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It is the absolute obligation of the holder of the Certificate of Professional Competence to be familiar with and comply with all aspects of the law relating to the Certificate of Professional Competence and in particular the obligation to obtain and maintain the level of training and instruction required for the Certificate of Professional Competence.

The training process has been designed and developed by the Road Safety Authority for the express purpose of facilitating the training of all classes of drivers required to acquire and hold the Certificate of Professional Competence.

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The contents of this manual are expressed in general terms and are not intended to be a detailed analysis of the law. It is based on the assumption that readers are familiar with many of the technical terms used when referring to HGV and PSV vehicles. This guide does not, and is not intended to provide legal advice or to represent a legal interpretation of the law.

It is the primary obligation of the driver to know the laws and regulations relating to their profession.



RSA Head Office

Údarás Um Shábháilteacht Ar Bhóithre Road Safety Authority

Páirc Ghnó Ghleann na Muaidhe, Cnoc an tSabhaircín, Bóthar Bhaile Átha Cliath, Béal an Átha, Co. Mhaigh Eo.
Moy Valley Business Park, Primrose Hill, Dublin Road, Ballina, Co. Mayo.

locall: 1890 40 60 40 **fax:** (096) 25 252 **email:** info@rsa.ie **website:** www.rsa.ie

For information relating to the tachograph, drivers hours, vehicle standards and CVRT contact the Road Safety Authority, Clonfert House, Bride Street, Loughrea, Co. Galway.
Phone: (091) 872 600 Email: enforcement@rsa.ie





FOREWORD FROM THE RSA CHIEF EXECUTIVE OFFICER

This Driver Certificate of Professional Competence (Driver CPC) syllabus has been developed by the RSA with the assistance of the transport industry and experienced training organisations.

The information contained in this manual (No. 1. Control of the Vehicle and Eco-Driving Techniques) together with the information provided in Manuals 2, 3, 4, 5 and 6 combines to become an excellent resource for use by professional drivers. Drivers are encouraged to keep all of the manuals together in a safe place and to refer to them from time to time whenever they want some clarification or guidance on how to approach a particular issue.

The next few pages set out what the programme has to offer those attending, whether you are already working as a professional truck or bus driver, or you are new to the profession and want to become a qualified driver with a view to working in the transport industry. By following the guidance provided and adhering to 'best practice' outlined in this manual, you will significantly reduce the likelihood of being involved in a serious incident. These incidents could ultimately involve financial penalties, loss of business and a risk of being involved in a serious injury or fatal collision.

The course is broken down into modules covering a wide range of areas outlined in the Driver CPC EU Directive and Irish National legislation, which will be of interest to all professional bus and truck drivers and all good employers. Some areas may be new to you, in other parts it may simply be a case of refreshing your skills or knowledge – in either case I am certain that you will find the programme challenging, yet enjoyable.

Driver CPC covers key aspects such as the Health and Safety of professional drivers as well as the rational use of fuel and important road safety related matters. As such you will possibly have encountered some or many of these topics before. However these topics have such a significant impact on the safe movement of passengers and goods that key messages are repeated and/or reinforced.

The Board of the RSA considers Driver CPC to be a key step in our common aim to reduce death and serious injuries on our roads. There will also be benefits to the transport industry through eco-driving, lower insurance costs and a highly trained resource of professional drivers. By participating in Driver CPC training you will be developing and refreshing the knowledge and skills required for your profession. It will help you not only keep on top of your profession but also to remain a safe and socially responsible driver.

By taking this training at an RSA approved training centre you can be confident that the provider has met all the quality assurance targets required of an RSA registered training provider and is committed to helping you achieve your own personal objectives from this course.

Please be prepared to ask questions of your trainer and the group and to share your own experiences. By actively joining in with each training session you will be initiating and contributing to debate among your group of peers. Sharing your experiences and listening to others will help to benefit everyone and may in itself make an important contribution to Irish road safety.

Once you have completed any of the training you will be able to view your Driver CPC training record by logging onto the RSA website and visiting 'MY CPC' (see the guide at the back of this manual).

From there you can print off your record and if required, you can provide a copy to your employer to prove your status as a professional driver or use it to support a job application when applying for work as a professional truck or bus driver.

May I take this opportunity to wish you well with the course and I look forward to your contribution in the ever-increasing demand for quality drivers.

Yours sincerely

Moyagh Murdock
CEO





IMPORTANT

The RSA endeavours to provide you with the latest information but please be aware that Road Traffic and other applicable legislation is continuously changing. As a consequence the information contained in this manual or provided via any of the related PowerPoint presentations is also subject to change. The RSA will continue to add up-dates or refresh the material from time to time but can in no way guarantee that this version contains the very latest information available. If you have any doubts about the validity of information contained within this manual or any of the presentation slides, please seek clarification from either your trainer, your employer or transport manager (as appropriate).

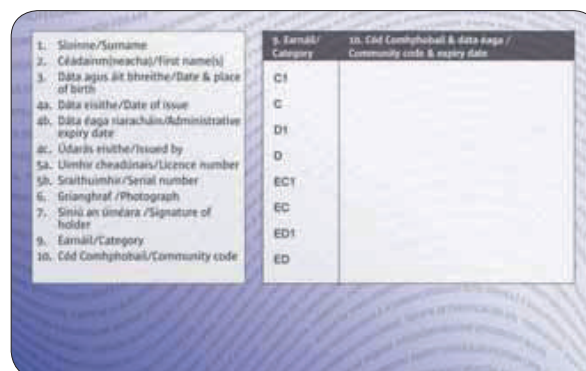
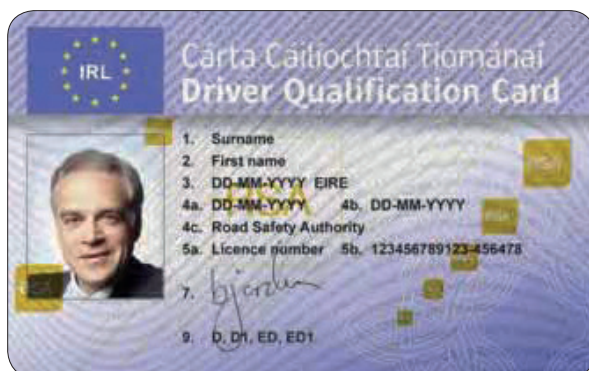
If necessary you may also wish to obtain independent legal opinion.

To ensure you have the latest version of this module, check our website for details, just click on the Driver CPC section of www.rsa.ie.

While every effort is made to ensure that the material in this manual is accurate at the time of going to press, it remains the responsibility of drivers to ensure they are informed of and familiar with all regulations, conditions and requirements relating to all aspects of their profession.

Sample CPC Card

Once you have completed your Initial Driver CPC training you can apply for your Drivers Qualification Card.



When driving a truck or a bus in a professional capacity, a driver must carry a

- CPC card for the category
- Driving licence for the category
- Tachograph card or tachograph charts





DRIVER CERTIFICATE OF PROFESSIONAL COMPETENCE
**CONTROL OF THE VEHICLE AND
ECO-DRIVING TECHNIQUES**

Session 1

DRIVER
CPC MODULE
NUMBER

1.3

Road Safety Authority – CPC Training Manual – Control of the Vehicle and Eco-Driving Techniques. V.1.3. Session 1





CONTENTS

Introduction.....	6
Overall Objectives of the Driver CPC Programme	10
Personal Objectives.....	11
Group Ground Rules.....	12
Session 1 Objectives.....	13
Section A – Curves relating to Torque and Engine Power.....	15
Section B – Vehicle Transmissions	21
Section C – Axle Configurations and the Final Drive	30
Section D – Fuel Consumption and Economical Driving.....	36
Section E – Managing Vehicle Inertia	50
Section F – Uncoupling/Recoupling Procedures.....	54
Scenario 1	60

Some driver essentials





INTRODUCTION

The following information is provided for persons who wish to become professional truck or bus drivers, and for those who are already qualified in the profession. It outlines the steps to be taken in order to obtain Initial Qualification and to maintain their CPC entitlement (Periodic Qualification)

Welcome to the Road Safety Authority's Approved Training Programme for the Drivers Certificate of Professional Competence. (CPC).

Driver CPC is a Certificate of Professional Competence issued to drivers who are entitled to hold one. It was first introduced across the EU in 2008 for professional bus drivers and 2009 for professional truck drivers.

The E. U. requires its member states to provide better training for professional drivers. Many professional drivers in the E. U. are working without the benefit of training or the opportunity to regularly refresh their skills. As a result, the E. U. introduced Directive 2003/59/EC, which makes it compulsory for member states to have a driver CPC programme in place for professional drivers.

In Ireland, this is given effect by S. I. (Statutory Instrument) 359 of 2008.

This course fulfils part of the requirements for CPC driver training under Directive 2003/59/EC.

For CPC purposes, a professional driver is someone who drives a truck or a bus, whether as self-employed, for a salary, on own account or for hire or reward, and who holds one or more of the following categories of driving licence; C1, C1E, C, CE, (trucks) or D1, D1E, D, DE. (buses).

Drivers of vehicles which can be driven by the holder of a Category B licence – cars and light commercial vehicles with a MAM (design gross vehicle weight) not exceeding 3,500 kg., and vehicles with passenger accommodation for not more than 8 persons – are not required to undergo CPC training.

IMPORTANT – A Driver CPC Qualification Card is not a driving licence. In order to drive a truck or bus you must:

- be the holder of a current valid driving licence for the category of vehicle you are driving, and
- be the holder of a current valid driver's CPC card for the category of vehicle you are driving professionally.

Once you are fully CPC qualified you can apply for and receive your Drivers CPC card. Both your driving licence and Drivers CPC card must be carried by you whenever you are driving your truck or bus professionally. You must also carry a digital tachograph card if your vehicle is fitted with a digital tachograph.

Key aims

The key aims of the Driver CPC programme are

- Ensuring all professional bus and truck drivers have high standards of driving and of road safety practices and that those standards are maintained throughout their driving careers
- Ensuring high standards of their personal health and safety
- Ensuring high standards in relation to fuel efficiency and reduced pollution
- Creating a common standard for the training and testing of drivers throughout the E. U.
- Reducing fatalities and serious injuries on the roads. The RSA's target is for Ireland to have one of the lowest casualty rates in Europe.

The Driver CPC

Professional drivers fall into two categories from a Driver CPC perspective:

- those who were already working as professional drivers when the scheme was put in place, and
- those who are new to the profession.





'Acquired rights' to Driver CPC

Acquired rights to a Drivers CPC qualification applies to those drivers who were already working as professional drivers when the scheme was put in place. If you got your bus licence on or before the 9 September 2008, or your truck licence on or before 9 September 2009, you are automatically entitled to a Driver CPC qualification, known as 'acquired rights'.

To keep your Driver CPC, you must then undergo 35 hours of periodic training over the next five years, and in each subsequent five year period throughout your professional driving career.

Training is on a one-day-per-year basis (minimum of 7 training hours each day).

If you are maintaining both a bus and a truck CPC entitlement you must complete 42 hours of training over each five year period.

Periodic training is compulsory and is designed to help you be:

- A better safer and socially responsible professional driver
- A more environmentally aware, fuel efficient and cost conscious driver
- Physically healthier

In Ireland CPC Periodic refresher training is only provided by RSA approved trainers at RSA approved training centres. When booking training check to make sure your trainer and centre are approved by the RSA. Unapproved training will not count towards your Drivers CPC.

If you don't qualify for 'acquired rights' for Driver CPC

If you obtain your bus licence on or after 10 September 2008 or your truck licence on or after 10 September 2009 you don't qualify for acquired rights and must obtain your 'Initial CPC' qualification.

There are four steps in this process.

To become a professional bus or truck driver and obtain your 'Initial CPC' qualification you first must pass:

- Step 1 – The new truck, the new bus or the new Combined Truck and Bus theory test as appropriate. (This new theory test also permits successful candidates to apply for their learner permit).
- Step 2 – A two-hour case study theory test
- Step 3 – The standard 90-minute driving test.
- Step 4 – A 30-minute practical knowledge test.

Before applying for a bus or truck learner permit you must hold a Category B licence, and also pass a medical exam.

Please note: If you obtained your bus or truck learner permit before 30th September 2014 you will need to complete the CPC Step 1 theory test (set out at No 1 above).

In addition, you must then maintain your Driver CPC by completing the Periodic refresher training of at least 35 hours of training over each subsequent five year period as mentioned above. If you are maintaining both a bus and a truck CPC you must complete 42 hours of training over each five year period.

Test locations

The Driver CPC bus/truck test and practical test can be carried out in any existing bus/truck test location, but not every type of vehicle can be tested at all centres. You should enquire beforehand as to which type of vehicle can be tested in each test centre.

Theory tests

The Driver CPC theory tests are part of the Driver CPC process, which is mandatory for all new professional drivers.

- Step 1: Drivers must first pass the relevant theory test and obtain their learner permit
- Step 2: Drivers then must take and pass their CPC Case study theory test/s.





CPC Step 1:

You have a number of options depending on what licences you want to get and what tests you have already completed.

Option 1 – applies for either a bus or truck theory test This test consists of 100 multiple choice questions - you must correctly answer at least 74 of them to pass either the bus or the truck exam.

Option 2 – applies for a combined bus and truck theory test This test consists of 140 multiple choice questions. If you want to drive buses and trucks, you may opt to take the combined bus and truck exam which costs €84. You must correctly answer at least 104 questions to pass this combined bus and truck exam.

If you have already passed either one of the new bus or truck theory tests since 30th September 2014 - you may then choose to add the alternate category by passing the bus module or truck module test (as appropriate). The cost of the Module test is €45. These Module tests consist of 40 questions. To pass you must correctly answer at least 30.

CPC Step 2:

Step 2 consists of three case studies which are short scenarios that describe various situations a driver might face in a typical driving day. There are 15 questions in each case study (45 in total). To pass, you must correctly answer 28 of the 45 questions, with a minimum of 5 questions correctly answered on each case study.

To prepare for any of these theory tests

Study material including advice on how to prepare for both the new exams and the CPC case study tests is available from Prometric Ireland. Visit www.theorytest.ie.

CPC Step 3:

The CPC standard driving test

When successfully completed, the standard driving test, which lasts for approx. 90 minutes, entitles a driver to apply for their driving licence in the relevant category

CPC Step 4:

This test is also conducted by the driver tester in the driving test centre and is usually taken directly after the standard driving test and using the same vehicle.

A vehicle must be available for the test, which is a practical knowledge test lasting approx. 30 minutes. It covers areas such as

- safety
- passenger comfort
- legal matters relating to driving
- vehicle loading and stability
- ability to deal with an emergency
- physical risks involved in driving

Booking a test

Driver CPC theory test: Lo-call: 1890 60 61 06 or go to www.theorytest.ie.

Driver CPC standard driving and practical knowledge test: Lo-call: 1890 50 60 80 or go the RSA's online booking facility.

If you wish, you can attend training in RSA-approved training centres to help you prepare for your Driver CPC examination.

Proof of certification

Drivers with acquired rights – applying for a CPC Qualification Card

For drivers who held 'acquired rights' - your licence will have an issue date before the September deadlines in the relevant category as proof of your acquired rights. When you complete your periodic training and apply for one, you will be issued with your CPC qualification card. Check this carefully as if





you did not already hold a licence before the start dates you do not hold a drivers CPC qualification and any periodic refresher training completed will not count – you must obtain the correct Drivers CPC first.

New drivers – applying for a CPC Qualification Card

When you have passed your Driver theory test, the case study tests and the two driving tests, you will be issued with an application form by your driver tester. Complete and return the form to the Driver Education Section, RSA, Primrose Hill, Ballina, Co Mayo. You can generally expect to receive your card within 10 working days.

Exemptions

Driver CPC certification is not required for drivers of vehicles used:

- For non-commercial purposes, e.g., driving as a volunteer; drivers of emergency or rescue vehicles e.g., Gardai, Defence forces, Ambulance and Irish Prison service.
- For registered RSA approved Driving Instructors who are giving driving instruction.
- In the course of someone's work, provided that driving the vehicle is not the driver's principal occupation, e.g., a plumber using a light truck to transport their plumbing materials.
- Vehicles with a maximum speed not exceeding 45 km/h

If you have any queries about whether your driving duties require you to hold a drivers CPC card check with your Transport Manager, with your legal advisor, with your Insurance Company, or consult the RSA. Where a doubt exists, the RSA recommends that you undergo the CPC training. However, clarification may ultimately be decided by the Courts.

