Safe Method of Use 10

HSNO Class 3.1 - Flammable Liquids

Purpose: This Safe Method of Use applies to **principal investigators (PIs), sector managers, designated laboratory person (DLPs)**, technical staff and students who use laboratories within the University of Auckland.

Note: 'Shall' denotes a mandatory requirement and 'should' denotes a recommendation.

MSDS Databases should be consulted for specific information about the flashpoints and toxicity of the compound you will be using. Gold FFX MSDS Database is available on the LEARN database for specific recommendations related to the compound in use. Instructions on how to source this information and interpret MSDS databases can be found in pamphlet "How to use and interpret MSDS sheets"

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.

B. Incompatibilities

1. 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.

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

See also the Safe Method of Use on specific chemical incompatibilities.

C. Storage

1. 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.

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

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

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

D. Storage of Ethers - Special Precautions

1. 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.

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

3. Ethers ***should*** not be stored for longer than 12 months, if there are no peroxide inhibitors and the presence of peroxides has not been tested.

E. Use of HSNO Class 3.1 Flammable Liquids

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

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

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

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

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

6. 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.

7. Ethers ***shall*** **NEVER** be distilled to dryness.

F. Decanting Class 3.1 Flammable Liquids

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

2. HSNO 3.1A flammable liquids ***shall*** only be opened and poured:
   a) in a suitable fume cupboard, or
   b) 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.

3. 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.

4. 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***:
   a) be carried out in a fume cupboard; or
   b) 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 19^0C 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.

6. Where opening and pouring operations cannot be carried out in a fume cupboard and the laboratory is well ventilated, the following will apply:

   a) Containers ***should*** be opened for as short a time as possible and never near any source of ignition.
   b) 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:

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

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

(see Appendix 1 for flashpoint)

G. Personal Protective Equipment for Handling HSNO Class 3.1 Flammable Liquids

1. Nitrile gloves should be used when handling many of these compounds and reduce skin absorption. Please consult the Safe Method of Use of Gloves

2. 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.

H. Toxicity of HSNO Class 3.1 Flammable Liquids

MSDS Database ***should*** always be consulted for more specific information about toxicity.

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 octanes) 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

1. NO MORE THAN 100 litres of solvent may be stored within a flame-proof cabinet
2. Bulk solvents SHALL always be kept inside a licensed Dangerous Goods store

J. Storage - Limits on Storage Time

Ethers should not be stored for longer than 18 months, f there are no peroxide inhibitors and the presence of peroxides has not been tested

See also the Safe Method of Use on Storage

K. Disposal

1. With the exception of small quantities of ethanol, methanol and acetonitrile all HSNO 3.1 flammable liquids shall be disposed by a licensed chemical waste contractor. See Appendix 2

2. Class 3 Flammable waste liquids shall be stored in flame-proof cabinets or in Dangerous Goods stores. Class 3 Flammable waste liquids SHALL NOT be stored in the open laboratory.

Contact Hazards and Containment Manager to arrange disposal.

All HSNO Class 3 waste shall be packed separately and the package labelled clearly as: “HSNO Class 3 - Flammable Liquids”

L. Small Spills

1. Extinguish all sources of ignition
2. Use correct gloves
3. Use absorbent material in spill kits to wipe up solvent – wiping from outside of spill toward centre
4. Place used absorbent material in impermeable/airtight container
5. Inform Laboratory Manager and arrange for immediate disposal

M. Large Spills

1. Extinguish all sources of ignition immediately
2. Evacuate laboratory immediately
3. Close all doors to laboratory and prevent re-entry until ‘all-clear’ given
4. Call fire brigade immediately
5. Inform Laboratory Manager and/or arrange for MSDS to be made available.
6. Prepare to evacuate building

Appendix 1: Representative List of HSNO 3.1 Flammable Liquids with Flashpoints

HSNO 3.1A Flammable Liquids

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

Acetaldehyde	-40
Carbon disulfide	-33
Diethyl ether	-10
Isopentane	-51
Isopropylamine	-37
n-Pentane	-49
propylene oxide	-37
Trimethylamine solution	-20
Vinyl ethyl ether	-30

