SAFE HANDLING OF PETROLEUM PRODUCTS

Background Information

All petroleum products are hazardous. They can cause **FIRE** or **EXPLOSION.**

All petroleum products are **TOXIC** and **ECOTOXIC**

PETROL

ERMA Classification: PETROL	**HSR001445 3.1A 6.1E 6.3B 6.7B 9.1B**
UN Number:	**1203**
HAZCHEM Code:	**3[Y]E –** (foam, violent reaction, breathing apparatus, evacuate and contain)

Explanation of the Environmental Protection Authority (EPA) Classification:

3.1A: Applies to any product with a Flashpoint <23°C - At the lowest recorded temperature in New Zealand petrol is giving off sufficient vapour to burn with an actual Flashpoint of -40 to -18°C depending on the information source; and

An Initial Boiling Point (IBP) of <35°C; actual: 30°C but may be as low as 15°C under the EPA approval – of academic interest only but which would normally result in the substance being Tracked and for Approved Handlers being required at any quantity.

Additional information not required to arrive at this classification includes an explosive range of 1.4% Lower Explosive Limit (LEL) – 7.6% Upper Explosive Limit (UEL) in air i.e. "from too lean to burn to too rich to burn," and an Auto Ignition temperature of approximately 230°C where temperature alone will ignite petrol vapour – no other source of ignition required. This is of concern following use of a fire extinguisher and where vapours are still present and a heat source in excess of 230°C is still present – a "flashback" is inevitable. The flamefront temperature of a petrol vapour cloud explosion is 550°C with a flamefront speed of 5-7 metres per second (18-25kph) – somewhat faster

than running speed and a temperature beyond which survival is not possible if sufficient area of skin is unprotected.

Jet-A1

EPA Classification: **Kerosene** **HSR001049** **3.1C 6.1E 6.3B 9.1B**

UN Number: **1223**

HAZCHEM Code: **3[Y] –** (foam, violent reaction, breathing apparatus, contain)

Explanation of the EPA Classification:

3.1C: Applies to any product with a Flashpoint 23°C - 61°C. At around 38°C the Flashpoint of Aviation turbine fuel is normally above ambient temperature and not likely to be producing flammable vapour. Mechanically generated mists or sprays may be flammable and able to be ignited below the Flashpoint.

Additional information not required to arrive at this classification includes an explosive range of 0.7% Lower Explosive Limit (LEL) – 5% Upper Explosive Limit (UEL) in air i.e. "from too lean to burn to too rich to burn," and an Auto Ignition temperature of approximately 210°C where temperature alone will ignite flammable vapour – no other source of ignition required. This is of concern following use of a fire extinguisher and where vapours are still present and a heat source in excess of 210°C is still present – a "flashback" is inevitable.

DIESEL

EPA Classification: **DIESEL** **HSR001441** **3.1D 6.1E 6.3B 6.7B 9.1B**

UN Number: **1202**

HAZCHEM Code: **3[Z] –** (foam, breathing apparatus and contain)

3.1D: Applies to any combustible product with a Flashpoint between 61°C and 93°C i.e. at ambient temperatures Diesel is not giving off flammable vapour. Ignition can only occur by raising the temperature of the fuel surface above the Flashpoint and applying a source of ignition. It is possible to ignite a mechanically generated vapour cloud at ambient temperatures with a source of ignition. This can occur if Diesel fuel is sprayed under pressure; if testing an automotive injector for example or from a leak in the injector line.

The classification for Diesel: **3.1D 6.1E 6.3B 6.7B 9.1B** Please note; the only difference between petrol and Diesel is Flashpoint which as noted above must be above 61°C and below 93°C. It is significant that the Autoignition temperature is less than that of petrol and is the reason why a Diesel engine works by the heat generated through air compression in the motor; insufficient to effectively ignite petrol.

