NATIONAL
HEAVY
VEHICLE
REGULATOR

Heavy Vehicle Purchasing Guide

Part of the NHVR's Vehicle Safety and Technology Uptake Plan (Vehicle SETUP)

NHVR

Contents

PREFACE

In a positive move towards road safety, vehicle-based technologies are developing faster than regulations. This means that the adoption of these technologies remains voluntary and without an overarching, nationally recognised, 'minimum required' standard it can be difficult to know which systems could be fitted in preference to others. This document sets out to guide vehicle buyers and contract managers to consciously consider the safety risks associated with the specific tasks they are carrying out and which technologies will help to reduce the likelihood and severity of on-road incidents.

This guide looks at what technologies are available, providing a simplified overview of their function. This information is not designed to give an extensive or detailed account of the technical working of every available safety technology but rather a starting reference that will assist vehicle buyers when making purchasing decisions.

Purchasing a vehicle, be it a new vehicle or upgrading to a newer vehicle, is a significant investment for many operators. This guide provides an introductory level of guidance regarding vehicle features that may assist operators in making purchasing decisions based on safety requirements over and above purely operational considerations.

The material included is designed to assist general vehicle operators, fleet operators, project managers and others who purchase or influence vehicle purchasing decisions, to purchase safer vehicles. Included is general information that explains safety technologies, how they work and when they may be of benefit. This document forms the foundation for a series of documents focused on specific industry sectors and applications with the view to help identify beneficial technologies.

INTRODUCTION

As the national authority on heavy vehicles and heavy vehicle safety, the NHVR is in a unique position to provide a simple overview of what each safety technology does and give guidance to the industry about which safety features they should look for in a heavy vehicle. Furthermore, it is hoped that developing a single recommended national safety package for some sectors could allow referencing of a consistent specification by those entering into contracts with those sectors.

Guides and policies that set out the minimum safety features a vehicle should include are nothing new, with state and territory authorities using fleet policies for their light vehicle fleet for years. Contracts containing a fleet purchasing policy are used to outline requirements beyond those regulated, that a vehicle must have to be eligible to be used for that contract. The benefit of these policies is that they allow organisations to lead by setting a higher level of safety for the vehicles used. Once vehicles are finished their fleet life, these vehicles are on sold and improve the level of safety in the general fleet.

New – Vs – Newer vehicles

It must be recognised that to get the most benefit from the technologies described in this document, the purchase of the latest model offering may be required. That said, there is still significant benefit for operators in considering upgrading vehicles to newer models.

Newer vehicles will likely have more safety features and technologies than the older vehicle they replace, improving the safety of the heavy vehicle fleet.

When purchasing a used vehicle, care should be taken to ensure that the vehicle is fitted with any specific technologies required as technologies mentioned in this document may not be fitted as standard. This may change as certain technologies become mandatory.

Risk Management = incident avoidance/severity reduction

The overarching goal of this guide is to improve the understanding of available safety technologies and how they can reduce the number and severity of heavy vehicle incidents. Not every freight task faces the same risks - by understanding the unique risks associated with each task and matching these with the right safety technologies and features, operators can realise the biggest safety improvement for their investment.

Vehicle safety technologies are one tool that can be used to ensure the safety of transport activities and should be considered by those in the chain of responsibility. Selecting vehicles with appropriate safety technologies will help to reduce heavy vehicle incidents.

Safety is not *'set and forget'* and for safety technologies to have a tangible impact on the safe operation of the heavy vehicle industry, it is imperative that they be incorporated into a holistic safety management system (SMS). Information about SMSs is available on the NHVR's website at https://www.nhvr.gov.au/sms

Technologies alone will not operate to their full capacity without driver training and engagement or without a supportive SMS.

It is important that operators are aware of the technologies fitted to their vehicles, how they work and what the information received from them means.

Understanding and using these systems to their full capacity assists operators in the monitoring and assessment of their transport activities and provide them with a suite of tools that support their primary duties. Check out the NHVR guidance on risk management in the heavy vehicle industry.

Safer Freight Vehicles

At the time of publication, several changes to the Australian Design Rules (ADRs) have been proposed. The proposed package of amendments, referred to as the Safer Freight Vehicle (SFV) reforms, are the first step in mandating some of the technologies discussed in this document. In exchange for the fitting of an approved technology package, SFVs will be granted increased overall width. The SFV technology package for heavy motor vehicles is set to include:

- Additional Indirect Vision Devices (IVD),
- Electronic Stability Control (or ESC),
- Advanced Emergency Braking (AEB),
- Lane Departure Warning Systems (LDWS),
- Blind Spot Information Systems (BSIS),
- Side Underrun Protection (SUP),
- Conspicuity markings.

VEHICLE BASED SYSTEMS AND TECHNOLOGIES

The section intends to give a very general overview of the technologies currently available in the market. The terms used are the most common names given to these systems however, it is important to note that different suppliers may brand their systems with a slightly different name. A good example of this is adaptive cruise control where there are currently more than 20 different names for these systems including adaptive, autonomous, active, intelligent, and dynamic cruise control. These systems all provide a similar safety outcome by performing the task in a slightly different way or by another name.

> ***Note***: The technologies listed below are grouped by function and not by preference. Many of these technologies are yet to be mandated in Australia, this means that they may be produced or certified to an international, or equivalent, standard.

Where available, the document identifies *standards to consider,* these are existing standards that apply either domestically or internationally. It is important to select technologies that meet the technical requirements of available standards, doing so gives confidence that the technology will perform as expected and meet any conditions identified by the regulator.

Readers are encouraged to make their own enquiries about the technologies and possible standards to ensure the suitability of the system for their specific circumstances.

Visibility and Road Presence

Blind Spot Monitoring

What it is & how it works

Blind Spot monitoring systems range in complexity from simple options such as adding extra mirrors to more complex camera and sensor systems that provide a bird's eye view of the vehicle and pretty much everything in between.

Blind Spot monitoring is generally achieved by fitting Indirect Vision Devices (IVDs) or Blind Spot Information Systems (BSIS).

