

ENGINE | CHASSIS | SERVICE
EXPERTISE IN HDV PARTS

TECHNICAL BROCHURE COMMERCIAL VEHICLES



RUVILLE'S PARTS RANGE FOR COMMERCIAL VEHICLES



For nearly 90 years now, RUVILLE has guaranteed top quality car and van parts in OE quality on the automotive aftermarket. The product portfolio concentrates primarily on parts for the engine and chassis. As far as engine parts are concerned, the range extends from belt drive components and water pumps over valve gear components through to camshafts and many other products that altogether round off the range. When it comes to the chassis, the key expertise lies in steering parts, axle links and wheel bearings. Here again, the range is rounded off by a number of other smaller product lines. All products are preferably offered as kits, making repairs much easier. This also helps to save transport and other costs, resulting in huge increases in customer satisfaction.

The many years of experience and reliability in parts for vans have been enhanced since 2008 by a HDV range. In order to score in this segment, we have kept our focus on RUVILLE's established product groups. This means that the existing tension roller range has been supplemented for HDV with the addition of corresponding steering and chassis parts together with water pumps.





The HDV sector presents a new challenge with other "rules of the game" as compared to cars. Staff with HDV experience have been added to the product management team in order to cope with these special requirements. Logistics also plays a crucial role in customer satisfaction and in minimising the downtimes of heavy trucks. An ordering system with 24/7 service has been set up to keep the logistics distances as short as possible.

The following pages take a closer look at the individual product groups with their special technical aspects.



Tension pulley
Water pump
Water pump repair kit
Steering part
Tie rod end
Wishbone

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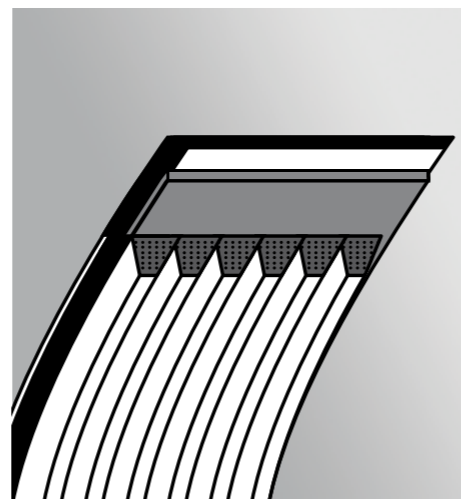
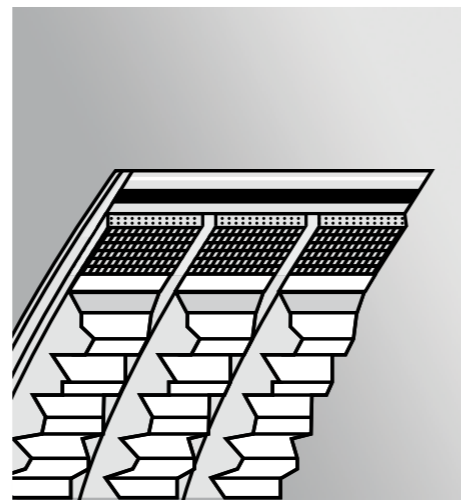
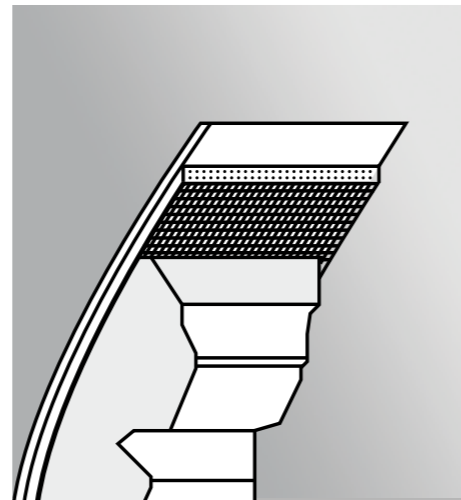
1. BELT DRIVE

1.1 Unit drive

HDV accessory unit drive systems have to cope with very heavy loads. So-called rotational irregularity at the crankshaft plays a major role in the design. Compression reduces the piston speed while ignition increases the piston speed again. The speed at the crankshaft is therefore never constant, resulting in unwanted vibrations in the unit drive. To eliminate these as far as possible and ensure smooth, vibration-free running, various different components are used that are featured in greater detail on the next few pages. But correct combination of the individual parts coordinated to the specific application is the only way to facilitate a unit drive system almost free of vibrations.

1.2 Typification of the drive belts

As a rule, conventional V-belts, multiple V-belts and poly V-belts are used to drive the individual units. Since the introduction of the poly V-belt, one and the same belt can drive up to 4 units. This means that the individual components have to produce top performance every day while being exposed to peak forces of 1,250 N and more. In contrast to conventional V-belt drive, a system with V-rib belts offers vital advantages. Deflection pulleys are used to create a serpentine drive system that plays an important role in terms of power transmission. In this case, the transmission of all forces takes place only by means of a power coupling. The serpentine drive achieves great wrap angles for optimum power transmission and short distances for reducing vibrations.