Additional information not required to arrive at this classification includes an explosive range of 0.7% Lower Explosive Limit (LEL) – 5% Upper Explosive Limit (UEL) in air i.e. again "from too lean to burn to too rich to burn," and an Auto Ignition temperature (in some documentation) as low as 170°C where temperature alone will ignite Diesel vapour – no other source of ignition required.

Of general and historical interest: Rudolf Diesel obtained the German patent for his invention of a peanut oil compression ignition engine in 1892. Petrol engines had been invented in 1876 and, especially at that time, were not very efficient due to inadequate carburetion. The written protocol is to capitalise the word Diesel and use lower case for petrol; stems from the use of the inventor's name.

A petrol engine compresses at a ratio of 8:1 to 12:1, while a Diesel engine compresses at a ratio of 14:1 to as high as 25:1. The higher compression ratio of the Diesel engine is required to raise the temperature of the air charge to reach temperatures above the Auto Ignition temperature of the fuelcharge injected directly into the cylinder head or into a pre-swirl chamber.

Petrol is typically C_9H_{20}; Jet-A1 is around C_9H_{16} while Diesel fuel is typically $C_{14}H_{30}$ in the hydrocarbon range. – The product that was to have been the subject of the "fart tax" is CH_4 - methane, the first of the group. It takes less refining to create kero and Diesel fuel, which is why they are generally cheaper than petrol even though they have a higher energy density and are therefore more cost effective.

Changes to the approved Controls for petrol at 3.1A, Jet-A1 at 3.1C, and Diesel at 3.1D require:

NB: Controls have been paraphrased and highlighted only. For the full requirements see the EPA classifications for petrol, Jet-A1 and Diesel at:
http://www.epa.govt.nz/search-databases/Pages/controls-search.aspx

Location Test Certificate (LTC): Diesel; None required

Jet-A1; "in use" 250 Litres; but

In containers <5 L = 1,500 L; and
>5 L = 500 Litres

Petrol required if >2 hours on-site; and

<50 L; in open or closed containers "in use"

The term "in use" is an interesting one that has generated much debate. It could be argued that if the lid was put on a container and it is put into a DG store or AS1940 Compliant DG cabinet it is no longer in use. The safer option and one preferred in the fire safety field is that once the factory seal on the container is broken it should be considered to be 'in use.' HSNO is strict liability legislation – effectively you don't need to intend to cause an incident, accident, fire etc, just the fact that it has happened is sufficient cause for a liability to exist. Better to err on the side of caution.

Where flammable vapours may be present for quantities of class 3 substances with Flashpoints **less than 61°C at 100 litres in storage, 25 litres when decanting, 5 litres open occasionally or 1 litre open continuously** there is a requirement to establish a Hazardous Area Zone. A Zoning Plan for the premises limiting the use of electrical sources of ignition shall be drawn in accordance with **AS/NZS 2430.3; 1997** – the Standard specified in the Hazardous Substances (Class 1 – 5 Controls) Regulations 2001 or now; the Code of Practice Approved by the EPA in accordance with s.79 of the Act; **AS/NZS60079.10.1:2009: HSNOCoP37.**

An **Electrical Compliance Certificate** is required valid within the last **4 years** before a Location Test Certificate can be issued. No Conditional Test Certificate can be issued.

A plan of the premises showing the location of all Hazardous Substance facilities and the boundaries of the **Controlled Zones specified in NZ Gazette Notice No. 35** is also required. GN35 is accessible from the WorkSafe New Zealand website

Stationary Container Systems (Tank) Certificates:

Petrol, Jet-A1 and Diesel:	Any belowground tank
Petrol Farm tank:	Any aboveground tank >2,500 litres
Petrol and Jet-A1 Industrial tank	Any aboveground tank >2,000 litres
Diesel:	Any aboveground tank >5,000 litres

Compounding for the storage of petrol, Jet-A1 and Diesel:

For containers up to 60 Litres	For:	<5,000 litres = 50%: (2,500 L); or >5,000 = the greater of 2,500 or 25%
For containers >60 Litres & <450 Litres		For: <5,000 litres = total quantity >5,000 = the greater of 5,000 or 50%
For containers over 450 L incl A/G tanks	=	110% of largest tank or container: at
Industrial tanks Petrol, Jet-A1 and Diesel:	=	>1,000 litres – compound (bund)
Farm tanks Petrol:	=	>2,000 litres
Farm tanks Diesel installed prior to 1/04/2004		>2,500 litres (old 500 gal tanks)
Farm tanks Diesel installed post 2004:	=	>2,000 litres

NB: Specific to Farms: An aboveground tank shall be either in a compound or located so that any spillage of fuel will not endanger any building, or flow into any stream, lake or natural water. Specific separations apply – for petrol, Jet-A1 and Diesel = 20 metres to regular habitation

Approved Handlers (AH):

AH's not required for Diesel at any quantity

AH's not required for Jet-A1 – applies to pilots (only) refueling their own aircraft. Approved Handlers are required where a hazardous area zone is established under Regulation 58 and where the likelihood of unintended ignition required by Regulation 60 is managed in accordance with specific regulations

AH's are required for petrol at:	100 litres
AH's are required for petrol at service stations at:	250 litres
AH's are required for petrol on farms at:	2,000 litres; **provided***

***Training has been provided to the farm owner or employee in the safe handling of petrol

The information contained in this document together with a "hands-on" assessment of safe practice by an Approved Handler for the substance (petrol) or the Person in Charge of the facility would be considered sufficient to fulfill the training obligation stated in the requirement above.

For the 2,000 litre AH limit for farms this document should be read in conjunction with the EPA Guide: Aboveground Fuel Storage on Farms (Jan 2012) on the WorkSafe New Zealand website

Other than on the farm: Petrol may be handled by a person who is not an AH if the person has been trained in the hazards associated with the substance and its safe use and handling, including steps to be taken in the event of spillage or other emergency **and an AH is available** to provide assistance, if necessary at all times while the substance is being handled by the person.

Hazardous Substances (Emergency Management) Regulations 2001:

Information must be held on the substance by the "person in charge" of the workplace when the substance is present at:

Petrol:	1 litre or more Level 1 5 litres or more Level 2
Jet-A1:	1 litre or more Level 1 5 litres or more Level 2
Diesel:	5 litres or more Level 1 50 litres or more Level 2

The level 2 information is in addition to the Safety Data Sheets (SDS) and EPA Approval (EPA weblink provided above) and relates more to on-selling product though does impose duties on the workplace "person in charge" to ensure the information provided by the supplier as required under level 1 continues to be made available in the workplace to employees and anyone using the product.

Fire Extinguishers must be provided in the workplace in accordance with Schedule 3:

Petrol:	50 litres:	1
Petrol:	200 litres:	2
Jet-A1:	500 litres:	2
Diesel:	500 litres:	2

Extinguishers must be placed within 30 metres of the facility

Signage is required at:

Petrol:	50 litres
Jet-A1:	1,000 litres
Diesel:	1,000 litres (for 9.1B classification);
Diesel:	10,000 litres (for 3.1D combustible);

An **Emergency Plan** is required by Schedule 4 when fuel is on site in quantities of

Petrol for classifications 3.1A and 9.1B:	1,000 litres or more
Jet-A1 for classification 9.1B:	1,000 litres or more
Diesel for classification 9.1B:	1,000 litres or more
Diesel 3.1D and Jet-A13.1C:	10,000 litres or more

The plan must for each reasonably likely scenario describe the actions to be taken to:

1. Provide a warning to anyone who may be adversely affected; certainly anyone on site but, potentially including neighbours and responding emergency service agencies. This needs to be in the form of pre-planning.

2. Advise those likely to be affected on actions they should take to protect themselves.

3. Help or treat any person injured in the emergency. This includes First Aid knowledge and actions specific to the effect of the substances on the body.

