Environment Protection Authority

Preventing Fires – Truck Inspection Manual

Acknowledgement of Country

The EPA acknowledges the traditional custodians of the land on which we live and work, and pay our respects to Elders past, present and future.

We recognise the connection to their land, their waters and surrounding communities and acknowledge their history here on this land.

We also acknowledge our Aboriginal and Torres Strait Islander employees who are an integral part of our diverse workforce and recognise the knowledge embedded forever in Aboriginal and Torres Strait Islander custodianship of Country and culture.

Dharawal Country, Royal National Park, NSW

Cover: B-double fire involving dangerous goods – Marulan NSW. Photo: Nigel Sargent/EPA

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ISBN 978 1 922778 19 2
EPA 2022P3690

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Guidance notes for fire risk assessments

Background

Truck fires can totally destroy a truck and its cargo and create a hazard for other road users.

Truck fires in vehicles transporting dangerous goods, especially dangerous goods in bulk, are very serious incidents that can cause:

- loss of life
- extensive environmental harm
- impact to people and property over a wide area.

Many truck fires are preventable. Factors that may cause fires can be identified and eliminated before the vehicle takes to the road and/or can be identified by the driver before or during a trip.

This document is a guide on how to identify preventable causes of truck fires. It applies to all heavy vehicles, not only those transporting dangerous goods.

You can find more guidance on the inspection and maintenance of dangerous goods tank vehicles in the **Dangerous Goods Tank Vehicle Inspection Manual (DGTVIM)** on the EPA website.[1]

This guide should be read in conjunction with relevant Work Health and Safety legislation to ensure you comply with your legal obligations under those laws. Information on the latest laws can be checked by visiting the NSW legislation website **www.legislation.nsw.gov.au**. You can also contact SafeWork NSW (the work health and safety regulator in NSW) on 13 10 50 or visit **www.safework.nsw.gov.au**.

Scope

This guidance applies to all types of heavy vehicles and identifies preventable causes of truck fires. But it **doesn't apply to fires started:**

- as a result of chemical reaction within the cargo, or
- after a crash, impact or other incident.

Basis

The checklists come from experience of heavy vehicle fires in Australia. They represent the accumulated knowledge of vehicle-fire investigators.

Fire behaviour

Combustible materials can react with oxygen when heated without catching fire. The materials often darken, which indicates that chemical changes are occurring without sufficient release of energy for the material to reach the unpiloted ignition temperature. Oxidation of fuel without flame is called **pyrolysis**.

Pyrolysis will occur at the fringes of a fire where the temperature is not yet extreme but where the material properties of combustible matter are changing.

Signs of pyrolysis should never be ignored. Inspection for fire risk is intended to identify signs of pyrolysis. Such signs should never be ignored and must be resolved. The vulnerable locations are close to heat sources (such as the exhaust pipe or electrical terminals).

Pyrolysis introduces carbon into the situation. Carbon can conduct electricity so pyrolysis can be the first stage in the breakdown of electrical insulation.

The smell or sight of **smoke** should never be ignored. It is a sure sign that pyrolysis and maybe flame exists. If smoke is smelt, seen or anticipated, the situation must be resolved.

Pyrolysis of a polymer relay case indicating high and unacceptable operating temperature.
Photo: Peter Hart/Hartwood Consulting

1 www.epa.nsw.gov.au/publications/dangerousgoods/dangerous-goods-tank-vehicle-inspection-manual

Levels of inspection

See Table 1 below for the kinds of inspection that should be done.

Table 1 Levels of inspection

Level	When	Who does it	What is done	Purpose
Pre-trip inspection	Before vehicle is driven	Driver	See Driver checklist (p 9).	To identify potential fire risks before driving.
Trip inspection	Normal stop	Driver	Focus on the wheel-end condition (tyres, rims, hubs) and any signs of leaks.	To identify potential fire risks that may have developed during the trip.
	Abnormal conditions develop	Driver	Pull the vehicle over when safe to do so and inspect it.	To investigate abnormal conditions, including: • variable performance of lights and gauges • signs of smoke from a wheel-end • loss of engine power (which could mean the turbocharger is about to fail).
Workshop inspection	Before a new or modified vehicle goes into service	Workshop	A detailed and comprehensive inspection.	To identify fire risks associated with the vehicle's setup that must be identified and controlled.
	After a vehicle goes into service	Workshop	A detailed and comprehensive inspection.	To identify fire risks associated with the vehicle's condition that must be identified and controlled.

Sources of heat

The sources of heat that can occur on a heavy vehicle and which need to be mitigated are:

1. electrical
2. exhaust
3. brake
4. friction
5. chemical.

1. Electrical heat

Common causes of electrical heat include:

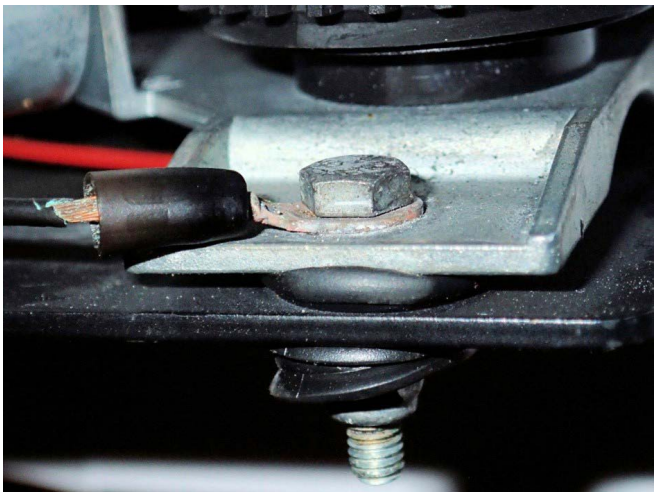
- a short-circuit or abnormal circuit conditions, including cable insulation on positive cables wearing through on earthed metal components
- the current being too high, making the wiring or a component hot. Sometimes the wiring insulation softens
- an electrical connection at a terminal having poor contact. The terminal gets hot with normal current
- a component having degraded under normal conditions. Insulation fails, leading to an abnormal current flow
- internal failure of a battery allowing release of stored chemical energy. The battery ruptures and explodes
- a cable that supplies a heavy load being discontinuous or badly connected. Sparking occurs at the bad connection point
- combustible contamination building up on an electric circuit (such as inside an alternator or on a printed circuit board). Electrical tracking occurs, which results in heating.