V-belt (classic, open flanks)
Multiple V-belt (composite V-belt)
Poly V-belt (V-rib belt)

1.3 Tension units and tension pulleys

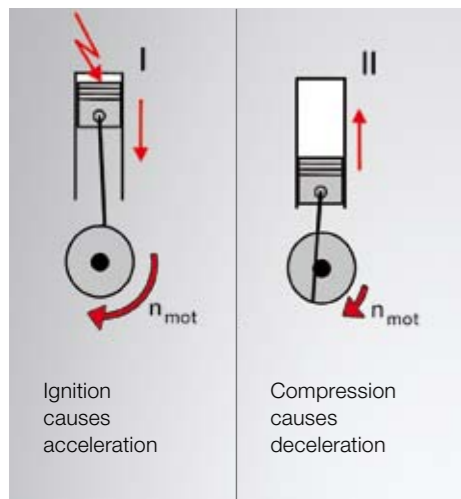
The tension units for unit drive are divided into manual and automatic systems. Automatic systems are coming into increasing use in today's engines. They then in turn are used in belt tensioner units with mechanical and hydraulic damping. Where which system is used depends among others on the existing space available.

Static belt tension unit

Static tensioners have a lesser role to play in the development of unit drive systems today, as they are not capable of absorbing the high vibrations from rotational irregularity at the crankshaft. However, when static systems are being fitted, they still have to be adjusted with great precision. If for the example the belt tension is too low, this can cause the belts to slip, resulting in premature wear of the belt and pulleys. It can also cause considerable reductions in drive power at the individual units under certain circumstances. If the belt tension is too high, this causes extreme radial load on all bearings in the complete unit drive system, with premature failure of the bearings in the water pump, hydraulic pump, A/C compressors, generators and pulleys.

Automatic tensioners with mechanical damping

Mechanically damped tensioner units have either an integrated flat friction plate or an integrated friction cone to cushion vibrations for conversion into friction energy. Preloading is defined by the leg spring characteristics. Together with the tensioning function, the leg springs also work as pressure springs and preload the friction plate or friction cone in the axial position against the housing. This preloading generates high friction to achieve the greatest possible damping effect. The friction in the tensioner causes wear to the friction plate, whose service life is therefore limited by wear and amounts to approx. 120k km. However, the service life can be drastically reduced under adverse operating conditions, such as in construction vehicles, for example.



Left: Static belt tension unit
Right: Automatic tensioner with mechanical damping



1. BELT DRIVE

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Automatic tensioner with hydraulic damping

Belt tensioner units with hydraulic damping usually have directional damping. That means that damping acts in only one direction. This is also the specific intention, in order to keep tension almost constant. Here we distinguish between dampers sealed to the bellows and dampers sealed to the piston rod. The necessary preloading is defined by the characteristics of the pressure spring and the leverage. When vibration forces act via the upper fixing eyelet on the piston of the damping element, the piston plunges into the cylinder and the hydraulic oil is pressed out of the high-pressure chamber through the gap. The size of the gap defines the damping effect. When the force on the piston decreases, the piston is forced upwards by spring force. The check valve opens and oil is sucked from the storage chamber into the high-pressure chamber, thus filling the high-pressure chamber for the next damping phase. The hydraulic damper also has a limited service life. The fixing eyelets can swing and the piston and cylinder can suffer

from wear caused by friction of the individual parts. The service life is approx. 120k km, depending on the operating conditions and the condition of the surrounding parts.

Tensioner and deflection pulleys

These are responsible for precise guidance of the belt and have to fulfil high demands in terms of alignment, force absorption and true running. The load rating of the bearing depends on the specific application. The bearing surface is made of either plastic or metal, with a trend towards plastic pulleys. They cause less noise during operation than metal pulleys and also offer huge advantages in terms of weight. Some special pulleys need a special seal, as in this case the sealing lip has no direct contact with the inner bearing ring. Without a protective cap on this pulley, water or dirt would penetrate the bearing and thus destroy it.

1.4 Overrunning alternator pulleys and crankshaft dampers

Overrunning alternator pulleys

In the whole unit drive, the alternator has the greatest mass and thus accordingly the greatest inertia. As a result of the rotational irregularity at the crankshaft caused by ignition, this inertia of the alternator sets the whole unit drive vibrating. In detail, this means that the alternator wants to continue rotating at a higher speed although the crankshaft speed is momentarily being retarded. The alternator tries to continue turning against the engine speed, resulting in unwanted belt vibrations with considerable reductions in the service life of all other components in the unit drive. However, up to now overrunning alternator pulleys have rarely been used in HDVs.

