Service
Tips & Information

PIERBURG

Electric

Fuel Pumps

Models, Damages, Reasons

MSI Motor Service International GmbH.
And what it stands for.

MSI Motor Service International GmbH is the sales organisation for the global aftermarket activities of Kolbenschmidt Pierbrug AG.
Under the premium brands KOLBENSCHMIDT, PIERBURG and TRW, we supply a comprehensive range of requirement-oriented products in and on the engine.

Repair shops and engine reconditioners have engine components for more than 2000 different engines at their disposal. All products meet high requirements on quality, economic efficiency and environmental protection.

Kolbenschmidt Pierburg AG.
Renowned Supplier to the International Automotive Industry.

As a long-standing partner of the automotive manufacturers, the companies in the Kolbenschmidt Pierburg Group develop innovative components and system solutions with renowned competence in the fields of air supply and emission control, for oil, water and vacuum pumps, for pistons, engine blocks and engine bearings.
The products of Kolbenschmidt Pierburg Group comply with the high demands and quality standards of the automotive industry.
Low emissions, reduced fuel consumption, reliability, quality and safety – there are the forces that drive innovation at Kolbenschmidt Pierburg.

1. Edition 08.06
Artikel-Nr. 50 003 855-02

Published by:
© MSI Motor Service International GmbH
Untere Neckarstraße
74172 Neckarsulm, Germany

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1 Introduction

1.1 Foreword

The heart of the vehicle

The electric fuel pump is an important component in the vehicle.

If there is a malfunction in the fuel pump, or if it fails completely, it is often difficult for a workshop to determine the cause of the damage with absolute certainty.

After a new pump has been installed, damages and malfunctions often occur again within a brief period of time because although the damaged components were replaced, the actual cause of the damage was not remedied.
Therefore a more comprehensive approach to the entire fuel system is required.

In the course of processing complaints concerning Pierburg fuel pumps we have discovered that the vast majority of electric fuel pumps that are returned are completely OK.

When an electric fuel pump malfunctions prematurely, this is almost always caused by fuel that is dirty or diluted with water, or of a poor quality.

The consequences of pumping contaminated fuel can be:
– Reduced delivery rate,
– Reduced pressure,
– Low performance,
– Misfires or even
– Complete failure of the electric fuel pump.

External appearances

In the workshop a defective or returned pump can be assessed only according to its outward appearance and delivery rate or pressure (please refer to Section 5.2 as well).

In many cases, the decision on whether a complaint is justified or not can be made only when the fuel pump is opened and the damage is viewed "from inside".

The staff of a workshop may not open a fuel pump that is still under warranty or returned due to complaints on their own.
If the staff of a workshop or parts distributor opens a fuel pump that has been returned due to a complaint, the guarantee will expire automatically.

Fig. 1 Severe damage
Damage is not always so obvious.

Views of hidden areas

An important concern of this brochure is to explain what could have been responsible for the failure of a fuel pump.

Therefore a host of pictures shows what it looks like inside the pumps that are returned due to complaints.

This brochure offers assistance in diagnosing and determining the causes. It is designed as a help for workshops and as information for distributors that handle defective or returned fuel pumps on a daily basis.

Based on common instances of damage, we show what it looks like inside defective or returned pumps, and what the causes of the damage could be.

This information will help you process damage claims with your customers in the workshop.

The content of this brochure is a compilation of findings gathered from service work by *MSI Motor Service International*, the Aftermarket Division of Kolbenschmidt Pierburg AG.

For this reason, this brochure concentrates on fuel pumps marketed by MSI Motor Service International.

1.2 General information on this brochure

– All illustrations and drawings in this publication are intended for general information.
– Certain details may not always match the current design of the construction.
– We reserve the right to make technical changes by further development without the necessity of changing this publication.

Please note:
This brochure was designed exclusively for technical personnel.
Technical personnel are persons who, based on their professional training, experience and schooling, have adequate knowledge of
– Safety regulations,
– Accident prevention regulations and
– Directives and acknowledged technical rules (e.g. standards)

1.3 Pictograms and Symbols

The following general pictograms and symbols are used in this brochure:

Calls attention to dangerous situations in which personal injuries or damages to vehicle components are a possibility.

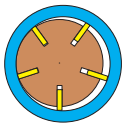
Information on environmental protection.

Information on useful advice, explanations and details on handling.

[...] Reference to sources and further reading (please refer to ➔ Section 6.1)

This type of damage cannot be detected from outside.
The damage descriptions with this symbol are visible only by opening, and thus harming the fuel pump.

By necessity, many of the images used in this brochure are extreme close-ups of very small components.
For a better understanding of the correlations, a pictogram of the model accompanies the illustrations of the pumping mechanisms.
The individual models are explained in Section 2.2


Sliding vane pumping mechanism


Side channel pumping mechanism


Toothed ring pumping mechanism


Screw pumping mechanism

1.4 Safety Instructions

- For safety reasons, only technical personnel may perform work on fuel systems and electric fuel pumps.
- The personnel charged with the work must have read and understood this publication before starting the job.
- Observe the applicable respective legal provisions specific to your country and the appropriate safety regulations.
- Safety devices must not be switched off or bypassed.
- Provide sufficient ventilation in the workplace.
- Wherever required or mandated by regulations, use personal safety equipment.
- In addition, the safety regulations specific to your country apply!
- Store parts that have been removed in a clean place and keep them covered.
- Keep the transportation seals on the new fuel pumps until you are ready to install them.
- Never use compressed air to clean an open fuel system.

Dispose of used materials, cleaning agents and waste matter in an environmentally friendly manner.

Observe the safety regulations governing the handling of fuel and fuel vapours.
Fuel and fuel vapours are highly inflammable.

During work on fuel pumps
- smoking,
- open fires,
- open flames and
- sparking producing activities

are strictly prohibited.

1.5 Liability

All information in this brochure has been carefully researched and compiled. Nevertheless, errors can occur, information can be translated incorrectly, information may be missing, or the information provided may have changed in the meantime.

Therefore, we cannot guarantee or accept legal responsibility for the correctness, completeness, update status or quality of the information provided.
We do not accept any liability for damages, especially direct or indirect and material and immaterial arising from the use or misuse of information or incomplete or erroneous information contained in this brochure unless caused by a deliberate act or gross negligence on our part.

Use of the information given is solely at the risk and responsibility of the workshop staff. Likewise, we shall not be liable for damages arising because the workshop staff do not have the necessary technical expertise, the required knowledge of, or experience in repairs.

2 Basic principles

2.1 Fuel system

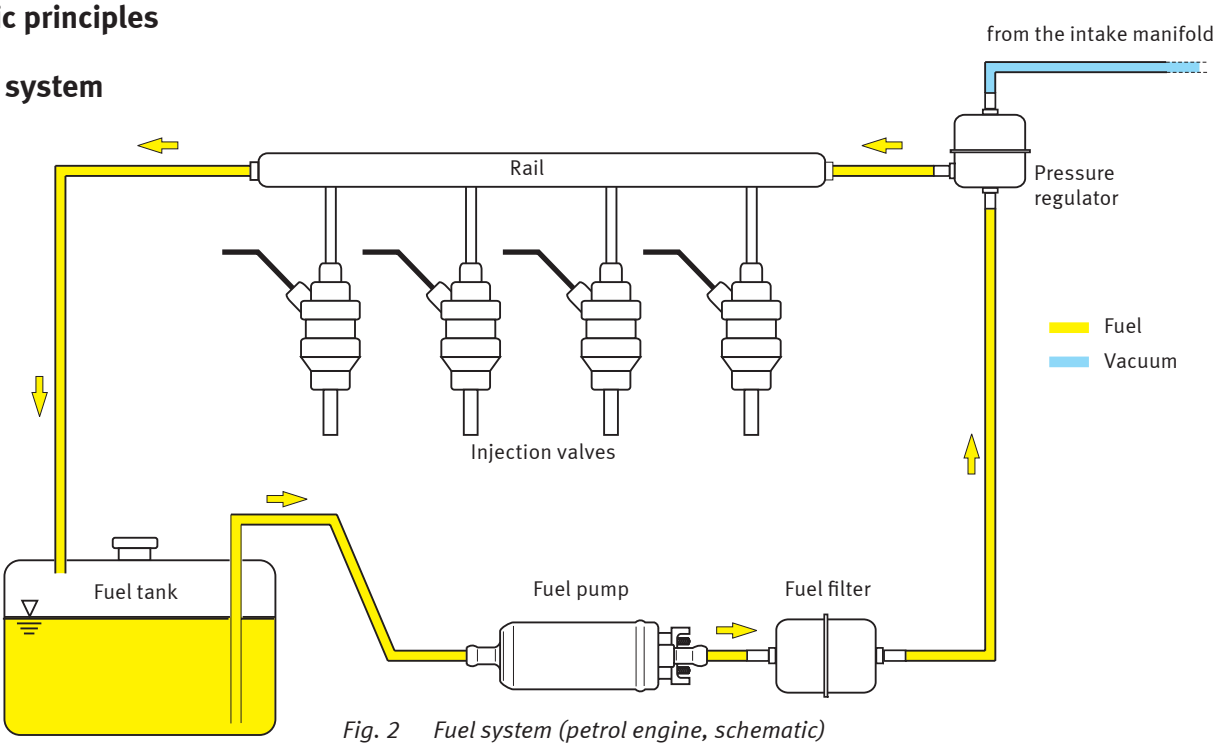


Fig. 2 Fuel system (petrol engine, schematic)

To operate vehicles and machines with combustion engines, normally petrol or diesel fuel is required.
The components used for this purpose are classified under the term "fuel system".
The components of the fuel system have changed over the decades. The current state of today's injection engines is explained in simplified form in Fig. 2.
The fuel pump suctions the fuel from the fuel tank and delivers it to the fuel supply system with the required pressure.
There is often a coarse filter (also "sieve filter") in the fuel tank or in the suction pipe.
A fine mesh filter on the suction side could damage the fuel pump by cavitation *).
There is also a risk of cavitation caused by other components installed on the suction side that constrict the width of the pipe.

The fuel filter on the pressure side of the pump protects the injection valves from impurities.
The pressure regulator regulates the pressure to the necessary level in the rail. It is often operated pneumatically by the vacuum in the intake manifold.
The fuel is fed from the rail to the individual injection valves.
All vehicle manufacturers offer injection systems in different versions.
A more detailed explanation of the individual systems is beyond the scope of this brochure.
Surplus fuel is fed back into the fuel tank.

The fuel pump is the "heart" of the fuel system.
In every operating state, sufficient fuel must be supplied to the engine. If this does not occur, there will be malfunctions in the vehicle operation and the vehicle can even stop running.

The fuel pump is only *one of many components* in the fuel system, and as such, is only one *possible source of faults*.
For this reason, when there is a malfunction, the fuel system must be considered in its totality.
Because, as with a person with "heart problems" the actual cause can be somewhere else.

The vast majority of all malfunctions in the fuel system are due to impurities in the fuel.

The cause of these impurities can be due to many sources, as explained in Section 3.

*) Cavitation is the formation of bubbles in liquids under low pressure.
The resulting bubbles implode immediately, which can damage parts of the pumping mechanism.

2.2 Models

The way electric fuel pumps are designed today, the pumping mechanism sits directly on the shaft of the electric motor.
They are flooded with fuel, which cools and "lubricates" them at the same time.

Advantages:
– Fewer moving parts
– Compact construction
– Low overall dimensions

There are different designs of pumping mechanisms.
Roughly a distinction can be made between *flow* and *displacement pumps*.

Flow pumps

In flow pumps the fuel is conveyed by the centrifugal force of a rotor.
They generate only low pressures (0.2 – 3 bar) and are used as the preliminary stage of a two-stage pump or as a pre-feeder pump.
The fuel flows through the flow pump freely without throttles or valves. For this reason the fuel can flow back through the flow pump when the vehicle is stopped.
Flow pumps are not self-priming, i.e., they must always be placed below the fuel level in the fuel tank (max. suction length 0 mm).
"Side channel" pumps are flow pumps.

Positive displacement pumps

In positive displacement pumps the fuel is forced through enclosed chambers.
They are used for higher system pressures (up to approx. 6.5 bar) such as those that dominate in conventional injection systems.
Except for leaks due to the design, even when the vehicle is stopped the fuel cannot flow back through the displacement pump in the opposite direction.
Positive displacement pumps include the toothed ring, sliding vane, roller vane and screw pumps.
Positive displacement pumps are self-priming only to a very limited extent, i.e., they should be installed below the fuel level of the fuel tank (max. suction length 500 mm).

Fuel cannot be forced *through* a positive displacement pump!
In other words, if such a fuel pump malfunctions, it must be replaced.
It is useless to install an additional pump before or behind the existing pump (in a row).

A distinction is made between *in-tank* and *in-line* pumps, based on their location in the vehicle.
The trend is toward in-tank pumps, or complete *fuel supply modules* in which other components such as fuel level sensors or diagnostic systems are included in or attached to the fuel supply module.