IVDs are typically mirrors or cameras that show the driver a real-time image of the area being monitored. IVDs are commonly described as a 'Class' of device, for example, a Class V IVD shows the area next to the passenger-side front door of a vehicle. Common classes of IVDs for heavy vehicles are Classes II, IV, V and VI.

BSISs use sensors to detect and increase the driver's awareness of vulnerable road users (VRU) by way of alarms and lights but not necessarily images.

Drivers may have increased awareness of the areas directly adjacent to the vehicle by camera feed to a screen in the cabin or an audible warning alerting them to the presence of a vulnerable road user.

Benefits

- Improved visibility for the driver
- Increased safety outcomes for vulnerable road users.

Best application

- Vehicles operating in metropolitan and urban areas

Standards to consider

- **IVD's:** ADR14 Rear Vision Mirrors or UNECE R46 - Uniform provisions concerning the approval of devices for indirect vision and of motor vehicles with regard to the installation of these devices
- **BSIS:** UNECE R151 Uniform provisions concerning the approval of motor vehicles with regard to the Blind Spot Information System for the Detection of Bicycles, or UNECE R159 Uniform provisions concerning the approval of motor vehicles with regard to the Moving Off Information System for the Detection of Pedestrians and Cyclists

Direct vision

While blind spot monitoring has the potential to improve safety, an often-overlooked aspect of vehicle selection is the amount of visibility directly available to the driver.

Vehicles with higher visibility designs such as low entry floors, vehicles fitted with additional windows to the lower part of doors, extending the windscreen and even bonneted vs cab over designs can make a significant difference in what the driver can see outside the cabin.

Standards to consider

- ADR 93 – Forward Field of View
- UNECE R125 Uniform Provisions Concerning the Approval of Motor Vehicles with Regard to Their Direct Vision

Conspicuity Marking

What it is & how it works

Conspicuity markings are retroreflective materials placed on the edges of a vehicle to make them stand out. They improve the ability of other road users to identify the outer edges of a heavy vehicle in low light. Markings may be full or partial contour or stripe style.

Other road users and drivers will be more readily able to identify the overall size of other vehicles on the road.

Benefits

- Added visibility of vehicle in low light

Best application

- All vehicles

Standards to consider

- ADR13 - Installation of Lighting and Light-signalling Devices on other than L-Group Vehicles
- ADR47 – Retroreflectors

Left Turn Alarm

What it is & how it works

Left turn alarms work by emitting an audible warning that the vehicle is about to turn left. These systems are generally linked to the vehicle's left indicator and may include a flashing light, they draw the attention of vulnerable road users (VRU) and alert them to the intended vehicle movement. Left turn alarms may sound a tone (similar to a reversing alarm) or may audibly repeat a warning that the vehicle is turning left and advise the VRU to "stand clear".

Benefits

- Alerts vulnerable road users to the intended movement of the heavy vehicle

Best application

- Vehicles operating in metropolitan and urban environments

Standards to consider

- ADR 94 – Audible Warning

Braking, Stability and Road Position

Electronic Braking Systems (EBS)

What it is & how it works

EBS* is a broad term used to describe a braking system that uses an electronic system to signal the brakes to apply, rather than the traditional air-signalled brake systems. Vehicles fitted with an EBS are sometimes also referred to as having a "smart" braking system. These systems may incorporate a variety of advanced functions such as:

- Anti-lock braking systems (ABS)
- Autonomous emergency braking (AEB)
- Electronic stability control (ESC)
- Traction Control.

*When EBS is used on a trailer it is called TEBS.

> ***Note***: Vehicles may be fitted with some of the above features without the vehicle being fitted with EBS.

Trailer Electronic Braking Systems (TEBS)

What it is & how it works

TEBS is a broad term used to describe a trailer braking system that uses an electronic system to apply the brakes, rather than the traditional air-controlled brake systems.

These systems may use sensors to improve the braking and stability of the combination. The system can also be set to record events or interventions, providing history to workshops and fleet managers and in some cases, real time warnings to the driver.

These systems may incorporate a variety of advanced functions such as:

- Anti-lock braking systems (ABS)
- Roll stability control (RSC)
- Traction Control.

Standards to consider

- ADR 38 —Trailer Brake Systems

> ***Note***: Trailers fitted with TEBS do not require the towing vehicle to be fitted with EBS in order to work, provided the tow vehicle is fitted with the appropriate plug that supplies power to the trailer's ECU.

Anti-lock Braking System (ABS)

What it is & how it works

Anti-lock braking systems (ABS) use the vehicle's braking system to improve directional (steering) control under braking, by reducing wheel lock-up in heavy braking scenarios.

In simplest terms, once the brakes on a vehicle lock up the brakes do not slow the vehicle and steering the vehicle in the direction intended is prevented. Traditionally, to optimise braking and maintain steering, drivers would rapidly apply and release braking via the brake pedal in the vehicle. With the introduction of ABS, sensors detect when a vehicle's wheels achieve lock-up and automatically 'pulse' the brakes. This generally happens faster than a driver can react and gives the driver more attention to devote to other inputs such as steering.

Drivers will not notice any changes to the braking performance prior to wheel lock-up but will notice a warning light on the dash and may notice a small amount of feedback that is described as a 'shudder' as the ABS rapidly cycles the brake application.

Benefits

- Reduced stopping distance under heavy braking situations where lock up occurs
- Improves directional control under heavy braking situations where lock-up occurs

Best application

- All vehicles operating in all conditions.

Standards to consider

- ADR 35 - Commercial Vehicle Brake Systems
- ADR 38 - Trailer Brake Systems

Advanced Emergency Braking (AEB)

What it is & how it works

Advanced Emergency Braking (AEB) systems identify possible hazards and helps the driver avoid them. These systems operate when the vehicle is travelling at speeds above 15 km/h. Some systems will operate at lower speeds and are known as Forward Collision Mitigation (FCM) systems.

By using information gathered from sensors, such as radar, cameras, or a combination of both, AEB detects and alerts the driver to a potential hazard directly in front of the vehicle. This alert will be both a visual and audible warning. If the driver does not act to avoid the hazard (i.e., brakes or steers around the object), AEB will apply the brakes of the vehicle and reduce the engine power. This will help to either prevent the incident or reduce the severity of the incident.