Crankshaft dampers

In the unit drive, the vibrations from the engine come up against the vibrations of all the individual accessory units. In some structures, they can cause a further build-up in vibrations. This is why crankshaft dampers are also used in some HDV engines to decouple the two vibration generators from each other in the whole engine system. This is achieved by physical separation of the driving and driven side of the pulley. The two components are connected by flexible vulcanised rubber with a considerable reduction in the mutual effect of the two vibration sources.

Together with overrunning alternator pulleys and automatic tensioner units it is possible to achieve the greatest possible reductions in overall system vibrations. On the other hand however, this also means that one single defective part will have a negative impact on the whole structure.



Crankshaft damper



1.5 Installation instructions

- Comply with the manufacturer's instructions
- Use special tools, particularly when replacing overrunning alternator pulleys
- Check all surrounding parts for any signs of damage
- Check the correct basic setting of static tensioning pulleys
- Check hydraulic tensioners for leaks
- Check mechanical tensioners for corrosion

Left: Automatic tensioner with hydraulic damping
Right: Overrunning alternator pulley

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1.6 Damage symptoms

Adhesion of particles to the bearing surface of the pulley

Possible causes:

- Differing speeds between belt and pulley because of inadequate belt tension
- Decomposition of the V-rib belt caused by aggressive media such as leaking oil or coolant

Poly V-belt tarnished on the side

Possible causes:

- Foreign body in the pulley, pulley damaged
- Inner damage of the tension members
- Alignment fault in the system

Broken fixing eyelet

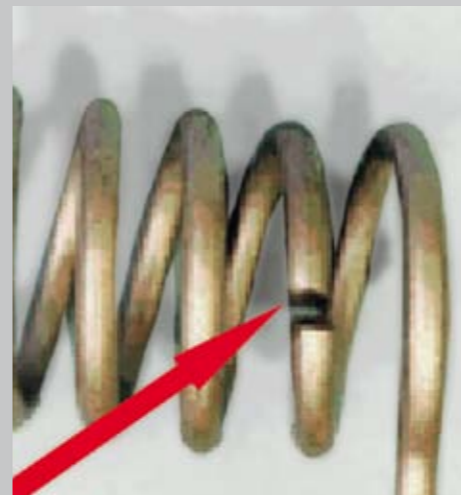
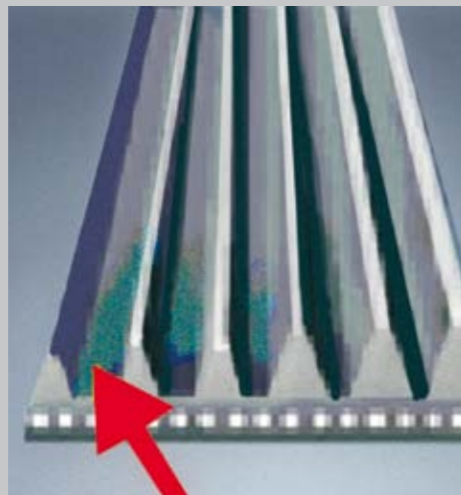
Possible causes:

- Blocked overrunning alternator pulley
- Hardened crankshaft dampers
- Tensioner unit has reached its wear point in time

Broken tensioner spring (mech. tensioner)

Possible causes:

- Jammed overrunning alternator pulley
- Worn friction plate or worn friction cone
- Defective crankshaft damper
- Natural wear of the spring steel



2. WATER PUMPS

2.1 Cooling circuit

Diesel engines in HDVs generate temperatures of more than 2,000 °C in full-load operation. Efficient cooling is necessary to protect the engine itself and the neighbouring components from these high thermal loads.

Liquid cooling is of course the most suitable here. The first cooling systems of this kind were used in vehicle engines in the early 20th century.

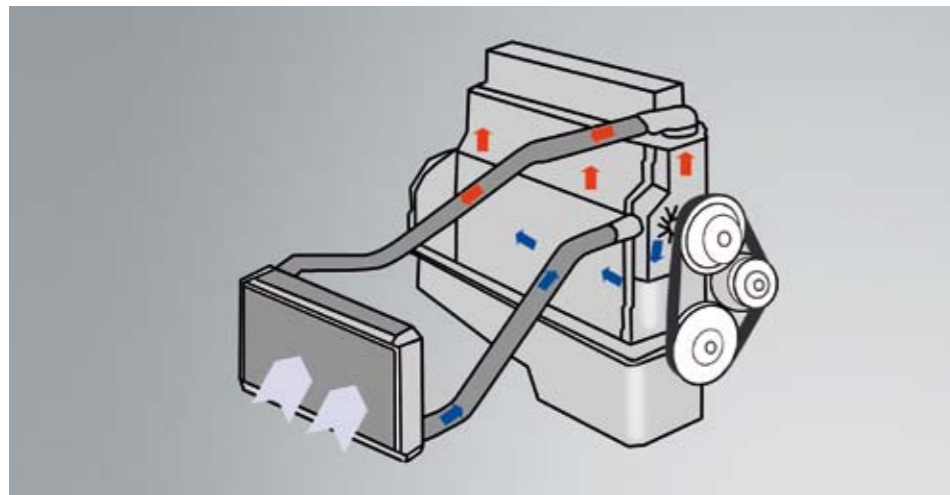
Thermosyphon cooling was developed, using the force of gravity to operate as automatic circulation cooling. It managed without using a pump. However, by 1910 this system was no longer sufficient for cooling "modern" engines.