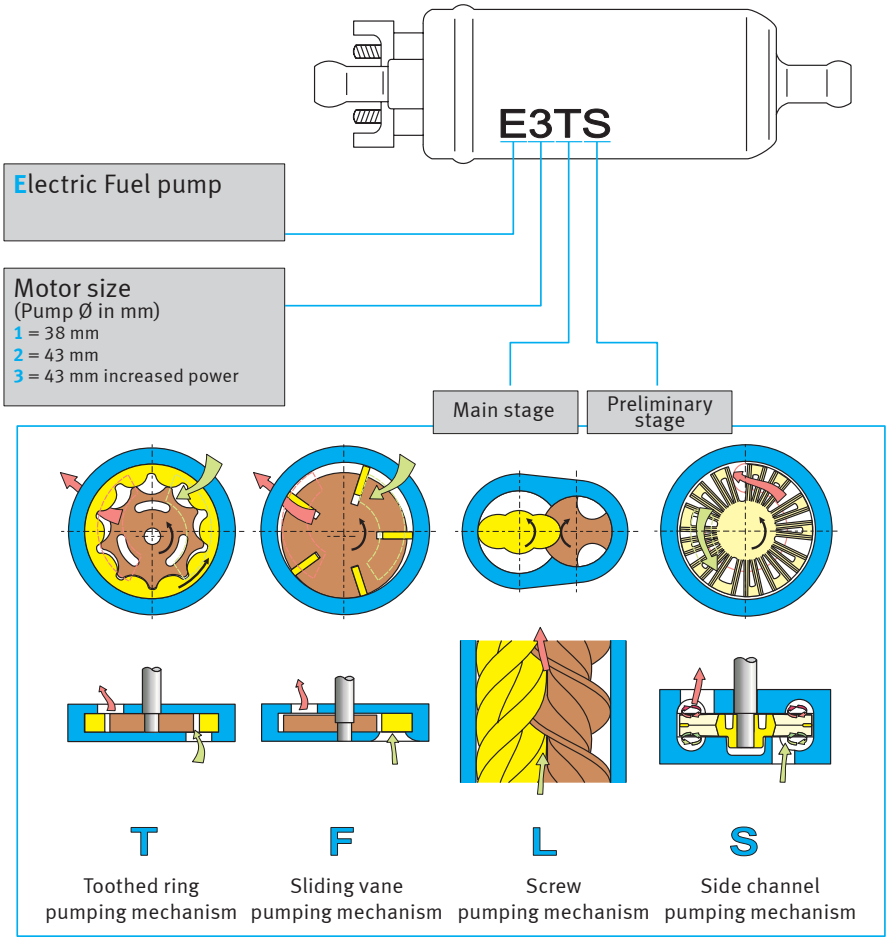
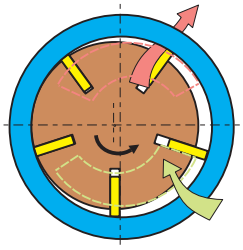


Fig. 3 Pierburg abbreviations for electric fuel pumps

Sliding vane pump – E1F



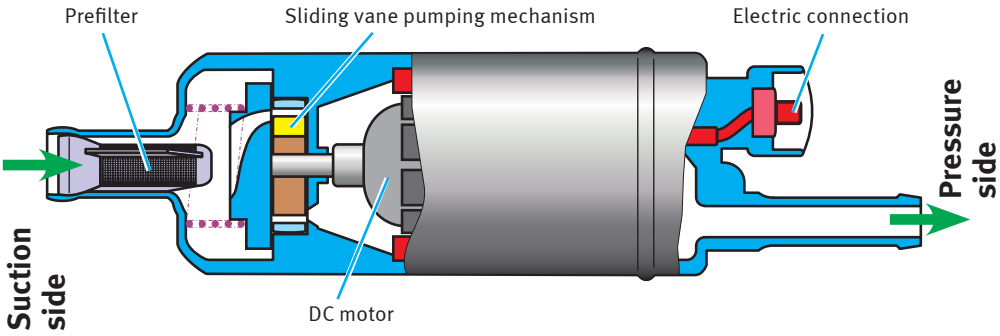
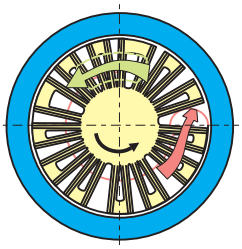


Fig. 4 Pumping principle and cross-section (schematic) of a sliding vane pump

Side channel pump – E1S



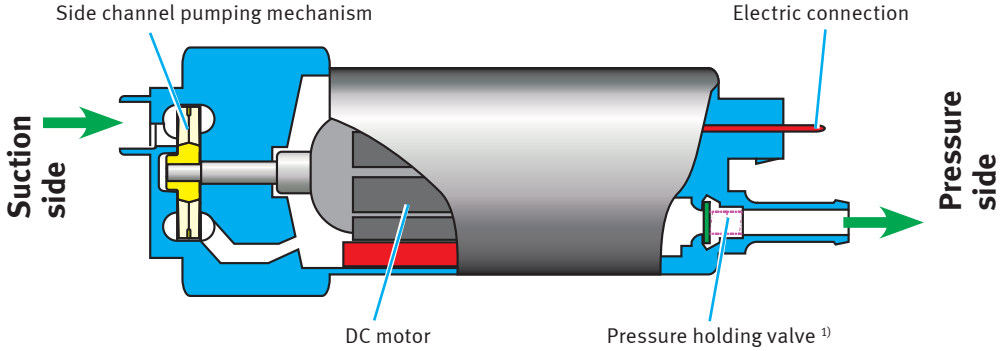
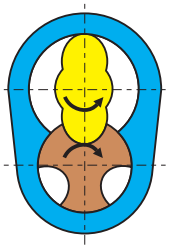


Fig. 5 Pumping principle and cross-section (schematic) of a side channel pump

Screw pump – E3L



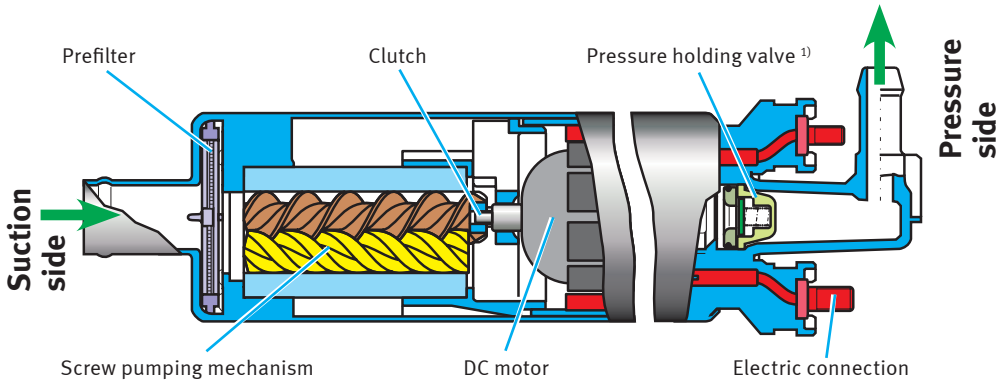


Fig. 6 Pumping principle and cross-section (schematic) of a screw pump

1) The pressure holding valve maintains a holding pressure in the fuel system even when the ignition is OFF.

Toothed ring pump – E2T/E3T

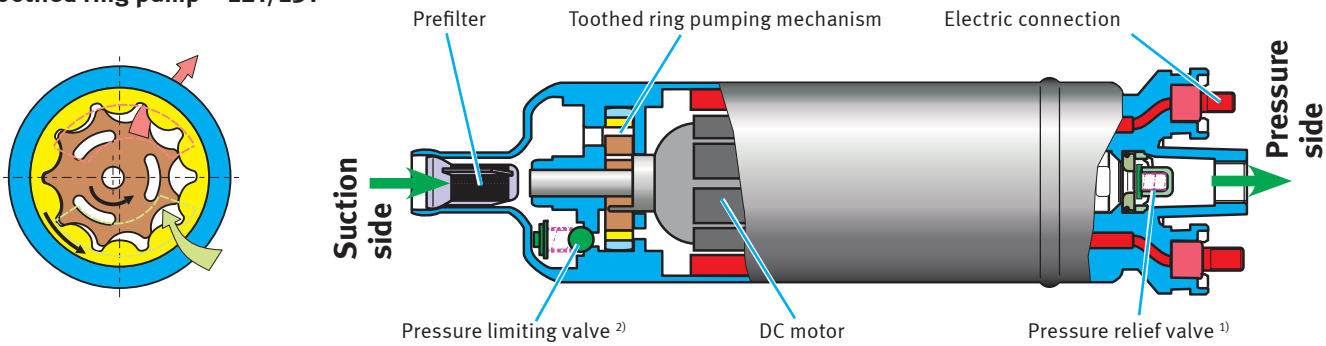


Fig. 7 Pumping principle and cross-section (schematic) of a toothed ring pump

Toothed ring pump with preliminary side channel stage – E3TS

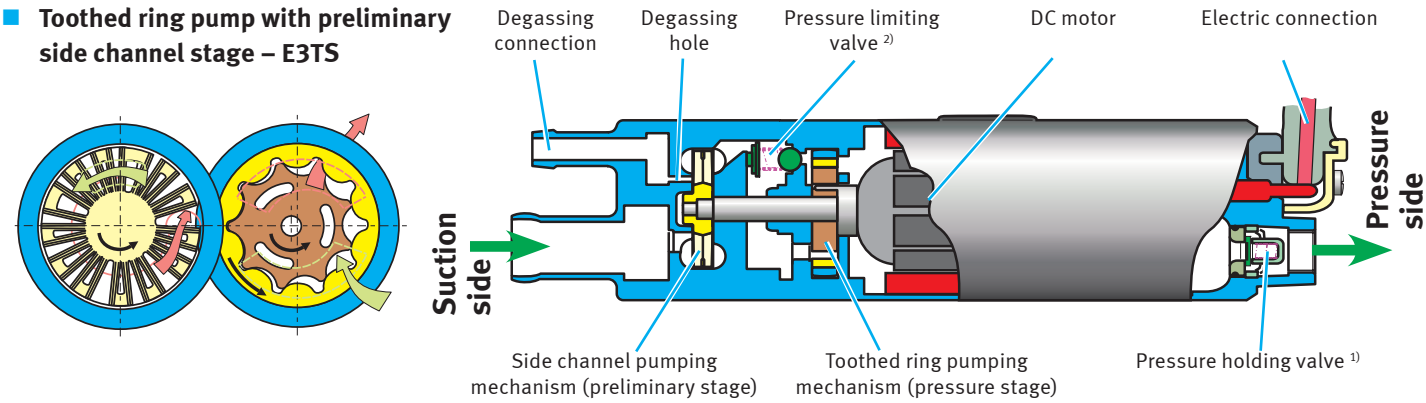


Fig. 8 Pumping principle and cross-section (schematic) of a two-stage pump

1) The pressure holding valve maintains a holding pressure in the fuel system even when the ignition is OFF.

2) The pressure limiting valve will open if the pressure inside the fuel pump increases to unacceptably high levels.

Fuel supply module

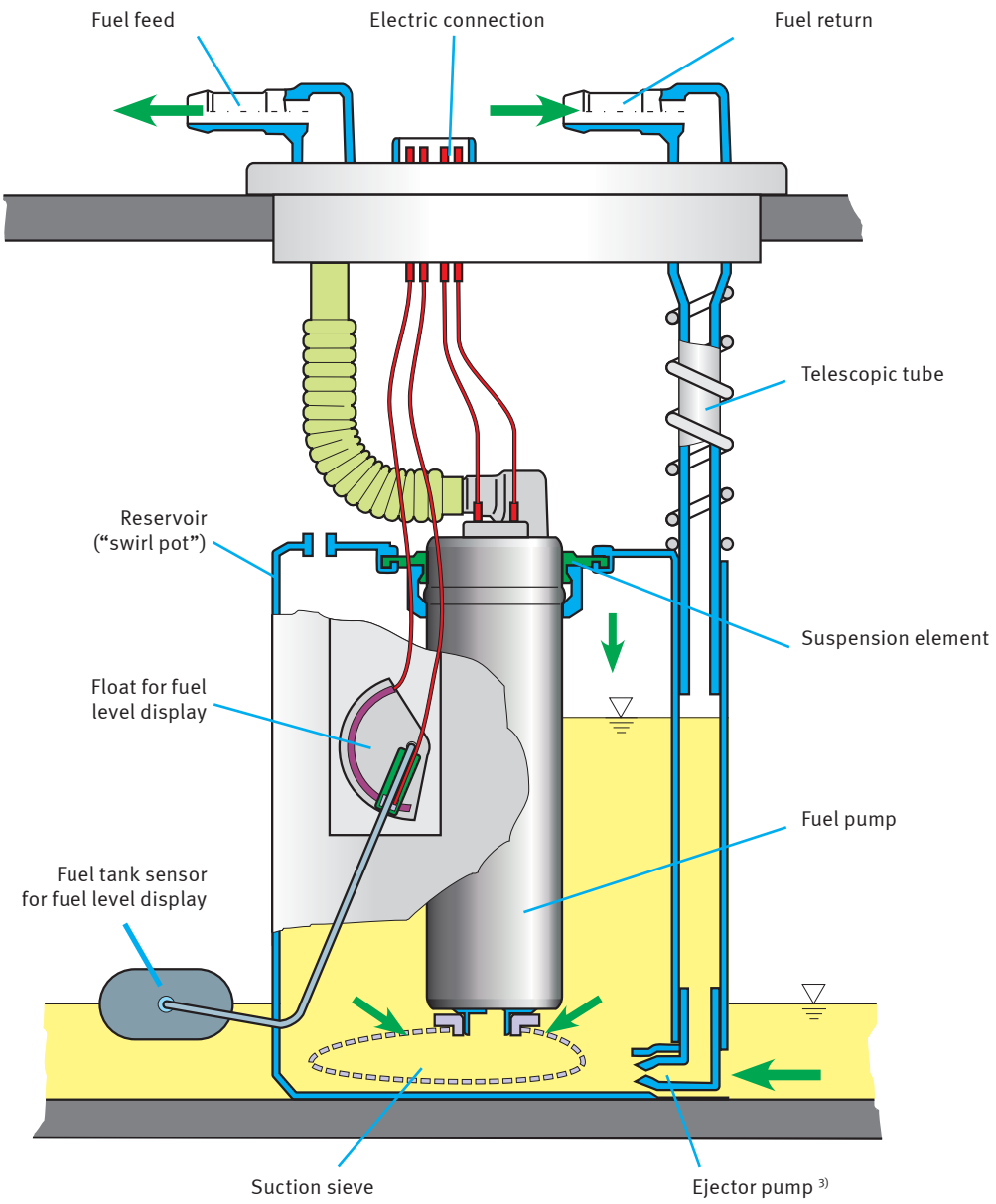


Fig. 9 Cross-section (schematic) of a fuel supply module

[3] The ejector pump uses the Venturi effect: The fuel flowing back from the engine is forced through the nozzle of the ejector pump, which ejects the fuel out of the tank into the reservoir.