The AEB system typically works best when combined with other systems like ABS, ESC and RSC to assist the driver control the vehicle during an emergency braking manoeuvre. ABS, ESC and RSC may be required for the AEB to operate as intended.

AEB is an assistive technology and does not replace the driver's responsibility to remain in control of the vehicle. AEB simply alerts the driver of a potential collision detected and intervenes if the driver does not.

Benefits

- Detect hazards in low light and greater distances than are visible to the driver
- Faster reaction in emergency situations = shorter stopping distance
- Will engage if driver distracted or unable to react

Best application

- Vehicles operating in metropolitan and urban areas
- Vehicles operating on highways

Standards to consider

- ADR97 – Advanced Emergency Braking for Omnibuses, and Medium and Heavy Goods Vehicles
- UNR131 Uniform provisions concerning the approval of motor vehicles with regard to the Advanced Emergency Braking Systems (AEBS)

Electronic Stability Control (ESC)

What it is & how it works

Electronic Stability Control (ESC) is an advanced braking feature on motor vehicles designed to help maintain steering control and to avoid vehicle rollover. When fitted to a motor vehicle, ESC includes both roll prevention and direction control functions.

ESC systems use information gathered from other vehicle systems and sensors to help maintain steering control and grip under harsh braking, cornering, and evasive manoeuvres.

Directional control

ESC systems help a driver maintain the direction of a motor vehicle. The system does this by monitoring sensors throughout the truck that show what direction the vehicle is travelling and compares this to the steering inputs given by the driver. When there is a mismatch between input and actual direction, the ESC system applies the brakes to individual wheels, to bring the vehicle back on course.

Stability Control

ESC helps to prevent rollovers by monitoring a number of factors like vertical tyre loads, sideways (lateral) acceleration and wheel speeds. When the system determines there is a risk of a vehicle rolling over, it will systematically apply the brakes on specific wheels or axles and/or by decreasing engine power and engaging engine braking. For combinations towing late model trailers, the truck may also apply trailer brakes.

When ESC activates, drivers may notice a warning light on the instrument panel, a sudden drop in power or an increase in braking.

Benefits

- Improved directional control in emergency and extreme conditions
- Reduced risk of vehicle rollover

Best application

- Particularly beneficial for vehicles with a high centre of gravity
- Vehicles where the load is likely to shift while in transit (i.e., fluids in tankers, livestock etc.)
- Vehicles operating in all road conditions

Standards to consider

- ADR 35 - Commercial Vehicle Brake Systems
- UNECE R13 Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to braking

Roll Stability Control (RSC)

What it is & how it works

Roll Stability Control (RSC) is an advanced braking system on trailers designed to help to avoid a vehicle rollover.

RSC systems use information gathered from other vehicle systems and sensors to help maintain grip under harsh braking, cornering, and evasive manoeuvres.

RSC systems use information gathered from vehicle systems, such as vertical tyre loads, sideways (lateral) acceleration and wheel speeds, to detect rollover risk. When the system activates, it will systematically apply the brakes on specific wheels or axles.

When RSC activates, drivers may notice a warning light on the instrument panel and vehicle braking.

Benefits

- Decreased wheel lift
- Helps reduce the possibility of vehicle rollover when cornering speed is too high or in emergency and extreme conditions

Best application

- Particularly beneficial for vehicles with a high centre of gravity
- Vehicles with dynamic loads, such as tankers
- Vehicles operating in all road conditions.

Standards to consider

- ADR 38—Trailer Brake Systems

Adaptive Cruise Control (ACC)

What it is & how it works

Adaptive cruise control is a traditional cruise control system that also monitors the area in front of the heavy vehicle and automatically varies the vehicle's speed to maintain a safe distance from the vehicle in front of it.

ACC systems use any combination of sensors including, radars, lasers, and cameras, to observe the area directly in front of the vehicle. The system is designed to detect and then monitor traffic in front of the vehicle and adjust the vehicle's speed to maintain a constant distance between vehicles. In most systems, this distance can be chosen by the driver. This may mean the vehicle automatically slows down when traffic slows and accelerates once traffic begins flowing more freely. Generally, drivers will only notice speed changes in accordance with the surrounding traffic.

Benefits

- Reduced forward collisions
- Maintains safe following distance

Best application

- Vehicles operating on highways

Standards to consider

- UNECE R13 Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to braking

Forward Collision Alert (FCA)

What it is & how it works

Forward Collision Alert (FCA) is a system intended to warn the driver about possible hazards in front of the vehicle.

FCA works by using sensors, cameras, or a combination of both, to detect a potential hazard and alert the driver with a warning light and/or alarm. This then allows the driver to take the necessary action to avoid the hazard. FCA is an alert (passive) system, and the vehicle will not take any action to assist the driver to avoid the hazard. Systems that alert and then intervene (active systems) are known as Advanced Emergency Braking (AEB) or Forward Collison Mitigation (FCM) systems.

When FCA activates drivers may notice a warning light and/or alarm.

Benefits

- Incident avoidance
- Multiple activations may indicate driver inattention or fatigue

Best application

- Vehicles operating in all conditions

Lane Departure Systems

What it is & how it works

Lane departure systems work by either alerting the driver when the vehicle is about to leave the lane it is travelling in, or by automatically correcting the position of the vehicle by gently steering it back to the middle of the lane.

These systems will activate when the vehicle begins to change lanes without using the indicator and takes information from a camera that monitors the vehicle's position in the lane. Lane departure systems may be integrated into other warning systems such as adaptive cruise control and forward collision alert systems.

Lane departure warning (LDW) systems are passive systems that alert the driver that the vehicle is about to, or has, veered out of the current lane.

Lane keep assist (LKA) systems are active systems that incorporate a gentle steering input to redirect the vehicle back into the current lane. These systems may also reduce the acceleration of the vehicle by either braking or reducing engine output. LKA is generally less commonly available.

Drivers may experience a warning light, alarm, vibration in the seat or steering wheel or, where lane keep assist is also fitted, steering correction or selective braking.