And so water pumps were used to pump the coolant through the engine and heat exchangers: this was the birth of forced circulation cooling.

But here again, this technical achievement only lasted 10 years because of the great fluctuations in engine temperature. The development of the thermostat around 1920 provided the solution to this problem.

Since then, the basic structure of the cooling system has scarcely been changed. The only difference has been the increase in components that need cooling, e.g. due to the retarder.

Initially, the system was filled only with water, that is why we still speak of water pumps today. The most important individual components of the cooling system are the water pump, the thermostat and of course the actual coolant. These components are described on the next few pages.



2.2 Requirements for HDV

Durability

The high temperatures inside the engine mentioned at the start have to be cooled down efficiently. The cooling system of an engine therefore has to be rated accordingly. Failure of the cooling system with subsequent overheating of the engine quickly causes destruction of the lubricating film, leading to total engine failure.

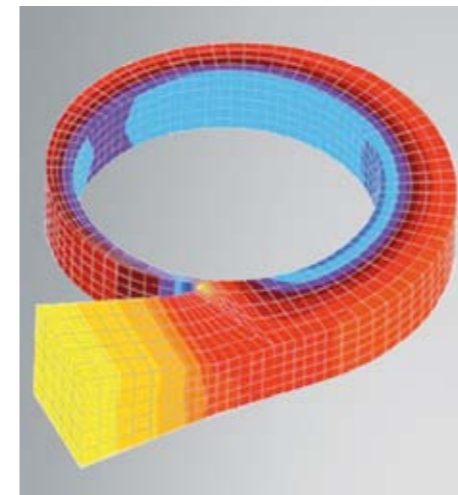
The water pump is a crucial part of forced circulation cooling in today's engines and is exposed to extreme loads. Vehicles used in long distance transport complete an average of one billion revolutions in three years, with temperatures fluctuating by up to 140 °C. This means that all components have to be perfectly tuned to each other to ensure the best possible cooling in all operating conditions in spite of these high differences in temperature. This applies particularly when additional parts also have to be cooled, such as the retarder, for example.

Functional capacity

Optimum cooling of an engine needs a certain flow of coolant to achieve the necessary delivery rate. And so the design of a water pump is not left to chance.

Transmission between the crankshaft gear and the water pump gear is just as important as the number and position of the guide vanes on the impeller, together with correct guidance of the coolant by a spiral or swirl duct.

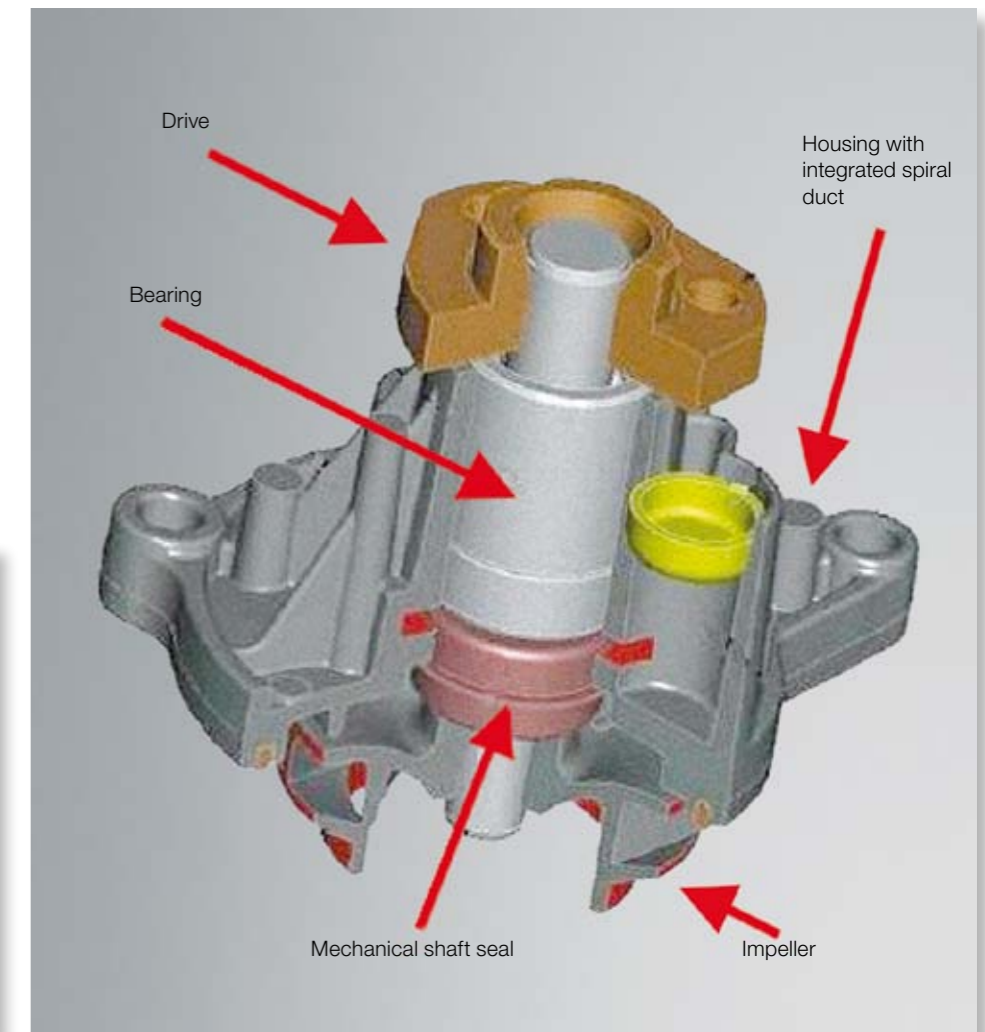
If the system also has a permanent brake (eddy current brake, retarder or aquatarter), the pump has to be adjusted to the increased power demand compared to a vehicle without permanent brake. In addition to the design rating of the individual components, as a rule an additional connection will be necessary for direct connection of the retarder.