More information on Driver CPC is available from:

Driver Education Section
Road Safety Authority
Moy Valley Business Park
Primrose Hill
Ballina
Co Mayo
Email: cpc@rsa.ie
Tel: 096 25015

It is recognised that many people who will participate in this training may be owner/operators, while others will work for transport organisations. Please note, any time the text mentions 'company' or 'your employer', those who are owner/operators should consider this to refer to them. This training material will contain references to best practice (should) in relation to specific areas which all professional drivers should follow. Local arrangements or manufacturers guidelines for your vehicle may differ, and should be followed. In areas where the term 'must' refers to legislation, this should be read as absolute.

Penalties for non-compliance with Driver CPC Regulations.

Possible Fines for the Driver	Euro
Driving while not the holder of a valid CPC Card	€2,000
Driving while not carrying a valid CPC Card	€1,000
Failing to produce a valid CPC Card to a Garda or an RSA Transport Officer	€1,000
Driving with fraudulent documentation	€5,000
Possible Fines for the Employer/Operator	
Allowing a non-compliant person to drive a vehicle	€5,000





OVERALL OBJECTIVES OF THE DRIVER CPC PROGRAMME

The purpose of the CPC training programme is to confirm and expand on the existing knowledge and skills of each driver, ensuring professional drivers continue to be safe, courteous and fuel-efficient drivers who drive from a road-sharing perspective.

It is intended that the development of a defensive driving style - anticipating danger, making allowance for other road users – together with rational fuel consumption, will have a positive impact both on society and on the road transport sector itself.

In particular it is designed to ensure that drivers know

- the characteristics of the transmission system in order to make the best possible use of it
- the technical characteristics and operation of the safety controls in order to control the vehicle, minimize wear and tear and prevent disfunctioning
- how to optimize fuel consumption
- how to load the vehicle (goods) with due regard for safety rules and proper vehicle use
- how to load the vehicle (passenger) with due regard for safety rules and proper vehicle use
- how to ensure passenger comfort and safety
- the regulations governing the carriage of goods
- the social environment of road transport and the rules governing it
- the regulations governing the carriage of passengers
- the risks of the road and of accidents at work
- how to prevent criminality and trafficking in illegal immigrants
- how to prevent physical risks
- their responsibility as a driver for managing their own health and only to drive when medically fit to do so
- the importance of physical and mental ability
- how to assess emergency situations
- how to adopt behaviour to help enhance the image of the company
- the economic environment of road haulage and the organization of the market
- the economic environment of the carriage of passengers by road and the organization of the market

This Module – Control of the Vehicle and Eco-Driving Techniques – deals with the characteristics of the transmission system, effective use of the safety controls on buses and trucks and optimisation of fuel consumption.

In Session 1 of this manual we will look at curves relating to torque and engine power, optimum use of a rev. counter, vehicle transmission systems, optimising fuel consumption, managing vehicle dynamics and uncoupling/recoupling a trailer to and from a drawing vehicle.

Session 2 looks at braking systems, retardation devices, (endurance brakes), driver assistance technologies, road speed limiters (RSL), speed limitation devices, action in the event of tyre failure and CVRT.

In addition, a number of appendices are provided at the back of this manual for your reference and which provide important additional information for professional drivers.





The RSA sets down standards for the CPC Training Organisations to follow. If you are not satisfied with any of the training room arrangements, please raise the matter with your CPC Trainer in the first instance. If it is not possible to resolve the issue, please refer to the CPC Training organisation. Finally, if you remain dissatisfied, please bring the matter to the attention of The Manager, Driver Education Section, RSA, by emailing cpc@rsa.ie

Typical Driver CPC Training Arrangements



PERSONAL OBJECTIVES

The Road Safety Authority provides the material for drivers who attend the Driver CPC courses. However, it is important that you reflect on what you would like to get from the course yourself.

Q1. What do I hope to get out of this training?

Your response

Q2. What would I like to see happening during the training that would help me in my day-to-day working arrangements?

Your response

Q3. What could happen during the training that could prevent me being able to benefit from it?

Your response





GROUP GROUND RULES

The course trainer will facilitate a discussion aimed at agreeing a set of `Ground Rules` by which the class agrees to abide.

By abiding by these rules the class will;

- Cover the required material
- Finish on time
- Not have people disrupting the training
- Be able to concentrate
- Not be distracting each other

By agreeing a set of rules together we all have an opportunity to clearly understand what is expected of ourselves and others.

By obeying your agreed rules, drivers can be confident that they will be able to avoid issues like those listed above. The day will be more enjoyable and easier to follow if we all observe the set of agreed ground rules.

Please consider what sort of things can or should be included and contribute to the discussion.

You may wish to note what has been agreed by the group in the box below.

Agreed Ground Rules





Outline of a typical training day.

The trainer will firstly carry out a registration session, gathering each participants details, including name, driver number and PPS Number. Drivers should produce their Driving Licence to the trainer.

The trainer will also check to ensure that all participants are attending the correct training module. If a driver should inadvertently attend the wrong training module, additional significant costs will be incurred by him or her to complete a further training day to correct the error.

The trainer will then carry out a short briefing session outlining the days agenda and informing drivers on typical housekeeping arrangements such as break times, emergency procedures, no smoking rules, no phone calls, etc.

The trainer will then carry out introductions during which he/she and all course participants will give a short introduction of themselves and a brief description of their driving career to date. These introductions will help the trainer to plan the delivery of the days training. During the course, the trainer will seek to engage each participant and draw on their driving experiences to date, good or bad.

This module – Control of the Vehicle and Eco-Driving Techniques - is divided into two separate sessions. Generally speaking, Session 1 is covered before the main break, which is then followed by Session 2.

The table below sets out the training aims for Session 1 along with an indication of the E. U. Directive requirements being covered.

SESSION 1 OBJECTIVES

Objective heading

To know the characteristics of commercial vehicle drivelines in order to make the best possible use of them.

Directive text

Curves relating to torque, power, and fuel consumption of an engine, area of optimum use of revolution counter, gearbox ratio cover diagrams.

Training aim.

At the end of this training the driver will understand;

1. Curves relating to torque
2. Engine performance curves
3. The area of optimal use of the rev counter according to the data of the vehicle manufacturers
4. Optimal engine speed range when shifting gears
5. Gearbox ratio cover diagrams according to the data of the vehicle manufacturers
6. Fuel consumption and economical driving
7. Vehicle Dynamics
8. Uncoupling and recoupling a trailer or semi-trailer to and from a drawing vehicle





Module 1.3 Control of the Vehicle and Eco-Driving Techniques.

In a highly competitive market place motor manufacturers constantly strive to improve vehicle performance and efficiency. Since the early 1990's they have invested heavily in efforts to reduce fuel consumption and achieve the standards defined in the 'Euro' emission regulations.

While improved vehicle aerodynamics and engine design have played a major role in reducing fuel consumption, the one area manufacturers have little control over is how the vehicle is driven on a daily basis.

"Manufacturers invest vast amounts of time and money trying to get a vehicle to go one more kilometre per 100 litres, but if the driver does not drive carefully and efficiently, the investment and savings are quickly lost" - Mr Martin Daum (Head of Operations, Mercedes-Benz, Woerth Germany).

In its present form the modern transport vehicle is now a fast, flexible and efficient means of providing transport services. Working within the limitations imposed by legal dimensions and emission regulations manufacturers are increasingly looking to the driver to further improve vehicle efficiency and performance.

All manufacturers can provide efficient driver training programmes tailored to particular vehicles and operating conditions. These programmes provide an update of new vehicle technology and explain how to get the best return from these new systems.

It is well established that even experienced drivers can have their driving style improved and therefore their fuel consumption reduced. At first, some more experienced drivers may not always see how the programmes could help them perform better, while others do. **However, it is now well established that the driver is the most important element in the challenge to reduce fuel costs** and the aim of this manual is to help drivers drive more safely and more economically.

By providing some information and guidance, it is hoped this module may enhance their individual skills, and prove beneficial for all.

Many training organisations provide practical driving assessments and training and some organisations use telematics to monitor the performance and behavior of their drivers. Committed and professional drivers have nothing to fear from these assessments. Many drivers report having found them useful and informative, particularly in relation to technological advances.

Data captured through telematics can be used to organize an individuals bespoke practical training, which can help the driver to make more efficient use of fuel and at the same time reduce the company's running costs.

Practical training like this is in addition to any Driver CPC Periodic refresher training provided as part of Driver CPC.

IMPORTANT

If in doubt about any of the specifications or guidelines relating to your vehicle, seek expert advice from the vehicle supplier or manufacturer, from your manager, or from another competent person.





SECTION A – CURVES RELATING TO TORQUE AND ENGINE POWER

When looking at the performance of commercial vehicles, whether a large Public Service Vehicle (bus) or Heavy Goods Vehicle (truck), torque and horsepower (hp) are the usual numbers quoted by vehicle manufacturers to indicate how strong or powerful their engines are. Understanding the principles of power and torque helps drivers to maximise the use of the power produced by the engine. This section is technical in nature and drivers should ask questions and seek any points of clarification if they are unsure about any aspect of it. In addition, drivers should feel free to ask questions on any related aspect of engine power.

Engine Horsepower

Horsepower is an Imperial measurement of power used to define the rate at which an engine performs work.

An engine is usually said to have achieved a certain maximum horsepower which is achieved at a specific engine speed. Once that speed is reached, no further increase in power is possible.

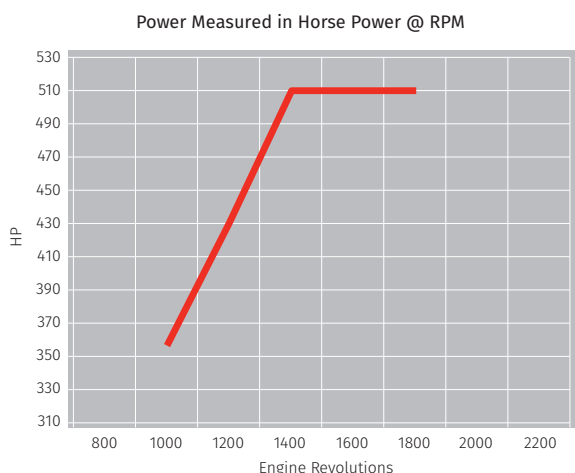
Example:

A maximum rated horsepower of 510 hp is achieved at 1,400 rpm.

The maximum horsepower of an engine is a function of its design and cannot be increased without changing components or engine parameters. Increasing engine speed above 1,400 rpm will not produce more power. While the term horsepower is still used when discussing engine power, the more correct term of Kilowatt (kW) is used by vehicle engineers.

Figures A1, A2, and A3 relate to Heavy Goods Vehicles (HGVs).

Fig. A1



As can be seen in figure A1 the power output of the engine increases as the engine revs increase from 1,000 rpm to 1,400 rpm. Above 1,400 rpm the

power output (Kw) levels off. Fuel consumption increases as the revs increase even though the power output remains the same. It is clear from figure A1 that it is inefficient to rev the engine above 1,400 rpm.

1 horsepower is equal to 745.7 watts or 0.75 kW and therefore 510 hp is equal to 380 kW.

$\text{kw} \times 1.36 = \text{hp}$.

Today, commercial vehicle manufacturers strive to produce high torque output at low rpm. This makes maximum use of the vehicle's ability to pull at relatively low engine speeds so fuel efficiency is increased.

Engine Torque

Torque is defined as a twisting force or 'turning effort'. It is measured at the end of the engine crankshaft. The unit of measurement is 'Newton Metres' (Nm). The higher the torque rating an engine has the better the vehicle will pull a load. As with horsepower, the maximum torque an engine can develop is a function of its design and is achieved over a specific engine speed range.

Example:

In the example given at Fig A2, the maximum torque of 2,500 Nm begins at 1,000 rpm, and peaks once the engine speed of 1,400 rpm is reached. Any further increase in engine speed cannot deliver more torque.

The higher engine speed will simply use extra fuel and this extra fuel is wasted as no additional torque can be achieved. This is important to a driver as he or she may simply be wasting fuel without any gain in time and may be unfavourably compared to another driver's fuel efficiency rating.

A driver who understands power curves and maximises efficiency by managing them may save a considerable amount of fuel by travelling extra distances for the same fuel consumption.

From studying the engine torque (Nm) output in





figure A2, it is notable that maximum torque is achieved from 1,000 rpm upwards.

Above 1,400 rpm the torque output (Nm) decreases - the engine performance decreases and is less fuel efficient.

Fig. A2

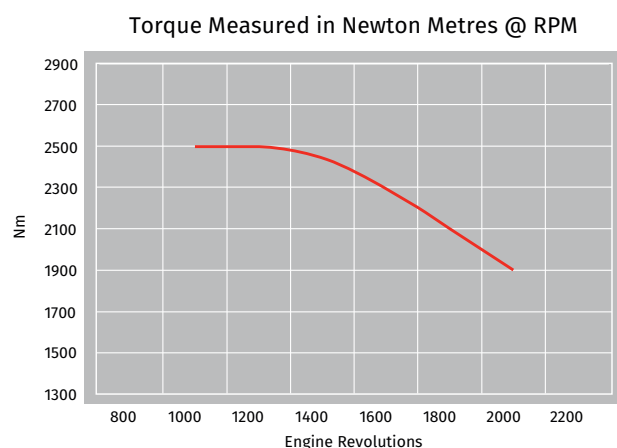
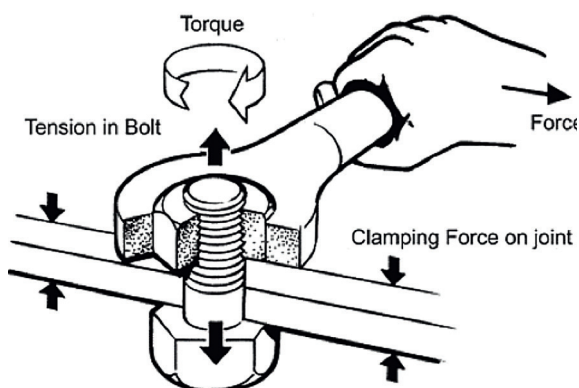
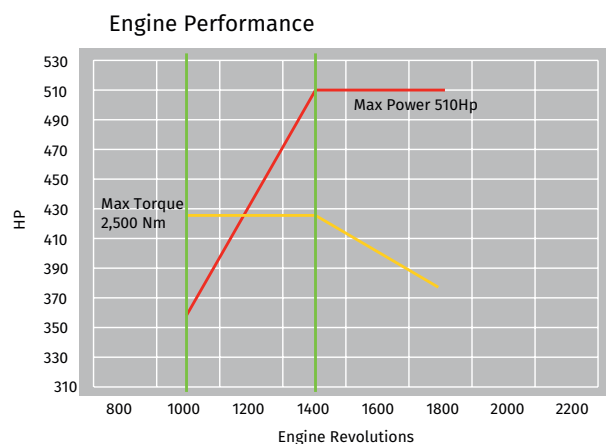


Figure A3 shows the power output (HP) as shown by the red line and torque (Nm) output as shown by the yellow line.

Fig. A3

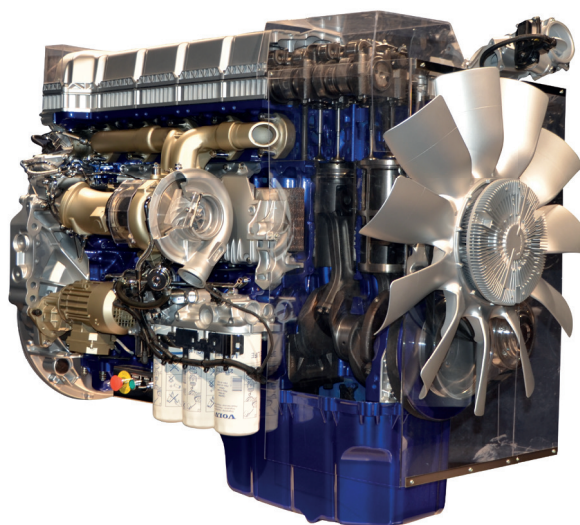
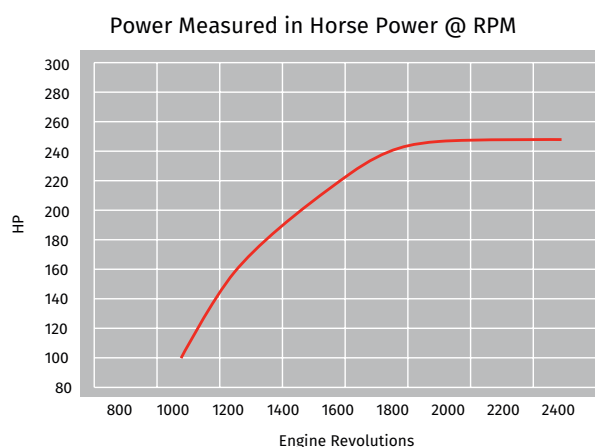


Example of how torque is produced

Performance curves for a typical 250hp engine

Observe the performance curve specified by a manufacturer on a specification sheet for a typical 250hp engine as shown in figure B1. Again, the power output chart is shown separate to the torque output chart (figures B1 & B2) to simplify the analysis, even though they are normally shown together on a specification sheet.