2.3 Block diagrams of examples of electric fuel pump installations

A distinction is made between in-tank and in-line fuel pumps, depending on the type of installation in the vehicle.
- In-line pumps are placed in the fuel line.
- In-tank pumps are placed in the fuel tank. In the case of in-tank pumps, other components such as fuel level sensors or diagnostic systems can be included directly in or attached to the fuel supply module.

Interim and special solutions such as half-in-tank pumps (e.g. Golf II) are not listed here.

One or two fuel pumps are connected one after another, depending on the requirements.
- A single fuel pump
- Two fuel pumps (pre-feeder and main pump)
  Pre-feeder pumps supply the fuel to the main pump at low pressure.
- A single, but two-stage fuel pump

These types of possible installations are shown in the adjoining illustrations.

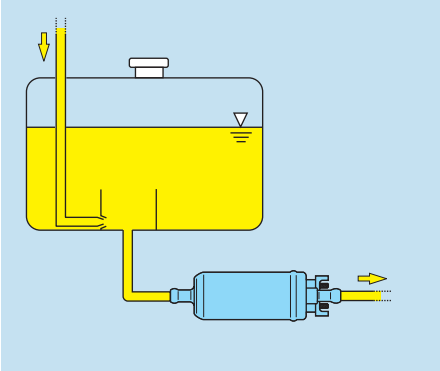


Fig. 10 Fuel pump in-line

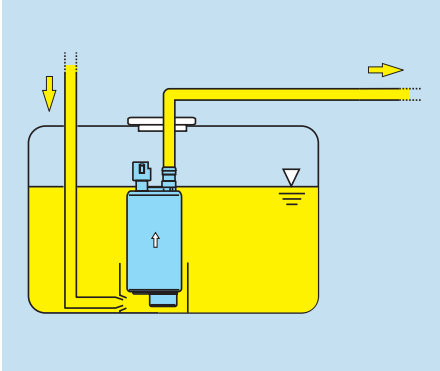


Fig. 11 Fuel pump in-tank

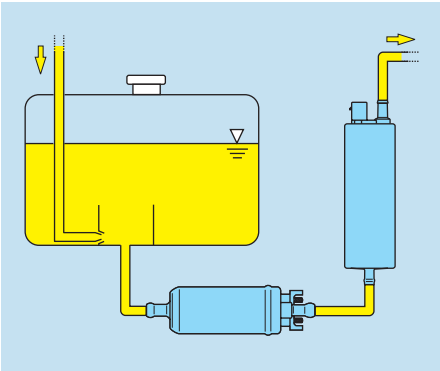


Fig. 12 Pre-feeder pump in-line/main pump in-line

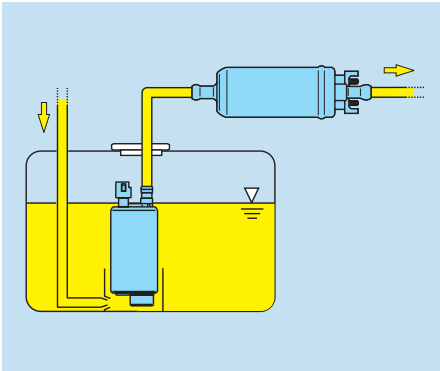


Fig. 13 Pre-feeder pump in-tank/main pump in-line

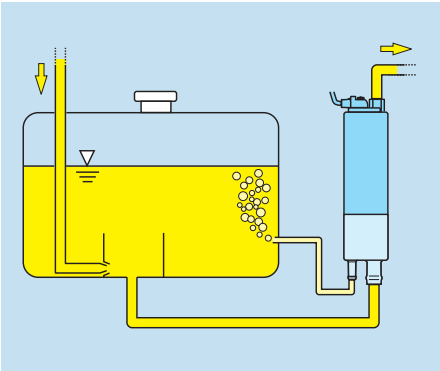


Fig. 14 Two-stage fuel pump in-line

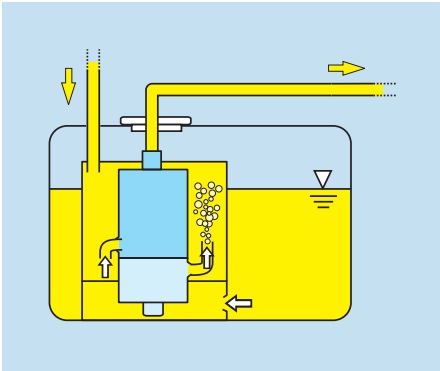


Fig. 15 Two-stage fuel pump in-tank Fuel in reservoir ("swirl pot"); stages are sealed off from each other

3 Damages

3.1 Overview

The main cause of malfunctions or damages to electric fuel pumps are consequential damages caused by fuel that is dirty or diluted with water.

Other causes are poor quality fuel, impact damage or simply the incorrect arrangement or choice of fuel pumps.

In the following subsections you will find individual damages and an explanation of their possible causes.
In order of frequency, they are:
– Damages caused by dirt
  (see ➔ Section 3.2.1)
– Damages caused by water
  (see ➔ Section 3.2.2)
– Wrong use or application
  (see ➔ Section 3.4)
– Poor fuel quality
  (see ➔ Sections 3.2.3 and 3.3)
– Mechanical damages/
  installation errors
  (see ➔ Sections 3.5 and 3.6)

Please note that the individual causes cannot always be clearly distinguished from each other.
Thus "rust particles" that are a result of water in the fuel, strictly speaking must also be listed under the "damages caused by dirt" category.
Likewise a frequent characteristic of poor quality fuel is too much water, which then can lead to corrosion and damages caused by dirt.
Due to the frequency of "water damages" they will be dealt with in a separate subsection.

Fig. 16 Heavily corroded electric fuel pump

An image that a workshop usually doesn't get to see. In many cases a fuel pump has to be opened to determine why a pump that looks OK on the outside has malfunctioned.

The content of this brochure is a compilation of findings gathered from service work by *MSI Motor Service International*, the Aftermarket Division of Kolbenschmidt Pierburg AG.

For this reason, this brochure concentrates on fuel pumps marketed by MSI. An important concern of this brochure is to explain what could have caused the damage because "from outside" it is generally impossible to tell by looking at a fuel pump why it is no longer working or why it isn't performing adequately.
In many cases the fuel pump has to be opened, and thus irretrievably damaged, in order to determine the cause of the failure.

Even a reading of OBD fault codes in newer vehicles can only be considered a helpful tool. Because it is not always the component indicated by the OBD that actually caused the damage.

This requires the expertise of a specialist with knowledge of the system. This is the only way to ensure that the actual cause will be addressed and not just a symptom, so that the damage will not recur after a few hundred kilometres.
In the course of processing complaints we have discovered that the vast majority of electric fuel pumps that are returned meet the required specifications.

To avoid unnecessary work and additional costs, MSI Motor Service International has developed an easy-to-operate tester for wholesalers and importers (please refer to ➔ Section 5.2).
It offers the ability to check the functioning of electric fuel pumps locally without damaging them.

This way unjustified complaints can be detected without a problem and unnecessary returns and costs can be avoided.

3.2 Contaminated fuel

3.2.1 Damages due to dirt

The most frequent cause of malfunctions in the fuel system or premature failure of fuel pumps is impurities with larger or smaller particles.

They produce different effects:
– Clogging of filters
– Reduction of fuel delivery rate
– Excessive noise in the fuel pump
– Dry running of the pump
– Blocking of the pumping mechanism

Possible causes can be:
– Rust or lime particles (for "water damages" see ➔ Section 3.2.2)
– Impurities in the fuel tank from outside (e.g. while filling the tank)
– Ageing of the fuel by long periods of disuse (formation of deposits)
– Failure to adhere to maintenance schedule (filter change)
– Poor fuel quality (see ➔ Section 3.2.3)
– Old, porous fuel hoses
– Impurities and water due to a frayed fuel tank vent hose or due to improper retrofitting of a fuel tank vent hose.

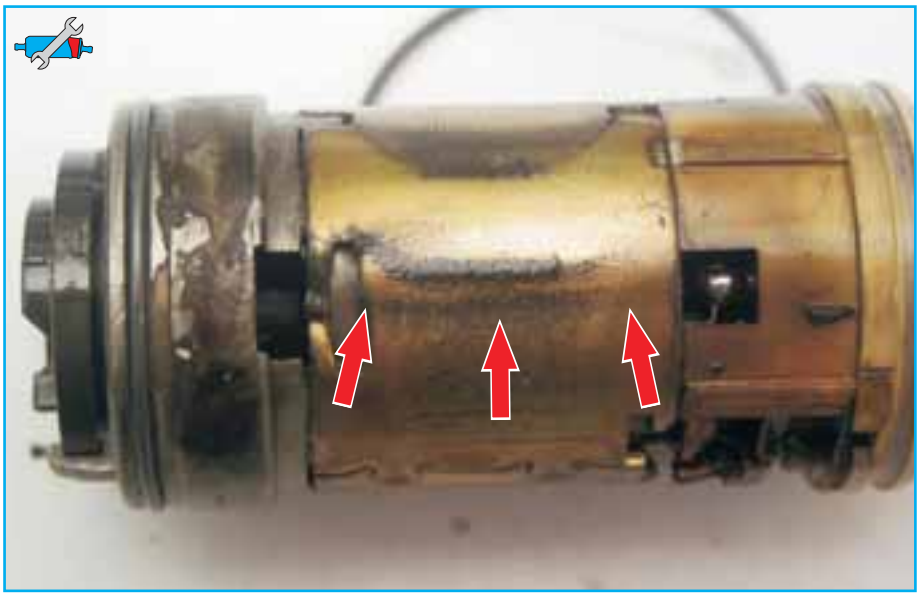


Fig. 17 Dirty fuel pump
The illustration shows a heavily soiled fuel pump. The outside cover was removed and you can see deposits and dirt particles running down the side.

Fig. 18 View inside a cut open housing of an E3T toothed ring pump - clogged with deposits

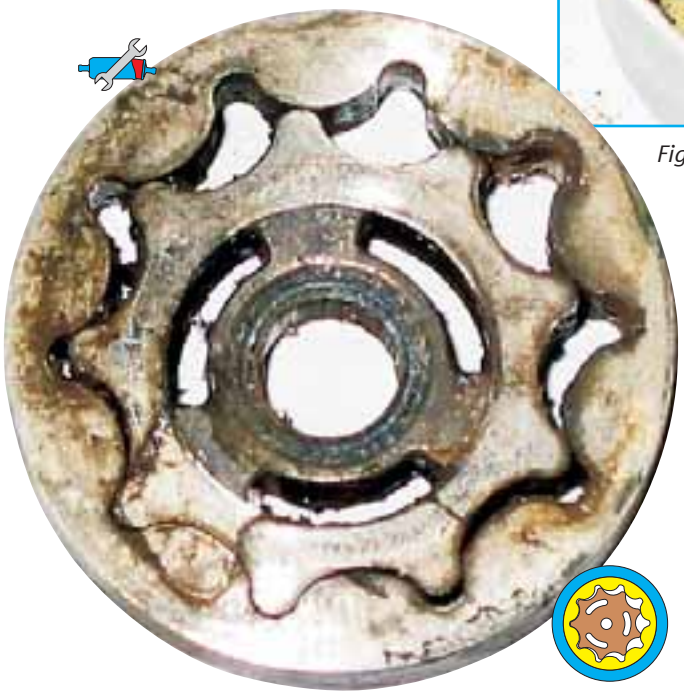


Fig. 19 Blocked pumping mechanism (trochoid toothed ring) of an E3T toothed ring pump

Clogging of filters

If fuel filters or sieves are clogged by impurities on the suction side, they will first show the following symptoms:
– Insufficient delivery rate
– Pressure not reached
– Excessive noise in the fuel pump
– Engine misfires (due to bubbles)
This can cause the fuel pump to fail and the vehicle to break down.

Most modern fuel pumps are rinsed thoroughly by the fuel, which also lubricates and cools them.
If this does not occur to a sufficient degree, for example, if a prefilter or sieve filter in a fuel pump intake is clogged, there is a danger of "dry running".
Dry running will cause damage to the pumping mechanism very fast.

Fig. 20 Scorching due to dry running

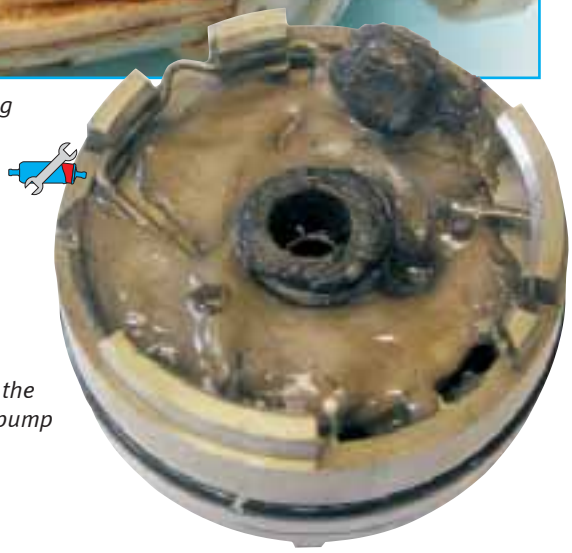


Fig. 21 Dry running has caused the plastic parts of the fuel pump to melt.