Often the substance that first catches fire from electrical heat is the electrical insulation or plastic conduit. Electrical insulation usually has fire-retardant properties, so it burns slowly, but the conduit does not and burns freely. Split plastic conduits can spread fire.

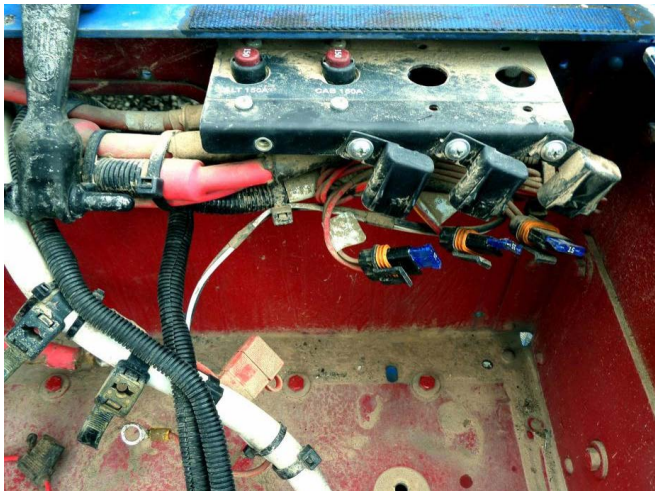
Electrical heat has its origin at the battery and alternator. As a guide, the fault current potential of a 12 V battery is ~ 20,000 A, while for the alternator it is ~ 200 A. Therefore, the closer the fault is to the battery, or the thicker the cable to the battery, the greater the heat likely to be generated if a short circuit occurs.

Electrical heating can occur **whether the ignition key is on or off**. The risks are greater when the engine is running because more circuits are live. Despite this, fires often occur at night when a vehicle is parked.

Experience shows that fire started by electrical heat is more likely to occur on a heavy-current circuit than on a light-current circuit.



Hot terminals can occur on minor or major circuits. In this case the return connection in a beacon light was poor because the rubber mount was not tight. Photo: Peter Hart/Hartwood Consulting



Distribution of power supply from starter motor terminals. Photo: Peter Hart/Hartwood Consulting

It's best if the alternator and cabin circuits are protected by an independent circuit breaker or fuse. Distributing these circuits directly from the starter motor terminals can cause problems because fuse protection cannot be conveniently provided at the starter motor.

2. Exhaust heat

Exhaust heat is generated at the turbocharger, exhaust manifold, muffler/reactor and exhaust pipe and tailpipe when the engine is running.

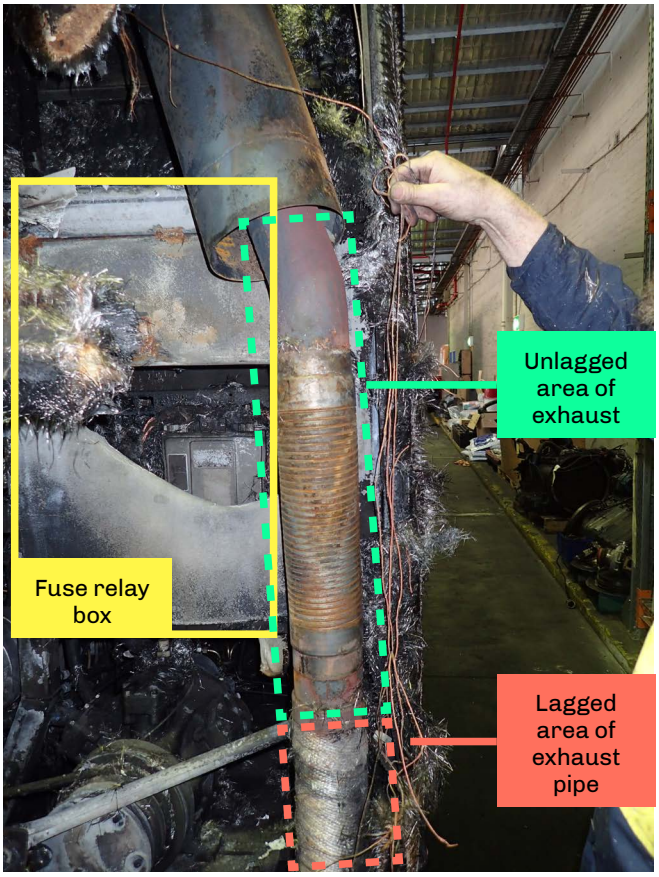
The risk of fire increases with increasing exhaust temperature. High exhaust temperatures can occur when:

- the vehicle has been working hard for a long time on a hot day
- the engine is being over-fuelled due to low boost air pressure (for example, due to a leak from the air intercooler)
- an LPG top-up injection system is used.