Fig. B1



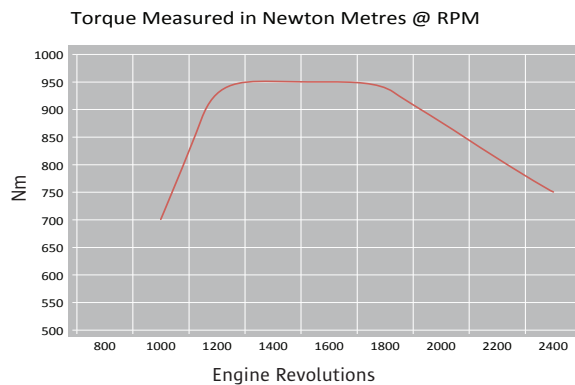
Cutaway view of a diesel engine

From studying the engine torque (Nm) output in figure B2, it is notable that there is high torque output (Nm) at 1,400 rpm.





Fig. B2



Note: The maximum torque output (Nm) from the diesel engine shown is achieved between the 1,400 to 1,700 rpm engine speed. Above 1,700 rpm the torque output (Nm) drops off - the engine performance decreases and is less fuel efficient.

Fig. B3

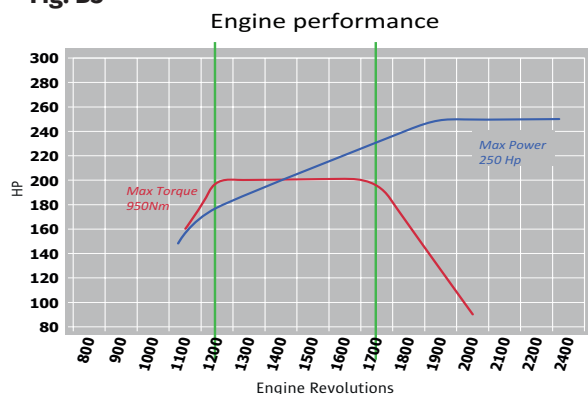


Figure B3 shows the power output (HP) as shown by the blue line and torque (Nm) output as shown by the red line.

Gear selection and performance curves

The larger commercial vehicles have high torque (Nm) output at low engine speed/revs. By utilising the many gears in the vehicle the driver can control the engine revs within the optimum rev zone on the tachometer/rev counter range (Green Zone) and the engine still functions with maximum efficiency.

When drivers confine the vehicle revs within the green zone of the tachometer (rev counter) the benefits are:

- High torque (Nm) output at low engine speed (rpm)
- Better fuel efficiency
- Less wear on engine parts

As was seen in the performance curves for the large commercial engines the modern diesel engines have very efficient power and torque curves that start at about 1000 rpm (low revs).

Revolution counter

A tachometer - more commonly known as a rev counter, shows the rate of rotation of the engines crankshaft. The display is traditionally in the form of an analogue dial but digital displays are increasingly common. The rev counter is one of the key tools for use by the driver in ensuring that the optimum use of the power produced by the engine is utilized in the most efficient manner.

The tachometer or rev counter measurement is made generally by a pick-up sensor on the engine fly wheel; however, components such as alternators can be used to pick up the engine speed. One revolution being a 360-degree rotation of the crankshaft. This can assist the driver in selecting the most appropriate throttle and gear settings.

Tachometers fitted to vehicles typically have markings indicating a safe range of speeds at which the engine may be operated. Prolonged use at high speeds may cause excessive wear and other damage to engines. On a tachometer this maximum speed is typically indicated by an area of the gauge marked in red.

A rev counter counts the revs per minute at which the engine is rotating. With modern engine management systems found in present-day vehicles, the tachometer is driven directly from the engine management system.





Optimum range

Modern large diesel engines have a small optimum range in the engine revolution band giving maximum power at minimal fuel consumption. Some manufacturers provide driver guidance in this respect by marking the optimum range on the face of the tachometer (rev counter). This is illustrated by the green zone from 1100 to 1500 rpm in the image below.

Blue range

The blue range indicated in the picture is the engine speed which produces the optimum braking effort when operating the endurance brake.

Top Torque Engines

Some manufacturers have developed what they describe as Top Torque engines. These engines have been designed to deliver improved performance and reduce fuel consumption.

A Top Torque rating means the engine will produce an extra 200 Nm of torque when cruising in top gear.

An example is a 13 litre engine with a rated power of 459 hp (330 kW) and a standard maximum

rated torque of 2,200 Nm delivered at 1,100 rpm. However, when cruising in top gear, (12th) the rated torque increases to 2,400 Nm – and importantly, it is still delivered at 1,100 rpm.

This helps the vehicle to achieve an improved torque curve with (almost) maximum torque being delivered at around 800 to 950 rpm. This means that when top gear is selected, an additional 200 Nm of torque is available to maintain cruising speed and reduce gear changing. This should make motorway driving more economical as the vehicle can maintain a consistently higher cruising speed, leading to improved journey times and reduced fuel consumption.

This new engine design combined with typical axle ratio of 2.533:1, allows the manufacturers to claim up to a 3% saving on fuel consumption.

In real terms, using calculations based on an annual mileage of 130,000 km, with an average fuel consumption of 28.5 litres per 100 kilometres, a 3% saving over 130,000 km equates to 1,100 litres of fuel and a reduction of about 3 tonnes of CO₂ emissions on a long distance tractor and semi-trailer.



Example of a tachometer





SELF-ASSESSMENT OF KNOWLEDGE

Please complete the following questions to help assess your understanding of the module so far:

Q.1 What is torque?

Your Response

Q.2 What unit is used to measure torque?

Your Response

Q.3 What happens if you accelerate beyond the maximum recommended rpm?

Your Response

Q.4 What does a typical manufacturers performance curve for an engine show?

Your Response

Q.5 What is horse power?

Your Response





Q.6 What unit is used to measure engine power?

Your Response

Q.7 Modern diesel engines have high torque output at what rev range?

Your Response

Q.8 Name 3 benefits of keeping engine speed/revs in the green optimum range of the tachometer rev counter.

Your Response

Q. 9 What are the benefits of a Top Torque engine?

Your Response

Q. 10 What is the typical difference in horse power output between the larger and smaller engines?

Your Response

Having completed these questions, your trainer will discuss typical answers with the group to ensure that drivers have a comprehensive understanding of the information and guidance provided. If you would like more information on any of the issues raised during this exercise, ask your trainer who will be pleased to discuss the issues and will encourage other participants to share their experiences to the benefit of all.

This concludes the section on Curves relating to Torque and Engine Power.





SECTION B – VEHICLE TRANSMISSIONS

This section looks at gearboxes and will give a definition as to the purpose of a gearbox in a vehicle. It will also provide some background as to how heavy vehicle gearboxes have changed over the years, and look towards future trends in gear selection in heavy vehicles. Whilst it is not possible to discuss every type of vehicle gearbox, it examines a number of gearbox types as commonly fitted to commercial vehicles. Your trainer will ask for relevant experience of the various gearbox types so that it may be shared with the group.

The Gearbox

The purpose of a gearbox in a vehicle is to provide a selection of ratios to suit varying road and load conditions.

This means the driver can select from the gearbox a ratio which multiplies the torque produced by the engine. This allows the vehicle to operate over a wide speed range, while maintaining the same engine speed.

From the previous section, we know that the power, and torque characteristics of an engine are set and cannot be changed. Therefore, the torque developed by the engine is maximized by the gearbox before it is transmitted to the final drive located in the rear axle, before being delivered to the road wheels. Effective use of the gearbox not only contributes to improved road safety but can also result in substantially improved fuel consumption as well a reduced environmental impact.

Crash Gearbox

Originally passenger cars and heavy vehicles were fitted with what is commonly referred to as a 'Crash Gearbox'. While remaining widely used in heavy vehicles throughout the world, in Europe their popularity has been in decline for many years and would now be quite rare. The Crash Gearbox required the driver to 'Double-Clutch' when changing gear. This method would enable the ratios to achieve the same speed and so the desired gear could be selected smoothly.

Synchromesh Gearboxes

The vast majority of manual transmissions fitted to heavy vehicles are described as Synchromesh Gearbox.

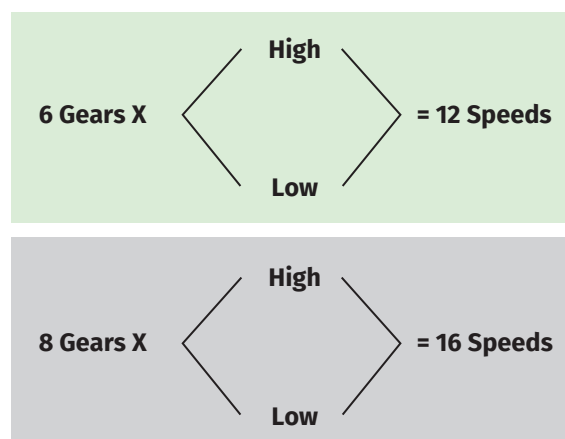
The transmission uses a small hub device, which contains a 'balk ring' and a 'cone'. This

device synchronises two gears that are rotating at different speeds. When the gear speeds are synchronised to the same speed gear selection is effortless. All ratios in a synchromesh transmission will have a synchromesh hub attached to aid gear selection, with the exception of first gear and reverse gear. These should only be selected when the vehicle is stationary.

It is recommended the driver use a 'Single-Clutch' action when selecting gears, as would be normal in a passenger car. Because of the mechanism involved, it is not necessary to double-declutch.

Number of Ratios

The number of ratios in heavy vehicle transmissions has been reducing over recent years. Typical transmissions may offer a standard six, or eight speed option. For heavier applications, the same six or eight speed can offer a 'high and low' ratio for each of the gears.



(This is not inclusive of Crawler Gears, or Reversing Gears. A crawler gear is used for particularly heavy pulling at low speeds).





The Range Change Transmission

A gearbox is fitted with an air/electric switch, which when activated changes between a lower set of gears and a higher set of gears. The number of gears in the Low Set and the High Set may vary between transmission types. Some may have three low and three high, giving an option of six gears. Others may have five low and five high giving an option of ten gears. The Range Change should be selected when in gear prior to changing range, but the 'range change' only operates when the gear selector passes through Neutral. Making optimal use of the range change helps drivers to reduce fuel consumption. Whilst it may take a little time to master use of the range change, the long-term benefits mean that the driver will be able to control the vehicle more smoothly and reduce unnecessary fuel wastage.

(Example)

Low Range Gears 1 – 4 ↔ High Range Gears 5 – 8

The Range Change Transmission with 'Splitter' Function

The Splitter function fitted to many transmissions allows the driver to select an alternative ratio in each gear. The benefit is that when heavily loaded or when climbing hills, vehicle momentum may not allow a full gear to be changed. By splitting the gear, the vehicle can increase momentum gradually. Split gears are sometimes referred to as half gears. The Splitter switch can be pre-selected, but will only engage the desired ratio when the clutch is depressed.

Example of splitting gears with a 12-speed transmission from a standing start

(Ls = Low Split) (Hs = High Split)

**(1st Ls) (3rd Ls) (Change to Hi Range) (4th Ls)
(5th Ls) (5th Hs) (6th Ls) (6th Hs)**



For drivers new to heavy vehicles it may appear somewhat daunting at first. However from the example above, moving from stopped to cruising speed requires only 'five' movements of the gear selector.

Pictured is a 16-speed range change with splitter function as fitted to a DAF 'CF' truck. The transmission is produced by the automotive component company 'ZF Friedrichshafen AG', and is widely used by a number of commercial vehicle manufacturers. While they may use the same gearbox, the method of changing gears and the shifting patterns may vary.

Gear Shifting Patterns

Shift patterns vary widely between vehicle types and producers may arrange the selection patterns of gears in formats such as-

Five speed / Six Speed / Eight Speed

For transmissions used in vehicle Categories - D1 and C1 and for some smaller vehicles of Categories D and C

Four-over-Four / Four-beside-Four / Three-over-Three

For transmissions used in heavier vehicles of Categories C, D, and vehicles in Categories D+E and C+E

Manufacturers' recommend the use of 1st. gear to move the vehicle from a standing position. From 1st gear, ratios may be skipped depending on load and road conditions.

Four-over-Four

This type of gear selection arranges the shift pattern in a similar manner to a four-speed passenger car. Moving from 1st through to 4th in the 'Low Box'. When in fourth gear, the driver should then operate the 'Range Change' Switch, normally this would mean moving the switch to the 'up' position.

When the vehicle has reached a suitable road speed, the gear selector should be moved back to the 1st gear position. As the selector passes through neutral, the Range Change switch is activated and moves into the 'High Box'. This means that when the selector arrives at the 1st gear position the transmission is now in 5th Gear. Once in the 'High Box' 6th, 7th, and 8th gears can be selected.

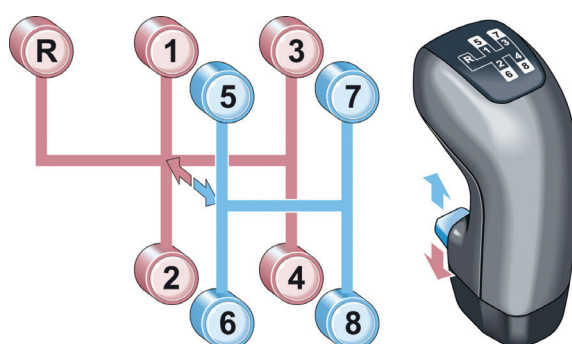




To return to the lower ratios 1-4, the Range Change switch must be flicked down and pass through neutral. Most vehicle and transmission manufacturers fit a device called an 'inhibitor' so as not to allow this action to occur when the road speed is too high. (Generally at speeds in excess of 25-30 km/h)



**8 Speed Range Change Transmission
Shift Pattern Arranged 'Four-over-Four'**



**GR875
8 - Speed Range Change Transmission
Shift Pattern**

Four-beside-Four

This transmission type in most cases is the same as the 8 or 16 speed Four over Four. The two transmissions only differ in the method of gear selection.

The primary difference with this version is that the range change switch is an installed component of the gearbox itself. The driver is not required to flick an external switch. The range is changed as the gear selector passes from the

lower four ratios to the higher four ratios and vice-versa.

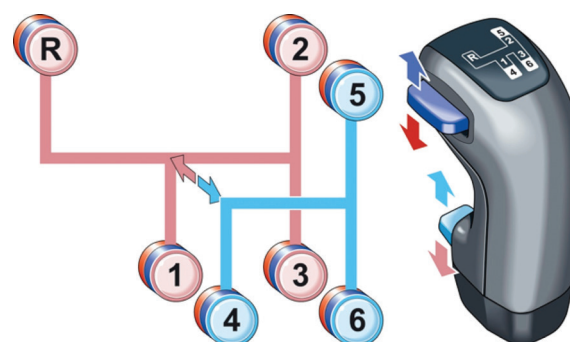


Range Change
Control located in
Neutral Position

8 Speed Range Change Transmission

From the picture, it can be seen that the lever moves from the low gears (1, 2, 3 & 4) to the high gears (5, 6, 7 & 8)

It must pass through Neutral where it activates the Range Change. The same action occurs when changing down from the high gears to the low gears.



Three-over-Three

Due to the wider usable torque bands of modern engines, a number of vehicle producers have moved away from 8 and 16 speed transmissions. Instead, they have opted for 6 and 12 speed models. This has realised benefits for the driver and many believe it leads to reduced fuel consumption.

