Part 3 **Maintenance guide**

What maintenance staff and fleet controllers can do to prevent fires

The Truck Fires Series is in four parts and addresses the many ways in which trucks and their trailers can catch fire.

It also provides advice on how truck and tralier fires can be prevented.

ARTSA-1 INSTITUTE

NBTA
National Bulk Tanker Association

TIC
TRUCK INDUSTRY COUNCIL
TODAY'S TRUCKS
SAFER GREENER ESSENTIAL

ACKNOWLEDGEMENTS

In 2019 the National Heavy Vehicle Regulator awarded the then Australian Road Transport Association (now known as the ARTSA Institute or ARTSA-i) and the National Bulk Tanker Association (NBTA) a Heavy Vehicle Safety Initiative Round 4 Grant to investigate truck fire prevention strategies.

In undertaking this work, ARTSA-i and the NBTA enlisted the technical expertise available within the Truck Industry Council (TIC) to assist in the development of the guidance material in these documents.

ARTSA-i, the NBTA and TIC wish to acknowledge the writing and editorial teams who provided their expertise and considerable time to allow these series of documents to be created.
Contributors included:

ARTSA-i:	Greg Rowe
Hartwood Consulting:	Dr Peter Hart and Jas Babilija
NBTA:	Justin Keast, Rob Perkins, Mark Anderson, Jason Stables, Shane Falkiner
Truck Industry Council:	Chris Loose and TIC Members
Other organisations:	Greg Hunter (MFB), Peter Cleary (Fire and Rescue NSW), Phil Brooks (NSW Police), Adam Gibson (NTI Insurance), Richard Calver (NatRoad), Steve Hudson (Liquip NSW), Brett Stewart (Isuzu)

DISCLAIMER

TABLE OF CONTENTS

ARTSA-I INSTITUTE

NBTA National Bulk Tanker Association

TIC TRUCK INDUSTRY COUNCIL TODAY'S TRUCKS SAFER GREENER ESSENTIAL

1 Introduction

Truck Fires have been a long-standing issue within the heavy vehicle sector. Recognising this risk, ARTSA produced a report in 2006 on "Why Trucks Catch Fire."[1] Despite highlighting the risks of truck fires, the heavy vehicle sector remains fire-prone.

NTI Insurance are the major heavy vehicle insurer in Australia.
Their report from 2020[2] states that:

- Over 10% of major losses were due to fire
- 32% of fires were in the engine bay and truck cabin area
- 55% of engine bay and truck cabin fires were due to electrical failure
- The balance of failures were mainly due to wheel and tyre issues

The impact of these fires can far exceed the actual loss of the truck and trailer equipment and its load. The disruption, safety risk to drivers and the public and environmental damage can be wide ranging.

Given the trend in fire claims in the last 10 years, this series of documents looks at the major causes of truck and trailer fires, and how these fires can be reduced.

The guidance material is arranged in four parts.

Part 1 – Fire risk guide	A detailed look at causes of fires in truck and trailers
Part 2 – Drivers guide	What drivers can do to lessen the risk of fires
Part 3 – Maintenance guide	What maintenance staff and fleet controllers can do to prevent fires
Part 4 – Fire investigation guide	Advice on how to conduct a fire investigation

This document is Part 3: **Maintenance guide**
It includes a maintenace check list for both trucks and trailers, to help guard against truck fires.

All parts of this guide including the summary can be downloaded from www.artsa.com.au/fires

[1] See http://www.artsa.com.au/library/index.html
[2] See https://www.nti.com.au/news-resources/research/latest-report

2 General

Heavy vehicles experience significant levels of wear and tear, vibration and environmental impacts from weather and road debris. All of these factors can lead to an increased risk of fires. Thorough routine servicing and maintenance are fundamental to reducing the incidence of heavy vehicle fires.

3 Maintenance in more detail

Maintaining heavy vehicles in line with Original Equipment Manufacturers (OEM) requirements is an important preventative measure that identifies component failure, excessive wear and correct operation of vehicle systems at regular intervals. The OEM's often provide extensive guidance to assistance customers and body builders. This can usually be accessed by registering and logging on to their websites.