Fig. 22 Sieve filter of an E1F sliding vane pump clogged on the left - new on the right

E1F, E2T and E3T series fuel pumps have a sieve filter built in on the suction side.
This small "prefilter" is a protection against impurities. Inspections of returned fuel pumps have revealed that this sieve filter is often clogged with dirt from the intake fuel.

When retrofitting with an E1F, please note:
In diesel operated vehicles the sieve filter must be removed because it can cause problems due to the higher viscosity of the diesel at low temperatures.

Fig. 23 Dirty sieve filter of an E3T toothed ring pump

■ **Blocking of the pumping mechanism**
If debris is sucked into the fuel pump, the rotating parts of the pumping mechanism will often become blocked.
Usually this will cause the pump to fail immediately.

Debris gets into the fuel pump if either the fuel filter or sieve on the suction side is damaged or missing.

There is a danger of debris getting into the fuel tank while work is being done on it.

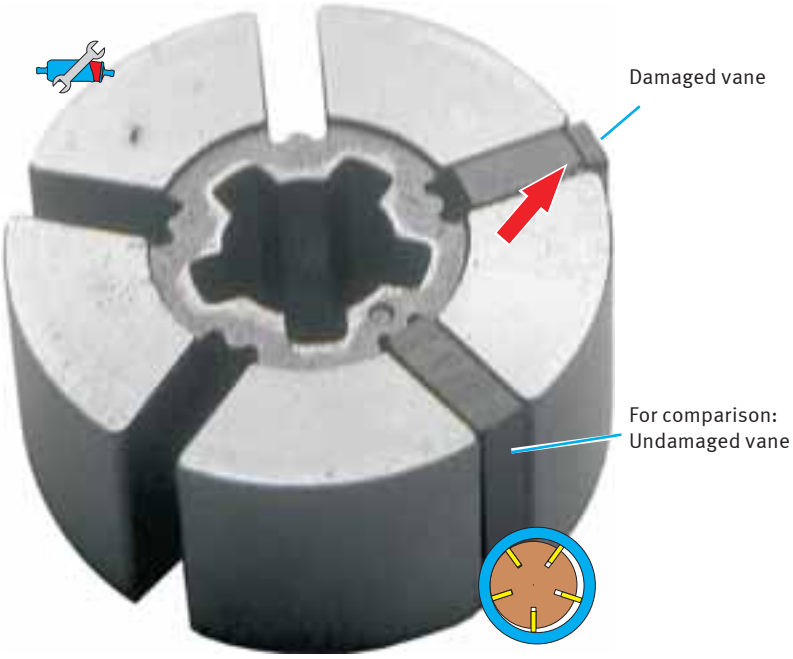


Fig. 24 Pumping mechanism of a sliding vane pump - damage due to debris
The upper right vane is severely damaged by debris.
For comparison purposes an undamaged vane was inserted on the bottom right-hand side.

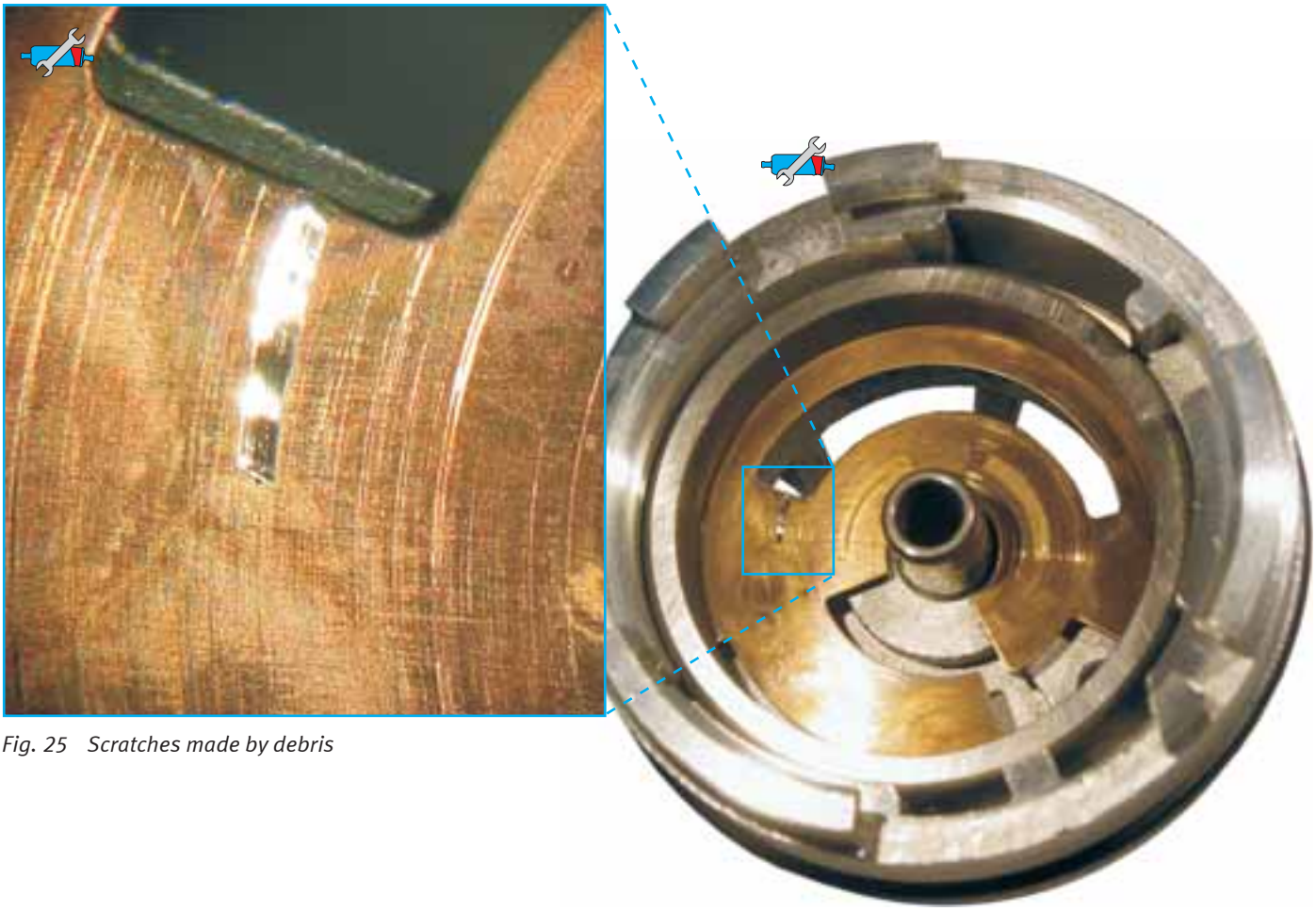


Fig. 25 Scratches made by debris

Fig. 26 E2T toothed ring pump - damaged by debris

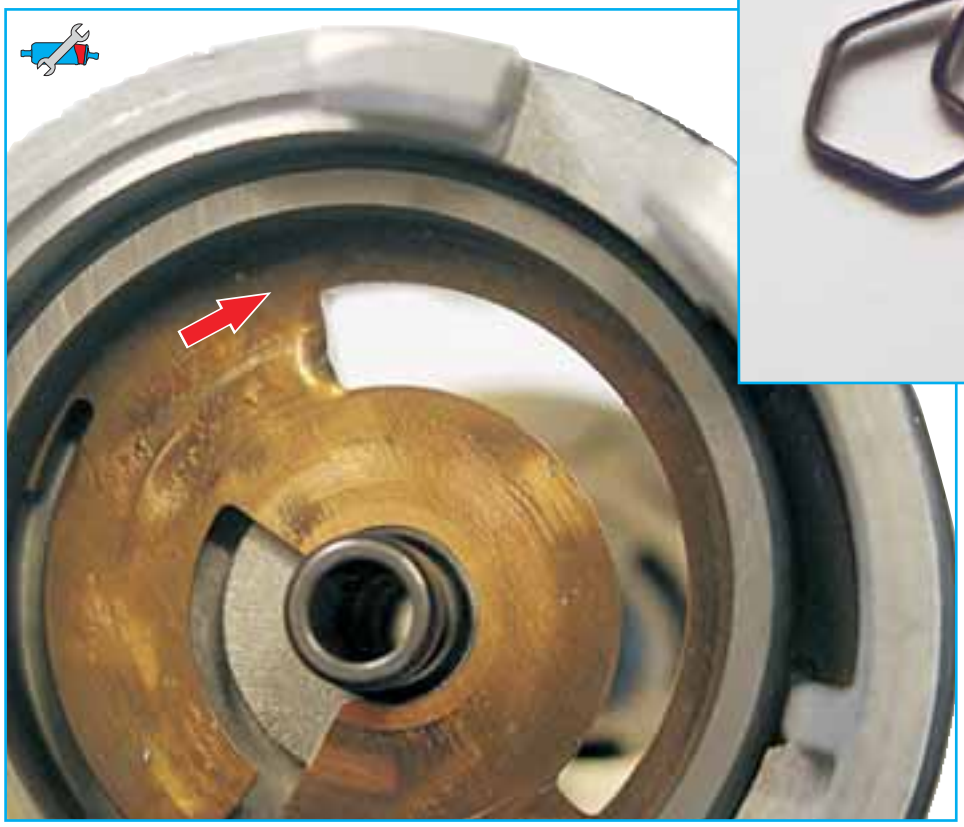


Fig. 27 Debris that has caused damage (enlarged compared with a paper clip)

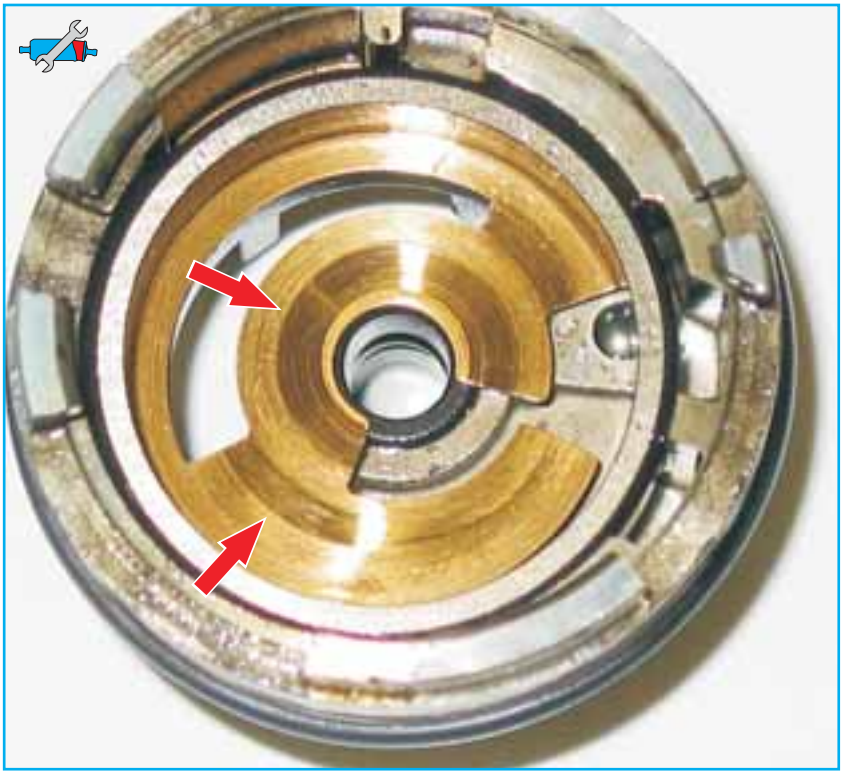


Fig. 28 Typical abrasions made by debris

Fig. 29 Chips in the sieve filter
Here metal chips have landed in the fuel tank while work was being done on the fuel system. The sharp-edged chips have damaged the sieve filter.
This way dirt can get into the pump and block the pumping mechanism.

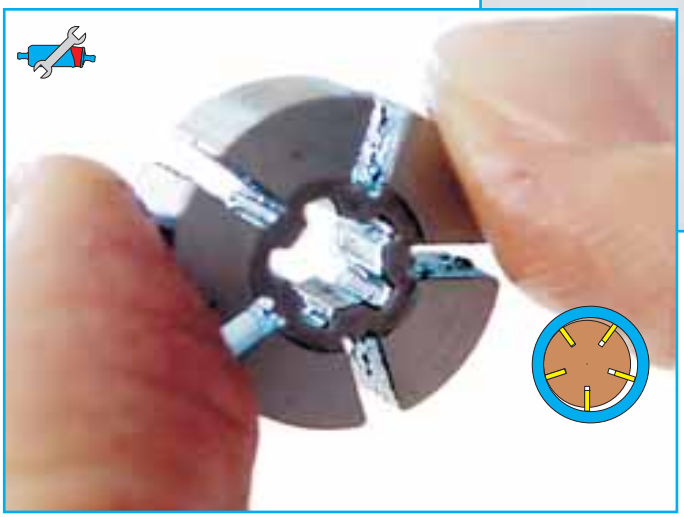


Fig. 30 Dirty pumping mechanism of a sliding vane pump
The rotor is so dirty that the individual vanes (removed here) can no longer move. The pump still "runs" but no longer conveys fuel.

Figs. 31 and 32 show a case where liquid sealing compound got into the fuel tank while work was being done on the fuel system.
The sieve filter was not able to stop this sealing compound. It jammed the pumping mechanism.