2.3 Structure and function

The water pump is responsible for constant circulation of the coolant in the cooling circuit to ensure constant heat dissipation from the engine, thus also supplying the heating circuit with sufficiently warm coolant.

This is why the design and coordination of the individual components is so important.

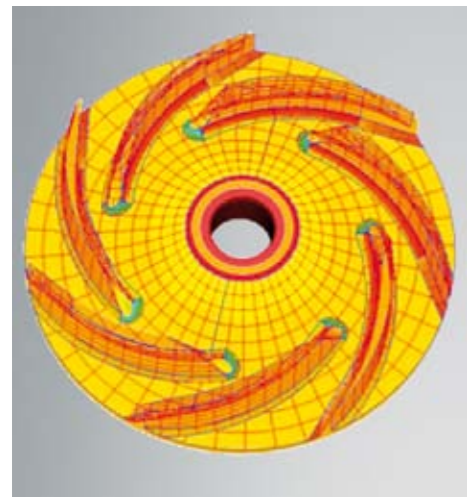


- 1. BELT DRIVE
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Impeller

The impeller is one of the main components in a water pump and is responsible for guiding the volume flow with the least possible losses. The guide vanes hurl the coolant out into the spiral duct which bundles the volume flow. Corresponding planning and design achieves a high performance rate and efficiency while reducing the risk of cavitation.

The surface quality of the guide vanes also influences the efficiency of the pump. While modern cars tend to have plastic impellers, HDV water pumps are still usually made of metal.



Bearing

The water pump bearing is designed according to the stipulations made by the vehicle manufacturer. Various different types are available here, depending on the kind of bearing. When transmitting great forces, it is advisable to use a ball/roller bearing. Ball/ball bearings can be used for applications with lower loads.



Ball/ball bearing

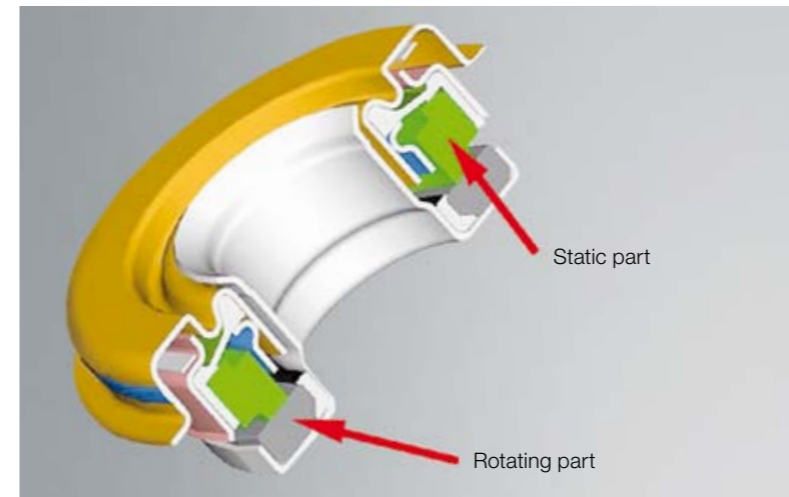


Ball/roller bearing

Mechanical face seal

The closed cooling circuit is sealed off from the atmosphere by the so-called mechanical face seal. A conventional radial shaft seal cannot be used in a water pump because the cooling system works with positive pressure of up to 1.5 bar.