Appendix 1 includes a list of leading OEM Truck and Trailer Manufacturers and links to their websites.

Your Vehicle Owners Hand Book will include servicing guidance but you can also discuss your specific requirements with the OEM.

Any maintenance should start with reviewing the driver's feedback about potential issues and take action accordingly.

Regular maintenance will allow the mechanic to thoroughly inspect components and critical systems, which can be the source of heat generation or the cause of ignition. These areas include wheel bearings, brakes, electrical wiring and tyres.

Appendix 2 provides a generic vehicle maintenance inspection guide to assist in the prevention of fires in heavy vehicles. It includes a 40-point check list with details of what to check and the reasons why maintenance is required. These checks cover:

Prime mover and rigid trucks - covering 6 parts and 25 points of detail

- Engine Compartment
- Chassis
- Axles
- Under Chassis
- Rear Chassis
- In the Cabin

Trailers - covering 5 parts and 15 points of detail

- Chassis
- Axles
- Under Chassis
- Front Chassis
- Body

All of these checks are designed to not only reduce the risk of fire in trucks and trailers but are also critical to proper on-going maintenance of heavy vehicles.

Appendix 1 - Original Equipment Manufacturer (OEM) Body Builder Guidelines and Links

The OEM's often provide extensive guidance to assistance customers and body builders. This can usually be assessed by registering and logging on to the OEM's dedicated website.

	Original Equipment Manufacturer (OEM)	Web site link
	Truck Industry Council	https://www.truck-industry-council.org/
	Allison Transmission	http://allisontransmissionpublications.com/
	Cummins Engine	https://www.cummins.com.au/
	DAF	https://www.daf.com.au/services/bodybuilder-information/
	Dennis Eagle	http://www.dennis-eagle.com.au/
	Detroit Engines	https://www.penskeps.com/ https://dtnacontent-dtna.prd.freightliner.com/content/public/dtnaconnect---daimler-trucks-north-america.html
	Eaton Transmissions	http://www.eatoncorp.com.au/Oceania/ProductsServices/Vehicles/Literature/index.htm
	Freightliner Trucks	https://www.freightliner.com.au/ https://dtnacontent-dtna.prd.freightliner.com/content/public/dtnaconnect---daimler-trucks-north-america.html
	Fuso	
	Hino	https://www.hino.com.au/ https://www.hino.com.au/bodyworx/
	International	https://australia.internationaltrucks.com/
	Isuzu Trucks	https://www.isuzu.com.au/ http://body.isuzu.com.au/frmLogin.aspx

IVECO	Iveco Trucks	https://www.iveco.com.au/
KENWORTH	Kenworth	https://www.kenworth.com.au/contact-us/
MACK	Mack Trucks	https://www.macktrucks.com.au/ https://volvogroup.sharepoint.com/sites/coll-mack-bbm
MAN	MAN Trucks	https://man.com.au/
Mercedes Benz	Mercedes-Benz Trucks	https://www.mercedes-benz-trucks.com/en_AU/home.html https://bb-portal.mercedes-benz.com/
SCANIA	Scania	https://www.scania.com/au/en/home.html https://truckbodybuilder.scania.com
UD TRUCKS	UD Trucks	https://www.udtrucks.com/australia http://udbi.it.volvo.com/web/app.php/login/ud
VOLVO	Volvo Trucks	https://www.volvotrucks.com.au/ http://vbi.truck.volvo.com/index.php
WESTERN STAR TRUCKS	Wester Star Trucks	https://westernstar.com.au/ https://dtnacontent-dtna.prd.freightliner.com/content/public/dtnaconnect---daimler-trucks-north-america.html

Appendix 2 -
Check lists and guide for maintenance staff

This appendix includes a generic vehicle maintenance inspection guide to assist in the prevention of fires in heavy vehicles. It includes a 40-point check list with details of what to check and the reasons action is needed. These checks cover:

Prime mover and rigid trucks - covering 6 parts and 25 points of detail:

1. Engine Compartment
2. Chassis
3. Axles
4. Under Chassis
5. Rear Chassis
6. In the Cabin

Trailers - covering 5 parts and 15 points of detail:

1. Chassis
2. Axles
3. Under Chassis
4. Front Chassis
5. Body

All of these checks are designed to not only reduce the risk of fire in trucks and trailers but are also critical to proper on-going maintenance of heavy vehicles. They should be included as part of the regular maintenance scheduling of your heavy vehicles.

Maintenance check list

Prime mover and rigid trucks

1. Engine & compartment, and includes auxillary engines if applicable

Item	Inspection Feature	Requirements / Explanations	Reasons for Maintenance Action
1.	Alternator positive cable integrity.	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. Notes: Rubber block type clamps are preferred. Hot terminals can occur on both positive and negative cables. Stacked ring terminal at the stud on the alternator must sit flat and be tight. Note if there is no circuit breaker protection for this cable. AS 2809.2:2020 Dangerous Goods does not mandate a circuit breaker; however, safe practice requires one. Without a circuit breaker, this cable is especially vulnerable.	1. The terminals at the alternator are loose or corroded. 2. The positive cable is resting against a metal bracket. 3. A metal spined clamp has a missing, cut or misplaced rubber insert. 4. The terminals at the far end of the alternator cables are loose, corroded or the crimp ends are close to chassis metal. 5. The number of stacked ring terminals at a stud exceeds three. 6. Cables are unrestrained in the engine compartment and could move around. 7. The alternator cable is not tied down in the engine compartment to prevent fouling. 8. 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.
2.	Alternator terminal integrity.	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.	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 nut) on each main alternator terminals. 4. The field terminals are loose or insulation from the alternator body is missing.
3.	Alternator cleanliness.	The alternator contains live electrical parts. Build-up of dust, oil, grains, could result in tracking faults. Blow the alternator out with compressed air.	1. The alternator is dirty or clogged when viewed through the cooling vents in the body. 2. Colouring of metal (i.e. due to high temperature) exists at the bearing housings.
4.	Starter motor positive cable integrity.	The starter motor cable runs directly to the isolation switch. This thick main cable cannot be bent sharply, so it is vulnerable to rubs when in confined spaces, such as at the starter motor. On some 12V trucks the starter motor is duplicated, which makes for more crowding. Note: rubber block type compression clamps to fix the cables are preferred. It can be difficult to inspect cables under the cabin.	1. A positive starter cable is rubbing on the chassis rail near the starter motor. 2. The positive terminal is loose at the starter motor. 3. Crimp ends on the positive cable at the starter motor or isolation switch come close to chassis metal or other terminals. 4. The cable insulation is rubbing against metal. 5. Metal spined clamps for the positive cable have missing, damaged or misplaced rubber inserts.
5.	Starter motor terminal integrity.	The starter motor terminals are difficult to see in-situ and it may require a photograph to reveal detail. The terminals must be tight and the ring terminals on cables must be sitting flat. Both positive and negative terminals are vulnerable. The terminals should be clean so that tracking (electrical conduction via surface contamination) cannot occur. It is advisable but not mandatory to have a plastic/ rubber boot over the positive terminal.	1. A terminal is loose. 2. A nut retention mechanism (spring washer, castellated washer, plastic-insert nut) is not provided. 3. Stacked ring terminals on the positive terminal are not separated and can interfere. 4. Ring terminals should not be stacked on the positive terminal. 5. The starter motor is covered in oil and grease, or otherwise dirty. 6. Ensure all terminals and cabling are refitted after a starter motor replacement.