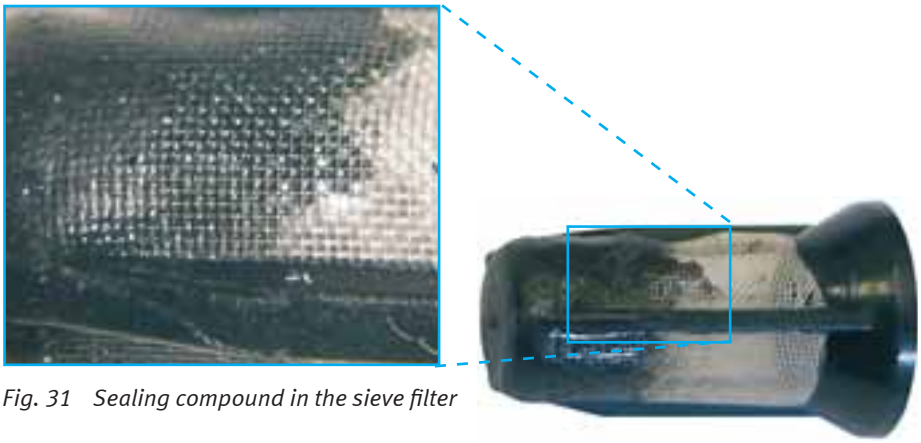


Fig. 31 Sealing compound in the sieve filter

Fig. 32 Sealing compound in the pumping mechanism (trochoid toothed wheel)

In-tank pumps often have a mesh filter on the suction side. During installation, make sure that the filter, and here especially any reinforcements that may be present in the filter, are not damaged (see also Section 3.6.2).

Fig. 33 Damaged filter of an in-tank pump
Here dirt can enter easily or fractions of the reinforcement in the filter can block the pumping mechanism.

Figure 34:
The vanes of the pump fan of a type E1S side channel pump were damaged by a piece of debris (below).
The fractions (right) ended up in the filter.

Figure 35:
For comparison: View of the suction side socket of a side channel pump with undamaged pump fan (below)

3.2.2 Water damage (corrosion)

A special form of damage due to dirt is damage from water in the fuel system.

Rust or lime particles that are a result of water in the fuel can clog filters and thus cause dry running.
Lime and rust deposits on or in the fuel pump reduce the slackness between the components.
This limited movement will increase the power consumption and reduce the delivery rate until the fuel pump is blocked.

The term “water damages” in the fuel pump may seem strange at first, but the fuel can become contaminated by water is many ways:

Fig. 36 Water damage to sliding vane pump
Right for comparison purposes a fuel pump with comparable mileage that was not exposed to water.

- **Water condensation in the tank**

The ambient air, as well as the air above the fuel level in the tank, always contains a certain amount of water. The degree of this water quantity is referred to as the “relative humidity”.
Cold air is able to hold less water than warm air, i.e., when the air cools, water can condense out of it.
This can be a problem with “garage cars”.
If vehicles with a relatively empty fuel tank are not driven for a longer period of time, the larger amount of air in the tank can also produce larger amounts of water condensation.

- **Improper use**

Fuel pumps are designed to convey fuel (petrol, diesel).
There are actually cases where a fuel pump was used as a “water pump”.

- **Fuel quality**

Fuel can already contain water when it is pumped at the petrol station.
Possible causes can be:
– Different fuel qualities in some countries
– Fuelling from moist drums, containers.
– Poorly managed tank systems
– Biodiesel
(please refer to ➔ Section 3.3)
– High alcohol content
Alcohol attracts water. When a certain limit is reached, this water precipitates.

- **Leaks in the fuel system**

Splashed water can get into the fuel system in many ways:
– Filling the fuel tank in the rain
– Leaky or missing fuel cap gasket
– Missing fuel cap
– By aeration holes of pneumatic valves that are exposed to splashed water, e.g. valves in the ACF system (activated carbon filter system).
– Faulty assembly of the fuel filler neck after an accident or auto body repair.
– Frayed or improperly retrofitted fuel tank vent hose

☞ If a vehicle is going to remain standing for a longer period of time, make sure that the fuel tank is full.

☞ The subject of “fuel quality” is discussed in greater detail in ➔ Section 3.2.3.

Fig. 37 E3T toothed ring pump – with rust and lime deposits

Fig. 38 For comparison: E3T toothed ring pump – still in good condition even after a lot of mileage

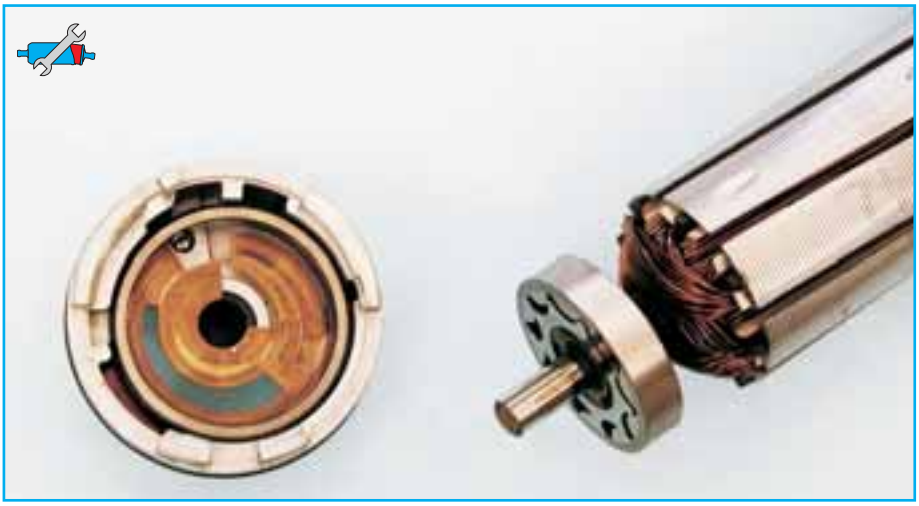
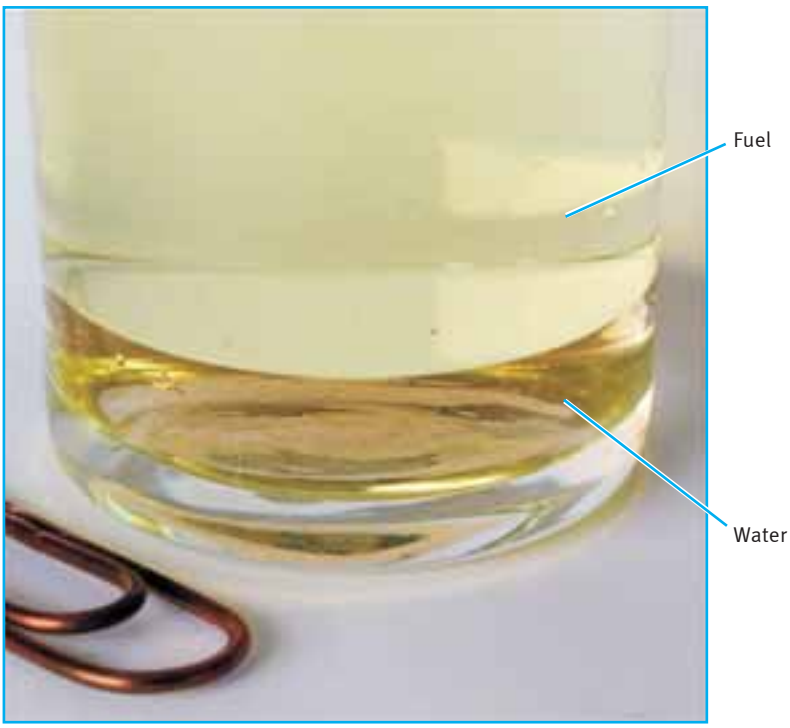


Fig. 39 Water in the fuel



This is the way to determine whether there is water in the fuel:
Pour a little fuel from the deepest possible location into a fuel resistant test tube.
After a while the water will separate.

Pay attention to the fire safety rules!

Fig. 40 Rusted intake of an E1F sliding vane pump
The outside cover of a fuel pump is usually made of aluminium.
Since aluminium cannot "rust", in such a case the causes of the rusting should be questioned in the workshop.

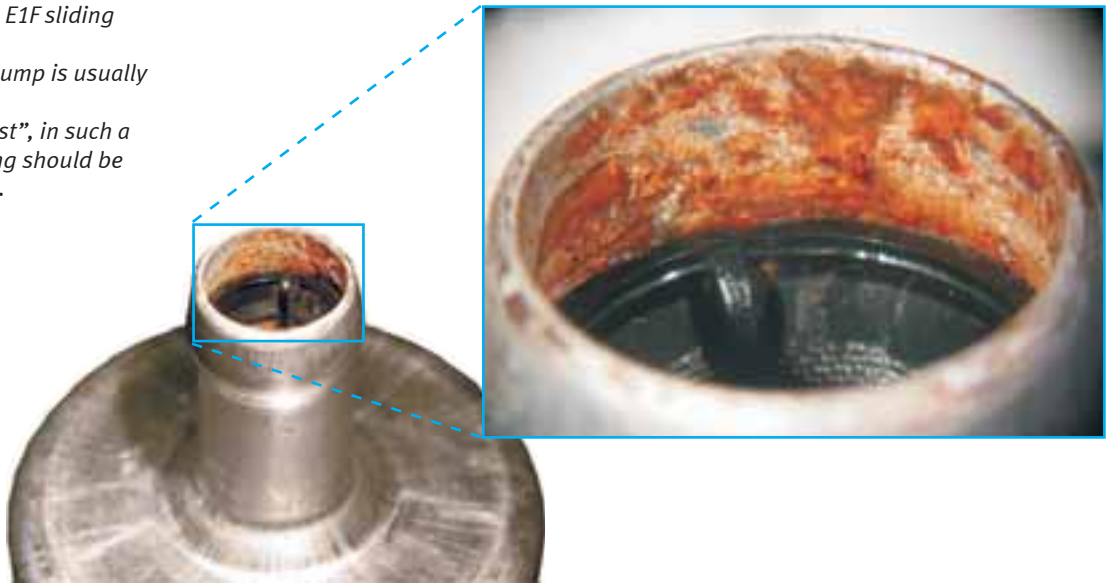


Fig. 41
left: Sieve filter clogged by rust
right: New sieve filter
If the sieve filter on the suction side of a fuel pump shows rust or lime deposits, this is a sign of water in the fuel.

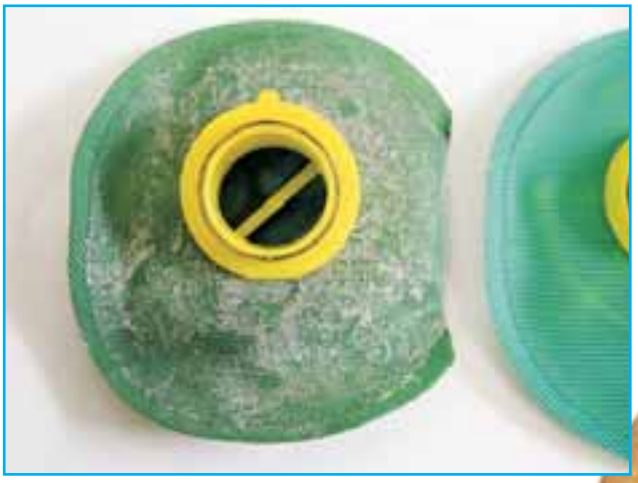


Fig. 42 left: Lime deposits in the filter of an in-tank pump right: For comparison, a new filter

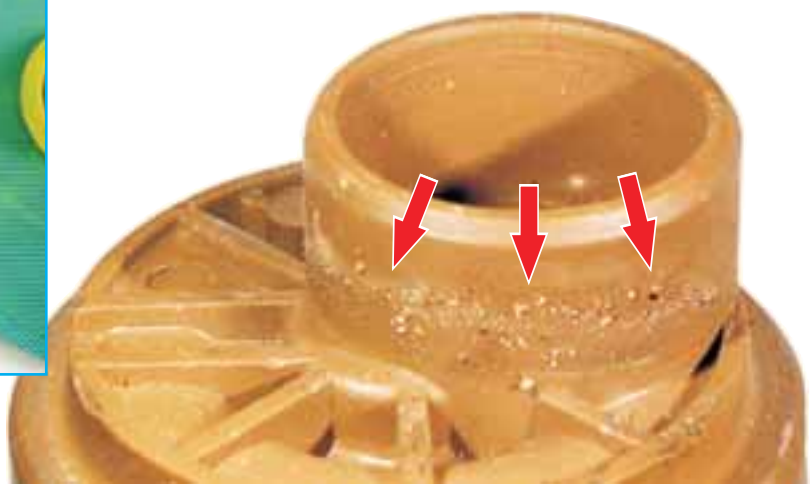


Fig. 43 Lime deposits in the intake of this in-tank pump

Fig. 44 Water in a fuel pump
In this case, the water was "standing" properly in the pump.
The pumping mechanism was so corroded that the water could no longer run out.
This fuel pump was incorrectly used as a "water pump".

Fig. 45 Rust and lime particles
If the rust or lime deposits grow to the extent that particles or grains form, these can block or damage the rotating parts of the pumping mechanism, as is the case with debris that is suctioned into the pump.

When this fuel pump was opened, proper "lime sand" that had damaged the vanes of the pump fan was discovered.

These particles could not have entered the pump through the undamaged sieve filter. They must have formed inside the pump.