The mechanical face seal consists of a static and a rotating part pressed against each other by spring force. These components rub against each other to create the corresponding sealing effect. The coolant acts not only to cool the friction components but also as a lubricant on account of its consistency. This means that part of the coolant can escape between the two friction components. The permitted quantity is 12 g/ 10,000 km. Without adequate cooling and lubrication, the mechanical face seal overheats within a short period of time and starts to leak. In the worst case, this can result in total engine failure.



- 1. BELT DRIVE
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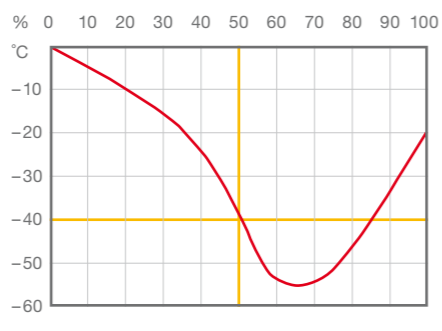
2.4 Coolant

Concentrated coolant

Correctly mixed coolant consists of non-calcic water and special additives to protect against frost, corrosion and cavitation. These concentrated coolants are usually made of ethylene glycol and other additives. Glycol is responsible for the antifreeze effect. Special additives protect the engine, the heat exchangers and all other parts against corrosion and scale deposits. Here it is important to note that these additives become less effective in time, so that the intervals stated by the vehicle manufacturer for changing the coolant must always be observed. The mixing ratio plays a crucial role in providing optimum protection. In our latitudes, it consists of approx. 50% concentrated coolant and 50% water.

Caution:

Antifreeze levels of more than 65% in the mixture reduce the frost protection effect again because of the chemical composition of the antifreeze additive, as illustrated by the antifreeze diagram shown here.



As well as losing its antifreeze effect, the specific conductivity of the coolant also falls. The engine heat is no longer dissipated as efficiently, with a subsequent huge increase in the risk of the engine overheating. Depending on the vehicle model, some manufacturers stipulate special mixtures where no water is added at all. These mixtures are available for purchase ready mixed.

The demands made on coolants have changed in time with regard to corrosion and electrolysis behaviour on account of the increasing use of light alloys in engine construction. Many of the metal alloys and polymers used in modern engines demand a wide range of coolants with adapted properties. In this context, it is important to note that not all of these coolants are miscible with others. Corresponding compliance is required with the manufacturer's instructions. In addition, the engine must always be operated using a coolant which is approved by the manufacturer.

Checking the antifreeze content

The correct antifreeze content can be checked easily with an antifreeze tester. In our latitudes (Central Europe), the display should indicate around -40 °C, which means a mixing ratio of approx. 1 : 1. The antifreeze effect does not decrease with aging of the concentrated coolant and depends solely on the mixing ratio. By contrast, corrosion protection decreases with increasing age. Simultaneous use of coolant containing silicates and silicate-free coolant can cause brown discoloration, generated by the chemical reaction between the two concentrated coolants. It is possible for this to generate a kind of gel, which settles in the engine and cooling circuit and considerably impairs the cooling performance.



If both concentrates have been mixed, the coolant must be drained completely and the system flushed thoroughly at least three times. Then fill the system with the intended coolant and vent the system accordingly.



2.5 Installation instructions

Regular changing of coolant with flushing of the cooling system helps to prevent sludge formation. The change intervals and specifications of the vehicle manufacturer must be observed. As a rule, it is advisable to change the coolant every 2 years.

- Always use new seals when installing the water pump
- Comply with the specifications of the vehicle manufacturer
- Comply with the approvals issued by the vehicle manufacturer when using concentrated coolants and sealants
- Only use water to fill the system if it can be described as "low-scale", or mix with demineralised water
- Observe the optimum mixing ratio of approx. 1 : 1 water and concentrated coolant
- Do not exceed the specified torques during installation
- Adjust the correct drive belt tension for the water pump. If the belt is too tight, this can lead to premature bearing damage in the pump. If the belt is not tight enough, it can slip very easily
- The cooling system must always be thoroughly flushed and vented every time after working on the cooling circuit.
- Soiled radiators or radiator grilles reduce the air flow; they must be checked for soiling from the outside and cleaned if necessary



2.6 Damage symptoms

Leaks in water pumps can be caused by:

- Normal wear after approx. 150,000–300,000 km, depending on operating conditions
- Contamination in the cooling system, e.g. caused by rust, deposits, rubber or plastic particles penetrating into the mechanical shaft seal
- Filling the cooling system with unsuitable fluids or using the wrong mixing ratio with too much tap water (limescale)
- Overpressure in the cooling system caused by defective pressure relief valves in the radiator cap
- Defective cylinder head gaskets that let pressurised combustion fumes or engine oil into the cooling system

Damaged bearing races

Possible causes:

- Incorrectly adjusted belt tension
- Overload caused by defective parts in the belt drive
- Dirt or water penetrating into the bearing

Cavitation

is a physical effect based on changes in pressure caused by varying flow speeds. From a certain flow speed, it is possible for gas bubbles to form between a liquid and the structure that it is flowing over; changes in speed which interrupt the flow then result in the bubbles collapsing again at the same structure. The liquid is thus hurled against the housing wall at high speed. Constant impact of the liquid causes abrasion to the material of the housing wall.