The ways in which exhaust heat can cause fire include:

- leaking of hydrocarbon liquids onto the exhaust. Liquids include
  - petrol
  - diesel
  - engine oil
  - hydraulic fluid
  - transmission oil
  - steering fluid
  - glycol coolant
- leaking of exhaust gases through a hole in the exhaust system onto combustible matter
- exhaust gases released normally from the tailpipe heating nearby vegetation
- combustible matter such as vegetation (grass, harvested grains etc.) lodging on or around the exhaust pipe
- failure of the oil seals inside the turbocharger, leading to an internal fire that sometimes escapes via the air-boost side and extends into the engine compartment.

Note: The engine block does not reach the auto-ignition temperature of hydrocarbon fuels (diesel and oil) likely to be found in the engine compartment. The exhaust pipe does.



Plastic conduits running too close to an exhaust can cause fire, as shown in red in the picture. Photo: Peter Hart/Hartwood Consulting

3. Brake heat

Brake heat occurs normally. There is a minor risk that combustible matter might be ignited on a hot brake drum or disc. The higher risk is that the brakes reach an abnormally high temperature because they are dragging.

Causes of dragging brakes include:

- wheel bearing failure. The brake is not running free because the hub is not centred
- the spring brakes are on, partially or completely, because the air pressure in the spring-brake system is low. This can be due to a hose failure, damage due to a strike with road debris or contamination in the air system that causes the spring-brake air valves to misbehave
- the spring brakes have not released at the back of a long combination vehicle because insufficient build-up time has been allowed
- the vehicle is driven off with the rear spring brakes rubbing
- the trailer-brake handpiece has been left partially on while driving, causing the trailer-service brakes to drag
- the trailer-brake air coupling is not correctly connected, and the trailer-brake air level is low.

4. Friction heat

Friction heating can be caused by:

- a tyre that is significantly under-inflated. The bulge of the tyre rubs on an adjacent tyre or the rubber sidewall heats up inside
- air suspension that is not fully inflated, leading to a tyre rubbing on a hard surface
- a heavy-duty mudguard rubbing on the tyre(s) because the mudguard support has failed
- a loose component or cable rubbing on a belt at the front of the engine
- vegetation matter rubbing against a driveshaft. This risk is greatest for drive shafts covered by a guard on agricultural machinery
- a trailer mezzanine vibrating sideways on its support brackets. The bracket surface is relatively soft and hot metal filings come off the bracket and accumulate on top of combustible freight packages.

Rubbing brakes cause extreme brake temperature. Photo: Peter Hart/Hartwood Consulting

5. Chemical heat

Sources of chemical heating include:

- reactive chemicals coming together because of a containment failure in the cargo
- a vehicle battery failing internally. Most vehicles have lead-acid batteries, although use of lithium ion-polymer batteries is increasing

  Lead-acid (vehicle) batteries produce hydrogen. If there is a crack in a metal path, sparking can occur that will cause the hydrogen to explode. Vents are provided to allow the hydrogen to escape.

  Lithium batteries are widely used in consumer goods and are occasionally used on trucks for auxiliary batteries. They have a higher energy density than lead-acid batteries. If the battery is damaged or fails during charging it can result in self ignition and significant heat release.

Preventing fires – truck driver guidance

Inspections at start-up

1. Start the engine.
2. Walk around and observe that the suspensions are inflated.
3. Check that all the tyres are inflated.
4. Check there's no smell of smoke. If there is, investigate it and resolve the situation.
5. Look for oil leaks.
6. Look for product leaks in cargo, especially when transporting dangerous goods.
7. Check that the trailer electrical connectors are in place and locked.
8. Check that the product hoses when fitted are restrained.
9. Listen for belt squeals. Slipping belts are unacceptable.

Driving off

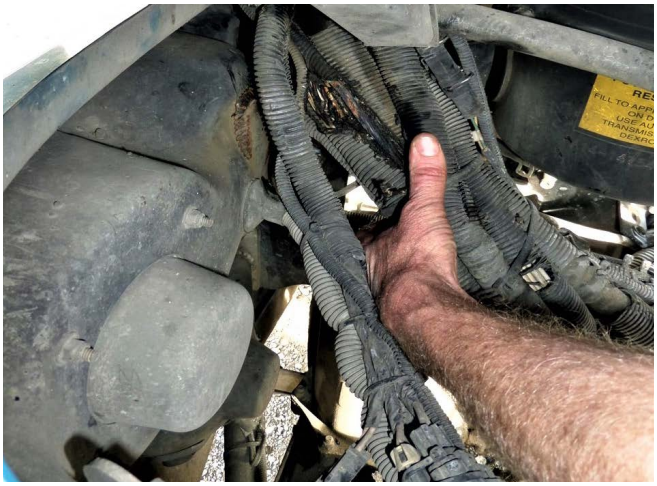
1. Do a brake check and assess whether the deceleration is adequate.
2. If the truck has a trailer-brake control, apply it to check that the trailer brakes are working and releasing.

After driving, at a break

1. Feel the hub for abnormal temperatures.
2. Look for oil, fuel and product leaks. Resolve the leaks before proceeding.
3. Feel the tyres for hot surface temperatures. Look for tyre rubs.

On the road

1. Don't ignore flickering lights or gauges. An electrical short-circuit on a main cable is probably occurring. Stop, investigate and report.
2. Don't ignore the smell or sight of smoke. Wisps of smoke from a wheel-end are probably a sign of a hot tyre. If you stop, the tyre might catch fire because windage cooling has stopped, but driving on at speed could also result in fire. Therefore, the best strategy is to stop. If there is a known supply of water close by, drive slowly to it. Use the water to cool the tyre. Call the fire brigade as soon as smoke is confirmed, even if the vehicle is still moving.
3. Loss of engine power may indicate turbocharger failure. Don't drive on with a failed turbocharger. An internal oil fire will eventually occur.
4. Don't ignore a fuel trail on the road from the vehicle in front. Leaking diesel fuel can eventually get onto a hot exhaust. Try to contact the driver using the radio.