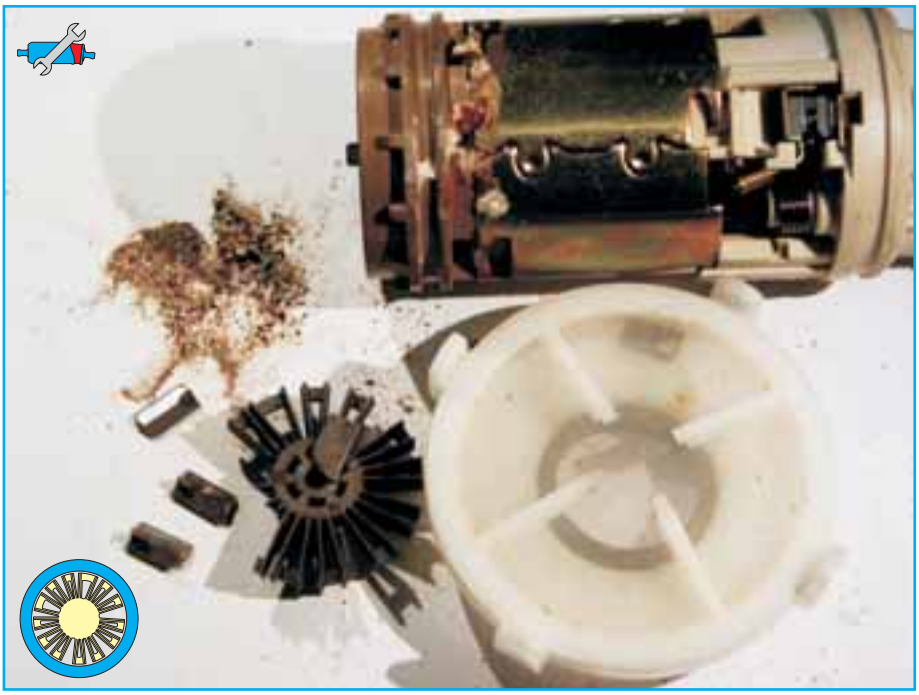


Fig. 46 Left: Corroded electric contacts
Right: New

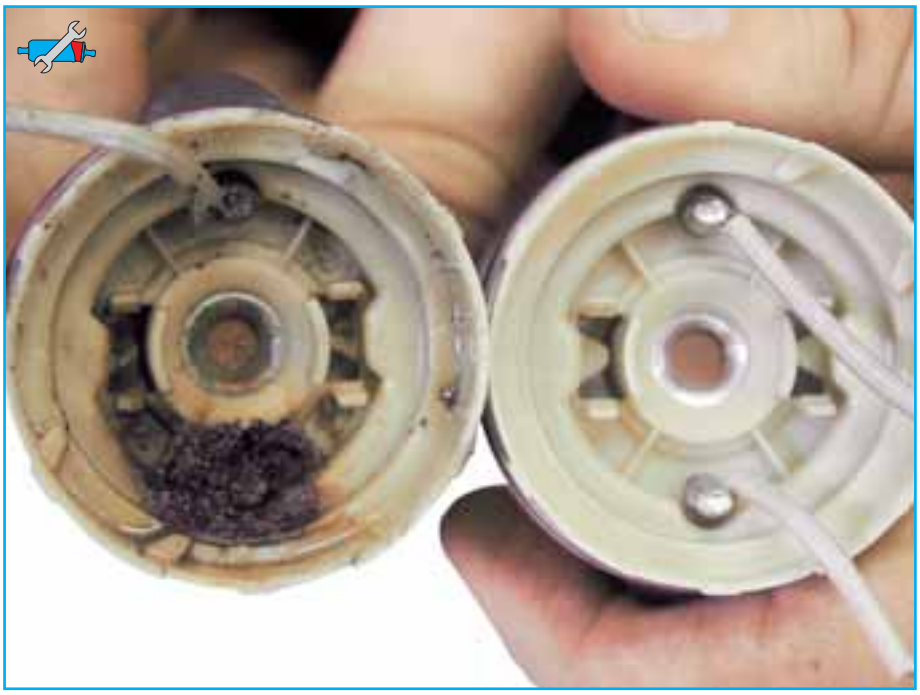


Fig. 47 Trochoid toothed ring blocked by rust particles (microscopic enlargement)

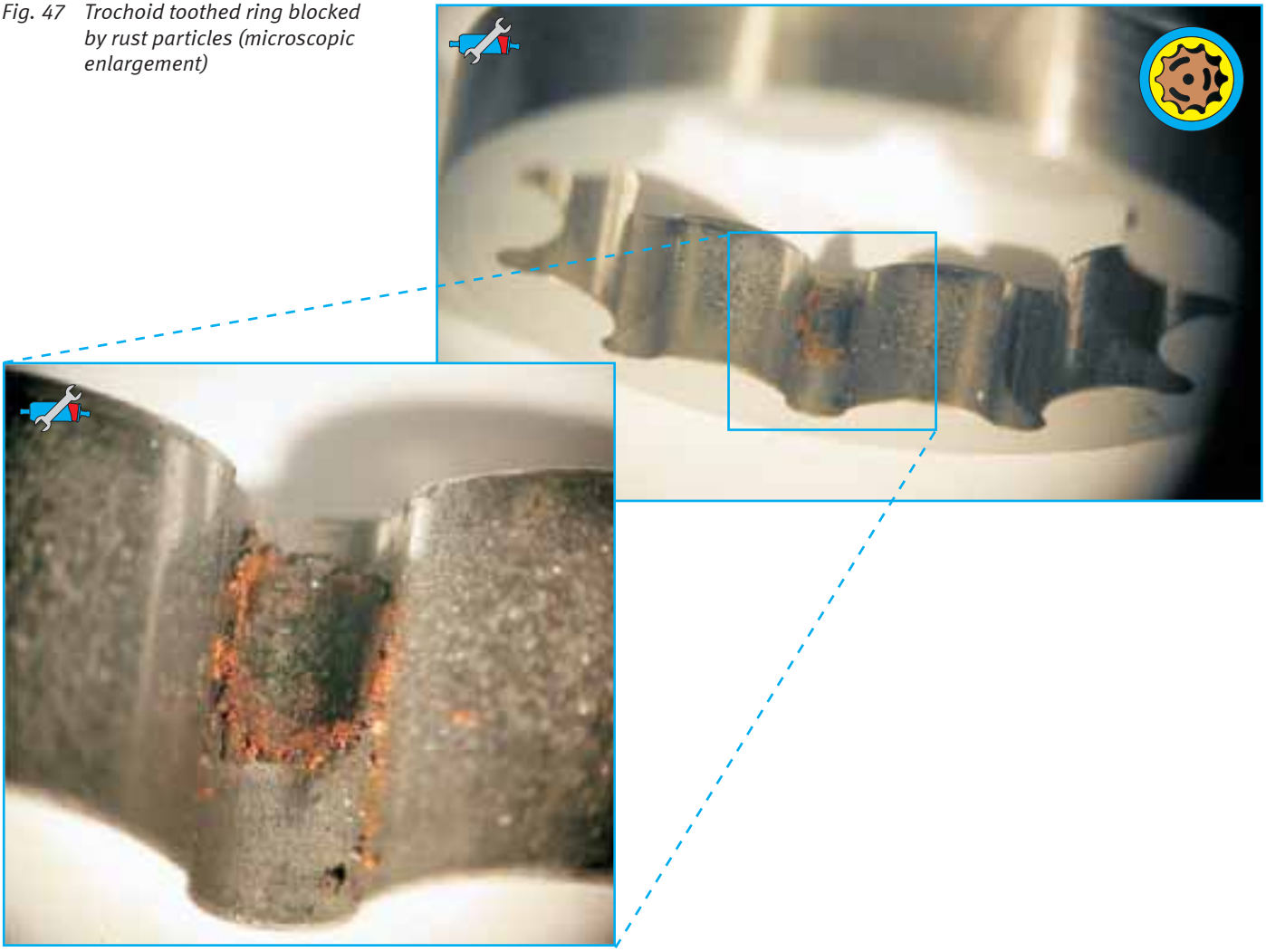


Fig. 48 Left: Heavily rusted trochoid toothed ring
Right: New

Fig. 49 Trochoid toothed wheel with lime deposits

Fig. 50 Calcified outside bearing of a fuel pump

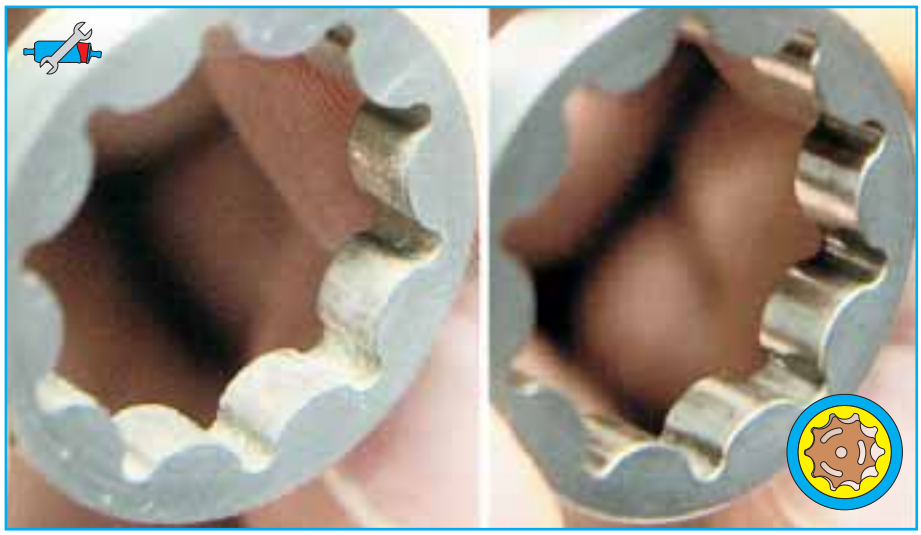


Fig. 51 Trochoid toothed ring (on the left with lime deposits and on the right, new)

Fig. 52 The parts of the trochoid pumping mechanism must be able to roll smoothly as they engage

It is easy to test the smooth running of a trochoid pumping mechanism:
If the pumping mechanism is rolled over an even surface, as shown here, the toothed ring and the toothed wheel must roll smoothly as they engage.

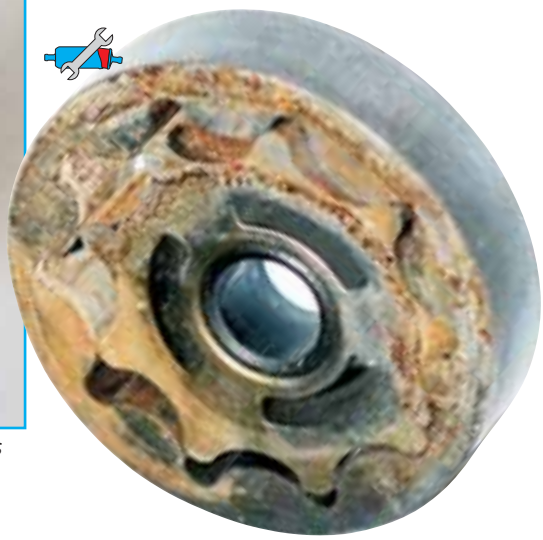


*Fig. 53 For comparison: A rusted trochoid pumping mechanism
Here, nothing can move any more.*

Fig. 54 Screw pump (on the left, rusted, and on the right, new)

3.2.3 Fuel quality

■ **Standards that are not maintained**
Problems with fuel quality have indeed become less, but cannot be ruled out completely.
This can still be a problem in countries outside Europe in particular. Reports and rumours of poor quality, contaminated fuel in foreign countries continue to surface in the news media from time to time.

■ **Fuelling from drums/containers**
Another cause of water and dirt getting into the fuel can be the use of a container that was previously rinsed or cleaned with water and not sufficiently dried, to fill the tank.

■ **Poorly managed tank systems**
Under some circumstances, failure to follow the prescribed operating instructions when building or operating fuel tank systems can be responsible for water and dirt entering the fuel.

■ **Ageing fuel**
If a vehicle is not operated for longer periods of time, the air in the tank can cause oxidation of the fuel.
The chemical reaction of the fuel with the oxygen in the air produces a resin-like "gum" [3] that can cause the entire fuel system and the pump to be stuck or clogged.

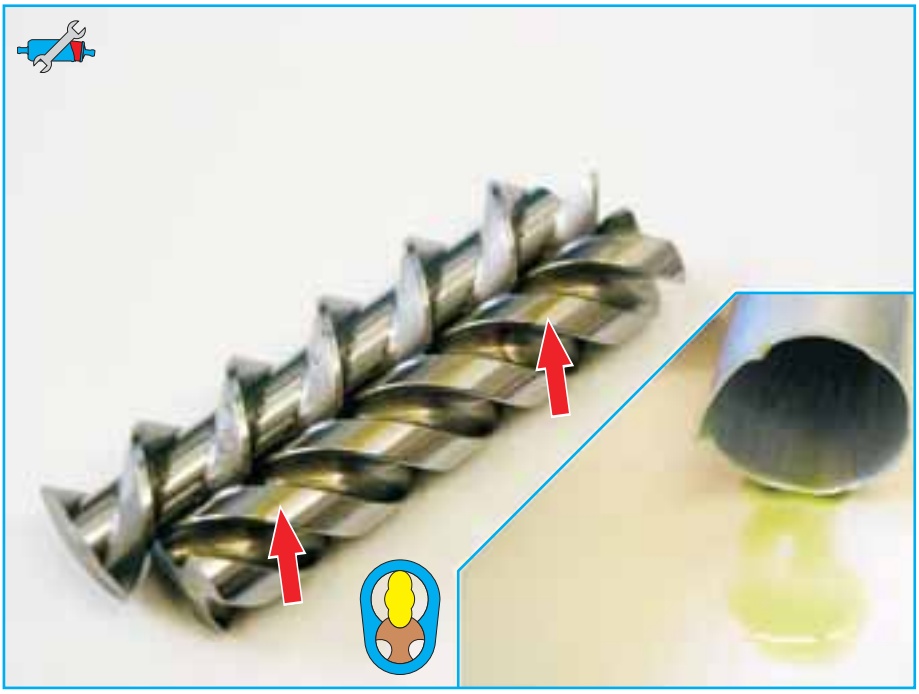


Fig. 55 Sticking due to prohibited medium

The illustration shows the pumping mechanism of a type E3L screw pump. The rest of a green liquid runs out of the housing that was cut open for evaluation.