4. Manage the emergency and bring it under control if possible. Or if it is identified in the plan that a particular type of incident is beyond the ability of staff on site;

5. Allow the emergency to be managed by the NZ Fire Service under s.28 of the Fire Services Act. Actions then under 1 above should be to evacuate upwind to a safe location.

6. Identify; skills required to manage the emergency, the actions to be undertaken by nominated personnel, and equipment required to deal with the emergency.

NB: **The following classification explanations are common to both petrol and Diesel.** If **Aviation Kerosene (Jet-A1)** is used or stored on site the classification differs in only one respect: The suspected human carcinogen classification does not apply.

6.1E: Acute toxic effect for substances with an LD_{50} (lethal dose with a 50% mortality) greater than 2,000milligrams but less than 5,000mg per kilogram of bodyweight – less than 0.5 litres. Siphoning petrol, Jet-A1 or Diesel by mouth is extremely hazardous.

6.3B: Mildly irritating to the skin with effects which are generally reversible.

6.7B: Suspected human carcinogen where the evidence is limited or not sufficiently strong that an expert can classify the substance as a 6.7A – a known carcinogen

9.1B: Ecotoxic in the aquatic environment at a range of values between 1 – 10mg / litre of water, and is not rapidly biodegradable and may or may not be bioaccumulative.

Fire and Explosion General

All petroleum products must be treated as being potentially explosive, even in small quantities.

Petrol, aviation gasoline (Avgas) and most solvents evaporate readily, producing an explosive mixture with air. Kerosene, aviation turbine fuel (Jet-A) and the less volatile solvents can also produce explosive vapours, particularly in poorly ventilated areas or when mechanically agitated or expelled under pressure.

All products can accumulate static electricity which may trigger an explosion. Kerosene type products are particularly susceptible with Diesel to only a slightly lesser extent.

Automotive diesel, fuel oils and lubricating oils can produce explosive conditions if sprayed or heated, even over small areas like exhaust manifolds. Mechanically generated vapour clouds from product under pressure can be ignited even below the products' Flashpoint.

Because of the differences in Flashpoint the ullage or vapour space in a fuel container be it a jerrycan, drum, or tank may contain fuel vapour or air. With petrol; the ullage will be vapour above the Upper Explosive Limit (UEL) i.e. too rich to burn, even if the container is subjected to heat above the Autoignition temperature – generally the container will fail and catch fire or split at a seam and be projected. If on the other hand the product has a Flashpoint above ambient i.e. from Jet-A on up to Diesel and lubricating oils the ullage space will contain air.

Subject the container to temperatures above Flashpoint and the fuel will start to vaporise, increase the temperature to the Autoignition temperature and somewhere within the explosive range the container will explode with about 1.25x the energy of a petrol container because of the higher energy density of Diesel compared to petrol. The exception to the above is ethanol or methanol containers which will always contain a fuel vapour / air mix within the explosive range.

In a fire, or when containers are subjected to sufficient heat, jerrycans, either plastic or metal and the common 20 litre round metal containers will generally fall apart and burn as a 'running pool fire'. 60 and 209 litre drums on the other hand act more as pressure vessels in a fire and can be projected 200 metres into the air and over a radius of 70 metres, or 200 metres horizontally if stored on their sides. With over 350kPa impact energy they will penetrate any building construction other than 150mm reinforced concrete.

It is a mistake to assume that Jet-A and Diesel are safer than petrol because of their higher Flashpoints. Under certain circumstances as detailed above the opposite is true. All fuels should be treated with caution; remember

Just because you "have always done it that way" does not make a practice safe, it speaks more to your good luck and innate common sense that nothing has happened to-date.

Precautions against Fire and Explosion

Keep all **SOURCES OF IGNITION** away from petroleum products and their vapours.