Leaks at the mechanical face seal

Possible causes and consequences:

- Too much sealant has been used
- Sealant flushed along in the system has penetrated the mechanical face seal
- Coolant leaking at the water pump bearing
- Destruction of the bearing

Material pitting at the impeller

Possible causes:

- Cavitation at the impeller
- Use of wrong coolant

Corrosion and limescale damage

Possible causes:

- Use of water containing minerals
- Use of non-approved coolants
- Wrong mixture ratio of concentrated coolant and water

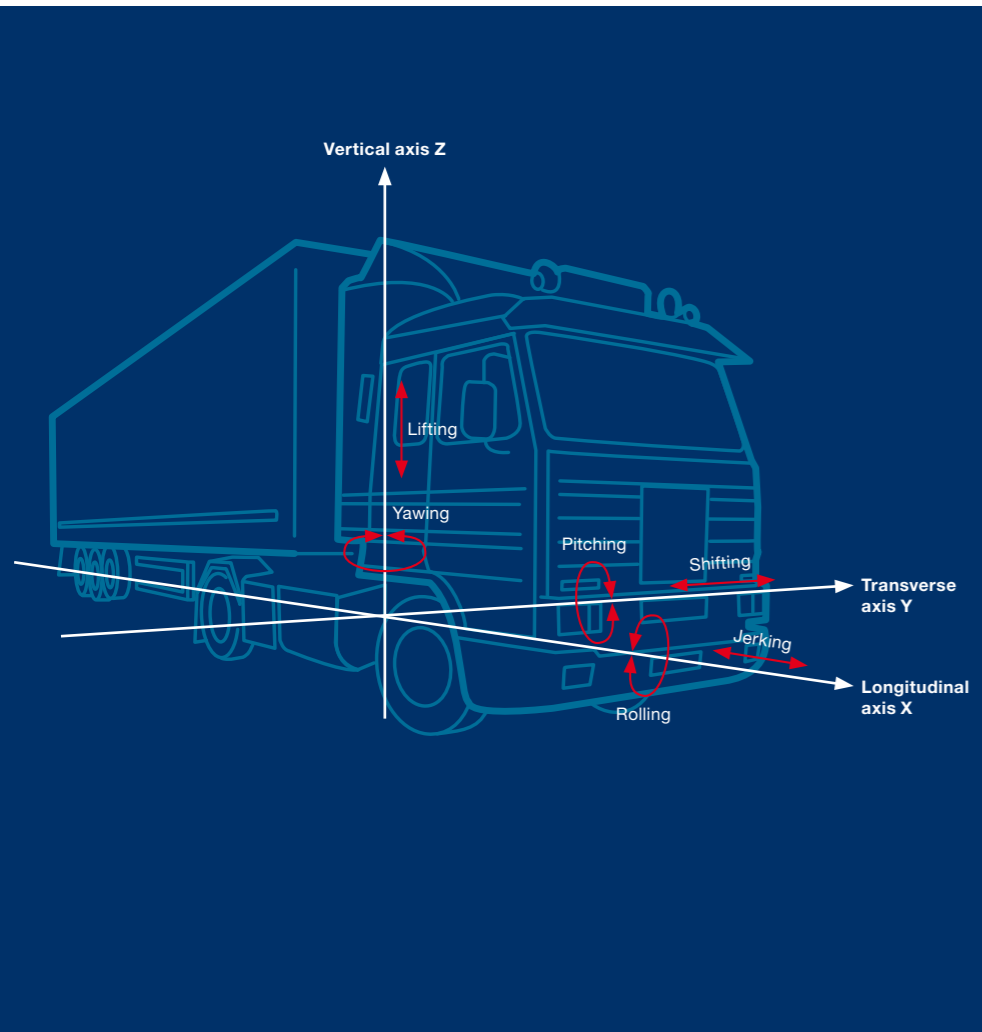
Brown discoloration in the whole cooling system

Possible causes and consequences:

- Use of non-approved coolants
- Mixing of unsuitable additives
- Inadequate cooling effect
- Sludging of the cooling system



3. CHASSIS PARTS



3.1 Axes of movement

When a vehicle is in motion, rotational movements cause load in the 3 geometric axes: the vertical, longitudinal and transverse axes. This is compounded by movement in the direction of these axes. Movement around the vertical axis consists of lifting and lowering together with yawing; rolling and jerking occurs around the longitudinal axis. Movement at the transverse axis consists of lateral shifting and pitching around the axis. Every change in the driving status changes the loads referring to these three axes. Accordingly, the vehicle's centre of gravity changes continuously. In order to take account of this behaviour of the vehicle, the chassis must be adjusted correctly during design and when making repairs. The following pages deal with the chassis and its peculiarities in the vehicle. All in all, it can be said that chassis parts are safety parts that concern all road users. Special attention should therefore be paid to these components in order to avoid major accidents.