Item	Inspection Feature	Requirements / Explanations	Reasons for Maintenance Action
6.	Cabin power supply cables integrity	The cabin power supply cables can come from the starter motor or from the isolation switch / battery. Some trucks have stud terminals that go through the firewall or the front of the cabin. The power supply terminal studs are a point of vulnerability. It is good practice to have plastic/rubber boots on both ends of a positive panel-stud.	1. Cables are rubbing on chassis metal. 2. A terminal is loose. 3. A nut retention mechanism (spring washer, castellated washer, plastic-insert 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 either the engine or cabin side of the power stud.
7.	Turbocharger oil line integrity.	Most diesel engines have turbochargers. Because the turbocharger spins at extreme speed, 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.	1. Evidence of oil leakage on the turbocharger or exhaust manifold exists (burnt oil produces black stains).
8.	Hydrocarbon fluid containment	Only the exhaust manifold, turbocharger and the exhaust pipe become hot enough to ignite diesel fuel, engine oil, transmission oil, steering fluid, brake fluid, propane refrigerant (non-standard) or glycol coolant. On its own the block temperature is insufficient to cause ignition. The exhaust-side of the engine is the most vulnerable. Whilst 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. Be aware that large diesel engines have a fuel return line.	1. Evidence of hydrocarbin fluid leaks on the exhaust side of the engine. 2. Fuel leaks from the fuel cooler at the front of the engine. 3. Leaking oil fitting on the transmission. 4. Glycol powder on the top tank or at top front of the engine. 5. Check condition of rubber or silicone coolant & heater hoses as these can burst or leak onto the exhaust and turbo. 6. Loose clamping of the high-pressure fuel tubes on the engine. 7. Evidence of vibration damage (scrapping or cracks) on the high-pressure fuel tubes. 8. Fuel leaks from the low-pressure hoses, filter housing or water separator. 9. Evidence of oil/fuel soaked insulation and lagging. 10. Check condition of hydraulic clutch hoses for signs of degradation or cracking 11. Check condition of power steering lines for signs of degradation or cracking
9.	Electrical system integrity.	There may be an electrical fuse and relay box in the engine compartment. The components should be inspected carefully for signs of damage or distress. 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.	1. The wire has blackened insulation at a terminal. This indicates terminal heating. 2. Insulation on a wire has cracked or there is exposed metal electrical cable. 3. A screw terminal is loose. 4. An electrical relay plastic case has blackened close to a terminal. 5. Ring terminals on a terminal are not sitting flat, 6. There are more than 3 ring terminals on one terminal post. 7. A wires can be easily pulled out of a crimp terminal. 8. A fuse or circuit breaker has operated.
10.	Engine drive belt integrity	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 of hoses drape and rub against the drive belts, heating and potentially fire could occur.	1. Drive belts are not tight and could slip. 2. Metal, electrical looms or hoses are rubbing, or could plausibly rub on a drive belt.

2. Chassis

Item	Inspection Feature	Requirements / Explanations	Reasons for Maintenance Action
11.	Exhaust system component clearance	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. Make allowance that the engine and the exhaust pipe can move when operating. Also check the exhaust behind the engine compartment.	1. Combustible material is within 150 mm of an unlagged exhaust pipe. 4. Combustible material is within 100mm of a lagged exhaust pipe. 5. Combustible material is not restrained close to an exhaust pipe. 6. A flexible steel (spiral) section of an exhaust pipe is damaged and exhaust gas is escaping. 7. A steel clamp that holds exhaust pipe sections tightly together is loose.
12.	Isolation switch integrity	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 night light and 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 situation.	1. A terminal is loose. 2. A nut retention mechanism (spring washer, castellated washer, plastic-insert nut,) is not provided on each terminal. 3. Stacked ring terminals on the positive terminal are not separated and barrels are interfering. 4. Stacked ring terminals on the positive terminal are close to earthed metal. 5. Assuming the switch is behind the cabin, the positive terminals are covered / insulated by plastic / rubber covers or boots. 6. There is no evidence that the alternator field winding is cut by the isolation switch.
13.	Battery box condition.	The battery cables are vulnerable because they have no circuit breaker protection. They loop around in the battery box between the four (usual) batteries. Cable rubs against metal are a high risk. Very rarely batteries explode because of the build-up of internal gas (hydrogen). If a conductive path breaks, a spark will occur and an explosion is possible. Sparking equipment, such as contactors, relays or solenoids.	1. A cable terminal on a battery post is close to a hold-down metal. 2. Battery posts are sitting under an exposed metal lid. Interior insulation is required. 3. A battery cable is sitting on or against a bolt thread. 4. Battery cable insulation is sitting on another cable and divots in insulation can be observed. 5. The batteries are loose. 6. The batteries are dirty. They are covered in road debris, organic trash, oil, …. 7. Batteries have swelled. The top and sides are bulging. 8. The battery-box cover is loose or not well retained. 9. Equipment capable of sparking, such as relays, contactors or fuses are installed in the battery box and are not inside a junction box.
14.	Static line for AS2809 dangerous goods vehicles.	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. If an electrical resistance test is conducted, the resistance should be calculated from the measured voltage when a current of 10A (minimum) is passed between the clamp end of the reel and a point located on the tank (if applicable) or otherwise on the chassis rail on the opposite side to the side of the static reel.	1. The electrical connection between the static earth reel and the chassis metal is or could be 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 0.5 ohm.