This "fuel" gummed up the pumping mechanism. The place where both screws of the pump were stuck together can be clearly recognised by the deposits on the screw (arrow).

Fig. 56 Film from poor quality fuel

3.2.4 Dissolved substances

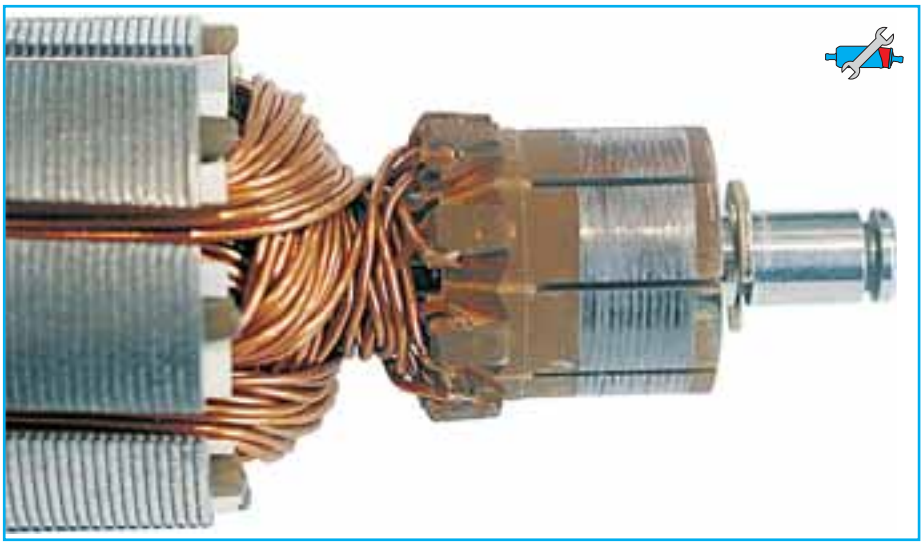


Fig. 57 Insulating film from softener in the fuel

Fig. 58 For comparison: The same type of pump without a film

A special case of dirt is the formation of impurities from dissolved chemical substances.

If poor quality materials are used to retrofit fuel systems (e.g. changing fuel lines, filters), substances such as vulcanisation accelerators, additives or softeners can dissolve into the fuel.

Such a case is shown in ➔ Fig. 57. Here all the pump components were covered with a yellow film. The substance that stuck to the surface of the components was crystalline, which is insoluble in water and fuel.
The commutators were not corroded or tarnished, but the nonconductive properties of the film produced an insulation between the commutator and the brushes.

3.2.5 What to do with impurities in the fuel?

As explained in the preceding sections, the causes of impurities can be many.

Find the source of the impurities!

If you only remedy the symptoms (e.g. by replacing a defective fuel pump), you will not be eliminating the source of the problem.
Sooner or later the damage will recur.

- Use clean, quality fuel to rinse out the fuel system.
  ☞ To do this, you may have to remove the fuel tank.
- Change the fuel filter regularly.
- Use only fuel resistant material for components that are exposed to fuel (e.g. rubber gaskets).
- Use quality materials.
- Please adhere to the maintenance intervals specified by the vehicle manufacturer.
- If a vehicle is going to remain standing for a longer period of time, make sure that the fuel tank is full.
- Store parts that have been removed in a clean place and keep them covered.
- Keep the transportation seals on the new fuel pumps until you are ready to install them.
- Never use compressed air to clean an open fuel system.

3.3 Biodiesel/vegetable oil

In the past, mostly RME (rapeseed oil methyl ester) was used as “biodiesel”. Since November 2003 the new DIN EN 14214 standard for fatty acid methyl ester (FAME) is in effect. It allows other admixtures such as soy oil, sun flower oil and old cooking fats (animal fats, fish oil, etc.) to be used in addition to RME.
The use of biodiesel can produce damages and malfunctions faster than the other (“fossil”) fuels [2].

- In vehicles that have not been specially authorised by the manufacturer for operation with biodiesel, gaskets and plastic parts can become corroded.
- Biodiesel reacts hygroscopically, i.e., it draws water out of the ambient air. In addition to corrosion, this can also lead to an increase in bacteria.
- Oxidation processes occur in biodiesel that can cause fat molecules to lump together and clog filters and injection nozzles.
- Along with the good biodegradability of biodiesel there is also poor durability. This can cause filters to be clogged by sedimentary particles.

Biodiesel may be used only if it has been approved by the vehicle manufacturer

Fig. 59 Stuck pumping mechanism
The boundary disk was stuck completely to a trochoid pumping mechanism. The pumping mechanism was removed to take this picture, but its outline can still be made out easily in the sticky mass.

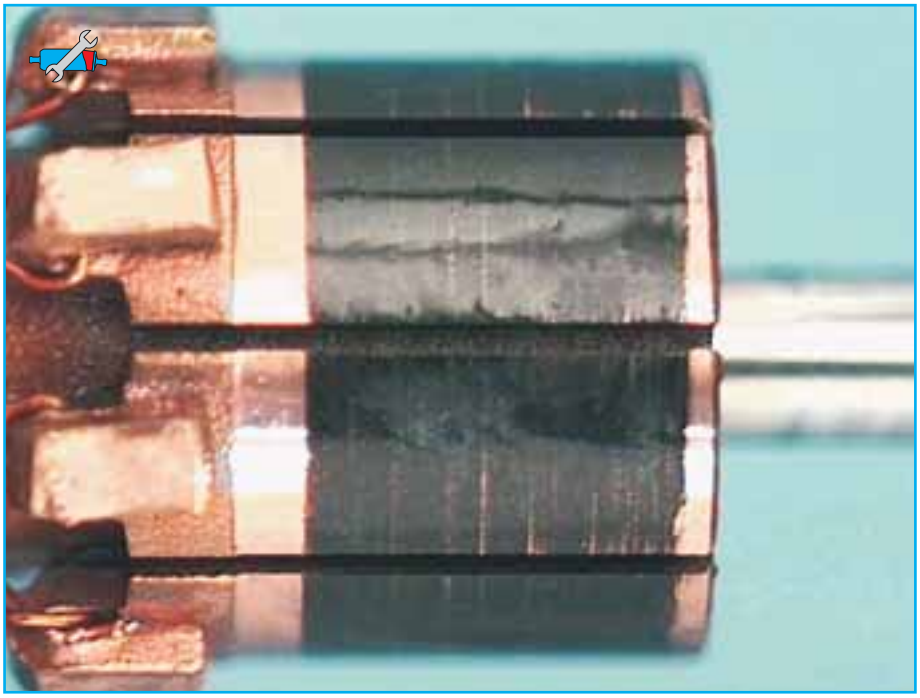


Fig. 60 Damages from biodiesel
In this case, RME (rapeseed oil methyl ester) had already caused the carbon brushes to disintegrate after about 3 hours operation and a varnish-like, insulating layer was formed on the commutator (“pole changer”). The pump broke down.

Checks made in the course of quality management at Pierburg have revealed that when biodiesel is used, especially poor quality biofuels, the following malfunctions and damages can occur after a brief operating time:

- Deposits clog up filters and block pumping mechanisms
- Deposits on commutators have an insulating effect
- Gaskets and plastic parts become corroded
- Carbon brushes burn out after a brief run time ("brush fire")
- Corrosion damages metals parts

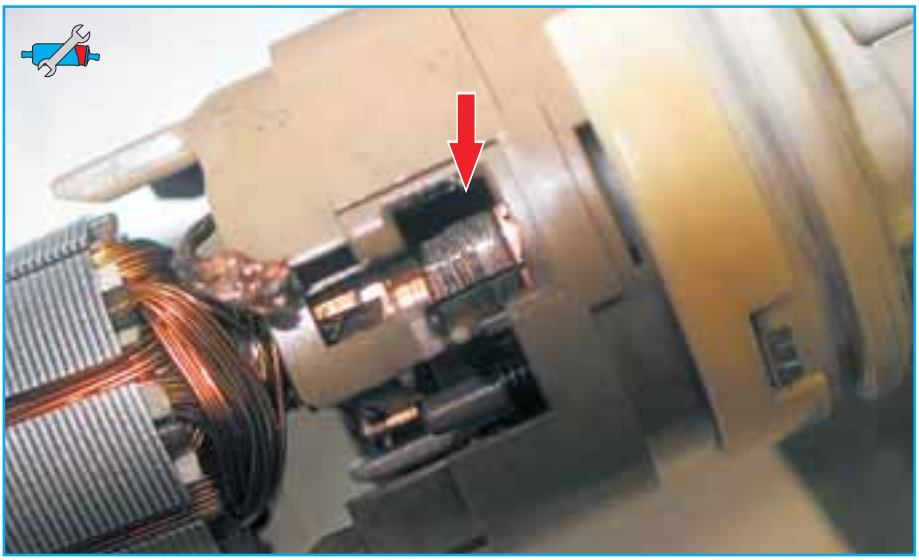


Fig. 61 View of the sliding contacts mounting
The carbon brushes disintegrated completely and formed a film on the pole changer.

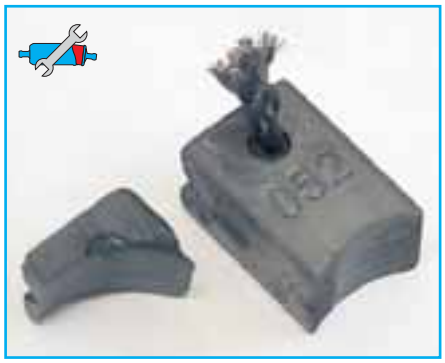
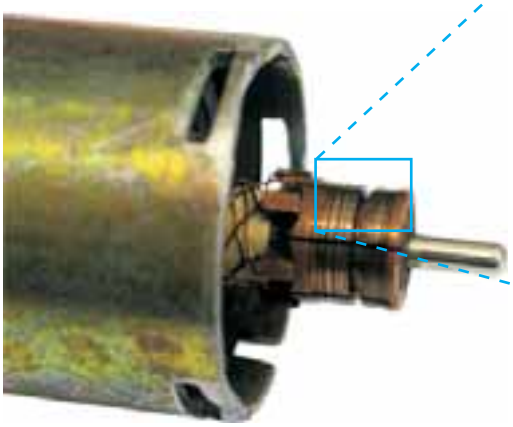


Fig. 62 Sliding contacts at about 15,000 km
left: Prematurely worn
on the right: Normal condition for this mileage

"Brush fire" refers to the generation of sparks in the commutator (pole changer) of electric motors. The carbon brushes make contact with the rotating part of the pump (rotor). In the brief moments in which the brushes short circuit two differently charged commutators, electrostatic discharges, which can be seen as sparks, are produced. An insulating film on the glide path generates multiple discharges that can burn the brushes prematurely.



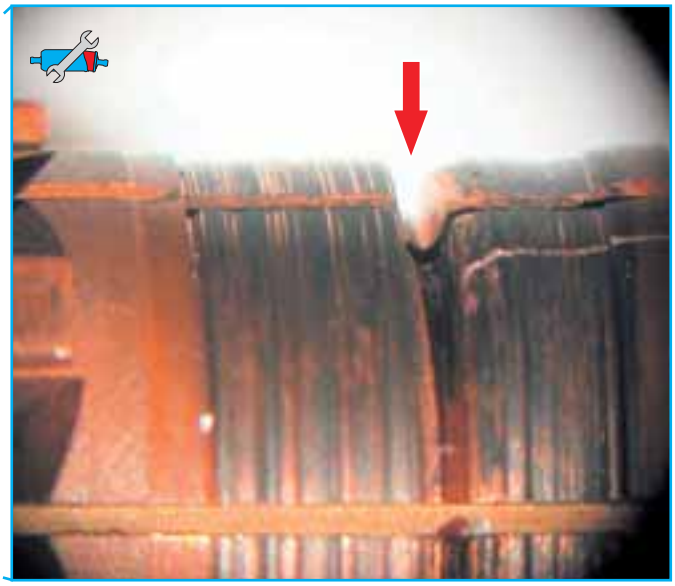


Fig. 63 Damaged glide path of the pole changer
Here the spring that presses the carbon brushes against the pole changer "burrowed" into the glide path after the carbon brushes were burnt.

3.4 Incorrect use/application

Incorrect selection
With recurring frequency the wrong fuel pumps are selected from catalogues or electronic media for replacement or retrofitting purposes.

As a result they produce pressure that is either too high or too low.

Improper use
It is even worse to use a fuel pump in a manner for which it is not intended.

Fuel pumps are designed to convey fuel (petrol, diesel).

This may seem obvious to most people. Yet again and again fuel pumps that have been used to convey other liquids (water, oil, battery acid) are returned due to malfunctioning.

In Fig. 68, for example, a type E3T in-line pump, i.e., a fuel pump that is used in the fuel line *outside* the fuel tank, was placed *in the tank*.
The rubber sleeve surrounding the fuel pump was dissolved by the fuel and plugged up the fuel pump and the rest of the fuel system.