Benefits

- Vehicle remains in lane
- Multiple alerts may indicate driver inattention or fatigue

Best application

- Vehicles operating in metropolitan and urban areas
- Vehicles operating on highways

Standards to consider

- ADR 99 – Lane Departure Warning Systems for Heavy Vehicles
- UNECE 130 – Uniform provisions concerning the approval of heavy vehicles with regard to the lane departure warning system (LDWS) for M2, M3, N2 and N3 vehicles

Drive Away Protection (DAP)/Parking brake alarm/interlock

What it is & how it works

Parking brake alarms and interlocks work by either alerting the driver when the parking brake has not been engaged or automatically applying the parking brake when triggered. These systems are installed to reduce the likelihood of vehicle roll away during loading and unloading.

Generally, a sensor is located in the driver's seat and/or door which will trigger the system when the driver attempts to leave the vehicle. These systems will typically only work when the vehicle is stationary and are not designed to work while the vehicle is moving.

The Australian Trucking Association (ATA) has advised that the use of a No Air in Motion (NAIM) interlock system is preferred. More details about the Safety Alert can be found here.

Benefits

- Reduced vehicle roll-away

Best application

- Vehicle used for local delivery work
- Vehicles used in freight tasks where the driver regularly leaves the cabin of the vehicle
- Vehicles use in the transport of dangerous goods

GENERAL SAFETY IMPROVEMENTS

Vehicle design

Performance Based Scheme (PBS) vehicles

The Performance Based Scheme (PBS) provides an alternative to traditional vehicle design requirements and offers a variety of safety and productivity benefits. PBS vehicles are assessed against stringent safety and infrastructure standards to ensure they can operate safely on the existing road network. Research has shown that PBS vehicles are involved in 46% fewer accidents than prescriptive vehicles and improve productivity by 15-30% on average.

It is important to consider that due to the innovative design of PBS vehicles, the vehicle may be subject to specific conditions. This may impact access to the road network or require it to only be used in a dedicated combination. Operators should consult with the NVHR or an approved PBS Assessor before purchasing a new or used PBS vehicle.

Cabin Strength

What it is & how it works

Vehicles that have a cabin strength rating have been built and certified to meet certain standards. These standards set the maximum amount a cabin will deform during incidents such as collisions and rollovers.

Currently, the accepted standard for cabin strength has been adopted from the United Nations Economic Commission for Europe (UNECE). Vehicles that are certified as UNECE R29 compliant have been shown to be constructed with the strength required to protect the occupants in the heavy vehicle. UNECE R29 was first developed in the late 1990s and despite there being no mandatory requirements, have become increasingly popular in the Australian market thanks to incentives such as steer axle mass concessions which were introduced more than 15 years ago.

Benefits

- Improved occupant survivability during impact and rollover incidents

Best application

- Use in all environments is recommended

Standards to consider

- UNECE R29 Uniform provisions concerning the approval of vehicles with regard to the protection of the occupants of the cab of a commercial vehicle

Front, Rear and Side Under-run Protection (FUPs, RUPs and SUPs)

What it is & how it works

Front (FUPS), Rear (RUPS) and Side (SUPS) under-run systems or devices are structures fitted to a heavy vehicle that provides an additional barrier between other road users and the underneath of the heavy vehicle. FUPS, RUPS and SUPS devices are designed to absorb and distribute some of the forces in impact and help to ensure that safety features such as airbags are deployed in the other vehicle. SUPS devices are designed to provide a physical barrier preventing vulnerable road users and vehicles from entering the space under the heavy vehicle between axle groups.

A FUPS will also help reduce damage to steering, and other front axle components. This helps the driver maintain control of the vehicle after a collision.

Benefits

- Severity reduction for other road users
- Maintained steering of heavy vehicle in frontal collisions

Best application

- Vehicles operating in metropolitan and urban areas
- Vehicles operating on highways

Standards to consider

- ADR 84 —Front Underrun Impact Protection
- ADR91 – Rear Underrun Impact Protection
- UNECE R73 Uniform provisions concerning the approval of goods vehicles, trailers, and semi-trailers with regard to their lateral protection

Coupling warning

What it is & how it works

Coupling warning systems are designed to alert the driver about the connection between the towing vehicle and a trailer. These systems may use sensors, lights, or physical devices. Sensor based systems, for example, will generally receive information that detects contact between the skid plate and the fifth wheel, the king pin in the jaws and the location of the locking handle. These sensors feed into an in-cabin display to alert drivers to incomplete coupling.

Drivers may notice visual or audible warnings but should always physically check the connection prior to departure.

Benefits

- Assurance that the primary connection is correctly engaged resulting in fewer dropped trailers.

Best application

- Vehicles used in combination
- Industry sub-sectors that require regular connection and disconnection of trailers.

Secondary trailer retention

What it is & how it works

Secondary trailer retention is a generic term given to any backup device installed to ensure the connection between the towing vehicle and a trailer. The most popular form of these devices are 'safety chains' but may also include any other method of maintaining braking and directional control of the trailer when there is a failure or unintended disconnection of the primary coupling.

Depending on the technology used, a visual or audible warning may alert drivers to the primary coupling failure. In all cases, the distance between the towing vehicle and the trailer in the event of a primary coupling failure will be maintained.

Benefits

- Maintain directional and braking control of trailer in cases of separation or trailer breakaway

Best application

- These devices are best suited to use with trailers that support their own weight such as dog, and well-balanced pig trailers.

Onboard Mass Monitoring System (OBM)

What it is & how it works

Onboard Mass systems provide drivers with real time axle group masses. By using scales or load cells fitted to the vehicle, mass information is relayed to a display unit that a driver can then check and make any necessary load adjustments. This is to make sure that the vehicle is not overloaded and that the load is distributed appropriately.

Benefits

- Alerts the driver of unintentional overloading
- Aids with effective weight distribution, which can improve stability
- Greater load carrying capacity when combined with Mass Management modules of the National Heavy Vehicle Accreditation Scheme (NHVAS).

Best application

- Vehicles used in the cartage of modular (freight) and dynamic loads (tankers/bulk haulage).