3. Axles

Item	Inspection Feature	Requirements / Explanations	Reasons for Maintenance Action
15.	Tyre and wheel integrity	Friction rubs can cause the tyre rubber to 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. 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 tryes rubbing on metal because the air suspension requires further time to fully inflate.	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. 4. A tyre sidewall has a deep cut or has a localised bulge. 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 has failed. The tyre is rubbing on the mudguard. 8. Suspension height is not correct causing the tyre to rub on the mudguard.
16.	Wheel hub Integrity	The hub must not have impact damage or signs of high temperatures. 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 choked and on level ground beforehand. Do not get underneath whilst the vehicle is lifted. Leaking hub seals can result in fire at a disc or drum brake.	1. The hub cap and / or hub has mechanical damage. 2. The paint on the hub has changed colour indicating a heat point. 3. When each wheel is lifted, spun and shaken, free play exists or the wheel does not rotate freely (investigation of the bearing condition is needed). 4. Bearing grease or oil is leaking from the hub. 5. Evidence exists that the vehicle has gone through hub-high water.
17.	Suspension Integrity	Most vehicles now have airbag suspensions. Some systems have one levelling valve and some 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. 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.	1. The clearance between a tyre and a fixed feature is less than 100mm when the vehicle is loaded. The suspension is not at correct ride height. 2. The suspension is leaning off vertical when loaded.

4. Under Chassis

Item	Inspection Feature	Requirements / Explanations	Reasons for Maintenance Action
18.	Electrical system mechanical protection	The electrical system behind the cabin must have mechanical protection equivalent to a conduiting standard. Cable entry into lamps should be conduited. Lamp housing should not be cracked. Wiring should be tied up every 1200mm or less.	1. A lamp housing is cracked. 2. Wiring is draping. 3. Wiring is not protected by either a closed conduit or by an approved cable type. 4. Grounding of a lamp is not correct and not displaying the correct operation.
19.	Integrity of hydraulic hoses and fuel lines.	Hydraulic hoses, fuel hoses, and fittings that are close to the exhaust pipe. Very occasionally swagged-end hoses fail and the hose comes out of the end fitting. If this results in a spray of oil or fuel onto the exhaust pipe, a fire will occur.	1. A hydraulic oil line is located close to an exhaust pipe (but further than 150 mm away), and oriented so it will squirt hydraulic fluid onto the exhaust pipe if the hose comes out of the end fitting. 2. A fuel line is located close to an exhaust pipe (but further than 150 mm away), and oriented so it will squirt fuel onto the exhaust pipe if the hose comes out of the end fitting. 3. A fuel tank fitting is leaking. 4. An under-tank fuel line fitting or tap is vulnerable to road-strike.