In principle it operates in the same manner as the 8/16 speed in that it is fitted with a range change for the 6 speed and a range change and splitter for 12 speeds. The difference is that the gear selector only moves through three gear positions.





In the low box the available gears are 1st, 2nd and 3rd. When in 3rd, the range change switch is moved up and the gear selector is returned to the 1st gear position. As the range change is activated as the selector passes through neutral when the lever arrives in the 1st gear position, it is now in the high box and 4th gear has been selected. From here, available ratios are 4th, 5th, and 6th. The splitter switch offers a high and low ratio on all of the six gears and it provides a total of 12 speeds for the driver to choose from.

As previously stated the number of ratios noted here does not include transmissions which are fitted with 'Crawler' gears. It also does not count gears for reversing the vehicle.

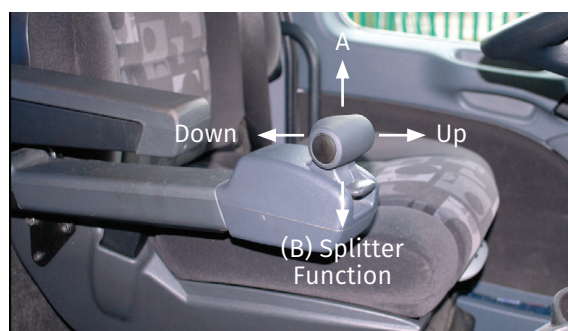
Electronic Gear Selection

Since the mid-to late 1980's some manufacturers' enhanced gear selection through the application of computer technology, making the selection of appropriate ratios more precise, and demanding less effort from the driver.

Depending on the vehicle make, to change gear the driver simply moved a gear selector to activate an 'Electronic Control Unit' (ECU). This ECU would then send a signal to the transmission to select a ratio higher or lower, suitable to the speed of the vehicle or the driving environment at the time. The system protected the transmission, and would only allow ratios to be selected that were suitable for the speed of the vehicle.

Gear selection was improved, as there was no need for a gear linkage assembly. This also allowed the electronic switchgear to be located somewhere other than the cab floor. It is important to note that the early versions fitted to vehicles still required the use of a clutch pedal when changing gear. In fact, the primary components used are exactly the same as an ordinary manual transmission system, and they operated in the same manner.

The main difference being as the title electronic gear selection suggests, that the gear selected by the driver - is changed electronically.



'Electronic Power Shift' Electronic Gear Selection Control

Selector (A) moved forward to change up and moved back to change down

Control (B) operates Splitter function

Automated Manual Transmission (AMT)

The popularity of AMT's has increased dramatically in recent years. On a European wide basis, in excess of 95% of all new heavy vehicles sold are now fitted with an Automated Manual Transmission and the percentage is increasing.

While each manufacturer will apply a different brand name to their version, in principle all AMT's operate in the same manner. As with Electronic Gear Selection, the title AMT best describes what an AMT is.

"An Automated Manual Transmission is: A manual transmission where the process of gear selection is automated"

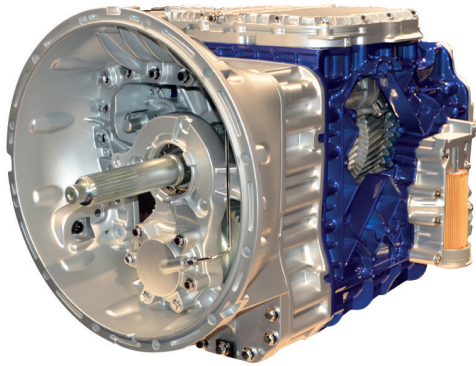
It is most important to note that an AMT is not an 'Automatic Transmission', and that it is only the changing of gear ratios that is automated. This is achieved via an electro mechanical system controlled by an ECU.

An Automated Manual Transmission fitted to a heavy vehicle, is in effect exactly the same as the Standard Manual Transmission alternative - fitted to the same vehicle.

AMT's offer the driver many benefits and relieve the stresses associated with continuous gear changing. This is of particular benefit for those engaged in city or urban driving where dealing with high traffic volumes where pedestrians and other vulnerable road users pose constant hazards.

Depending on vehicle specification, the driver selects the 'Drive Mode' and the ECU will ensure that the correct ratio is selected at any time during the journey. A separate 'Manoeuvring Mode' can be selected for low speed driving either forwards or when reversing.





Cutaway view of a gearbox.

The majority of AMT's do not have a clutch pedal and as such are often referred to as 'two pedal' systems. Manufacturers will recommend that when stationary for any extended period of time, or when holding the vehicle on a hill, that the driver selects 'Neutral', and applies the Parking Brake, or uses the Hill Holding device - as would be the case with manual transmission.

This is recommended because most AMT's are fitted with the same clutch disc and pressure plate arrangement as the manual versions, and to leave "in gear" for prolonged periods may cause the clutch disc to overheat resulting in excessive wear.

Since their introduction, AMT's have proven to be very reliable, improve fuel economy, and reduce driver stress and fatigue. The rate at which they are being improved and enhanced is ever increasing.



Automated Manual Transmission

'I-Shift' 12 Speed - (Two Pedal)

For smaller vehicles Volvo use a similar system 'I-Sync'



Tipmatic AMT

Driving Mode Selector I



Example of Stralis Gear selector



Stralis Driving Mode Selector

Example of Automatic Gear Selection





Automatic Transmission

A full Automatic Transmission in a heavy vehicle operates in the same manner as one fitted to a passenger car, using a hydraulic fluid (ATF) to change ratios. In a fully Automatic Transmission the clutch pressure plate and disc is replaced by a 'Torque Converter'.

As the engine speed increases, the Torque Converter also increases in speed, and moves hydraulic fluid from one side to the other. This movement operates a series of clutch bands, which multiply the torque in the transmission.

Automatic Transmissions are well suited to multi stop-start operations such as refuse collection, city centre passenger services, and multi drop deliveries. Another benefit of the torque converter is its ability to absorb large amounts of stress by acting as a damper or impact absorber for the driveline. This ability makes the fully automatic transmission well suited to heavy haulage applications.

Dual Clutch Transmissions

A Dual Clutch Transmission (DCT) is a method of running two gearboxes in parallel, with all the odd number gears in one gearbox and the even number gears in the other. This allows the next gear ratio to be preselected and then engaged instantly when required.

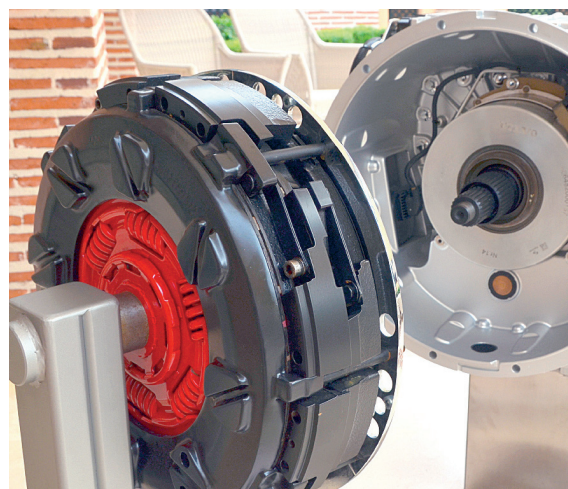
Being able to preselect means that there is almost no interruption in the transfer of torque through the driveline to the road wheels.

This results in reduced driveline wear and an improved ability to climb hills.

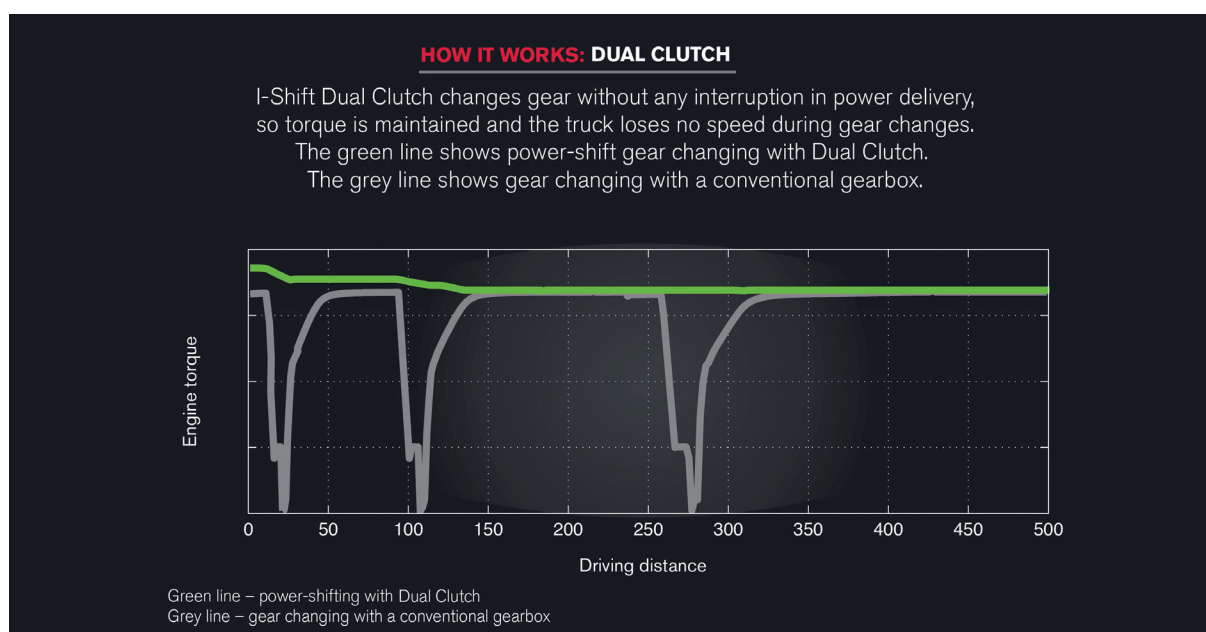
The technology behind Dual Clutch Transmissions (DCT) is not new. In the passenger car sector DCTs have been available for many years and their popularity is increasing. However, the fitting of DCT systems to heavy vehicles has previously posed some engineering problems.

Currently, some Dual Clutch Powershifting only works for sequential gear changes. This means that the transmission will only change from e. g., 7th to 8th to 9th, etc. in sequence.

However, when driving conditions allow the truck to skip gears – for example when moving off – the transmission may shift from 2nd to 4th to 6th. In this case the transmission behaves as a



Example of Dual Clutch.



Example of unbroken torque with a DCT system.





normal AMT. Also when changing range from 6th to 7th or using the kick-down function, (if fitted) a Powershift does not take place.

When operating in Powershift mode the gear changes are hardly noticeable unless you are watching the rev counter.

The DCT system delivers particular benefits for certain transport applications, an example being in forestry work where operating a truck that will change gear without breaking torque can mean the difference between getting stuck or not.

Other applications include hanging loads, liquid tank transport and when running laden on twisting roads or over hilly terrain. Some vehicle producers believe that within ten years, DCT's will be the standard transmission function.

Transmission

Equally as important as power and torque figures is the method of transmitting the power from the engine to the road wheels. Selecting the correct gearbox or transmission to suit the type of work intended for the vehicle is vital.

The transmission suitable for a heavy haulage vehicle with a high torque rating would deliver poor fuel consumption if fitted to a long-haul truck or a coach. However, while a high ratio driveline fitted to a coach is fine for passenger transport, it would not have sufficient torque to pull a heavy vehicle weighing in excess of forty tonnes.

The transmission and driveline fitted to a vehicle should be suitable to the work intended for that vehicle.

The example below shows how the transmission and final drive can affect vehicle performance.

Example:

Vehicle	Rated HP	Rated Torque	rpm @ 80 Km/h
A	510 Hp	2,500 Nm	1,150 rpm
B	510 Hp	2,500 Nm	1,450 rpm

Vehicle 'A' will provide better fuel economy when driven at a steady 80 Km/h on main roads or motorways. Whereas vehicle 'B' due to a lower ratio transmission or final drive has a higher engine speed at the same road speed which will increase fuel consumption.

The benefit of the driveline fitted to vehicle 'B' is that it will deliver maximum torque at lower rpm and would be more suited to urban driving or off-road work.



Fully Automatic six-speed transmission



ZF Automatic Transmisson





SELF-ASSESSMENT OF KNOWLEDGE

Please complete the following questions to help assess your understanding of the module so far:

Q.1 What is the purpose of a gearbox?

Your Response

Q.2 How does a synchromesh gearbox work?

Your Response

Q.3 What is a gear 'splitter' function?

Your Response

Q.4 How does an Electronic Control Unit (ECU) affect gear changes?

Your Response

Q.5 What is an automated manual transmission?

Your Response





Q.6 What type of gearbox ratio would be fitted to a truck?

Your Response

Q.7 What type of gearbox ratio would be fitted to a bus or coach?

Your Response

Q.8 What are the advantages of an automatic gearbox?

Your Response

Q.9 What are known as two-pedal systems?

Your Response

Q.10 How did electronic gear selection affect the traditional gear linkage assembly?

Your Response

Having completed these questions, your trainer will discuss typical answers with the group to ensure that drivers have a comprehensive understanding of the information and guidance provided. If you would like more information on any of the issues raised during this exercise, ask your trainer who will be pleased to discuss the issues and will encourage other participants to share their experiences to the benefit of all.

This concludes the section on Vehicle Transmissions.





SECTION C – AXLE CONFIGURATIONS AND THE FINAL DRIVE

The Final Drive in standard commercial vehicles is nearly always located in a rear axle of the vehicle designating them as 'rear wheel drive'. There are some 'front wheel drive' trucks and buses, though the majority of these are special purpose units built for particular applications. For the benefit of clarity in this section, we are describing the final drive and differential unit in a 'rear wheel drive' format.

Most standard road-going commercials regardless of the number of axles fitted use only one of the axles to drive the vehicle. A passenger bus or coach with two axles will employ the rearmost axle to drive the vehicle. If a bus or coach were fitted with three axles, it will still only use one of the axles, and one set of wheels to drive the vehicle.

The same applies for heavy goods vehicles. Where trucks including tractor units are fitted with two axles, the rear set are driven. If the truck has more than two axles it remains the norm for only one set to drive the vehicle. However, employing more than one axle to drive the vehicle is a practice more commonly found in trucks than buses. It is more common for trucks to require some degree of off-road capability than passenger transport units. For example construction vehicles which operate in quarries and on building sites.

Axle Configurations

The axles of transport vehicles can be configured in many different ways. Vehicles are designated with regard to the number of axles and the number of those axles that are driven. For example a standard bus or truck having two axles with one of the axles driven is commonly referred to as a '4 x 2'. The vehicle has four wheels of which two are driven. Some other common configurations are shown in the table below.

The table notes some of the more common configurations found in general use. For special

types of work the principle can be extended to use all of the axles to drive all of the wheels. For example, purpose built trucks used by defence forces and emergency services may be configured to have four axles with eight wheels, with all wheels being driven – (8 x 8).

Trucks and buses having more than two axles may employ more than one axle to assist with steering. This configuration, known as 'twin steer' is commonly found on tipper trucks in Ireland. Another alternative can be to locate another steering axle at the rear of the vehicle known as a 'rear steer' axle. Depending on vehicle specification, it may be possible to lift one or more of these axles when the extra carrying capacity is not needed.

The Rear Axle

(Front engine rear wheel drive vehicles)

The rear axle is the last major component of the vehicle's driveline. Power from the engine is transmitted through the transmission to the drive shaft which connects the transmission to the rear axle.