Sources of ignition include but are not limited to:

- Matches, lighters and cigarettes, etc.
- Any flame or spark.
- Any non-flameproof electrical equipment, including switches, hand torches, electric radiators, vacuum cleaners, power tools and 2 way radios and cellphones.
- Welding sets, their leads, connections and hand-pieces.
- Gas welding torches and gas igniters.
- Motor vehicles and all internal combustion engines. Must be turned off when being filled with no sources of ignition brought within 3 metres of a vehicle being filled
- Tools which can cause a spark if dropped, etc.
- Grinders
- **NB**: Keep all oxidisers (HTH and O_2 cylinders) away from fuels

- Petroleum vapours are heavier than air and will readily collect in pits, drainage sumps, cellars, and any low areas. Small quantities of vapour can be dispersed by ventilation. Do not suck out interceptors with a vacuum tanker if the spilt product is petrol.

- Do not carry out any hot work (e.g. welding, gas cutting, grinding, drilling or power wire-brushing) on any tank, container, or any equipment that still contains petroleum product or that has not been tested and certified gas free by a competent person using appropriate vapour testing equipment within its test date – normally a service not readily available unless Oil Industry Contractors are on-site.

- Do not pour petroleum products from one metal container to another, without ensuring that both containers are fully earthed and that an effective earthing connection is made between hose nozzle and receiving container before any transfer is started, and is maintained as long as the transfer continues. It is especially important to not allow the free fall of fuel from the nozzle to the bottom of a container without earthing or ensuring metal to metal contact; freefall of fuel generates up to 27,000 volts of static.

- If filling of drums with fuel on a service station forecourt or from a commercial or farm tank is a common practice it would pay to have an oil industry approved contractor make up a "fill dropper tube" which screws into the drum bung and extends, with holes in the end, to the bottom of the drum thereby ensuring electrical continuity and limits free fall of fuel. This practice is anticipated where helicopter operations are carried out on remote farms and drums of Jet-A are filled from a trailer tank for carrying by air on a sling. The "principal" as the "person in charge" has a duty to ensure any operation is safe.

Diesel – Petrol contamination

Inadvertently putting petrol into a Diesel vehicle or the other way around can lead to significant fire or explosion risk depending on how the "shandy" is handled, and also for vehicle damage to occur.

Just 1% or less of petrol will lower the Flashpoint of Diesel below the specification minimum for Diesel fuel and may void any vehicle warranty. This will not affect the fuel's engine performance but it will make the fuel more hazardous to handle. Larger amounts of petrol will lower the viscosity and / or the cetane number of the fuel below the specification.

Drain the tank and refill with Diesel – there will be no residual effect once the petrol has been removed from the fuel system. Treat the shandy as if it was petrol. Disposal is a

problem issue. It cannot be used in an oil stove or burner – there is a serious risk of explosion.

Up to 2% petrol Diesel mix has not been shown to cause operability problems in Diesel vehicle engines but as the percentage approach 5% the effects noted will be white smoke on start up, Diesel knock and engine overheating. There will be increased fuel pump wear and failure of seals and gaskets. Continued use (from as little as one tank full) will lead to rapid engine failure.

At 5% the Flashpoint of the fuel must be considered to be the same as petrol as the separate products flash-off independently. In general for homogenous mixes below 5% for every 0.05% increase in petrol the Flashpoint will drop between 1.5°C. and 2°C.

Toxic Hazards

Petroleum vapours can quickly asphyxiate. At lower concentrations, they irritate the eyes and lungs, and may cause nausea, headache and depression.

Petroleum products will irritate the skin and may cause dermatitis on prolonged or repeated contact. As a suspected human carcinogen (cancer causing agent) with a classification of 6.7B petrol should never be used as a general solvent where it could contact the skin. It should not be used for this purpose anyway due to the extreme flammability risk – there are better degreasing agents available commercially.

In addition, aviation gasoline (Avgas) still contains tetra ethyl lead compounds – a serious Central Nervous System (CNS) toxin - as did previous leaded automotive fuels. Internal surfaces of tanks which have contained these products will be contaminated and must be treated as highly toxic, even after all product has been removed, often for some years. Disused fuel tanks either aboveground or belowground are required to be disposed of appropriately and only by experienced oil industry contractors.