20.	Integrity of brake components.	Dragging brakes can cause the brake drum or brake disc to experience extreme temperature. This might result in the bead of the tyre catching fire or the oil seals on the inside of the hub to leak oil. Dragging brakes can result from road strike causing mechanical damage to an actuator. Sticky air valves that do not allow the spring brake pressure to build-up or return springs on drum brakes that are missing.	1. An actuator or a slack adjuster has mechanical damage from road strike. 2. Spring brakes release very slowly (taking much more than 1s to release when the air tanks are charged). 3. The vehicle was fitted with brake return springs, but one is missing. 4. A brake actuator is located below axle level and no mechanical shield is provided
21.	Integrity of auxiliary power systems.	An auxiliary power system for pumping etc., could be fitted to the truck. This could have a drive belt and a hydraulic motor. For vehicles that cart non-flammable materials, an auxiliary internal combustion engine could be used. An auxiliary power system for pumping or cab cooling etc., could be fitted to the truck. Icepacks have fuel lines added into the truck fuel tank and could provide another leak source. Also these lines could be mounted close to the exhaust components or rub points.	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 is closer than 150 mm to combustible material, unless it is shielded or lagged. 4. A lagged or shielded exhaust is closer than 100 mm to combustible material.

5. Rear Chassis

Item	Inspection Feature	Requirements / Explanations	Reasons for Maintenance Action
22.	Integrity of trailer electrical plug connections.	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.	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 some heat marks (‘blueing’). 6. An ‘Anderson Plug’ is used. Note: This open style plug is not acceptable under AS 2809: 2020.
23.	Trailer brake coupling integrity.	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, or drag.	1. The brake connections are dirty. 2. The brake connections do not lock reliably when pushed into the mating trailer connector.

6. In the Cabin

Item	Inspection Feature	Requirements / Explanations	Reasons for Maintenance Action
24.	Electrical integrity generally.	There will be an electrical fuse and relay box in the cabin. The components should be inspected carefully for signs of damage or distress. 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. For example, check lighting. 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. Check that the lighting functions are all working.	1. The wire has blackened insulation at a terminal. This indicates terminal heating. 2. Insulation on a wire has cracked or there is exposed metal in the electrical cable. 3. A screw terminal is loose. 4. An electrical relay plastic case has blackened close to a terminal. 5. Ring terminals on a terminal are not sitting flat, 6. There are more than 3 ring terminals on one terminal post. 7. Wires can be easily pulled out of a crimp terminal. 8. A fuse or circuit breaker has operated. 9. A function is not working when the control is on. 10. If the incoming power stud can be inspected, the terminal is loose or had no retention mechanism (spring washer castellated washer or plastic-insert nut) 11. There is no rubber boot or other insulation protecting the incoming positive stud terminal. 12. A main positive cable is rubbing on earthed metal in the vicinity of the positive stud.

Maintenance check list

Trailer Checklist

1. Chassis

Item	Inspection Feature	Requirements / Explanations	Reasons for Maintenance Action
1.	Integrity of the static electricity reel on AS2809 dangerous goods tankers.	Static electricity build-up leading to sparking is an ever-present danger on tankers carrying flammable liquids or gases and organic dust and grains. 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. If an electrical resistance test is conducted, the resistance should be calculated from the measured voltage when a current of 10A ac or dc (minimum) is passed between the clamp end of the reel and a point located on the tank (if applicable) or otherwise on the chassis rail on the other side from where the static reel is installed.	1. The electrical connection between the static earth reel and the chassis metal is or could be corroded. 2. The earth strap between the tank and the chassis metal is missing or is corroded. 3. The electrical resistance between the end of the static reel and the chassis metal at a distance location is greater than 0.5 ohm.