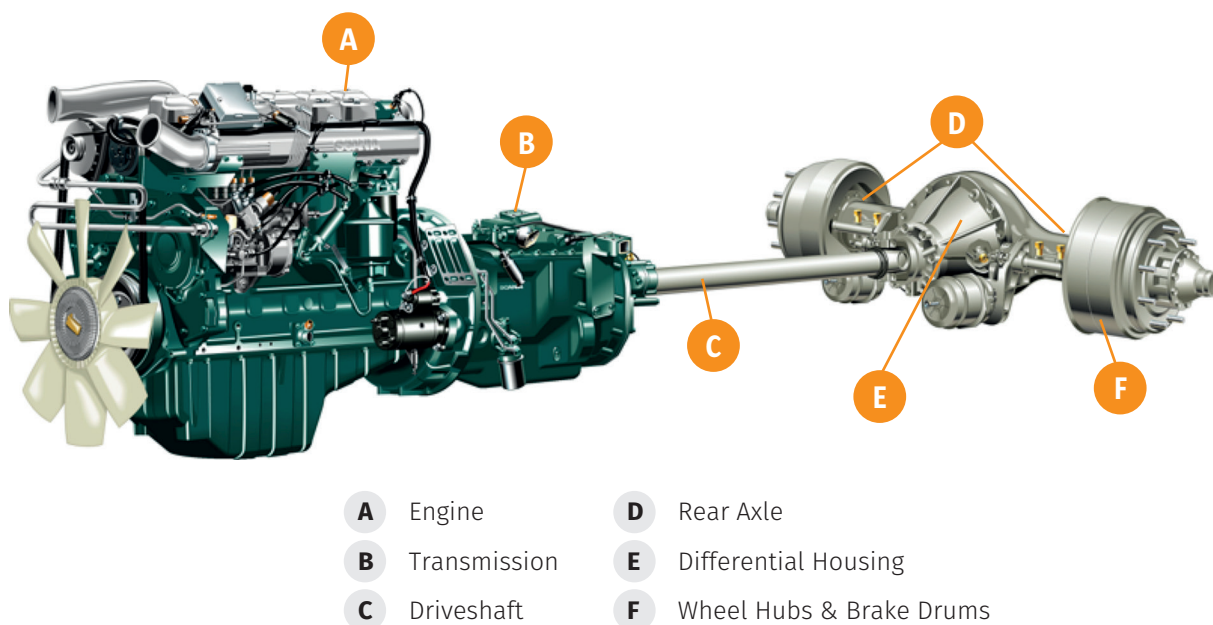
A common trait of engines is that they are designed to work in a 'clockwise' direction. One effect of the engine turning clockwise is to turn the transmission in the same direction and likewise the driveshaft. When the engine's torque reaches the rear axle it must then be turned at a right angle before it can be transmitted to the road wheels. This is accomplished by fitting a 'Crown Wheel & Pinion'.

Vehicle Type	Number of Axles	Number of Wheels	Number of Driven Wheels	Designation	Application
Truck/Bus	2	4	2	4 x 2	General Purpose
Truck/Bus	3	6	2	6 x 2	General Purpose
Truck	4	8	2	8 x 2	General Purpose
Truck	3	6	4	6 x 4	Off-Road Ability
Truck	4	8	4	8 x 4	Off-Road Ability

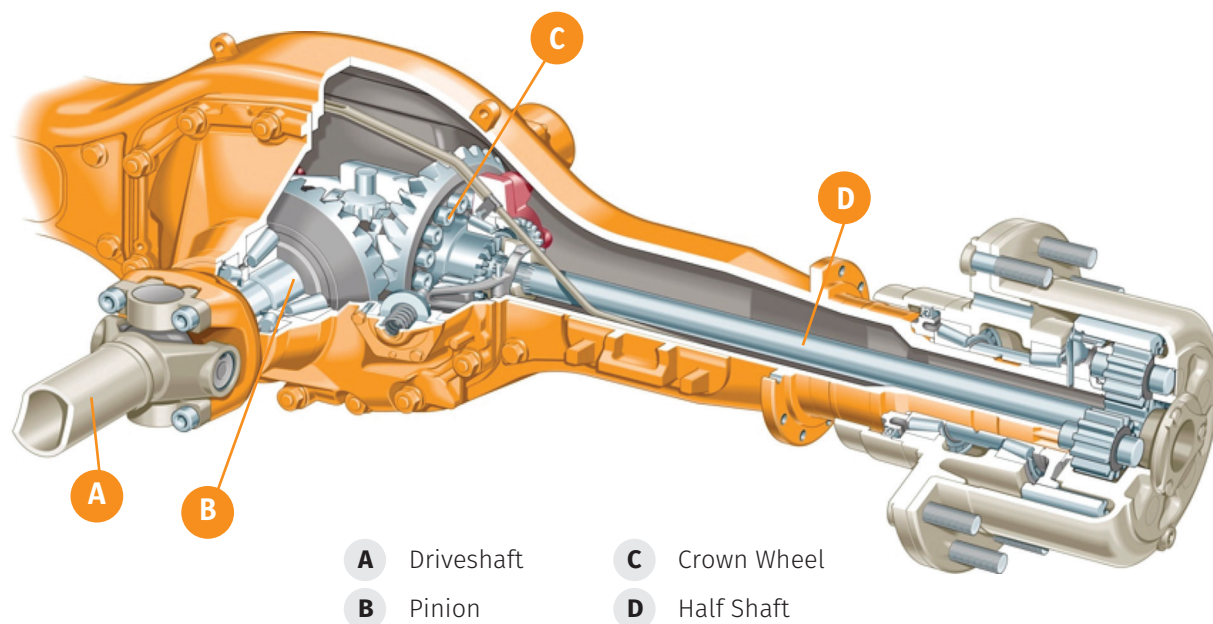




Typical Vehicle Driveline



The diagram below shows a 'cutaway' view of a Drive Axle. Its main components consist of a 'Pinion' and 'Crown Wheel'. The Pinion is located at the end of the Driveshaft and is turned by the Driveshaft in the same direction. The Crown Wheel sits at a right angle to the Pinion. When the Crown Wheel is turned by the Pinion - the Crown Wheel is rotated at a right angle.



Connected to either side of the Crown Wheel are two Half-Shafts which transmit the drive from the Crown Wheel to the road wheels. As the Crown Wheel is rotated the Half Shafts are turned and therefore the road wheels are turned. To enable the vehicle to reverse the driveshaft must rotate in the opposite direction. This is accomplished by a reverse gear within the transmission where the drive from the engine is altered to allow the driveshaft to rotate 'anticlockwise' - causing the desired effect within the differential.





In addition to transferring the engine's drive at right angles to turn the road wheels, another function of the differential is to allow one set of wheels on an axle to rotate at a higher speed than the other set when turning. For example, if a vehicle is turning left the drive wheels on the offside must travel a greater distance than those on the nearside. The differential enables the offside wheels to travel faster and so cover the greater distance in the same amount of time.

Differential Locks

If a vehicle encounters driving conditions such as soft or slippery ground which allows one or more of the drive wheels to spin, the 'Differential Lock' should be engaged. The diff-lock has the effect of joining the two rear axle half-shafts together meaning that engine torque will be distributed evenly to both drive wheels. Ensuring that both drive wheels rotate at the same speed should improve traction until normal conditions resume.

NOTE. Once normal traction has resumed it is imperative that the differential lock is disengaged at the first opportunity, as the system operates by ensuring the wheels rotate at the same speed. It will not allow the vehicle to turn or manoeuvre in normal driving conditions and any attempt to do so could result in extensive damage to the components.

Inter-axle Locks

Vehicles engaged in more extreme off-road work may require an inter-axle lock. This system would normally lock two or more axles together to rotate at the same speed. Further traction can be gained from engaging the diff-locks or cross locks on each of the axles if conditions demand.

Engaging inter-axle locks has the effect of changing a vehicle from a standard road going six-wheeled (6 x 2) to a six-wheeled (6 x 4), or an eight-wheeled (8 x 2) to an eight-wheeled (8 x 4 or 8 x 6).

Axle Ratios

The final drive ratio has a significant effect on vehicle performance. The drive ratio of a vehicle depends on the number of teeth on the Crown Wheel and Pinion.

Example:

Number of teeth on the Crown Wheel = 60 /
Number of teeth on the Pinion = 16

To find the ratio divide the number of teeth on the Crown Wheel by the number of teeth on the Pinion.

$$(60 \div 16 = 3.75)$$

The example shows a ratio of 3.75, this is normally expressed as 3.75 to 1 (3.75:1)

This means that the driveshaft must turn 3.75 times for the axle to turn once

When discussing drive axle ratios what can appear unusual is that the term 'Low Diff' is in fact numerically higher. Conversely, a ratio termed as a 'High Diff' is numerically lower.

(A) A final drive ratio of 3.15:1 - would be described as a 'Higher Diff'

than

(B) A final drive ratio of 4.15:1 - which would be described as a 'Lower Diff'

Example	Axle Ratio	Turns of Drive Shaft	Turns of Axle	Performance Rating
A	3.15:1	3.15	1	Good Fuel Economy / Less Pulling Power
B	4.15:1	4.15	1	Good Pulling Power / Less Fuel Economy

The **Lower** the number - the **Higher** the ratio

The **Higher** the number - the **Lower** the ratio

Key Points

- Specification of the Final Drive ratio greatly affects vehicle performance.
- Only operate Differential Locks on loose or slippery surfaces.
- Disengage Differential Locks once normal traction is resumed.
- Differential locking systems vary widely in methods of engagement and operation.
- The onus is on the driver to understand how to operate the system correctly.
- If not operated as per manufacturer's recommendations, the risk of severe damage to driveline components is high.





Rear engine rear wheel drive vehicles

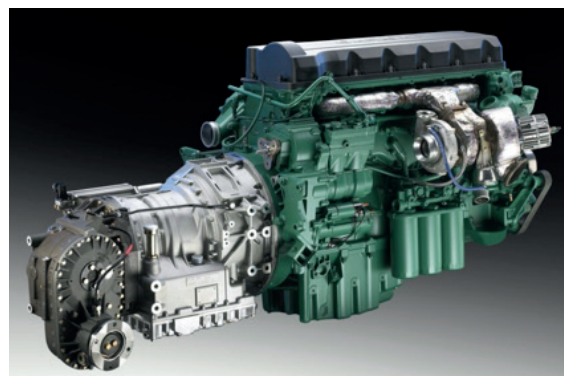
The use of rear or mid-engined vehicles is more widespread in passenger transport than the goods sector. Mid or rear engine vehicles are usually used in the passenger carrying industry where space is saved enabling additional carrying capacity. From the drivers perspective, where the engine is located has no significant effect on a vehicles performance.



Example of a bus chassis and a rear mounted engine

A rear engined rear wheel drive bus still requires the same components to construct the driveline as described previously.

The main difference being that the components are arranged in a different way. In a rear or mid-engined vehicle the driveshaft may be shorter.



Example of a rear engine rear wheel drive transmission.

Alternatively, for some rear wheel drive passenger vehicles, there may be no need for a drive shaft as the half shafts are driven directly from the differential, housed within the transmission casing.

For urban and city centre passenger vehicles, it can be more beneficial to locate the drive train transversely at the rear. By mounting the components in this manner, it can allow greater scope to increase carrying capacity.

Irrespective of whichever format the drive-line is arranged in, the concepts discussed previously in this section apply to all.

It is important to obtain exact operating instructions from the vehicle Manufacturer regarding specific vehicles.





SELF-ASSESSMENT OF KNOWLEDGE

Please complete the following questions to help assess your understanding of the module so far:

Q.1 What vehicles may have more than one drive axle?

Your Response

Q.2 What is meant by the term 4x2?

Your Response

Q.3 What is the advantage of having a 4-wheel drive vehicle?

Your Response

Q.4 What are the main components of a drive axle?

Your Response

Q.5 What is the function of a differential?

Your Response





Q.6 What does a differential lock do?

Your Response

Q.7 When should the differential lock be disengaged?

Your Response

Q.8 Why does a tipper truck need a different rear axle ratio than a bus?

Your Response

Q.9 What is the benefit of choosing a vehicle with a mid or rear-mounted engine?

Your Response

Q.10 When should you refer to the manufacturers specifications?

Your Response

Having completed these questions, your trainer will discuss typical answers with the group to ensure that drivers have a comprehensive understanding of the information and guidance provided. If you would like more information on any of the issues raised during this exercise, ask your trainer who will be pleased to discuss the issues and will encourage other participants to share their experiences to the benefit of all.

This concludes the section on Axle Configurations and the Final Drive.





SECTION D – FUEL CONSUMPTION AND ECONOMICAL DRIVING

This section focuses on the fuel consumption of a vehicle. As fuel consumption is directly linked to the profitability of an organization, it can ultimately affect the security of employment of all staff including the driver. The efficient use of fuel is also closely linked to improved road safety in that less harsh acceleration and braking leads to reduced wear and tear on the vehicle and the smoother flow of traffic. In turn it can also have a positive effect on the stress levels of the driver as well as on the environment.

The Environment

Transport is an essential part of modern life, but we cannot ignore its environmental consequences – local, regional and global. There is increasing public concern for the protection of our environment, with the result that many motor vehicle manufacturers are devoting more time, effort and resources to the development of environmentally-friendly vehicles. Considerable research and effort is taking place to develop more efficient vehicles and the following explains the effects of pollution and what you, the driver, can do to help.

The drive for fuel efficiency

As fuel plays a fundamental role within a transport or logistics organisation, the fluctuation of the price of fuel can have a marked effect on the profits of a company. It is impossible to forecast crude oil prices accurately because there are so many unpredictable factors at work, including political instability, level of world demand, and policy decisions on production volumes by the major oil producing countries. This means that an investment in an efficient fuel management programme may pay greater dividends in the future.

Factors affecting fuel consumption

The fuel consumption of a large vehicle is dependent on a number of factors, including

- the driver
- the vehicle
- the road
- the load

- the traffic
- the weather

While many factors affecting fuel consumption are outside a drivers control, it is helpful to understand their effects so you can begin to measure your litres per 100 kilometres (l/100km) effectively and set a benchmark for yourself. Experienced and professional drivers can reduce the impact of these negative factors on fuel economy.

The adoption of a smoother driving style will deliver many benefits for the driver, for the operator and for road safety. A smoother driving style with good forward planning will, whenever possible, allow the vehicle to keep moving.

This approach will involve less gear changing and will reduce the number of stop/starts by using the vehicles momentum to achieve a good journey time.

An example would be when approaching an obstruction such as a parked car - by slowing the vehicle early allowing room for oncoming traffic to pass by, it then may be possible to block change down a number of gears - and then resume progress as the oncoming traffic clears, allowing you to keep your vehicle moving without having to stop completely.

To move a loaded vehicle from a standing stop requires more gear changing and demands more fuel than if the vehicle's momentum can be used to keep moving.

A key point of driver training programmes for advanced/economical driving is to read the road well ahead and plan accordingly.

This enables the driver to maintain reasonable forward progress.





Early and appropriate use of auxiliary braking systems such as retarders and exhaust brakes help to reduce brake lining wear and reduce maintenance costs.

Harsh braking should be avoided if possible, especially for passenger vehicles as this can result in discomfort and even injury to the occupants.

With goods vehicles, harsh braking may affect load stability and vehicle dynamics, particularly with hanging or liquid loads or vehicles with a high centre of gravity.

In addition, fuel consumption is increased when re-accelerating back up to cruising speed.

Fuel consumption

Remember - the driver has the single biggest impact on both fuel consumption and safety.

While there are a number of ways to improve fuel economy, the four approaches outlined below should feature on your list:

Driving style: Always drive sensibly and keep within the speed limit. Exceeding a speed limit by only a few kilometres per hour will mean that you use more fuel but, more importantly, you are breaking the law and increasing the risk of serious injury if you're involved in a collision. Use cruise control, when appropriate, if it's fitted. Using cruise control keeps a steady setting on the accelerator, so not varying the intake of fuel. It can also help to maintain your speed within the speed limit. Do not use the cruise control in adverse road conditions such as frost or ice. If in doubt, refer to the manufacturers guidelines.

Accelerator: Try to use the accelerator smoothly and progressively. When appropriate, take your foot off the pedal and allow the momentum of the vehicle to take you forward. Taking your foot off the accelerator when going downhill can save a considerable amount of fuel without any loss of vehicle control. Rather than use your brakes for a long period, with the risk of brake fade, you should control downhill speed by early use of the lower gears and correct use of endurance braking systems. Whenever possible, avoid rapid acceleration or heavy braking as this leads to greater fuel consumption and more pollution.

Driving smoothly can reduce fuel consumption as well as reducing wear and tear on your vehicle.

Engine power: Modern vehicles are designed to deliver power even when engine revs are quite low.

You'll find that you can make use of the higher gears at low speeds.

Gears: It is not always necessary to change up or down through each gear - it is possible from time to time to skip gears. This helps to reduce the amount of time you spend accelerating, and as this is when fuel consumption is at its highest, you can save fuel by missing out some gears. Take time to practice missing out on some gears when safe and appropriate to do so, and familiarise yourself with the effect on the vehicle.