Rubbing electrical cables caused disturbance to the lights, which alerted the driver to a problem. Photo: Peter Hart/Hartwood Consulting

An engine bay after a fuel fire

Fuel leaks from injector tubes should never be ignored. Above and below: Sections of high-pressure fuel line.The green arrow indicates where fuel would leak from. Photos: Peter Hart/Hartwood Consulting

Look for road-strike damage to brake actuators. Photo: Peter Hart/Hartwood Consulting

Notes

1. Don't stand in front of a smoking or burning tyre: the internal air is being heated and the pressure will be rising. The tyre may rupture and debris can harm people close by, particularly if it is an outer tyre. If you can, stay behind vehicle features and strong metal covers when close to a hot (smoking) tyre or suspected wheel-end failure. Ask bystanders to stay well away.
2. A dry chemical fire extinguisher is unlikely to stop a tyre fire because it does not remove heat from the tyre and the brake drum. A water extinguisher or a garden water supply (if available) will be more effective. Use soft drink or any other non-flammable liquid you have if you don't have water.
3. If you don't have any suitable liquid, use the dry-chem extinguisher. It may be effective for leaking wheel oil seal fires, which sometimes occur when a disc brake gets extremely hot.
4. Running on a flat or partly inflated tyre can cause heating of the tyre sidewall. Occasionally the rubber will pyrolise but not catch fire until the cooling air flow stops. Lots of water is usually necessary to extinguish a tyre fire.
5. If the engine loses power, there could be a fuel problem, or the turbocharger might have failed. Whatever the cause, stop and investigate. Driving on with a failed turbocharger is dangerous and can result in an engine bay fire.

Preventing fires – truck driver guidance

Petrol tanker fires are very hard to put out and can cause significant pollution. Photo: Fire and Rescue NSW

1. High-current cable integrity

Guidance – All high-current cables

High-current cables are best secured with rubber-block compression clamps. Metal-spine clamps with rubber inserts are less reliable because the inserts sometimes move or come out. The positive and negative cables must be separated by insulated features so that cables cannot rub against each other.

Guidance – Alternator positive cable

The alternator positive cable runs from the alternator on the engine to the isolation switch or to the starter motor. This cable is vulnerable to mechanical rubs. Inspect it carefully where it can be seen.

If the alternator positive cable starts at the starter motor, it is unlikely to have circuit breaker protection. A circuit breaker is highly desirable. The circuit breaker would eventually open if a rub exists and an instrument warning light would probably come on to inform the driver.

Hot terminals can occur equally on both positive and negative terminals.

Stacked ring terminals at the stud on the alternator must sit flat and be tight.

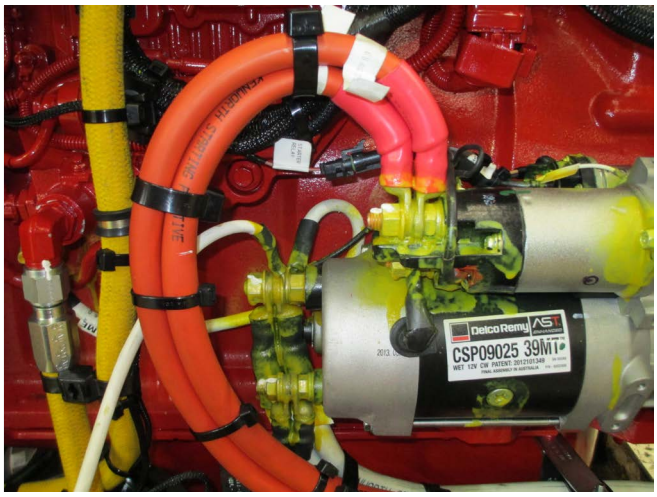
Note: Without circuit breaker protection, this cable is especially vulnerable. For tank vehicles transporting flammable liquids, AS 2809 does not mandate a circuit breaker. However, it is safe practice to have one fitted.

Guidance – Starter motor cable

This thick main cable carries high current when the vehicle is started and it cannot be bent sharply. It is vulnerable to rubs when in confined spaces, such as at the starter motor.

On some 12 V trucks the starter motor cable is duplicated, which makes for more crowding at the starter motor terminals. The risk of rubs on the main cable is greatly increased.

Inspecting the full length of the cable can be difficult, especially under the cabin. Focus on clamp points and crossover points. Use a powerful torch to help with the inspection.



Duplicate cables at a starter motor increase the risk of rubbing. Photo: Peter Hart/Hartwood Consulting

Guidance – Isolation switch

Where fitted to comply with AS2809, the isolation switch must have a trigger on the right side behind the driving compartment. The isolation switch might be located here or otherwise close to the batteries. Operate the isolation switch with parking lights and/or hazard lights on to check operation.

The supply cables from the battery must run directly to the isolation switch. AS2809 does not require that both poles are switched, but this is the usual method.

Crowding of the heavy cables at the isolation switch is a significant risk for rubbing at this location. Scrutinise the isolation switch terminal connections.

Battery isolation switches should be operated every three months, in conjunction with testing of a rollover switch (where fitted), to ensure that they operate correctly. The live terminals on the switch must be covered.

The isolation switch should be tested with the engine running to ensure it shuts the engine down as well as all electrical power sources not permanently energised.