Tyre Pressure Monitoring System (TPMS)

What it is & how it works

Tyre pressure monitoring systems (TMPS) rely on sensors that provide information about tyre inflation and can also provide temperature information.

TPMSs provide a visual and/or audible warning to drivers where pressure is too high or low and/or when temperatures are too high. Having this information available to drivers provides vital information so that they may be able to act before an incident or fire occurs.

Drivers may notice an audible or visual alarm.

Benefits

- Alerts the driver of tyre failure, or slow leaks
- Temperature warnings may prevent wheel end fires

> ***Note***: Preventing wheel end fires has additional financial benefits as almost half of losses due to non-impact fires attributed to wheel end fires in 2019, with 45% of those fires found to have originated in the wheel end.

Best application

- Vehicles that travel long distances
- Vehicles that carry dangerous goods
- Vehicles operating in remote areas and on unsealed roads

Standards to consider

- UNECE R141 Uniform provisions concerning the approval of vehicles with regard to their Tyre Pressure Monitoring Systems (TPMS)*

*This standard applies to light vehicles. Heavy vehicles will not be certified to this standard but should still be considered.

Signs and markings

Signs can provide vital safety information to other road users and increase the visibility of the vehicle/combination. They are a relatively cheap and easy method of providing a visual cue to other road users to modify their behaviour around certain vehicles.

Signs may be used to describe the dimensions of a heavy vehicle (e.g., long vehicle, road train or oversize), to highlight the outer edges of the vehicle (e.g., conspicuity markings, rear marking plates etc.) or to the performance of a vehicle (e.g., do not overtake turning vehicle, blind spot, and cyclist specific warning signs).

Driver Aids

Integration of multiple systems and displays

Many of the technologies described above provide additional safety outcomes when multiple systems are used together. Technologies may be installed prior to purchase or retrofitted to an in-service vehicle. It is important to consider the current and future demands that may be placed on the vehicles' electrical, communication and processing components.

It is also important to consider the cumulative effect of multiple systems on the driver. While the technologies discussed in this document are designed to only step in once the risk of an incident has been detected, asking drivers to monitor multiple screens or displays while driving may be distracting and ultimately counterproductive. Providing adequate driver training and familiarisation with the technologies is one way to reduce this and will be the focus of future projects from the Regulator.

Cabin liveability

Cabin liveability relates to the comfort and appropriateness of the inside of the heavy vehicle. Consideration should be given to the environment the vehicle will be operating and the length of time a driver will spend living out of the cabin. Environmental factors like temperature, noise and ride can negatively impact a driver causing distraction and discomfort. Additionally, the size and comfort of a sleeper cab may affect the quality of sleep and added facilities such as fridges can affect the weight of the vehicle.

Fatigue/distraction detection technology (FDDT)

What it is & how it works

FDDTs are systems that monitor the driver and warn when they may be either distracted or fatigued while driving. These systems may focus on monitoring compliance with work and rest hours, driver appearance or driver behaviours.

Systems that monitor driver appearance map a driver's facial features paying particular attention to their eyes. Once a baseline has been established, the system monitors the driver for signs of inattention, this may include eye movement, how long the driver's eyes remain closed when they blink, the general shape of the driver's face and the movement of driver's head.

Systems that monitor driver behaviours make assessments based on vehicle performance. Steering and lane keep systems may identify when the vehicle is 'wandering' within in lane, braking and engine systems may identify unintentional speed variance or inattention. These systems can provide early warnings to drivers and external parties through in-cabin alerts or text messages.

Systems that monitor driver appearance and behaviours should be considered more effective than those that only monitor compliance with work and rest hours.

Depending on the system, drivers may receive a warning in the form of a light, an alarm, or a vibration through the seat. When incorporated with telemetry the vehicle fleet operator may also be notified of the warning.

Benefits

- By detecting early signs of decreased alertness, drivers are encouraged to rest before the onset of fatigue.

Best application

- Drivers operating on long journeys
- Drivers doing repetitive or monotonous trips

Business systems and practices

Telematics

What it is & how it works

Telematics systems use a device fitted to the vehicle that collects and sends information to a delegated person via a telematic provider. Telematic systems are a way for fleet managers to monitor vehicles in their fleet in real time. The system is programmed to record certain information such as GPS location, vehicle speed, fuel level/consumption, harsh acceleration or braking and other engine conditions such as time spent at idle etc.

Telematics may be fitted to a single vehicle or an entire fleet. Telematic systems can be programmed to send alerts to delegated persons within the company to alert of certain conditions.

Drivers will not notice the device in the cabin and the device does not impact the operation of the vehicle.

Benefits

- Realtime information about vehicle locations and operating parameters
- Trend monitoring to support driver coaching

Best application

- Use in fleets of any size
- Vehicles operating in rural and remote areas
- Vehicles operating on Highways

Driver engagement and education

Many of the safety technologies and systems described in this document will be unfamiliar to existing and experienced drivers. For this reason, the introduction of new systems can be met with resistance and uncertainty. Ensuring that drivers are aware of how specific safety technologies work and providing support for drivers in adopting and adjusting to the technology is vital to the effectiveness of the system.

Safety Management Systems (SMS)

To increase safety outcomes, many of the systems and technologies discussed in this document can be integrated into a Safety Management System (SMS). Developing an effective SMS helps operators to identify hazards and risks associated with their transport activities and documents the steps that can be taken to manage the risks.

Having an SMS is one way of ensuring a safety-focused business and can assist with complying with safety duty obligations under the Heavy Vehicle National Law (HVNL).

For information about developing and integrating safety management systems into your business, refer to the NHVR guide.

Other safety improvements

Quality of parts and components

While not a primary consideration of new vehicle purchases, the continued performance of vehicles and associated safety systems is heavily dependent on the quality of the replacement parts and the ongoing maintenance of all components.

Compatibility of multiple systems

The reality of the heavy vehicle industry is that very few vehicles will be chosen to operate in a dedicated combination, and prime movers are often required to connect to many different trailers and be driven by different drivers. Consideration should be given to the existing vehicles in the fleet, how similar the new technology is to operate, the driver's need for additional training and how compatible the technologies used in the cabin are to the technologies fitted to the trailers.