As soon as conditions allow, use the highest gear possible without making the engine struggle.

Economical Driving

All professional bus and truck drivers should be aware of the following, particularly if they are conscious of the high costs of fuel both in financial and ecological terms.

- By planning well ahead and keeping the vehicle moving, gear changes will be reduced and fuel will be saved. Awareness is essential to road safety. It also enables early selection of the gear and speed appropriate for the situation. The result is a safe and economical drive.
- Using the correct gear, engine speed and position for any given situation also results in a more environmentally friendly operation.
- Use of information gained through observation gives more time to plan ahead and systematically avoid hazards.
- The speed gathered under power can be used to ascend and descend hills on undulating roads without the use of the accelerator.
- The fewer the gear changes, the less the physical activity needed and the more fuel efficient the operation. When the footbrake is used the road speed that has been lost has to be made up by using the accelerator, thereby burning fuel.
- If it becomes necessary to change down a gear or half gear then even more fuel is used. The load is also more likely to shift under heavy braking.
- Regaining vehicle momentum after harsh braking uses more fuel and requires an increase in the number of gear changes that you may subsequently have to make.
- By using the exhaust brake/retarder system instead of the footbrake, brake life is extended. When the exhaust brake is applied, there is no delivery of fuel to the combustion chamber. The vehicle is driven forward by its own momentum, so there is





- no need for fuel to be consumed.
- Use of endurance braking will contribute to smoother reductions in speed, increase the lifespan of brake linings and save fuel. Wear and tear on the engine and running gear will be reduced and the vehicle will be able to run at its most economical output.
 - Optimum use of motorways and dual carriageways will result in a safer, more consistent and more economical drive. Use of constant speeds on motorways and dual carriageways will enable full use of cruise control, leading to less gear changes.
 - Commercial vehicles that have a large frontal area will use less fuel if fitted with correctly adjusted aerodynamic body styling equipment.
 - Correct load distribution may reduce your fuel consumption. Care should be taken not to overload any axle on the vehicle or trailer.
 - Technology will only assist in fuel economy and safe and efficient operation if the driver is fully familiar with the vehicle's systems.
 - Vehicle technology advances rapidly, therefore drivers should read the vehicle's handbook to ensure they are fully up-to-date with the on-board systems installed.
 - Lower engine speeds give higher levels of fuel economy. Good engine choice and computer controlled management systems reduces noise levels (to avoid engine strain) and computer-controlled engine management systems reduces noise levels and assists in maximising fuel economy.
 - Minimising the height of the load will save fuel by reducing the drag of the vehicle. This is particularly relevant when using a flat-bodied vehicle or trailer. Knowing how to load your vehicle is central to your fuel performance.
 - Sheeting a load or an empty tipper body can save fuel because it reduces aerodynamic drag.
 - Correctly inflated tyres offer less resistance on the road, improve fuel economy, give greater stability and reduce the risk of accidents.
 - Telematics can also be a useful tool to help ensure operational efficiency.

From the image below, we can see that the average fuel consumption is in the red and therefore requires further attention.



Example of On-board Eco Driving Assessment.





Defensive and Eco-Driving

Defensive and Eco-driving is a recognised and proven style of driving that contributes to road safety, while reducing fuel consumption and emissions. One of the main factors in increasing road safety is the emphasis on planning ahead so that you are prepared in advance for potential hazards. By increasing your hazard perception and planning skills you can make maximum use of your vehicle's momentum and engine braking. By doing this, you can also help reduce damage to the environment, reduce operating costs and improve road safety. You should be constantly scanning all around as you drive. Check into the far distance, midground and foreground.

Also check behind and to the sides by frequent use of all mirrors. Early recognition of potential hazards is important but just looking isn't enough, you need to act correctly on what you have seen. This will mean you are able to

- anticipate problems;
- take appropriate action in good time;
- ensure you are travelling at the correct speed when dealing with a hazard.

Keep a safe distance from the vehicle in front as this will help you to plan your driving.

Leave yourself sufficient room so you don't have to brake immediately or harshly when traffic in front of you slows or stops.

By simply taking your foot off the accelerator, your vehicle will slow down and fuel consumption will be reduced.

Driving tips

The following tips can apply to the driving of all large vehicles.

- Avoid unnecessary engine idling time. A typical 420hp commercial vehicle engine consumes fuel at the rate of around 2-3 litres per hour when left idling.
- Plan your journeys to avoid congestion and road works.
- Slow and tortuous routes through hilly terrain will increase the fuel consumption of even the best vehicle.
- Know your vehicle's optimum operating bands and change gears accordingly.
- Engage cruise control where appropriate and at appropriate speeds.

- Use air conditioning appropriately as it increases fuel consumption.

Driving away

Avoid over-revving your engine when you start your vehicle and try to pull away smoothly.

Check your fuel consumption

Check your fuel consumption regularly. To make sure you are getting the most from your vehicle, simply record the amount of fuel you put in against kilometres travelled. Fill the tank and note the odometer reading. After driving several hundred kilometers, fill the tank again and calculate the number of litres used to travel the number of kilometers driven. This will help you check whether you're using fuel efficiently.

An eco friendly driver is constantly aware of how much fuel their vehicle uses. If a trip computer is fitted, this can help you check fuel consumption.



Cutaway view of a fuel injector.





Keep your vehicle well maintained

You should make sure that your vehicle is serviced and maintained regularly.

- Have your vehicle serviced as recommended by the manufacturer. The cost of a service may well be less than the cost of running a badly maintained vehicle - for example, even slight brake drag can increase fuel consumption.
- You should ensure that all waste products are disposed of safely and in accordance with the relevant regulations.

Refuelling your vehicle

When refuelling your vehicle, you should aim to fill it up to the bottom of the filler neck and no further. If you fill the tank to the brim, when the fuel becomes hot and expands, its only way of escape is via the breather vent.

Also, knowing your particular vehicle's average l/100km can help early identification of problems. If the ratio rises, this may indicate a problem with the vehicle.

Do not over fill fuel tanks – diesel spills are a hazard to other road users, in particular to motorcyclists.

The following checklist of tell-tale signs may indicate that a commercial vehicle needs workshop attention to stop it wasting fuel.

- Any fuel or oil leaks
- Missing seal in fuel tank cap or signs of fuel spills around filler neck
- Low tyre pressure

Factors that can affect Fuel Consumption

The route

- City driving – stop/start
- Motorway/National roads driving
- Secondary roads
- Hills

Weather

- Wind
- Rain
- Surface water
- Ice/snow

The Vehicle/Trailer

- Load distribution
- Power to weight ratio
- Roof spoiler/Air deflector kit
- Trailer side skirts
- Brake balancing (truck and trailer)

Tyres and wheels

- Inflation pressures
- Low rolling resistance tyres
- Aluminium wheels
- Alignment
- Axle lifts

The Driver

- Rev. counter in the green band
- Using rolling energy of the vehicle
- Anticipating traffic hold-ups
- Gentle braking in good time
- Gentle steady acceleration
- Skip gears as appropriate
- Obey speed limits
- Short idling periods

The Operator

- Suitable vehicle for the work
- Regular maintenance/inspection
- Recommended service parts
- Good quality fuel
- Properly trained drivers
- Driver incentives for economical driving
- Modern vehicles
- Leaks and spills





Aerodynamics

A Major consideration for drivers regarding the efficient use of fuel is the aerodynamics of the vehicle being driven. Understanding how aerodynamics and drag affects a vehicles fuel consumption can help drivers or their employers to select the most efficient vehicle design.

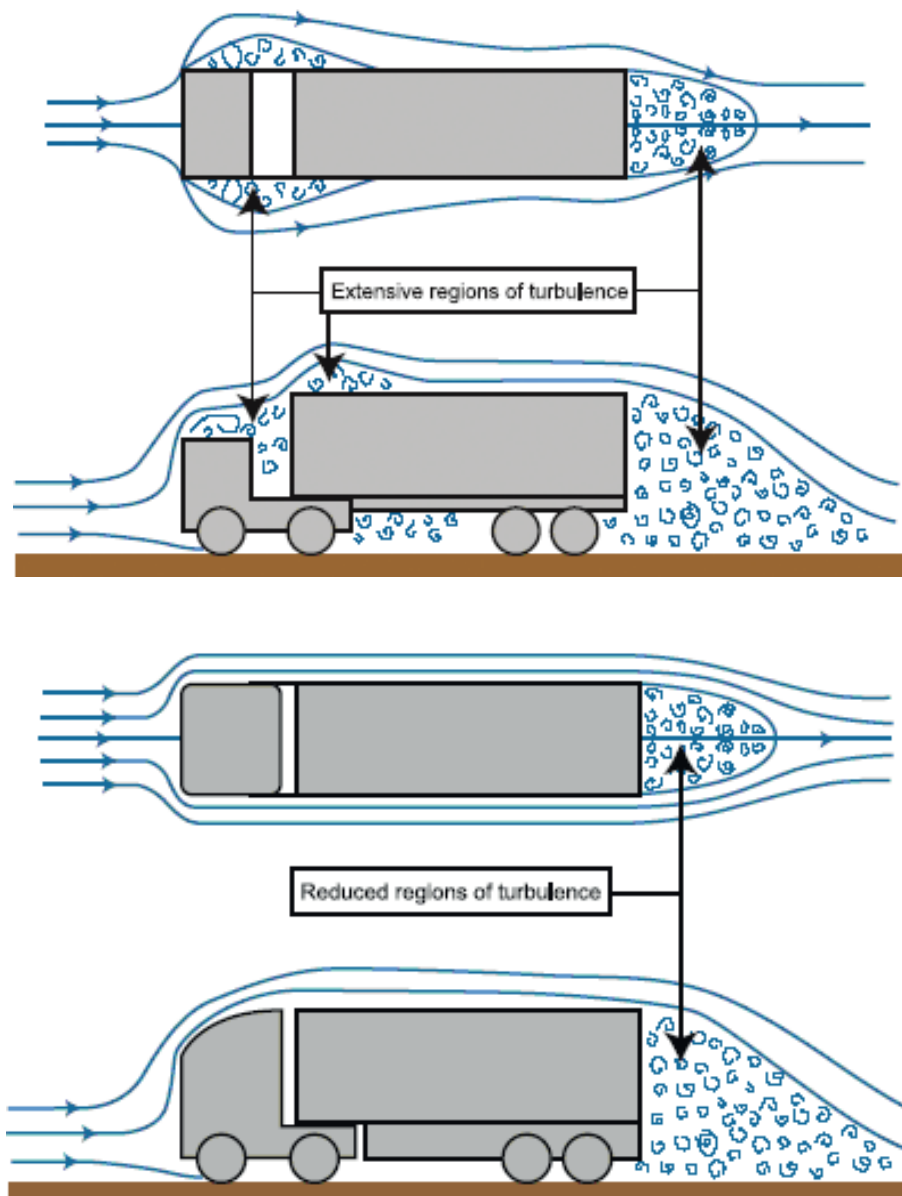
Aerodynamics is the study of forces acting on objects moving through the air. When a large vehicle (bus or truck) moves, the air exerts a force on the vehicle that resists its motion. This force is the aerodynamic drag and it has a significant effect on the fuel consumption of vehicles.

Drag

Drag is affected by vehicle shape, frontal area and speed. The greater the frontal area of a vehicle, the greater the aerodynamic drag will be. Similarly, the higher the vehicle speed, the greater the aerodynamic drag will be.

The frontal area of the vehicle affects drag and if you can reduce the area you can help to increase drag.

IMPORTANT. Under no circumstances should a driver drive too closely to the vehicle in front in an attempt to reduce the negative effects of the vehicles drag. In particular, drivers must always drive at a speed at which they can stop the vehicle safely in the distance they can see to be clear.





As such, the primary function of aerodynamic styling fitted to all large vehicles (trucks and buses) is to reduce aerodynamic drag, thereby reducing vehicle fuel consumption and realising cost savings, as well as reducing environmental impact. It is important to specify a well-styled aerodynamic vehicle from new.

However, there is a range of retro-fit features available that can significantly improve the aerodynamics of many vehicles on the road today. The diagram above shows the airflow pattern in windless conditions around a simplified version of an articulated vehicle that has poor aerodynamic design.

The extensive airflow separation around the front of the vehicle can create substantial aerodynamic drag and associated turbulence. As well as impeding the progress of the vehicle, this constitutes a potential safety hazard, e.g. for cyclists or pedestrians that may be adversely affected by the aerodynamic drag of a passing vehicle. Give these vulnerable road users plenty of space. The lower 2 diagrams above presents the comparative flow pattern around a more streamlined truck.

The substantial alteration of the airflow around the vehicle can be achieved by relatively small modifications to the vehicle geometry - in this case, modest curving to the front, side, top and bottom of the cab.

For goods vehicles - position of the load

For trucks, including flatbed vehicles, the load forms part of the external vehicle shape. Therefore, suitable location and orientation of the load can realise fuel savings. Ensuring that axle weights are not exceeded, remember to arrange the load so that it protrudes as little as possible beyond the perimeter of the cab when viewed from the front. This minimises the frontal area of the vehicle and typically reduces aerodynamic drag. It also underlines the importance of drivers checking that the load is secure and is distributed properly.

Tractor units - fifth wheel positioning

A large gap between the tractor unit and trailer will also have a negative effect on truck aerodynamics. A wide gap between the tractor and trailer causes air to turn downwards into the gap, resulting in pressure changes between cab and trailer and increasing the drag of the vehicle. Air pressure increases as a result of a large gap between tractor and trailer, and is also affected by the way a vehicle is loaded.

TIP: Reducing speed reduces aerodynamic drag

and reduces the power that a large vehicle must produce to move at a constant speed.

Additional lights/horns

It is preferable to position additional lights below the level of the windscreen to avoid increasing drag. It may be possible to locate lights and horns at some distance back from the front edge of a cab for rigid or drawbar vehicles without fairings or deflectors, and articulated vehicles with sharp front roof edges. New vehicles use more streamlined body component parts with reduced air resistance e.g. tear drop shaped side lights and/or integrated light systems. In fitting additional lights, drag is not the only consideration. Any additional lights must comply with the Road Traffic Lighting Regulations.

Full width mud or spray guard

If these features are used in isolation, the increased pressure generated on the front face of the flap encourages spray to be exhausted from the side of the vehicle, thus increasing drag. In addition, the safety of adjacent motorists may also be affected.



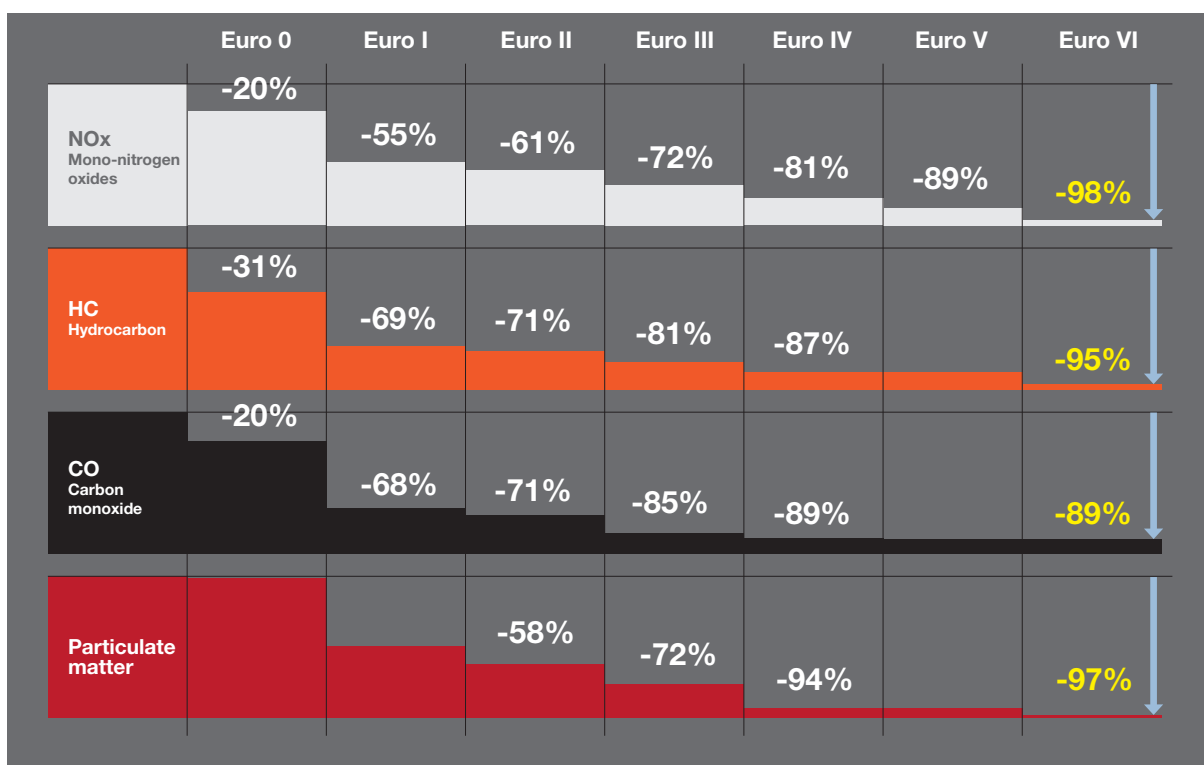
Example of an aerodynamic truck

Manufacturers are continuously working to develop engines and vehicles that are more fuel-efficient because, by reducing fuel consumption, they can also reduce running costs and exhaust emissions. However, besides vehicle and engine design, the fuel consumption for a large vehicle is also dependent on a number of other factors, such as the load, the driver, the equipment, the road and the weather conditions

Euro Emission Regulations

The early 1990s saw the introduction of stricter regulations governing heavy vehicle emissions. The Regulations, known as the Euro Emission standards came into force in 1993. Since then vehicle manufacturers have striven to meet





Evolution of Euro emission controls

these stringent standards. The regulations have achieved a significant reduction in the amount of Oxides of Nitrogen and Particulate Matter emitted from road vehicles. Implementation of the regulations combined with other measures have contributed to improving air quality in most European cities.