Reasons for rejection

1. The terminals at the alternator are loose or corroded.
2. The terminals at the far end of the alternator cables are loose or corroded, or the crimp ends are close to chassis metal.
3. The alternator cable is not tied down in the engine compartment to prevent fouling.
4. The positive terminal is loose at the starter motor.
5. A positive starter cable is rubbing on the chassis rail near the starter motor.
6. Crimp ends on positive cables come close to chassis metal or other terminals.
7. A positive cable is resting against a metal bracket.
8. A metal-spined clamp for a positive cable has missing, damaged or misplaced rubber inserts.
9. There are more than three (3) stacked ring terminals at a stud.
10. Stacked ring terminals do not sit flat and tight.
11. Automatic reset circuit breakers have been used.
12. Cables are unrestrained in the engine compartment and could move around.
13. There is inadequate slack where the cable runs between the engine and the chassis. Because the engine moves, this cable could be pulled against chassis metal.
14. The cable insulation is rubbing against metal.
15. If a battery isolation switch is fitted, when the switch is operated with the engine running the engine does not stop.
16. When operated, the battery isolation switch does not shut down lights and other circuits.
17. Exposed positive terminals of an isolation switch (where fitted) are not covered/ insulated by plastic or rubber covers/boots.

Having electrical cables sitting against a bolt stud (at left of picture) is a recipe for disaster! Plastic conduit will not protect the cable from a thread. Photo: Peter Hart/Hartwood Consulting

2. Alternator terminal integrity

Guidance

Positive and negative terminals are equally vulnerable to heating if the terminal nut is loose or if multiple ring terminals are stacked and not sitting flat.

External field terminals will usually be evident on the alternator. They have probably been added. Check that they are clear and covered.

Reasons for rejection

1. There is poor clearance between connectors and the alternator body at the alternator positive or negative terminal.
2. The alternator terminals are loose.
3. There is no nut retention (spring washer, castellated washer, plastic-insert (Nyloc) nut) on each main alternator terminal.
4. There is no evidence that the isolation switch, if fitted, breaks the alternator field winding when opened.
5. The field terminals are loose or insulation from the alternator body is missing.
6. The alternator positive cables are rubbing on engine features.

In this case, a fire was caused when the alternator cable rubbed on a stud that protruded from the side of a large engine.
Photo: Peter Hart/Hartwood Consulting

3. Alternator cleanliness

Guidance

The alternator contains live electrical parts. Build-up of contamination including dust, oil and road grime can result in tracking faults. A tracking fault is an abnormal flow of electricity via contamination. It is a form of short-circuit but the current level may not cause a fuse or circuit breaker to open. A tracking fault can cause heating that over time might pyrolise insulation and circuit components.

Blow the alternator out with compressed air.

Reasons for rejection

1. **The alternator is dirty or clogged when viewed through the cooling vents in the body.**
2. **Metal is discoloured (due to high temperature) at the bearing housings.**

4. Turbocharger integrity

Guidance

Most diesel engines have turbochargers. Because the turbocharger spins at very high speeds, the bearings are lubricated and cooled by engine oil. The engine oil is delivered via a metal oil tube that is connected to the turbocharger, usually at the top. If the oil line leaks, oil will get onto the turbocharger and may ignite.

Oil leaks where the oil tube connects to the centre (bearing) zone of the turbocharger are unacceptable. Check that the nut is tight.

Turbochargers are wearing items with a limited lifespan. They should be maintained and/or replaced in accordance with the original manufacturer's guidance. Turbochargers may have a shortened lifespan if they have experienced very hot exhaust conditions (such as occur when the air boost has been low or there is an LPG 'top-up' injection system).

It is important to replace the turbocharger before it fails.

A fire inside the turbocharger that is confined to the exhaust side will probably not start a fire because the exhaust is designed to accept hot gases. However, if such a fire spreads to the impeller (air-intake) side, the fire will get out via melted aluminium or burnt rubber elbows.

Never drive on with a suspected turbocharger bearing fault.

Reasons for rejection

1. **There is evidence of oil leakage on the turbocharger or exhaust manifold. (Burnt oil produces black stains.)**
2. **The oil-line nut is not tightened to the correct torque.**

5. Hydrocarbon fluid containment

Guidance

In the engine bay, only the exhaust manifold, turbocharger and the exhaust pipe are hot enough to ignite diesel fuel, engine oil, transmission oil, steering fluid, propane refrigerant (non-standard) or glycol coolant. The block temperature is insufficient.

The exhaust side of the engine is the most vulnerable. Although the fuelling side is always on the other side of the engine, a spray of fuel from the fuelling side can reach the exhaust side as an aerosol. If that happens an explosion is likely.

Be aware that large diesel engines have a fuel return line. If the return line is close to an exhaust under the cabin, a dangerous condition exists. A leak from the return line will not degrade engine performance and so may go unnoticed.

Hydrocarbon leaks such as oil and fuel must be investigated and resolved. Leaks can signal cracked hoses, failed seals or loose fittings. Look for deep rubs and cuts on hoses that could develop into a leak.

Use a torch to inspect the oil and fuel fittings from underneath (via the pit). Leaks behind the engine compartment can result in fuel, transmission oil or hydraulic fluid getting onto a hot exhaust, particularly if the exhaust discharges underneath the truck.

Reasons for rejection

1. Evidence of oil leaks, particularly on the exhaust side of the engine.
2. Leaks from the fuel cooler at the front of the engine.
3. Leaking oil sitting on the transmission.
4. Glycol powder on the top tank or at top front of the engine.
5. Loose clamping of the high-pressure fuel tubes on the engine.
6. Evidence of vibration damage (rubbing or cracks) on the high-pressure fuel tubes.
7. Fuel leaks from the low-pressure hoses, filter housing or water separator.
8. Evidence of oil/fuel-soaked insulation or lagging in the engine bay.
9. Fuel lines resting on sharp metal corners, in particular polyamide fuel lines.