3.2 Steering and tie rods

Steering and tie rods have become indispensable chassis parts to ensure that the vehicle can drive perfectly straight. Although invented by Fritz Faudi as early as 1922, it was only in the second half of the 20th century that the ball joint really came into its own. Until then, plain bearings were used for axle suspension and steering, resulting in heavy axle structures. As crucial parts of the steering and tie rods, we distinguish between ball joints depending on whether they are spring loaded or not. But it takes more than just these parts to keep the vehicle perfectly on the road in all circumstances and conditions. Correct axle alignment is one important aspect, particularly for HDVs. This kind of investment pays off in more ways than one, particularly in these times of extremely high raw material prices, as it results among others in lower fuel consumption and reduced wear to the tyres.

Another important point is excessive play between the individual parts. For example, if a tie-rod head is worn out, this can result in unresponsive handling and subsequently in excessive wear of all parts involved in the suspension and tyres. This comes primarily from constant self-steering by the vehicle with corresponding counter-steering by the driver. In many cases, these driving properties are not noticed straightaway, as it tends to be a gradual process that the driver will think is normal.



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3.3 Axle link

Guidance of the axles is one of the most important tasks performed by the chassis of an HDV. If the axles are not guided properly, this causes problems with the driving characteristics; in the worst case, the vehicle can swerve and cause major accidents. The various different axle links are the trailing arm, the wishbone and the 4-point link.

While the trailing arm is used to guide the front and/or rear axle, the wishbones and 4-point links are to be found only on the rear axle. There are 2 different possibilities for suspending the axle links. These consist of the molecular joint and the plain bearing. The advantages of the plain bearing over the molecular joint are quite obvious, as it offers the greatest possible freedom of movement paired with almost zero-play guidance of the link. In addition, the plain bearing has a longer service life. The advantages of the molecular joint consist in vibration damping, no maintenance and less sensitivity to water (e.g. power cleaners).

Molecular joint
Ball joint



Trailing arm

Wishbone

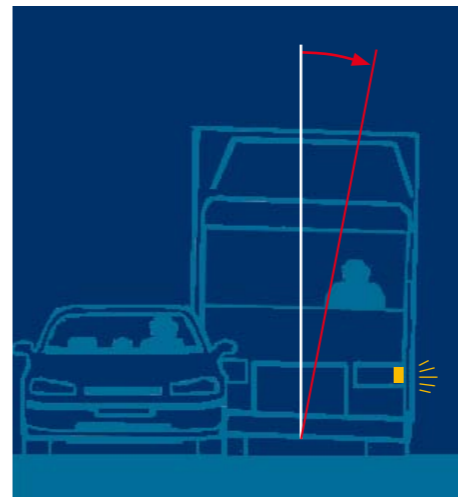


3.4 Stabilisers

The vehicle's longitudinal axis offers great potential for chassis problems, above all when going round corners, over rough road surfaces and as a result of sudden evasive manoeuvres. This means that the left side of the vehicle has to be stabilised against the right side. Stabilisers are used for this purpose, connecting the two halves of the axle suspension. They act as a kind of transverse spring, conveying the forces generated when one half of the vehicle is subject to loads to the other half in order to minimise the rolling movement. Stabilisers make an active contribution to safety, particularly in heavy HDVs with high bodywork.

For example, if a heavily loaded vehicle has to swerve suddenly, the vehicle's high centre of gravity would tend to make it roll. This rolling tendency is considerably reduced by using a stabiliser, as the forces occurring on one side of the axle are transmitted to the other side by the inner rotation (torsion) of the stabiliser rod, thus stabilising the vehicle. In the following example, the stabiliser is suspended flexibly from the vehicle axle by bushings at two points. At both ends, there is another flexible connection to the stabiliser supports, which in turn are fastened to the vehicle chassis frame.

As a rule, the flexible connections consist of plastic or rubber bushings. These bushings are subjected to very high loads on a daily basis, so that regular inspections are very important. Defective fastening elements usually make themselves heard very clearly through loud clattering noises when the vehicle drives over uneven surfaces.





3.5 Maintenance instructions

It simply cannot be said often enough that chassis parts are highly relevant to the safety of a vehicle. Maintenance and installation of these parts must therefore be extremely conscientious to rule out the risks of subsequent damage caused by defective or incorrectly fitted components.

- Check the play of all parts
- Visual inspection of the dust boots of all joints
- Check the tread profile of the tyres
- Visual inspection of the chassis springs and air spring bellows
- Check the steering rods, tie-rods and axle links for mechanical damage
- Use new split pins and lock nuts
- Vehicle alignment after replacing adjustable parts



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