The standards began with Euro 1 in 1993 and have since progressed to the current level of Euro 6 which was introduced in 2013. Once the specific regulation came into force, no engine for a truck or bus can be produced by a manufacturer for sale in Europe that does not comply with the regulation in force at the time.

The initial reductions in pollutants was relatively easy. Significant improvements were gained with the improved quality of diesel fuel linked to the reduction of sulphur content. Nevertheless as we progressed through the regime it became ever more difficult to achieve further reductions to an increasingly clean engine system.

For this reason vehicle and engine manufacturers need to employ additional systems and processes to treat the exhaust gases before they were expelled to the atmosphere.

The first was a process called Selective Catalytic Reduction (SCR) the second was a process called

Exhaust Gas Recirculation (EGR). Both of these are then combined with a Diesel Particulate Filter (DPF). Different manufacturers may use a combination of any or all of these systems to meet the required standard.

We will look briefly at what each system does and how they operate and what contribution it makes to the overall performance of the vehicle.

Diesel Oxidisation Catalyst (DOC)

DOC is designed to oxidise carbon monoxide and oxides of nitrogen to Carbon Dioxide and water. It helps to boost the performance for quicker catalysis within the SCR process.

Exhaust Gas Recirculation (EGR)

Variations on the principle of EGR have been used in some heavy commercials for a number of years. The principle works on the basis that during the combustion process not all of the fuel gets completely burned, and that a small quantity of fuel remains within the exhaust gases. As this exhaust gas is expelled from the combustion chamber into the exhaust manifold, a quantity of the gas (ranging from 10% to 30%) is first cooled and then redirected into the inlet manifold and mixed with the incoming fresh air. This new mixture of fresh air and cooled



exhaust gas is then drawn into the combustion chamber and ignited, which in turn burns the 'old' exhaust gas a second time.

Selective Catalytic Reduction (SCR)

The process of selective catalytic reduction happens after combustion and uses a large exhaust box through which the spent gases are directed. After the gases are passed through the catalyser, an injector located in the exhaust pipe then sprays a Urea based solution (AdBlue) into the air flow and neutralises the Nitrogen Oxides (NOx) and Ammonia to Nitrogen and Water. The exhaust gas then passes through a device called a Slip Cat which removes any further traces of Ammonia.

Diesel Particulate Filter (DPF)

As the name would suggest the DPF is a filter that removes the fine particulate matter (PM) from the exhaust gas. It is the high level of PM that causes such concern over diesel engine emissions. In most cases the DPF is a ceramic filter designed to remove the PM as the exhaust gas passes through.

However the whole process of EGR, SCR, and DPF are highly sensitive to temperature, and the devices will not operate correctly unless they are at their optimal working temperature - usually around 300 to 400 degrees centigrade. This high temperature is required to burn off the soot and ash which collects on the filter.

For this reason, if a truck or bus is lightly laden or the engine is not under enough stress, it will not generate enough heat or enough hot gas to 'burn' off the ash. Manufacturers use sensors to monitor operating temperatures and gauge the volume of ash buildup. If necessary they may use an additional injector to spray in fuel to increase the operating temperature and so burn off the ash deposits.

There are two types of this process of regeneration - passive and active.

With a passive system the driver is not required to do anything. However with an active system the driver may be required to engage a forced regeneration programme which burns off the deposits.

In the case of a forced regeneration the driver should be aware that during this process the exhaust system can reach very high temperatures. These high temperatures may pose a risk of fire, depending on the vehicles location at the time, e. g., drivers should avoid parking over dry grass or any type of flammable material.

A malfunction with many of these systems will result in a warning light illuminating on the vehicle dashboard. It is important for the driver to be familiar with the system of warning lights that are displayed on any vehicles that they may drive or operate.

The required information can be found in the manufacturers operating manual.

AdBlue

AdBlue is a product developed to minimise the harmful effects of exhaust gases. The product is a Urea based solution that is light blue in colour and is generally not harmful, not dangerous or flammable. However AdBlue may corrode some metals including copper and therefore should be kept away from contact with electrical components and connections.

As AdBlue may contaminate water courses, measures should be taken to prevent it entering drains and any spills should be quickly absorbed and cleaned up.

On the vehicle AdBlue is held in a separate tank or reservoir usually located near the diesel tank but can be located anywhere on the truck or bus. The AdBlue tank would normally be closed with a bright blue coloured cap and the filler neck has a much smaller opening (19 mm) than the diesel tank. The reason for this is to ensure diesel is not mistakenly pumped into the AdBlue tank.

IMPORTANT

Any cross contamination of the vehicle's AdBlue reserves can do serious and irreparable damage to the sensitive dosing system.

Similar damage can also be caused by poor quality AdBlue.

The vehicles diesel fuel system can also suffer irreparable and costly damage if contaminated with AdBlue.

As the regulations advance the number of vehicles coming under the scope of the regulations widens, and it now includes many





light commercials and minibuses, as well as some passenger cars. The table on page 43 shows how the various emissions have been reduced in tandem with the introduction of respective Euro ratings. As an example, we can see that typical particulate emissions have fallen from the starting point of 100% down to just 3% between Euro1 and Euro6.

Important notes

For the earlier vehicles of classes of Euro 4 and some Euro 5 and Euro 5 EEV (Enhanced Environmental Vehicle). If the vehicle ran out of AdBlue there would generally be no noticeable change in performance. Nevertheless if a vehicle claimed to emit a lower level of harmful gases and was to benefit through lower tax or toll charges, this would be unfair to other competitors.

However, with the introduction of more stringent regulations and to ensure that AdBlue is always used correctly, it was required that vehicle manufacturers develop a warning system to inform the driver that the level of AdBlue was low. The absence of AdBlue would then cause the emission levels to increase – a condition which would be recognised by the vehicle ECU (Electronic Control Unit). If the driver did not refill the tank, then normally after a restart the engine speed would be

limited until the AdBlue tank was refilled.

The effects of pollution

If you follow the principles of 'eco-safe' driving, you will become a more environmentally friendly driver. You could considerably reduce both your fuel bills and those emissions that cause damage to the atmosphere. Developing your planning, perception and anticipation skills will also help to make you a safer driver.

However, although it is beneficial to save fuel, you must not compromise the safety of yourself and other road users when attempting to do so. Road safety is more important. At all times you should be prepared to adapt to changing conditions and it may be that on occasion you will have to sacrifice fuel saving for safety, but never the other way round.

Alternative Fuels

Compressed Natural Gas (CNG): While there have been improvements in the quality of exhaust emissions produced, some of the technical disadvantages relate to the size and design of the fuel tanks required.

Electricity: Trials have been taking place with electric vehicles for a number of years, but it is only recently that advances have been made in overcoming the



Example of gas-powered truck.





problems of battery size and capacity.

Fuel cells: These operate like rechargeable batteries and produce little or no pollutants, but have greater range and improved performance than most battery electric vehicles.

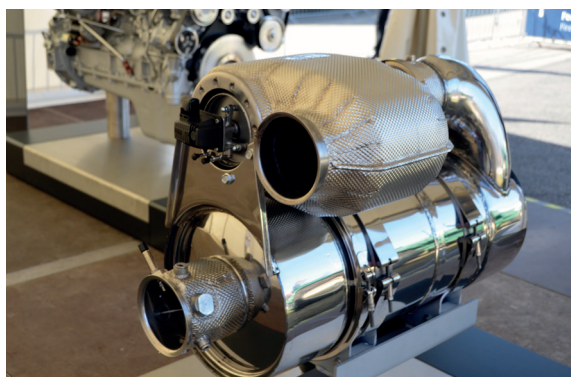
Hybrid vehicles: These offer the advantages of electricity without the need for large batteries. The combination of an electric motor and battery with an internal combustion engine gives increased fuel efficiency and greatly reduced emissions.

Hydrogen: This is another possible fuel source for road vehicles that is being studied. However, technical problems include storage of this highly flammable gas.

Liquid Petroleum Gas (LPG): This fuel system is predominantly used in smaller type vehicles, e. g., cars and light vans. This consists mainly of methane, produced during petrol refining. Vehicles can run on LPG alone or both LPG and petrol (known as “dual fuel”). Most types of engines can be built or converted to run on LPG. Benefits include low cost, lower emissions and reduced wear and tear to engine and exhaust systems. Disadvantages include cold start problems and valve-seat wear.

Methane: Because of the naturally occurring renewable sources of this fuel, it is also being considered as a possible alternative to diesel oil, which is a finite resource

Solar power: Needing only daylight to function, solar vehicles are small, light, slow and silent. They produce no emissions at all; however, they are very expensive as yet and improvements are needed so they can store energy for use in the dark.



Example of Catalytic Converter.

Conclusion

As a professional driver you should be ready to learn, no matter how experienced you are. You should know your average l/100km for the vehicle you drive. Read your vehicle’s handbook.

TIP. If possible, park up in a way that will avoid early-morning manoeuvring with a cold engine as this wastes fuel.





SELF-ASSESSMENT OF KNOWLEDGE

Please complete the following questions to help assess your understanding of the module so far:

Q.1 How can a driver safely use momentum to save fuel?

Your Response

Q.2 Name 3 steps a driver can take to maximise fuel economy.

Your Response

Q.3 List 3 negative effects of harsh braking.

Your Response

Q.4 List some driving tips that will reduce fuel consumption.

Your Response

Q.5 What happens when you over fill the fuel tank?

Your Response





Q.6 What is the purpose of AdBlue?

Your Response

Q.7 How can reading the road ahead improve fuel economy?

Your Response

Q.8 Who or what has the single biggest impact on fuel economy?

Your Response

Q.9 How is the environment affected by the transport industry?

Your Response

Q.10 How can you calculate how much fuel your vehicle is using?

Your Response





Q.11 Approximately how many litres of fuel is used by a 420 hp engine if left idling for one hour?

Your Response

Q.12 How can the air turbulence around a vehicle affect vulnerable road users?

Your Response

Q.13 How can aerodynamic drag be reduced?

Your Response

Q.14 What are the benefits of using the endurance braking system?

Your Response

Q.15 Why should fairings and other features be retro-fitted on older vehicles?

Your Response

Having completed these questions, your trainer will discuss typical answers with the group to ensure that drivers have a comprehensive understanding of the information and guidance provided. If you would like more information on any of the issues raised during this exercise, ask your trainer who will be pleased to discuss the issues and will encourage other participants to share their experiences to the benefit of all.

This concludes the section on Fuel Consumption and Economical Driving.





SECTION E – MANAGING VEHICLE INERTIA

This section deals with the theories of vehicle inertia and looks at the various forces acting on the vehicle that need to be managed by the driver so as to ensure the maximum stability, safety and security of the vehicle.

Vehicle dynamics

Vehicle dynamics and handling are affected by many things, including vehicle mass, vehicle inertia and the cornering stiffness of the tyres. All these are subject to variation and often differ even over the course of a single trip.

A stationary bus/coach with a full complement of passengers and a loaded goods vehicle may weigh up to the maximum of its design gross vehicle weight. It requires a great deal of force to make it begin to move, even on a level road, but it then takes relatively little power to keep it rolling at a constant speed. Resistance to movement is called inertia and the force that keeps the vehicle rolling is called momentum. Large modern vehicles have engines with a high power output to:

- Provide good acceleration;
- Overcome inertia efficiently.

These forces also affect passengers and loads. Inertia of a passenger or load has to be overcome in much the same way as that of the vehicle.

Acceleration will push the weight back, while braking will move the weight forward due to momentum. Sudden braking will cause weight to be thrown forward and could be dangerous.

Therefore, all acceleration and braking should be smooth, controlled and as progressive as possible.

The energy that is stored up in the vehicle and its passengers when travelling is known as kinetic energy.

Timing: Plan ahead and take early action. The timing of braking is important to avoid the need for harsh braking. Much more effort is needed to stop a fully laden large vehicle than an ordinary car travelling at a similar speed. Professional drivers are continuously scanning the road ahead to reduce the need for braking and thereby have a corresponding reduced need to accelerate.

Gravity: When a vehicle is stationary on level ground the only force acting upon it is the downward pull of gravity (ignoring wind forces etc).

On an uphill gradient:

- More power is needed from the engine to move the vehicle forward and upward;
- Less braking effort is needed and the vehicle will stop in a shorter distance.

A downhill gradient will:

- Increase the vehicle's speed;
- Require more braking effort;
- Increase stopping distances.

Centre of gravity:

The vehicle's centre of gravity is the point around which all its weight is balanced. Violent steering, acceleration or braking places excessive forces on the vehicle's tyres and suspension, and on the passengers.

Heavy braking while cornering can bring components very close to their design limits.

In buses it will be uncomfortable for passengers and in trucks it will affect load movement and stability.

Centrifugal force:

When the vehicle takes a curved path at a bend, the forces acting upon it tend to cause it to continue on the original straight course.

This is known as centrifugal force. At normal speeds this is overcome by the traction between the tyres and the road surface. If a large vehicle like a truck, bus or coach takes a bend too fast, centrifugal force will cause the passengers or load to be thrown towards the outside of the bend or overturn.

In order to minimize the adverse effects of centrifugal force a driver should plan well ahead, reduce speed and engage the correct gear before negotiating the bend at a steady or constant speed. Any sudden change may result in centrifugal force becoming dominant, resulting in possible catastrophic loss of control.

Kinetic energy: The energy that's stored up in the vehicle and its passengers and load when travelling is known as kinetic energy. This is converted into heat at the brake shoes/pads and drums/disc when braking occurs.





This could result in brake fade and extra wear on the braking components.

Drivers should plan ahead and adjust their driving style to make efficient and effective use of the endurance brake whenever required in order to reduce overall brake wear.

Friction: This is the grip between two surfaces. The grip that the tyres have on the road surface transmits the force (traction), which is essential when:

- Moving away or accelerating;
- Turning/ changing direction;
- Braking/ slowing down.

The amount of grip will depend on:

- The weight and speed of the vehicle, and the condition of the tyre tread.

If the tyres are:

- under inflated
- over inflated

The type and condition of the road surface:

- loose
- smooth
- anti-skid

Weather conditions

- fine and dry
- rain
- ice or snow

Other material present

- mud
- wet leaves
- diesel spillage
- other slippery spillages
- inset metal rails
- if the vehicle is braking or steering sharply
- the condition of steering and suspension components

Sudden acceleration or braking can lead to loss of friction between the tyre tread and the road surface. Under these conditions the vehicle may:

- lose traction (wheel spin)
- break away on a turn (skid)
- not stop safely (skid)
- overturn

The same will happen when changing into a lower gear if travelling too fast, or if the clutch is briskly engaged, because the braking effect will only be applied to the driven wheels.