2. Axles

Item	Inspection Feature	Requirements / Explanations	Reasons for Maintenance Action
2.	Tyre and wheel integrity.	Friction rubs can cause a tyre rubber to catch fire. Check that the tyres are correctly inflated and without sidewall tears or bulges. Look for signs (scuffing) that the tyres have been rubbing on metal brackets or against the mudguard or against each other. 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.	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. The tyre has been rubbing on a fixed feature. 4. A tyre sideway has a deep cut or has a localised bulge. 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 has failed. The tyre is rubbing on the mudguard. 8. Suspension height is not correct causing the tyre to rub on the mudguard

3.	Wheel hub Integrity.	The wheel hub must not have impact damage or high temperatures markings. 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 choked and on level ground beforehand. Do not get underneath whilst the vehicle is lifted. Leaking hub seals can result in fire at a disc or drum brake.	1. The hub cap and / or hub has mechanical damage. 2. The paint on the hub has changed colour indicating a heat point. 3. When each wheel is lifted, spun and shaken, free play exists or the wheel does not rotate freely (investigation of the bearing condition is needed). 4. Bearing grease or oil is leaking from the hub. 5. Evidence exists that the vehicle has gone through hub-high water (the bearing lubrication must be refreshed).
4.	Suspension integrity.	Most vehicles now have airbag suspensions. Some systems have one levelling valve and one 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. 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 spiring leaf may result in the vehicle leaning.	1. The clearance between a tyre and a fixed feature is less than 100mm when the vehicle is loaded. The suspension is not at correct ride height. 2. The suspension is leaning off vertical when loaded.

3. Under Chassis

Item	Inspection Feature	Requirements / Explanations	Reasons for Maintenance Action
5.	Electrical system mechanical protection.	The electrical system must have mechanical protection equivalent to a conduiting standard. Cable entry into lamps should be conduited. Lamp housing should not be cracked. Wiring should be tied up every 1200mm or less.	1. A lamp housing is cracked. 2. Wiring is draping. 3. Wiring is not protected by either a closed conduit or by an approved cable type. 4. Electrical connectors, if used do not have water seals. 5. Grounding of a lamp is not correct and not displaying the correct operation.
6.	Integrity of brake components.	Dragging brakes can cause the brake drum or brake disc to experience extreme temperature. This might result in the bead of the tyre catching fire or the oil seals on the inside of the hub to leak oil. Dragging brakes can result from road strike that can cause mechanical damage to an actuator, or sticky air valves that may cause the spring brake pressure to build-up.	1. An actuator or a slack adjuster has mechanical damage from road strike. 2. Spring brakes release very slowly (taking much more than 1s to release when the air tanks are charged). 3. The vehicle was fitted with brake return springs, but one is missing. 4. A break actuator is located below axle level and no mechanical shield is provided.

4. Front Chassis

Item	Inspection Feature	Requirements / Explanations	Reasons for Maintenance Action
7.	Integrity of trailer electrical plug connections.	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. Internal inspection of the plug and socket is not required.	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 some heat marks ('blueing'). 6. An 'Anderson Plug' is used. This open style plug is not acceptable under AS 2809.

8.	Trailer brake coupling integrity.	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, or drag. The trailer brake couplings must be separated to allow this inspection.	1. The brake connections are dirty. 2. The brake connections do not lock reliably when pushed into the mating trailer connector.

5. Body

Item	Inspection Feature	Requirements / Explanations	Reasons for Maintenance Action
9.	Structural integrity and unsafe movements. Trailers with a load platform.	If the trailer has a platform that is free to move sideways in support brackets (such as a mezzanine deck), the movement could generate rubbings that might fall onto sensitive freight below. The rubbings will be hot due to friction. Accumulation of rubbings on top of combustible packaging might cause a fire. Structural defects in the trailer load frame can be a potential failure point and in rare cases, a spark generator. Structural cracks are often observed in, for example, uprights on open-sided trailers.	1. Evidence of rubbings underneath support locations for load platforms or structural elements that are intended to be retained but allowed to move. 2. Evidence of structural defects at support locations and in uprights supporting.

6. Auxillary Engines

Not all trailers have auxillary engines. For those that do, these imems apply.