Fuel or oil trails should never be ignored. Photo: Peter Hart/Hartwood Consulting

6. Engine drive belt integrity

Guidance

The engine may have several drive belts. These belts are flexible and made from a rubber or polymer compound.

If the belts slip, they will get hot. If other features such as wiring looms or hoses drape and rub against the drive belts, heating and potentially fire could occur.

Reasons for rejection

1. Drive belts are not tight and could slip.
2. Metal, electrical looms or hoses are rubbing, or could rub, on a drive belt.

7. Exhaust clearance

Guidance

The exhaust pipe surface temperature is high enough to ignite most combustible materials.

No combustible material should be closer than 150 mm to the exhaust pipe unless the pipe is lagged or a shield is installed. Combustible materials should be tied back securely. Check that the ties are secure because failure of a tie might result in a fire.

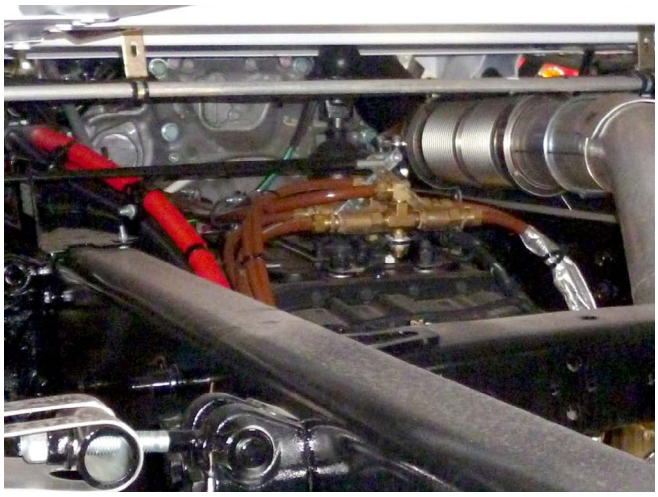
Where possible, oil- and fuel-containing fittings should be installed so that a failure of the hose at a fitting will not spray the exhaust. If the engine bay configuration does not allow for this, inspect the hoses and fittings carefully for signs of deterioration. Pay particular attention to the oil and fuel hoses that have sharp bends at end fittings. These are weak points.

Make allowance that the engine and the exhaust pipe can move when operating.

Also check the exhaust behind the engine compartment.

Reasons for rejection

1. Combustible material is within 150 mm of an unlagged exhaust pipe.
2. Combustible material is within 100 mm of a lagged exhaust pipe.
3. Combustible material is not restrained close to an exhaust pipe.
4. A flexible steel (spiral) section of an exhaust pipe is damaged and exhaust gas is escaping.
5. A steel clamp that holds exhaust pipe sections tightly together is loose.
6. Oil/fuel-containing fittings have damaged or deteriorated hoses or connections.
7. Oil or fuel lines are bent where they come into an end fitting .



Fuel line (brown polyamide tubes) positioned close to the exhaust pipe. Further shielding may be required. Photo: Peter Hart/Hartwood Consulting

8. Cabin power supply cables and electrical system integrity

Guidance

The cabin power supply cables can come from the starter motor or from the isolation switch/battery.

The power supply terminal studs at both the batteries and at the starter motor are points of vulnerability.

It is **essential** to have plastic/rubber boots on both ends of a positive panel-stud that traverses the firewall.

There may be an electrical fuse and relay box in the engine compartment. These components should be inspected carefully for signs of damage, blackened terminals or blackened insulation (pyrolysis).

Inspect where possible the wiring at terminals and the condition of fuse holders and relays.

Turn the controls on and check that the functions operate.

Some trucks have terminal studs that come through the firewall or the front of the cabin. Inspect these for signs of heat, tightness and insulation protection. Ensure that other electrical cables are well clear of these studs.

Check that the lighting functions are all working.

Reasons for rejection

1. Cables are rubbing on chassis metal.
2. A terminal or screw terminal is loose.
3. A nut retention mechanism (such as a spring washer, castellated washer or plastic-insert (Nyloc) nut) is not provided.
4. Stacked ring terminals on the positive terminal are not separated and barrels are interfering.
5. Stacked ring terminals on the positive terminal are close to earthed metal.
6. Cables are rubbing on earthed metal on the either the engine or cabin side of the power stud.

7. The wire has blackened insulation at a terminal or at a component. This indicates terminal heating.
8. Insulation on a wire has cracked or there is exposed metal electrical cable.
9. An electrical relay plastic case has blackened close to a terminal.
10. Ring terminals on a terminal are not sitting flat.
11. There are more than three (3) ring terminals on one terminal post.
12. A terminal post is not fitted with a locking (e.g. spring) washer or lock nut on either power or return sides.
13. A wire can be easily pulled out of a crimp terminal.
14. A fuse or circuit breaker has operated and the cause was not determined.
15. A function is not working when the control is on.
16. The point where the cable goes through the firewall is not protected with a rubber grommet or similar.
17. There is no rubber boot or other insulation protecting the incoming positive stud terminal.
18. A main positive cable is rubbing on earthed metal in the vicinity of the positive stud.
19. An electrical cable is very close to, or is rubbing on, the thread of a terminal stud.

A main cable rub at a metal-spined clamp. Photo: Peter Hart/Hartwood Consulting

9. Battery condition

Guidance

The battery cables are vulnerable because they have no circuit breaker protection. They often loop around in the battery box between the two or four batteries. Cable rubs against metal edges are most risky.