Where there is a mix of older trucks without advanced safety features and new trailers with safety features, operators should consider fitting appropriate connections that power trailer smart systems.

Emissions

While not specifically a safety technology, advanced emissions systems have been shown to have a positive effect on the environment. Reductions in gas and particulate emissions have been introduced by way of European standards. These standards have been developed and implemented firstly in the European Union and then progressively adopted in the Australian Design Rules (ADRs). Engines that meet European emission standards are referred to using the term Euro, followed by a Roman numeral e.g., Euro IV (4).

> ***Note***: The ADRs accept equivalent emission standards that do not originate in Europe. Vehicles that comply with the American EPA or the Japanese Standards (as listed in the ADR) will provide equivalent reduction of environmental concerns effect on the environment.

ADR80/00 (Euro III or equivalent)

Mandatory in new heavy vehicles produced after 1 January 2003.

ADR80/02 (Euro IV or equivalent)

Mandatory in heavy vehicles produced after 29 February 2008.

ADR80/03 – (Euro V or equivalent)

Mandatory in new heavy vehicles produced after 1 January 2010.

ADR80/04 – (Euro VI or equivalent)

Mandatory for new model vehicles from 1 November 2024 and all new vehicles from 1 November 2025

Emissions summary

Pollutants such as carbon monoxide, hydrocarbons, nitrogen oxides and particulate matter are by-products of the combustion necessary to drive vehicles. These by-products are emitted into the atmosphere via the vehicle's exhaust and contribute to poor air quality and adversely affect human health. The graph and table below show the decrease in pollutants since 2003. Upgrading to vehicles with better performing emission standards can have a positive effect on air quality and human health.

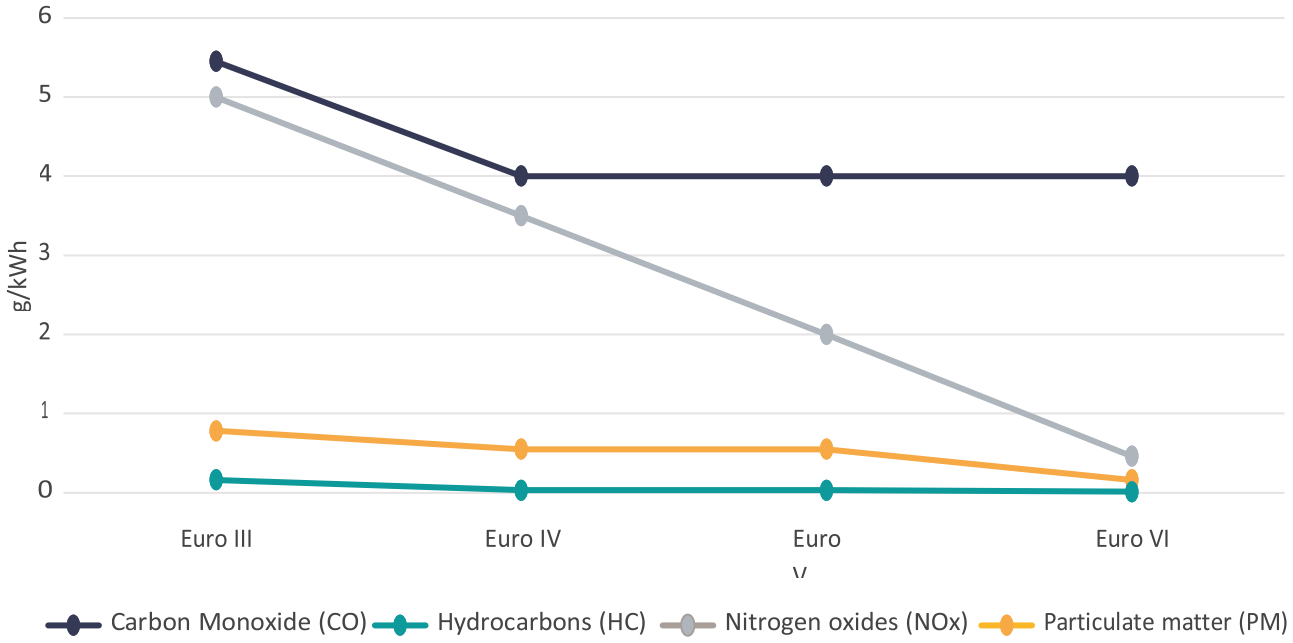

Figure 1. Emissions summary

Table 1: Overview of maximum emission

ADR (EURO)	Pollutants (g/kWh under specific (ETC)test conditions)				
	Carbon Monoxide (CO)	Hydrocarbons (HC)	Nitrogen oxides (NOx)	Particulate matter (PM)	Year
ADR80/00 (EURO III) (baseline)	5.45	0.78	5.0	0.16	2003
ADR80/02 (EURO IV)	4.0 (↓26%)	0.55 (↓29%)	3.5 (↓30%)	0.03 (↓81%)	2005–08
ADR80/03 (EURO V)	4.0 (↓26%)	0.55 (↓29%)	2.0 (↓60%)	0.03 (↓81%)	2010
ADR80/04 (EURO VI)	4.0 (↓26%)	0.16 (↓79%)	0.46 (↓90%)	0.01 (↓93%)	2025

ETC means *European Transient Cycle* and is designed to test vehicle emissions across a variety of driving conditions (i.e., frequent stop/start, idling, highway etc.).

OPERATING ENVIRONMENTS

There are inherent risks associated with any heavy vehicle freight task. These risks will generally present across different operating environments to varying degrees. To assist with matching the most effective technologies to the operating environment, a simple risk assessment has been conducted against the most common hazards. This is not an extensive list and there may be local variances depending on the specifics of the location and activity being undertaken. It is advised that consideration be given to the unique circumstances that may apply to your unique situation.