HSNO 3.1B Flammable Liquids

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

Acetone	-17
Acetonitrile	5
n-Amyl acetate (1-pental acetate)	23
Benzene	-11
2-Butanone	-3
n-Butyl acetate	22
sec-Butyl acetate	16
tert-Butyl acetate	15
tert-Butyl alcohol (2-methyl-2-propanol)	11
Cyclohexane	-1
Cyclohexene	-12
Di-isopropyl ether	-12
Di-isopropylamine	-6
Di-n-propyl ether	4
Diethyl ketone	12
Diethylamine	-28
Dimethylamine	15
Dimethyldichlorosilane	-20
Dioxane	15
Ethanol	12
Ethyl acetate	-3
Ethyl acrylate	15
Ethyl isobutyl ketone	13
Ethylene dichloride	6
Ethylene glycol diethyl ether	20
Ethylene glycol dimethyl ether	0
n-heptane	-1
heptene	-8
n-hexane	-23
Isopropanol	22
Isopropyl acetate	16
Methanol	11
Methyl acetate	20
Methyl acrylate	6
Methyl ethyl ketone	-3
Methyl formate	-32
Methyl isobutyl ketone	13
Methyl methacrylate	10
1-Methyl piperidine	3

Methyl propionate	6
Methyl propyl ketone	7
Methyltetrahydofuran	6
Piperidine	4
n-Propanol	15
2-Propanol	23
n-Propyl acetate	12
Propionaldehyde	-26
Pyridine	20
Tetrahydrofuran	-17
Toluene	4
Triethylamine	-6
Vinyl acetate	-6

HSNO 3.1C Flammable Liquids

Liquids with a flashpoint between 23 and 65 degrees Celsius

Acetic Acid	40
Anisole	51
Butanol	35
2-Butanol	26
Butyl acrylate	39
Butyl alcohol (2-butanol)	26
Cyclohexanone	46
p-Cymene	47
n-Decane	46
Di-n-butyl ether	25
Diethylene glycol mono-n-butyl ether	47
Dimethyl Formamide	57
Ethoxyethanol	42
Formaldehyde	56
2-heptanone (n-Amyl methyl ketone)	47
n-heptanal (n-heptaldehyde)	35
1-hexanol (n-hexanol)	60
2-hexanol	41
Isoamyl acetate	25
Isoamyl alcohol	45
Isobutyric acid	55
Isopropyl benzene	46
Morpholine	35
Petroleum spirits	57
m-Xylene	25
o-Xylene	32
p-Xylene	27

Appendix 2: Disposal to Sewer – Dilution Guide

Ethanol (Allowable limit is 50 g/l)

The required dilution can be achieved by using tap water for the following times (in minutes):

	0.5 litre	1 litre	2litres	3 litres
70% EtOH	1 min	3 min	6 min	8 min
60% EtOH	1 min	2 min	5 min	7 min
50% EtOH	1 min	2 min	4 min	6 min
40% EtOH	1 min	2 min	3 min	5 min
30% EtOH	1 min	1 min	2 min	4 min
20% EtOH	1 min	1 min	2 min	2 min
10% EtOH	1 min	1 min	1 min	1 min

(Assuming a tap flow rate of 4 l/min)

Methanol (Allowable limit is 10 g/l)

The required dilution can be achieved by using tap water for the following times (in minutes):

	0.5 litre	1 litre	2 litres	3 litres
70%	7 min	14 min	28 min	42 min
60%	6 min	12 min	24 min	36 min
50%	5 min	10 min	20 min	30 min
40%	4 min	8 min	16 min	24 min
30%	3 min	6 min	12 min	18 min
20%	2 min	4 min	8 min	12 min
10%	1 min	2 min	4 min	6 min

(Assuming a tap flow rate of 4 l/min)

Acetonitrile (Allowable limit is 2 g/l)

The required dilution can be achieved by using tap water for the following times (in minutes):

	0.5 litre	1 litre	2 litres	3 litres
70%	35 min	.	.	.
60%	30 min	.	.	.
50%	25 min	.	.	.
40%	20 min	.	.	.
30%	15 min	30 min	.	.
20%	10 min	20 min	.	.
10%	5 min	10 min	20 min	30 min

(Assuming a tap flow rate of 4 l/min)

NB: Discharging large volumes and/or high concentrations of acetonitrile should not be attempted.