Very rarely batteries explode because of the build-up of internal gas (hydrogen). If a conductive path breaks, a spark can occur, and an explosion is possible.

Sparking equipment – such as contactors, relays or solenoids – can ignite hydrogen gas.

Multiple ring terminals on a single stud can result in a hot terminal developing. Photos: Peter Hart/ Hartwood Consulting

Reasons for rejection

1. A cable terminal on a battery post is close to a metal hold-down.
2. Battery posts are sitting under an exposed metal lid. Interior insulation is required.
3. Battery terminals are corroded. (Protect with petroleum jelly.)
4. A battery cable is sitting on or against a bolt thread.
5. Battery cable insulation is sitting on another cable and divots/wear marks can be seen in the insulation.
6. The batteries are loose.
7. The batteries are dirty. They are covered in road debris, organic trash, oil or similar.
8. Batteries have swelled. The top and/or sides are bulging.
9. The battery-box cover is loose or not well retained.
10. Equipment capable of sparking, such as relays, contactors or fuses, is installed in the battery box and is not inside a sealed junction box.

10. Integrity of trailer electrical plug connections

Guidance

The trailer electrical plug and socket connections degrade with time because they are exposed and can have hoses pulling over them as the vehicle moves and turns. Mechanical damage and heating of the electrical connectors can damage them.

The light-duty round seven-pin plug (AS 4177.5-2004) that is sometimes used on multi-combination trailers is vulnerable to melted pin separators. Scrutinise both the plug and socket for signs that the terminal pins or sockets have moved.

Internal inspection (dismantling) of the plug and socket is not required.

Note that ADR 42/04 specifies the acceptable standards for trailer lighting plug–socket pairs that can be used. There is an 'accessories' plug–socket pair available that complies with ISO 1185:2003, which is suitable in principle for accessory circuits.

Some electrical components burn freely, which is a problem. Notice that the cable insulation does not burn freely. Photo: Peter Hart/Hartwood Consulting

Reasons for rejection

1. Live parts can be seen when the trailer plug is inserted into the socket.
2. The plug or socket body is cracked.
3. The plug is not securely locked when it is inserted into the socket.
4. Terminals have moved because the plastic in the socket has softened.
5. Any of the terminal pins or sockets show some heat marks ('blueing').
6. Corrosion is visible on the pins or in sockets.
7. An 'Anderson Plug' is used on vehicles transporting flammable liquids/gas. This open style plug is not acceptable for vehicles transporting flammable cargoes.

11. Electrical system mechanical protection

Guidance

The electrical system behind the cabin must have mechanical protection equivalent to a conduiting standard.

Cable entry into lamps should be within conduit. Lamp housing should not be cracked.

Wiring should be tied up every 1200 mm or less.

Reasons for rejection

1. A lamp housing is cracked.
2. Wiring is draping and could rub.
3. Wiring is not protected by either a closed conduit or by an approved cable type.
4. Electrical connectors, if used, do not have moisture seals.

12. Protection against spillage

Guidance

For vehicles transporting flammable or combustible liquids, an opening in the cargo tank should not be in the vicinity of the wheels (brake drums or discs). Leakage from an opening must not be able to run or drip onto the brake drums or discs.

Reason for rejection.

1. An opening in the cargo tank is directly above a brake drum or brake disc, without any deflection, guard or shield to prevent leakage getting onto the brake drum or disc.

13. Tyre and wheel integrity

Guidance

Friction rubs can cause the tyre rubber to pyrolyse and it may catch fire.

Check that the tyres are correctly inflated and without sidewall tears.

Look for signs that the tyres have been rubbing on metal brackets or against the mudguard or against each other.

The inner tyre on a dual wheel is often hard to inspect and inflate. Pay particular attention to inner tyres.

If a heavy-duty (rubber sheet) mudguard support has failed, the mudguard may rub on the tyre and heat it up.

Note that driving the vehicle off as soon as the spring brakes release may result in the tyres rubbing on metal because the air suspension requires further time to fully inflate. This is a particular vulnerability for multi-combinations such as road trains.

A tyre fire that resulted from a deflated air suspension. The tyre rubbed on the metal guard, causing the tyre tread to overheat.
Photo: Peter Hart/Hartwood Consulting

Reasons for rejection

1. A tyre is deflated.
2. The bulging of dual tyres is causing tyres to rub (pressure is low).
3. The tyre tread has a distinct rub mark indicating that the tyre has been rubbing on a fixed feature.
4. A tyre sidewall has a deep cut or has a localised bulge or has been scuffed.
5. Tyre valve caps are missing.
6. The wheel rim exhibits strike damage. The outer edge of the rim is dented so that the tyre bead is disturbed.
7. A mudguard support bracket has failed. The tyre is rubbing on the mudguard.

14. Wheel hub integrity

Guidance

The hub must not have impact damage or signs of high temperatures such as discolouration.

Bearing condition can be sensed by lifting each wheel, spinning it and shaking it. As the park brakes must be released to do this, ensure the vehicle is chocked and on level ground beforehand. Do not get underneath while the vehicle is lifted.

Spinning wheels should rotate freely without tight points. A tight point may indicate a bearing problem, particularly if a clicking sound is heard from the hub as the wheel is turned. However, the tightness could be due to brake drum eccentricity.

Wheels should be tight when rocked in and out.

Leaking hub seals can result in fire at a disc brake.