Hazards

Traffic

Traffic is collectively all other vehicle-based road users that a heavy vehicle shares the road with. It does not include people not in vehicles which will be discussed next under vulnerable road users. While road authorities have taken some steps to educate the general road going population, the traffic environment remains to be unpredictable in nature. A report by National Transport Insurance (NTI) found that where a truck and a car were involved in a fatal crash, the car was at-fault 80% of the time. Irrespective of the cause, operators and drivers must live with the consequences of an incident long after the event. It is for these reasons that where possible, adding safety technologies that will avoid, or reduce the severity of negative interactions with other road users is recommended. Safety technologies such as smart braking systems, blind spot detection and underrun protection have the potential to significantly reduce the severity of an incident.

To reduce the safety risk associated with this hazard, prioritise the use of safety technologies and features associated with improved braking, stability, and road position general safety improvements such as vehicle design.

Vulnerable road users

Vulnerable road users are essentially people not in vehicles, and the term broadly includes cyclists and pedestrians. Unfortunately, survivability rates for vulnerable road users involved in an interaction with a heavy vehicle are low. This vulnerability, when combined with the unpredictable nature of humans and the inherent blind spots on and around a heavy vehicle makes for a deadly combination. For these reasons, it is important to consider the inclusion of technologies that increase the drivers' situational awareness.

Safety technologies that are aimed at protecting vulnerable road users include features that increase the drivers' visibility and awareness of the area immediately adjacent to the vehicle by cameras and or buzzers and by engaging advanced braking systems.

To reduce the safety risk associated with this hazard, prioritise the use of safety technologies and features associated with improved visibility, road presence and general safety improvements such as vehicle design.

Inattention/distraction & fatigue

Inattention causes delayed reactions and when heavy vehicles are involved, even a small delay in reaction time can have catastrophic results. Driver inattention may be caused by a variety of contributing factors including distraction and fatigue.

Fatigue remains a major concern for the heavy vehicle industry and unfortunately, is attributed as the single largest cause of truck driver deaths. While fatigue is commonly considered a feeling of tiredness caused by a lack of sleep, the physical need for sleep is only a small (albeit very important) part of the picture. For the purpose of this document, fatigue is considered a contributing factor in driver inattention, but it is important to keep in mind that other demands on a driver's mental and physical situation directly affect driver alertness. Factors including cabin noise and comfort, personal stresses (emotional, financial etc.), boredom and even the number of gauges and displays on the dashboard all play a significant role in the amount of attention a driver has available.

Safety technologies that monitor driver alertness are most commonly marketed as fatigue management devices. While taking regular breaks from driving is important, systems that actively monitor the driver in addition to checking that a driver has taken the minimum amount of rest required by regulations are recommended. Expected safety outcomes are increased when combined with lane keep assist and active braking systems.

To reduce the safety risk associated with this hazard, prioritise the use of safety technologies and features associated with general safety improvements such as driver considerations and business practices and systems.

Physical environment

The physical environment a vehicle is operating in includes such features as the condition of the roads and any other items of infrastructure a vehicle may encounter such as road furniture, overhead power lines and wild animals.

Factors such as sealed versus unsealed roads can impact the choice of safety technologies.

To reduce the safety risk associated with this hazard, prioritise the use of safety technologies and features associated with general safety improvements such as vehicle design, emissions, driver considerations and business practices and systems.

Emissions

Vehicle emissions have become an increasing point of interest. Consideration should be given to the environment that the vehicle is operating in, as the higher the concentration of vehicles (both heavy and light), the more important reducing emissions becomes.

To reduce the safety risk associated with this hazard, prioritise the use of safety technologies and features associated with general safety improvements such as emissions.

Metropolitan and Urban

Metropolitan and urban environments include cities and suburbs and are characterised by a high concentration of population, traffic, and vulnerable road users. Areas with greater population density present an increased likelihood of unintentional interaction with both people in vehicles (traffic) and people not in cars (vulnerable road users).

Hazard	Contributing factors	Likelihood of interaction	Severity of interaction	Overall risk (uncontrolled)	Mitigating safety technologies and features
Traffic	High traffic density	High	High	High	Braking stability and road position
Vulnerable road users (pedestrians push bike riders)	High density vulnerable road users	High	Very high	Very high	Visibility and road presence
Inattention/ distraction & fatigue	Run sheets used more than logbooks, multiple short trips, regular trips on familiar roads	Low	Moderate	Low	GSI: driver considerations, business systems and practices
Physical environment i.e., road conditions/ infrastructure	Predominately sealed roads, more road furniture, more overhead power lines	Low	Moderate	Low	Vehicle design, driver considerations, business systems and practices
Emissions	High traffic density, high population density	Very high	High	Very high	Emissions

Safety systems that help drivers operating in this type of environment include:

- Blind spot monitoring devices,
- Smart and autonomous braking systems,
- Adaptive cruise control,
- Forward collision alert,
- Lane departure/keep assist,
- FUPs, SUPs and RUPs

Rural

Rural areas generally consist of a mixture of lower population density but greater risk of animal strike and an increased number of slow-moving vehicles on roads with high-speed limits, such as agricultural vehicles. Roads are generally sealed but may also include unsealed sections, narrower lane widths, and trips and scenery will tend to be similar which can cause the driver's attention to wander.

Hazard	Contributing factors	Likelihood of interaction	Severity of interaction	Overall risk (uncontrolled)	Mitigating safety technologies and features
Traffic	Lower traffic density	Moderate	High	High	Braking stability and road position
Vulnerable road users (pedestrians push bike riders)	Low density vulnerable road users	Low	Very high	High	Visibility and road presence
Inattention/ distraction & fatigue	Inattention due to boredom, long trips more likely	Moderate	Moderate	Moderate	GSI: driver considerations Business systems and practices
Physical environment i.e., road conditions/ infrastructure	Sealed/unsealed roads, high chance of animal strike, likely interaction with slow moving vehicles i.e., ag vehicles	Moderate	Low	Moderate	GSI: vehicle design, driver considerations, business systems and practices
Emissions	Lower traffic density, lower population density	Moderate	Low	Moderate	GSI: Emissions

Safety systems that help drivers operating in this type of environment include:

- Smart braking systems,
- Roll stability,
- TEBs,
- Conspicuity markings,
- R29 cabin strength,
- Fatigue monitoring devices,
- FUPs, SUPs and RUPs.