Recognising and removing the cause of a skid

The most common causes of skidding are:

Excessive speed for the circumstances or conditions.

Coarse steering in relation to a speed which may not in itself be excessive.

Harsh acceleration.

Harsh or excessive braking.

When a skid develops, the driver should immediately remove the cause. Once the initial cause is removed, your next action may depend on the exact circumstances. For instance, on a slippery road, if your vehicle is not fitted with an anti-lock braking system (ABS) or in the unlikely event of the ABS system not working, you may need to pump the brakes rhythmically while steering to avoid a collision.

This technique is called 'cadence braking'.

Note; the following advice is only applicable to vehicles not fitted with ABS.

If you brake hard in wet or slippery conditions, it is likely that your road wheels will lock and you will lose directional control. Your vehicle will skid in a virtual straight line and could collide with something before the skid ends. To alter the course of your vehicle and perhaps avoid a collision, the road wheels must be allowed to rotate. The greatest degree of control is gained by pumping the brakes rhythmically (cadence braking). Brakes are most effective when they are applied to the point of locking up, so each time the brake is pumped hard, maximum braking effect takes place. When the brakes are released, the wheels rotate and steering control is regained. Therefore, cadence braking gives a combination of 'braking while the brakes are on' and 'steering while the brakes are off'.

Remember; pump the brakes with a deliberate movement, pausing momentarily at the full extent of brake pedal travel - avoid bouncing the foot on and off the pedal.





SELF-ASSESSMENT OF KNOWLEDGE

Please complete the following questions to help assess your understanding of the module so far:

Q.1 What is vehicle inertia?

Your Response

Q.2 What is vehicle momentum?

Your Response

Q.3 What is vehicle centrifugal force?

Your Response

Q.4 Where is a vehicles centre of gravity?

Your Response

Q.5 What is friction?

Your Response





Q.6 What reduces tyre grip?

Your Response

Q.7 How does sudden braking affect passengers?

Your Response

Q.8 How does under-inflation affect tyres?

Your Response

Q.9 What are the most common causes of skidding?

Your Response

Q.10 When should the 'cadence braking' technique be applied?

Your Response

Having completed these questions, your trainer will discuss typical answers with the group to ensure that drivers have a comprehensive understanding of the information and guidance provided. If you would like more information on any of the issues raised during this exercise, ask your trainer who will be pleased to discuss the issues and will encourage other participants to share their experiences to the benefit of all.

This concludes the Section on Vehicle Inertia.





SECTION F – UNCOUPLING/RECOUPLING PROCEDURES

This Section looks at the procedures for uncoupling and recoupling a trailer from/to a conventional articulated tractor unit as well as a rigid truck or bus. If a trailer becomes detached from its drawing unit whilst driving, the consequences can be disastrous.

Therefore, it is important for drivers to adopt a consistent and safe set of standard procedures for carrying out these tasks.

Drivers who may be uncoupling/recoupling a combination with a sliding fifth wheel should be trained in and apply the correct procedures as outlined in the manufacturers operating guidelines for the particular type of combination.

The driver must be fully aware of and understand the potential dangers to themselves and to others if they deviate from approved safety procedures.

Where a valuable cargo is on the trailer, drivers should consider using a kingpin lock or drawbar locking mechanism if driving a drawbar combination.

On all occasions before exiting the cab, the RSA strongly recommends that the engine be switched off.

Procedure for uncoupling a standard trailer.

- Ensure that the trailer is being parked in a safe position to avoid obscuring someone's vision or where someone might collide with it.
- Ensure that the ground is firm and level, to prevent the trailer from rolling or sinking.
- Apply the handbrake (parking brake) on the tractor unit, remove the rear number plate (with lenses and bulbs if fitted) and stow them in the cab.
- Apply the trailer brake.
- Lower the landing gear (legs/jockey wheels).
- Stow the handle away safely in its designated location.
- Climb carefully on to the cat-walk using the steps and grab-handles provided.
- Turn off all air taps if fitted. (Yellow – service line. Red – emergency line. Blue – auxiliary line on older tractor units). Most new tractor units are fitted with automatic air valves.
- Disconnect all air and electrical lines (suzies, ISO-ABS cables) and stow them away safely. When disconnecting the air-lines, grip the connections firmly as they may kick back when released due to air pressure in the line.
- Step down off the cat-walk, descending backwards and checking left and right before doing so. Always ensure 3 points of contact with the vehicle using either hands or feet.

- Remove the safety clip on the kingpin release handle, or the spring-loaded safety clasp.
- Pull the kingpin release handle.
- Re-enter the cab, engage forward gear, move slowly forward approximately 30 cm (one foot).
- If the tractor unit is fitted with parabolic suspension (steel springs) continue to move slowly forward as this will prevent the tractor unit from rising suddenly as the trailer weight is removed from the fifth wheel.
- If the tractor unit is fitted with air suspension, use the suspension control unit to lower the rear suspension of the tractor unit until the landing gear has taken the full weight of the trailer, then drive slowly forward. (Lowering the suspension will prevent the rear of the tractor unit from rising suddenly as the trailer weight is removed from the fifth wheel).

Procedure for recoupling a standard trailer.

- Carefully check the condition and all around the trailer being coupled to, ensuring that the trailer brake is applied.
- Line up the tractor unit (using the rear mudguards left and right as a guide) and reverse close to the front of the trailer. Stop the tractor unit, apply the handbrake, and dismount from the cab. Check the height of the fifth wheel in relation to the trailer kingpin.





- If on parabolic (steel springs) suspension, some adjustment may be required to the height of the trailer using the second speed on the landing gear.
- If on air suspension, adjust the height as required by using the suspension control unit.
- Ensure that the fifth wheel handle is in the open position. Ensure that there is no gap between the top of the fifth wheel and the trailers rubbing plate. This is extremely important because if there is a space between the kingpin and the rubbing plate, the kingpin will not properly engage.
- Reverse slowly until the fifth wheel engages the kingpin. Listen for an audible click.
- Select a low forward gear, bring up the clutch to bite point and 'rock' the unit gently, checking to ensure that the tractor unit is fully engaged with the trailer.
- Apply the handbrake and dismount from the cab.
- Connect the safety clip on the handle, locking the kingpin handle in place, or ensure that the spring-loaded safety clasp is in place.
- Climb carefully on to the cat-walk and carefully connect all air and electrical lines. Turn on air taps if fitted.
- Descend carefully from the cat-walk, facing the truck and checking all around for moving vehicles.
- Raise the landing gear fully (legs/jockey wheels)
- Stow the handle safely in its designated location.
- Release the trailer brake.
- Fit the number plate securely, including any bulbs or lenses.
- Conduct a Vehicle Walkaround Check, including
- Examine all tyres, wheel nuts, rear or side doors or curtains, locks or security devices to ensure their integrity.
- Re-enter the cab and check that all electrics are working – lights, dials, gauges. Ensure that all external lights are working – ask another driver for advice if available.

Check all air pressure gauges to ensure that air pressure is building and holding at approximately 8 to 12 bar. Do not attempt to drive the vehicle if any buzzer, audible alarm or other warning device is sounding.

- Check the ABS light if fitted (green light at the front of the trailer) by applying the footbrake.
- Ensure that the mirrors are clean and correctly adjusted – the type of load might be relevant.
- If possible, before driving on the public road, ensure that the trailer brakes are working properly and that none of the brakes are binding or dragging. This is especially important if the trailer has been lying idle for a period, or in icy weather conditions.



Example of 5th wheel

**Procedure for uncoupling a rigid and drag unit.
(Rigid truck and drawbar trailer).**

- Ensure that the trailer is being dropped in a safe place to prevent obscuring someone's vision or where someone might collide with it.
- Ensure that the ground is firm and level, to prevent the trailer from rolling or sinking.
- Apply the handbrake (parking brake) on the drawing vehicle and switch off the engine.
- Apply the trailer brake – button/ratchet type.
- Lower the landing gear (legs/jockey wheels) at the front and rear of the trailer if fitted.
- Stow the handle away safely in its designated location.
- Turn off all air taps if fitted – yellow service line, red emergency line. This can be a combined unit with some systems-ISO/ABS cables. Many new rigid trucks with towing capabilities are fitted with automatic air valves.





- Disconnect all air and electrical lines (suzies) and stow away safely in their designated locations.
- Remove the safety clip on the drawbar coupling automatic locking system. Pull the drawbar coupling release handle if fitted, or use the automatic release system if fitted.
- Re-enter the cab, start the engine, engage forward gear and drive forward approximately 60 cm (2 feet) until the drawing vehicle is disengaged from the drawbar.
- Remove the number plate and any lenses and bulbs not fixed in place and stow them safely in the cab.

Procedure for recoupling a rigid and drag unit. (Rigid truck and drawbar trailer).

- Carefully check the condition and all around the trailer being coupled to, ensuring that the trailer brake is applied.
- Line up the drawing vehicle using the side walls of the vehicle for guidance
- Be aware of the length of the trailer drawbar being coupled to.
- Reverse slowly towards the trailer, carefully gauging the distance between the rear of the drawing vehicle and the drawbar. Stop the engine, apply the handbrake and check the height of the drawbar coupling in relation to the drawbar itself.
- If on parabolic (steel springs) suspension, adjust the height of the drawbar by using the second speed on the landing gear handle.
- If on air suspension, adjust the height of the suspension on the drawing vehicle as required.
- Depending on the type of coupling – the safety handle may need to be used to open the pin – or it will open automatically when the eye of the drawbar is engaging.
- When all the above is in order, reverse the drawing unit slowly and engage the coupling into the drawbar. Listen for an audible click of engagement. Ask another driver for advice if available.
- Re-enter the cab, engage a low forward gear, bring the clutch up to bite point and ‘rock’ the unit gently, ensuring that the drawing vehicle is fully engaged with the trailer.

- Apply the handbrake and switch off the engine.
- Connect the safety clip on the drawbar coupling (if fitted).
- Carefully reconnect all air and electrical lines (suzies). Turn on all air taps if fitted.
- Raise the landing gear (legs/jockey wheels) front and rear if fitted.
- Stow the handle away safely or return it to the cab.
- Release the trailer brake.
- Attach the number plate (with any bulbs and lenses).
- Conduct a Vehicle Walkaround Check, including
- Carefully check all tyres, wheel nuts, rear and side doors, locks and security devices.
- Re-enter the cab and check that all electrics are working – lights, dials, gauges. Ensure that all external lights are working – ask another driver for advice if available
- Check all air pressure gauges to ensure that air pressure is building and holding at approximately 8 to 12 bar. Do not attempt to drive the vehicle if any buzzer, audible alarm or other warning device is sounding.

Supplementary safety rules for standard semitrailers. It is important to follow these safety rules:

- Always ensure vehicle and trailer parking brakes are applied.
- Always ensure that all safety devices are deployed.
- Do not give others the opportunity to take control of your vehicle, always apply the tractor unit parking brake.
- Never pass, or allow others to pass, under the trailer.
- Never place fingers into the fifth wheel jaw.
- Wherever possible avoid coupling to a semitrailer from any position other than straight in line as this can give rise to a situation where excessive force is required, the kingpin may miss the fifth wheel, the trailer may be pushed sideways, damage could be caused or personal injury could occur.
- Do not release the fifth wheel with the susies connected, unless using the split coupling method.





- Do not connect the trailers unless the kingpin is fully engaged in the fifth wheel jaws unless using the split coupling method.
- Never attempt to couple to a trailer when the kingpin is above the height of the fifth wheel.
- When dropping a trailer at a loading dock (uncoupling) always leave a small gap (e. g., 50 mm) to allow for a possible drop in the air suspension levels.
- Do not attempt to uncouple a trailer unless it is equipped with landing legs.
- Ensure that the tractor unit and trailer are designed to work as a combination.
- Do not attempt to pull away with the low air pressure warning buzzer sounding. Always allow the system to become fully charged.
- If your vehicle is equipped with a parking brake test position, use it as described in the truck manufacturers instructions.
- Ensure the parking brake on the trailer has been applied when leaving the coupled vehicle for extended periods, e.g. overnight.

Special applications

To accommodate some applications it may be necessary for an operator to use equipment that is not covered within these procedures. For example dual or multi position sliding fifth wheels and dual height raising fifth wheels. Other users may be engaged in special types operations or use non-standard trailers. In these instances it will be necessary to provide training for drivers to ensure that bespoke operating instructions are followed correctly, following a risk assessment.

Parking semitrailers – good and bad practice

Good practice means always ensuring:

- The ground is firm and level and will support both landing legs.
- That, after uncoupling, you check that the landing legs are not sinking into the surface.
- Uncouple while in a straight line as this will make coupling easier.
- The trailer will not cause an obstruction or

hazard to other traffic.

- The trailer will not pose a danger to pedestrians.
- The trailer will not contravene any national or local traffic regulations.
- Lower the air suspension, if fitted, when the trailer is to be left for extended periods. However, a driver should be aware that if the air is dumped from the suspension that another problem may be created, e. g., rear crash bar going behind a kerb.
- The parking brake on the trailer is always applied before it is uncoupled from the tractor unit.

Avoiding bad practice means:

- Do not under any circumstances use the automatic application of the brakes caused by disconnecting the supply air line (red) as the parking brake. This is not a fail safe condition as on reconnecting the trailer to another tractor unit the truck can roll away or have an unintended acceleration which can have very serious consequences.
- Do not park the trailer on soft ground.
- Do not park the trailer on an incline, front, rear or sideways.
- Do not create an obstruction or park the trailer where it overhangs any vehicle routes or carriageways.
- Do not park the trailer where coupling may be difficult.





SELF-ASSESSMENT OF KNOWLEDGE

Please complete the following questions to help assess your understanding of the module so far:

Q.1 When uncoupling, why should the parking brake be applied on the trailer?

Your Response

Q.2 When uncoupling or recoupling, why should the parking brake be applied on the tractor unit?

Your Response

Q.3 How can the trailer height be adjusted?

Your Response

Q.4 How can the driver confirm that the fifth-wheel jaws have locked around the kingpin?

Your Response

Q.5 After recoupling a trailer, what checks should be carried out before moving away?

Your Response





Q.6 Name 3 aspects of good practice when parking a semi-trailer.

Your Response

Q.7 Name 3 aspects of bad practice when parking a semi-trailer.

Your Response

Q.8 After uncoupling, why should the air and electrical connections be stowed safely?

Your Response

Q.9 What is the difference in function between the red and the yellow air lines?

Your Response

Q.10 How can the tractor unit air-bags be affected when uncoupling?

Your Response

Having completed these questions, your trainer will discuss typical answers with the group to ensure that drivers have a comprehensive understanding of the information and guidance provided. If you would like more information on any of the issues raised during this exercise, ask your trainer who will be pleased to discuss the issues and will encourage other participants to share their experiences to the benefit of all.





SCENARIO 1.

Rigid truck driver Seamus had recently obtained his C+E driving licence and was looking forward to his new assignment as an artic driver working on multi-drop deliveries for his company. As is practice for all new drivers in the company the transport manager gave him a demonstration in uncoupling and recoupling procedures. The transport manager explained and stressed the importance of following the correct sequence.

While Seamus listened attentively to the transport manager, he was also thinking about the urgent delivery that was to be made and how cold and wet a day it was.

Pleased with his relatively new tractor unit, he jumped in, reversed up close to the front of the trailer and began the process of recoupling.

Seamus applied the tractor unit handbrake, engine still running, left the cab to check that the fifth wheel release handle was in the open position.

Returning to the cab he then reversed slowly as he had been shown until he heard the audible click of the fifth wheel jaws clamping around the kingpin.

He again applied the handbrake and left the cab.

He released the trailer brake and partly raised the landing gear until the weight of the trailer was borne by the tractor unit.

He mounted the catwalk and connected the air and electrical Suzie's as he had been shown.

He carefully dismounted the catwalk and returned to the cab

He then proceeded to drive the articulated unit to the entrance of the compound and was surprised to see the transport manager running towards him and waving at him to stop.

List 5 things that Seamus did wrong in the scenario above.

Your Response

1.

2.

3.

4.

5.

This concludes the Section on Uncoupling/Recoupling a Trailer. It also concludes Session 1 of the Control of the Vehicle and Eco-Driving Techniques module. After the break, Session 2 will look at Effective use of Safety Controls in buses and trucks.