Correct wheel bearing adjustment, especially when fitting new bearings, is a high priority. Always follow the manufacturer's recommendations with regard to wheel bearing nut tension and do not under-tighten or over-tighten. Poorly adjusted new bearings can fail very quickly. Bearing adjustment has a 'sweet spot'.

The mechanic must decide whether to replace the wheel bearings or tighten the hub nut if the wheel does not turn freely or rocks in and out. The bearings should be inspected before making that decision. It is unwise to tighten the bearing installation to take up bearing wear without inspecting the bearing.

Reasons for rejection

1. The hub cap and/or hub has mechanical damage.
2. The paint or metal on the hub has changed colour, indicating a heat point.
3. When a wheel is lifted, spun and shaken, free play exists, or the wheel does not rotate freely. (You should investigate the condition of the bearings.)
4. Bearing grease or oil is leaking from the hub.

5. It is known that the vehicle has gone through hub-high water, or there is evidence that this has happened. (The bearing lubrication must be refreshed.)

New bearings can be over-tightened. Blackened grease indicates hot bearing conditions. Photo: Peter Hart/Hartwood Consulting

15. Suspension integrity

Guidance

Most heavy vehicles now have airbag suspensions. Some systems have one levelling valve and others have two.

A leak in an airbag or a leak in the air system that supplies the airbag can result in the suspension not fully inflating. This can result in tyres rubbing on mudguards and overheating.

If the system has one levelling valve, a leaking system will have low ride height on both sides. If the system has two levelling valves, the vehicle will lean.

If the vehicle has a spring suspension, a broken spring leaf may result in the vehicle leaning.

Note that drivers can often sense that a trailer is leaning to one side when driving. The driver should stop and observe the suspension height and tyre clearance when the truck or trailer is leaning abnormally.

Reasons for rejection

1. The clearance between a tyre and a fixed feature is less than 100 mm when the vehicle is loaded. The suspension is not at the correct ride height.
2. The suspension is leaning off-vertical when loaded.
3. Mudguards and/or protrusions in the wheel arch show signs of rubbing against tyres.

16. Trailer-brake coupling and air-line integrity

Guidance

The trailer air supply coupling should be clean and locked when connected. If this coupling were to come out, the trailer brakes would lock up and could cause a crash. If the fitting is loose but retained, air loss may occur and the brakes may drag, potentially causing a fire.

Reasons for rejection

1. The air supply connections are dirty.
2. The air supply connections do not lock reliably when pushed into the mating trailer connector.
3. There is kinking, crushing, abrasion or other mechanical damage to the air line.
4. Air leaks can be heard.

Wheel bearing failure caused the brake to drag and the tyre to catch fire. Dragging brakes cause extreme brake temperature that can spread to the tyre beads. Photo: Peter Hart/Hartwood Consulting

17. Integrity of auxiliary power systems

Guidance

A trailer might be fitted with auxiliary power system, such as a pump. This could have a drive belt and a hydraulic motor. Trailers can also be fitted with an auxiliary internal combustion engine.

Reasons for rejection

1. A drive belt on the auxiliary motor is slipping or could rub on some other feature.
2. A drive belt is cracked or has stiffened and may fail shortly.
3. An exhaust is dirty, or it is closer than 150 mm to combustible material and is not shielded or lagged.
4. A lagged or shielded exhaust is closer than 100 mm to combustible material.
5. For tank vehicles carrying flammable liquids – the exhaust of an auxiliary power system engine discharges into a hazardous area (such as near to vents or valves).

18. Load platform structural integrity

Guidance

If the trailer has a platform (such as a mezzanine deck) that is free to move sideways in support brackets, the movement can generate metal shavings. Hot from friction, these can fall onto combustible freight packaging below and ignite it.

Structural defects in the trailer load frame are potential failure points: in rare cases, they may generate sparks. Structural cracks are often observed in, for example, uprights on open-sided trailers.

Structural cracks in tank support brackets or their gussets might result in chafing of metal. Chafing generates heat and this is unacceptable.

Reasons for rejection

1. Evidence of metal shavings (rubbings) underneath support locations for load platforms or structural elements that are intended to be retained but allowed to move.
2. Evidence of movement-related wear on platform brackets and anchor points.
3. Evidence of structural defects at support locations and in uprights supporting the load space and roof.
4. Evidence of structural cracks at tank support brackets.

This fire was caused by hot metal particles cast off from a mezzanine support bracket.
Photo: Peter Hart/Hartwood Consulting

19. Integrity of the static electricity reel (vehicles carrying flammable liquids or gases)

Guidance

Static electricity build-up leading to sparking is an ever-present danger on tankers carrying flammable liquids or gases.

The electrical connection between the static line and the chassis metal should be checked.

A visual inspection is adequate unless corrosion is seen or the electrical connection to the tank or chassis cannot be seen, in which case investigation and electrical tests are needed.

A multimeter and wire can be used to check that the earthing wire through a product discharge hose is connected.

If an electrical resistance test is conducted for certification purposes, the resistance should be calculated from the measured voltage drop when a current of 10 A (minimum) is passed between the clamp end of the reel and:

- a point located on the tank (if applicable)

or

- on the chassis rail on the side opposite the static reel.

Reasons for rejection

1. The electrical connection between the static earth reel and the chassis metal is corroded.
2. The earth strap between the tank and the chassis metal is missing or is corroded.
3. The measured electrical resistance between the clamp end of the static reel and the tanker or a distance location on the vehicle chassis is greater than 10 ohm.
4. The electrical resistance between the metal end fittings of a product discharge hose is more than 10 ohm when checked using a multimeter.
5. Lugs for static clamps are not made of bare metal or have been painted.

Prime mover fire that impacted cargo. Photo: Fire and Rescue NSW

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