9.1D, 9.2B, 9.3B	Y	15	Ceiling 5 ppm ($20mg/m^3$) Sensitiser
Ethylene dichloride	**3.1B**, 6.1C, 6.3A, 6.4A, 6.5B, 6.6B, 6.7B, 6.9B, 9.1D, 9.3B	Y	6	TWA 5 ppm : 21 mg/m^3
Ethylene glycol diethyl ether			20	

Ethylene glycol dimethyl ether	**3.1B**, 6.1D, 6.8A	N	0	
Ethyl isobutyl ketone			13	
Formaldehyde			56	
2-heptanone (n-Amyl methyl ketone)			47	
n-heptanal (n-heptaldehyde)				
n-heptane	**3.1B**, 6.1E, 6.3B, 9.1A	Y	-1	TWA 400 ppm : 1640 mg/m^3 STEL 500 ppm : 2050 mg/m^3 Biological Indices Measurement Possible
Heptene	**3.1B**	N	-8	
n-hexane	**3.1B**, 6.1E, 6.3A, 6.4A, 6.9A, 9.1B	N	-23	TWA 20 ppm : 72 mg/m^3 Biological Indices Measurement Possible
1-hexanol (n-hexanol)			60	
2-hexanol			41	
Isoamyl acetate			25	
Isoamyl alcohol			45	
Isopentane			-51	
Isopropanol	**3.1B**, 6.1E, 6.3B, 6.4A, 6.5B	N	22	
Isopropyl acetate	**3.1B**, 6.1E, 6.3B, 6.4A, 6.9B	N	16	TWA 250 ppm : 1040 mg/m^3 STEL 310 ppm : 1290 mg/m^3
Isopropyl benzene			46	
Methanol	**3.1B**, 6.1D, 6.3B, 6.8B, 6.9A	N	11	TWA 200 ppm : 262 mg/m^3 STEL 250 ppm : 328 mg/m^3 Biological Indices Measurement Possible
Methyl acetate	**3.1B**, 6.1E, 6.3A, 6.4A	N	20	TWA 200 ppm : 606 mg/m^3 STEL 250 ppm : 757 mg/m^3

Methyl acrylate	**3.1B**, 6.1C, 6.3A, 6.4A, 6.5B, 6.9B, 9.1D, 9.2B, 9.3B	Y	6	TWA 10 ppm : 35 mg/m^3
Methyl ethyl ketone	**3.1B**, 6.1E, 6.3B, 6.4A, 6.9B	N	-3	TWA 150 ppm : 445 mg/m^3 STEL 300 ppm : 890 mg/m^3 Biological Indices Measurement Possible
Methyl formate	**3.1A**, 6.1D, 6.4A, 6.9B, 9.3B	Y	-32	TWA 100 ppm : 246 mg/m^3 STEL 150 ppm : 368 mg/m^3
Methyl isobutyl ketone	**3.1B**, 6.1D, 6.3B, 6.4A, 6.9B, 9.2B, 9.3B	N	13	TWA 50 ppm : 205 mg/m^3 STEL 75 ppm : 307 mg/m^3
Methyl methacrylate	**3.1B**, 6.1D, 6.3B, 6.4A, 6.5B, 6.9B, 9.1D	N	10	TWA 50 ppm : 208 mg/m^3 STEL 100 ppm : 416 mg/m^3 Sensitiser
1-Methyl piperidine	**3.1B**, 8.2B, 8.3A, 9.1C	N	3	
Methyl propionate	**3.1B**, 6.1E, 6.3A	N	6	
Methyl propyl ketone	**3.1B**, 6.1D, 6.3B, 9.2D, 9.3C	N	7	TWA 200 ppm : 705 mg/m^3 STEL 250 ppm : 881 mg/m^3
(2 -) Methyltetrahydofuran	**3.1B**, 6.1E, 6.4A, 9.1C	N	6	
Morpholine			35	
n-Pentane			-49	
Petroleum spirits			57	
n-Propanol	**3.1B**, 6.1D, 6.4A, 9.3C	N	15	
2-Propanol	**3.1B**, 6.1E, 6.3B, 6.4A, 6.5B	N	23	

n-Propyl acetate	**3.1B**, 6.3B, 6.4A, 9.1D	N	12	TWA 200 ppm : 835 mg/m^3 STEL 250 ppm : 1040 mg/m^3
Piperidine			4	
Propionaldehyde	**3.1B**, 6.1D, 6.3B, 6.4A, 9.1B, 9.3C	N	-26	
Propylene oxide			-37	
Pyridine	**3.1B**, 6.1D, 6.3A, 6.7B, 6.9B, 8.3A, 9.1C, 9.3C	N	20	TWA 5 ppm : 16 mg/m^3
Tetrahydrofuran	**3.1B**, 6.1D, 6.3A, 6.4A, 6.7B, 6.9B, 9.3C	N	-17	TWA 100 ppm : 295 mg/m^3
Toluene	**3.1B**, 6.1D, 6.3A, 6.4A, 6.6B, 6.8A, 6.9A, 9.1B, 9.3C	N	4	TWA 50 ppm : 188 mg/m^3 Skin Absorption
Triethylamine	**3.1B**, 6.1C, 8.2A, 8.3A, 9.1D, 9.3B	Y	-6	TWA 3 ppm : 12 mg/m^3 STEL 5 ppm : 20 mg/m^3 Skin Absorption
Trimethylamine solution			-20	
Vinyl acetate	**3.1B**, 6.1C, 6.3A, 6.4A, 6.6A, 6.7B, 6.8B, 6.9B, 9.1D, 9.3C	Y	-6	TWA 10 ppm : 35 mg/m^3 STEL 20 ppm : 70 mg/m^3 A3 Carcinogen
Vinyl ether ether			-30	
m-Xylene			25	
o-Xylene			32	
p-Xylene			27	

A1 Carcinogen =Confirmed Human Carcinogen
A2 Carcinogen = Suspect Human Carcinogen
A3 Carcinogen = Confirmed Animal Carcinogen with unknown relevance to Humans.