Precautions against Toxic Hazards

- Avoid splashing, or any contact with the eyes or skin.
- Wear PVC gloves and boots, and cotton, Tyvek® or Nomex® overalls.
- **NB**: Beware of static discharge from dissimilar clothing
- Wear goggles or face shield if splashing is possible.
- If clothing gets contaminated with product, remove under a running shower – preferably an outside hose. Do not move as saturated clothing may generate static sparks
- **NB**: do not wash contaminated clothing in a washing machine due to the risk of electrical spark and ignition / explosion. Do not wash any clothing contaminated with hazardous substances including agrichemicals in the family washing machine due to differences in susceptibility to toxic effects between adults and children.

First Aid Treatment for Petroleum Products 0800POISONS 0800 764766

Swallowed

- **DO NOT INDUCE VOMITING**! The main hazard following accidental ingestion is aspiration of the liquid or vapour into the lungs, and children are more susceptible than adults. Small amounts of water or fruit juice may be given, not milk as this may increase absorption (marginally)

- **EVACUATE TO HOSPITAL IMMEDIATELY if > 1 x mouthful. If in doubt evacuate anyway**

Eye Contact

- Wash with copious amounts of water for at least 10 minutes and seek medical advice if redness or discharge continues.

Skin Contact

- Drench the skin immediately with cold water.
- Remove contaminated clothing under a running shower or outside hose and wash all contaminated skin with soap and water

Inhalation

- Move victim to fresh air.
- Keep the patient warm and at rest.
- If unconscious, place in the recovery position.
- If patient is not breathing, give artificial respiration if safe to do so. It is not safe if they have swallowed or inhaled liquid fuel. Minor inhalation of vapour only
- Give cardiac massage if necessary. Current protocols dictate cardiac massage only instead of both artificial respiration and cardiac massage
- **EVACUATE TO HOSPITAL**

Emergency Action:

Petroleum Spillage

Evacuate upwind if at all unsure and call for emergency services assistance

- If a spill occurs, extinguish all naked flames.
- Shut down any other potential sources of ignition (from a safe location).
- Ensure area is well ventilated.

Small Spill:

- Absorb spills in enclosed areas.
- Absorb outside spills using a proprietary absorbent or kittylitter .
- Spread on an impervious sheet and allow low FP product to vaporise.
- High FP product, as above, mix with composts and allow to weather

Large Spill:

- Call for assistance from fuel supplier.

Petroleum Fire:

- Use AFFF foam or dry powder, but only if safe to do so – request separate information on extinguishers,
- Do not use water jets — these will spread the fire.

An additional safety warning for those working on vehicles exposed to fire

Safety Warning!

Everyone who comes in contact with Oil Seals and “U” Rings made of **VITON** should note:

- **Viton** is a fluoroelastomer, a synthetic, rubber-like material containing fluorine, which is used for gaskets, “O” rings, and seals of various kinds.
- Trade names include **FLUOREL** and **TECMOFLON**.
- When used under their design conditions they are perfectly satisfactory and safe.
- However, if exposed to high temperatures, the material decomposes and one of the by-products is **hydrofluoric acid**. This acid is **extremely corrosive** and almost impossible to remove, particularly from human tissue.

Recently a man, who badly burned a finger while handling this material, had the finger partially amputated, as the only way to get rid of the decomposed **VITON**.

When inspecting equipment which has been exposed to a high temperature, check any gaskets for decomposition, which will appear as charred, or a black and sticky mess.

DO NOT UNDER ANY CIRCUMSTANCES touch either the seal or the equipment until a substantial cooling period has been allowed.

The affected area should be decontaminated before undertaking any further work by cleaning **using wire wool and detergent solution.**

Disposable heavy-duty plastic gloves should be worn and safely discarded immediately after use.