Highway

Highways are the circulatory system that keeps freight moving around the country. The population density on highways can vary considerably depending on the proximity to a city or town, the time of day, the day of the week and even the time of the year. To minimise interactions with elements like traffic and to maximise the distances travelled, many heavy vehicle movements are scheduled to occur at night. While this approach mitigates one risk, it increases others such as the chance of animal strike, driver fatigue and inattention. Additionally, because the nature of highway driving occurs at a higher speed, the severity of any incident is increased.

Hazard	Contributing factors	Likelihood of interaction	Severity of interaction	Overall risk (uncontrolled)	Mitigating safety technologies and features
Traffic	Variable traffic density	High	High	High	Braking stability and road position
Vulnerable road users (pedestrians push bike riders)	Low density vulnerable road users	Low	Very high	High	Visibility and road presence
Inattention/ distraction & fatigue	Long trips more likely, boredom on long/remote journeys, night-time travel more likely	High	Moderate	High	GSI: driver considerations, business systems and practices
Physical environment i.e., road conditions/ infrastructure	Predominately sealed roads although unsealed roads may be present in remote areas, animal strike in rural and regional areas	Moderate	Moderate	Moderate	Vehicle design, driver considerations, business systems and practices
Emissions	Moderate traffic density, lower population density, greater distances travelled	Moderate	Moderate	Moderate	Emissions

Safety systems that help drivers operating in this type of environment include:

- Smart braking systems,
- Roll stability,
- TEBs,
- Conspicuity markings,
- R29 cabin strength,
- Fatigue monitoring devices,
- FUPs, SUPs and RUPs.

Closed sites and road-related areas

Closed sites and road-related areas include mine haul roads, vehicles operating on private property and areas of road that are under construction. Vehicles operating in these areas face a unique set of risks but will inevitably also operate in one or more of the areas described above. Consideration should be given to all areas of operation.

Hazard	Contributing factors	Likelihood of interaction	Severity of interaction	Overall risk (uncontrolled)	Mitigating safety technologies and features
Traffic	Lower traffic density	Moderate	High	High	Braking, stability, and road position
Vulnerable road users (pedestrians push bike riders)	Low density vulnerable traffic users	Low	Very high	Moderate	Visibility and road presence
Inattention/ distraction & fatigue	Multiple short trips and more days 'on shift'	High	High	High	Driver considerations, business systems and practices
Physical environment i.e., road conditions/ infrastructure	Sealed/unsealed roads, chance of animal strike, other construction vehicles	Low	High	Moderate	Vehicle design, driver considerations, business systems and practices
Emissions	Lower traffic density, lower population density	Low	Moderate	Moderate	Emissions

Safety systems that help drivers operating in this type of environment include:

- Blind spot monitoring,
- Fatigue monitoring and
- Smart braking systems.

FUTURE DEVELOPMENTS

The heavy vehicle industry is in a period of rapid change that will fundamentally alter the vehicles that are used to deliver the road freight and passenger transport tasks. These changes, relate not only to the technology discussed in this guide but also, increasingly automated systems and a shift to low and no emission vehicles.

Connected and automated heavy vehicles

As developments towards Connected and Autonomous Vehicles (CAV) continue in the light vehicle space, it is recognised that similar developments will flow into the heavy vehicle space. The early stages of these can be attributed to the development and inclusion of Advanced Driver Assistance Systems (ADAS). Many of the technologies discussed in this document will form the foundation of an ADAS, however, specific heavy vehicle application is still in its infancy. While it is essential that these developments are monitored and considered, it is too early to include any robust guidance on the purchasing of these types of vehicles at this time.

Low and zero emission vehicles

As the push towards decarbonising the heavy vehicle fleet gains momentum, greater interest is being placed on how low and zero emission vehicles (LZEVs) will fuel the heavy vehicle fleet in the future. Work on battery electric vehicles (BEVs) and hydrogen fuel cell vehicles continues to evolve and may be considered in future iterations of this document. For more information on these vehicles, the NHVR has released the Future Heavy Vehicle Roadmap.

ADDITIONAL RESOURCES

Registered industry codes of practice

A Registered Industry Code of Practice (RICP) is a resource that can help you and your business fulfil your primary duty by implementing risk management into your operations.

Incorporating the skill and experience of industry participants, Industry Codes of Practice offer a means of translating the requirements of the law into a practical methodology incorporating good practice for the whole industry.

The NHVR has registered a number of codes and continues to work with industry to develop more. Existing RCIPs include:

- Master Code of Practice
- Tasmanian agricultural and horticultural RICP
- Managing effluent in the livestock supply chain

INDUSTRY SECTORS

The majority of vehicles operating in the heavy vehicle industry perform the same basic task, that is, moving items from one place to another. That said, the heavy vehicle industry remains uniquely diverse and while the base task remains constant, the configuration of vehicles used, the load and the environments in which they operate can be vastly different. In these documents we look at the safety technologies available and match them to the type of work the vehicle is used for and the operating environments that the vehicle is being used in.

Appendix A: LIST OF ACRONYMS

Acronym	Term
ADR	Australian Design Rules
BSIS	Blind Spot Information Systems
COP	Code of Practice
CLOCS-A	Construction Logistics and Community Safety – Australia
CANbus	Controller Area Network Bus
DA	Design Approval
DAP	Drive Away Protection/Parking Brake Alarm/Interlock
UNECE	United Nations Economic Commission for Europe
EBS	Electronic Braking Systems
ESC	Electronic Stability Control
FCA	Forward Collision Alert
FDDT	Fatigue/distraction detection technology
FUP	Front Under-Run Protection
GPS	Global Positioning System
HVNL	Heavy Vehicle National Law
IVD	Indirect Vision Devices
LDW	Lane Departure Warning
LKA	Lane Keep Assist
OBM	Onboard Mass Monitoring System
PBS	Performance Based Standards
RICP	Registered Industry Code of Practice
RUP	Rear Under-Run Protection
RSC	Roll Stability Control
SMS	Safety Management System
SUP	Side Under-Run Protection
TEBS	Trailer Electronic Braking Systems
TPMS	Tyre Pressure Monitoring System
VA	Vehicle Approval
VRU	Vulnerable Road Users