Item	Inspection Feature	Requirements / Explanations	Reasons for Maintenance Action
10.	Electrical system integrity.	There may be an electrical fuse and relay box on the trailer. The components should be inspected carefully for signs of damage or distress. 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. Check for example lighting. Check that the lighting functions are all working.	1. The wire has blackened insulation at a terminal. This indicates terminal heating. 2. Insulation on a wire has cracked or there is exposed metal electrical cable. 3. A screw terminal is loose. 4. An electrical relay plastic case has blackened close to a terminal. 5. Ring terminals on a terminal are not sitting flat, 6. There are more than 3 ring terminals on one terminal post. 7. Wires can be easily pulled out of a crimp terminal. 8. A fuse or circuit breaker has operated. 9. A function is not working when the control is on. 10. If the incoming power stud can be inspected, the terminal is loose or had no retention mechanism (spring washer castellated washer or plastic-insert nut) 11. A main positive cable is rubbing on earthed metal.
11.	Integrity of hydraulic hoses and fuel lines.	Hydraulic hoses, fuel hoses fittings that are close to the exhaust pipe. Very occasionally swagged-end hoses fail and the hose comes out of the end fitting. If this results in a spray of oil or fuel, a hazard could occur, particularly if the trailer has an auxiliary power system.	1. A hydraulic oil line is located close to an exhaust pipe (but further than 150 mm away) on an auxiliary power plant, and oriented so it will squirt hydraulic fluid onto the exhaust pipe if the hose comes out of the end fitting. 2. A fuel line is located close to an exhaust pipe (but further than 150 mm away) of an auxiliary power plant, and oriented so it will squirt fuel onto the exhaust pipe if the hose comes out of the end fitting. 3. A fuel tank fitting for an auxiliary power plant is leaking. 4. An under-tank fuel line fitting or tap is vulnerable to road-strike.
12.	Integrity of auxiliary power systems.	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. Internal inspection of the plug and socket is not required. However, all the electrical plugs and sockets must be separated this inspection.	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 some heat marks (‘blueing’). 6. An ‘Anderson Plug’ is used. This open style plug is not acceptable under AS 2809.

13.	Isolation switch integrity. If applicable. An isolation switch may not be fitted to the trailer.	If the trailer has a battery box, it should have an isolation switch. Check that isolation switch disconnects all trailer circuits that are supplied from the trailer battery.	1. Operation of the isolation switch does not turn off all electrical functions. 2. A terminal is loose. 3. A nut retention mechanism (spring washer, castellated washer, plastic-insert nut) is not provided on each terminal. 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.
14.	Battery & battery box condition. Note. A battery may not be fitted to the trailer.	Some trailers have a battery box to supply auxiliary functions on the trailer. The battery cables are vulnerable because they have no circuit breaker protection. They loop around in the battery box. Cable rubs against metal are most risky. Very rarely batteries explode because of the build-up of internal gas (hydrogen). If a conductive path breaks, a spark will occur and an explosion is possible. Sparking equipment, such as contactors, relays or solenoids should be enclosed in a sealed junction box.	1. A cable terminal on a battery post is close to a hold-down metal. 2. Battery posts are sitting under an exposed metal lid. Interior insulation is required. 3. A battery cable is sitting on or against a bolt thread. 4. Battery cable insulation is sitting on another cable and divots in insulation can be observed. 5. The batteries are loose. 6. The batteries are dirty. They are covered in road debris, organic trash, oil, …. 7. Batteries have swelled. The top and sides are bulging. 8. The battery-box cover is loose or not well retained. 9. Equipment capable of sparking, such as relays, contactors or fuses are installed in the battery box and are not inside a junction box

Appendix 3 - Hose clamps

A common cause of hoses failing is the over tightening of hose clamps. Unless specified otherwise, a traditional clamp should only be torqued by hand (never using a ratchet devise) to about 3.5-4.5Nm. Any tighter than this could damage the integrity of the screw mechanism as well as damage to the hose under the clamp. Choose hose clamps that are not too large for the job to avoid the temptation to use a ratchet tool, a few turns of the nut with a screwdriver should be all you need to get the correct tightness.