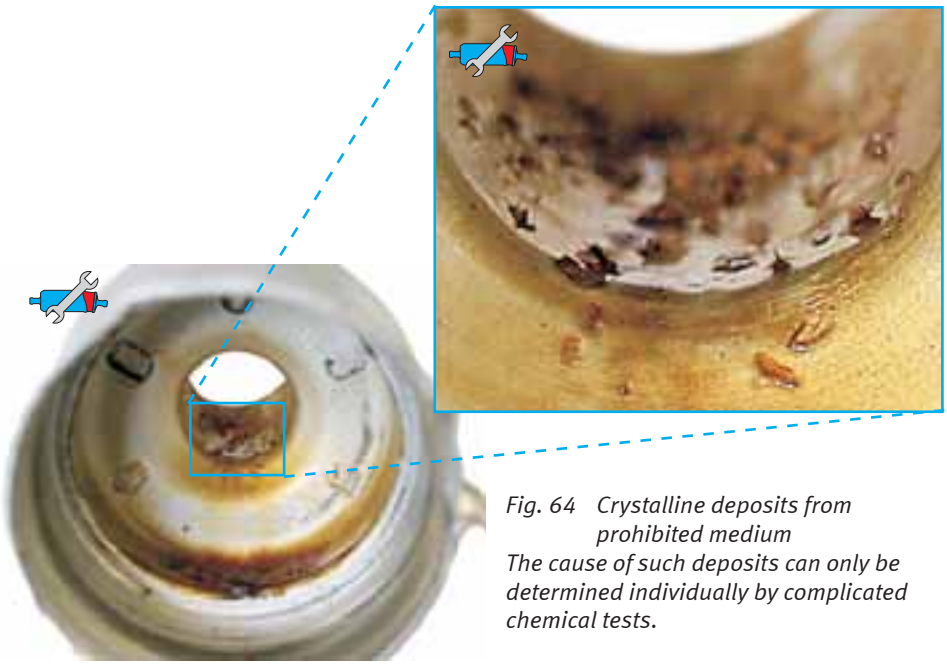


Fig. 64 Crystalline deposits from prohibited medium
The cause of such deposits can only be determined individually by complicated chemical tests.

Fig. 65 In-line pump that was used as an in-tank pump

Rubber sleeve
This rubber sleeve is used to adapt larger models made by competitors so that the fuel pumps sold by MSI will fit into the existing mountings (see ➔ Fig. 66).
An additional advantage of this rubber sleeve is that vibrations are not transferred to the auto body.
You will find further information in the *Pierburg Product Information PI 0027/A*.

Fig. 66 Pump made by a competitor (left) and E3T with rubber jacket by Pierburg

3.5 Improper installation

Precisely when an electric fuel pump is being **retrofitted**, certain points must be observed because otherwise malfunctions can occur in the fuel system or damages can be caused in the fuel pump.

– Types **E1F and E3L** pumps are in-line pumps. They may be placed only **in the fuel line**.
  Maximum suction height: 500 mm

– As an in-tank pump, the **E1S** may be installed only **in the tank**.
  Maximum suction height: 0 mm

– All modern pumps are driven by an electric motor. Fuel flows through the drive unit, where it also serves as a coolant.
  For proper functioning/cooling a flow must always be present.

– The pump circuits designed to produce a constant flow when they are energised.
  When there is little flow or none at all, the power consumption will increase but no cooling will occur. The consequences will be gas forming in the pump, problems with the engine fuel supply and subsequent wear on the pump.
  This can be prevented by a return fuel line, for example.

– Install fuel pumps where they will be protected from dirt and splashing water.

– For type E1F electric fuel pumps, a sieve filter must be placed in the fuel line on the suction side upstream from the pump to prevent damages from dirt.
  This filter should have a large enough filter surface (based on the application) and a mesh width of 60–100 µm (microns).
  Paper filter is not suitable because the mesh width is too narrow.

⚠ For use in diesel engines the sieve filter must be removed from the suction side socket.

– For type E1F fuel pumps Pierburg offers the fuel sieve filter 4.00030.80.0 that protects the fuel pump from dirt and other debris dependably, thus preventing premature failure (please refer to Fig. 67).
  The sieve filter should be changed at the same maintenance interval as the fuel filter.

– Select a location where the fuel pump will not be exposed to excessive heat (near engine or exhaust pipe) or vibrations (rigid lines, tight installation).

Fig. 67 Fuel sieve filter 4.00030.80.0

– When retrofitting an electric fuel pump, a safety shut-off must be installed according to § 46 of the German road traffic licensing regulations.

☞ As long as the ignition is ON, the pump will convey fuel. Installation of the safety shut-off 4.05288.50.0 (please refer to ➔ Service Information "SI 0016/A") is mandatory so that the carburettor will not overflow or fuel will not run uncontrolled out of separated fuel lines when the engine is stopped with the ignition ON (engine stalled, accident)! The safety shut-off will switch the fuel pump OFF "when the engine is OFF".

– Dry running will cause damage to the pumping mechanism very fast. To prevent this, the pumps must be installed far down ("wet", below the level of the liquid) near the tank. Here narrow areas ("tight spots") must be avoided on the suction side. If this is not possible, a type E1S sliding vane pump should be placed in the tank as a pre-feeder pump.

– Only fuel resistant material should be used for components that are exposed to fuel (e.g. rubber gaskets).

– Make sure that no combination of materials is used that would trigger a contact corrosion. Thus the pump housing (aluminium) must not come into contact with zinc plated surfaces, for example (please refer to ➔ Fig. 72).

– Depending on where an electric fuel pump is retrofitted, resonance can cause noises that will make the fuel pump sound like it is defective.

– Also fuel lines that are laid under tension can cause excessive noises to develop.

You will find further information on this subject in the brochure Fuel Systems – Components and solutions for universal applications [6].

Fig. 68 Service Tips & Info "Fuel Systems – Components and solutions for universal applications"

3.6 Mechanical damages

3.6.1 Installation errors

When a fuel pump is installed or removed incorrectly, the gasket, housing and connections (electric, fuel) can be damaged.

■ **Fastening without locking**
In the case of types E2T and E3T toothed ring pumps when the fuel connection line is tightened, often the counterpiece on the pump housing is not locked in place. Therefore the entire pump cover with the connections is twisted in the housing. This crushes the sealing ring that lies under the cover.
By twisting the pumping mechanism, the O ring that seals off the housing from the cover is often displaced or damaged. The pump then leaks at the flanging.

Fig. 69 Twisted pump cover
Types E2T and E3T fuel pumps have markings. These marking must face each other. If they don't, the pump has been handled incorrectly and has become damaged.

Important installation instructions:
When the connection line is being tightened, the lower hexagonal bolt of the fuel pump must be locked because otherwise this could cause the fuel pump to leak.

Leaky fuel pumps increase the danger of fire!

Before delivery, all fuel pumps undergo a quality and function check in the plant.
Such damages can occur subsequently due to improper handling.

Fig. 70 Incorrect installation: Fastening without locking

Fig. 71 Correct installation: The lower hexagonal bolt of the fuel pump must be locked in place

■ **Contact corrosion**
When an installation or retrofit is performed improperly, materials can be combined that trigger contact corrosion. Thus the pump housing (aluminium) must not come into contact with zinc plated surfaces, for example.

If steel conduit clamps with zinc plating are mounted directly on the aluminium body of the pump without insulation, for example, and electrolyte (splashed water) is present, a contact corrosion can occur.
This can even produce pitting which will make the pump body leak.

Fig. 72 Contact corrosion by incorrect combination of materials

Leaky fuel pumps increase the danger of fire!

3.6.2 Heavy damage

■ **Housing damaged**
Improper handling (e.g. dropping) can cause damages to the fuel pump housing.
For example, dropping the pump during installation can produce cracks in the plastic, which will make the fuel pump leak (please refer to ➔ Fig. 73).

Leaky fuel pumps increase the danger of fire!

Fig. 73 Severe damage to the housing

■ **Damaged connections**
An improper installation/removal can cause the connections to be damaged or broken off
(please refer to ➔ Fig. 74 and 75).

⚠ There will be extreme danger of fire if the fuel connection leaks!

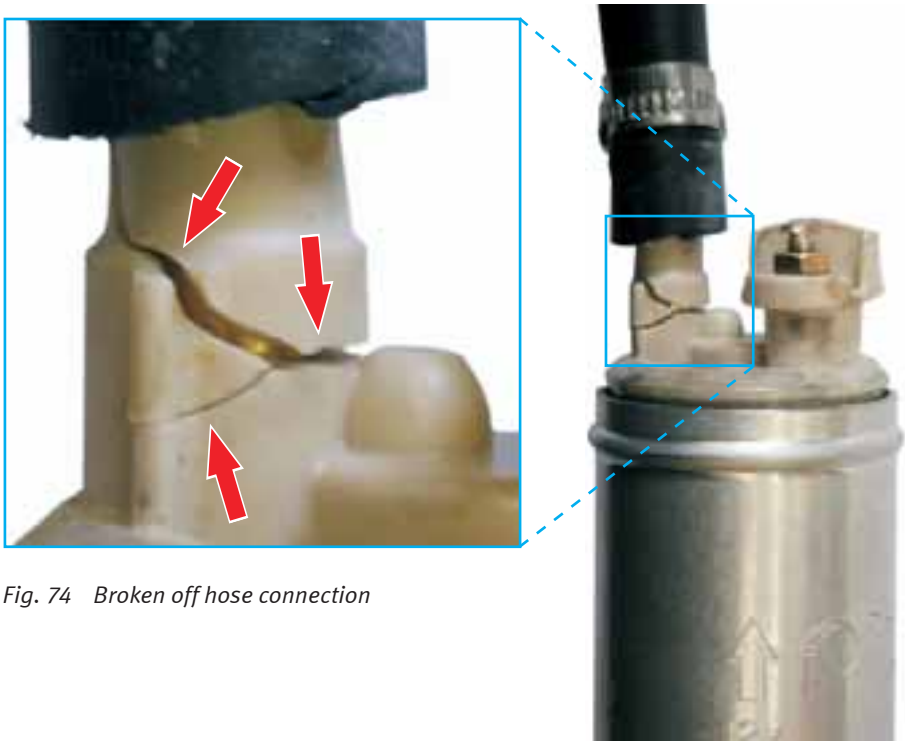


Fig. 74 Broken off hose connection

Fig. 75 Heavy damage to the electric contacts

Before delivery, all fuel pumps undergo a quality and function check in the plant.
Such damages can occur subsequently due to improper handling.

Damage to filters

In-tank pumps often have a mesh filter on the suction side.
Some filters have reinforcements for stabilisation.
In the case of an improper installation, the filter and any reinforcements that may be present in the filter can be damaged (please refer to ➔ Fig. 76).

Here dirt can enter or fractions of the reinforcements in the filter can block the pumping mechanism.

Fig. 76 Broken reinforcement in the filter of an in-tank pump

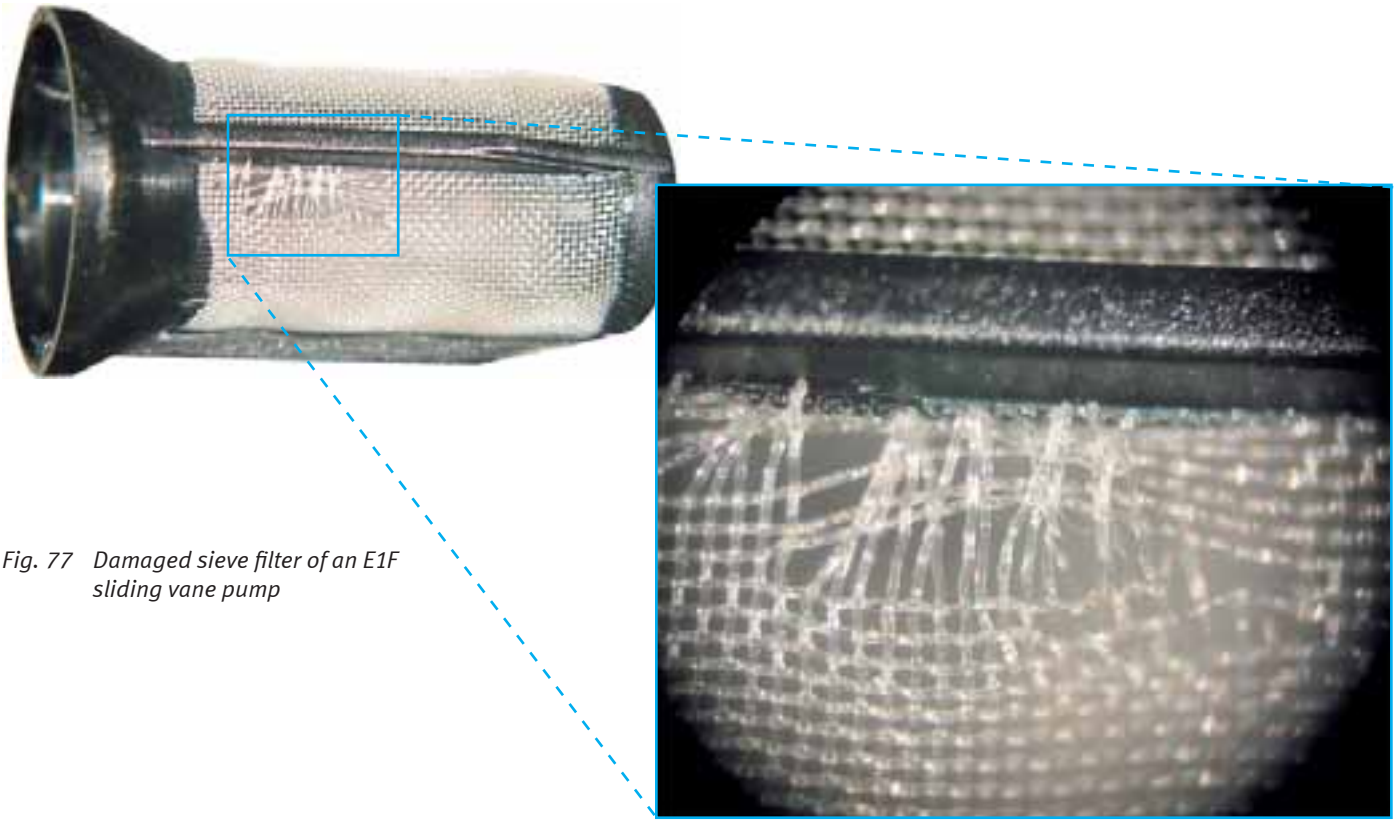


Fig. 77 Damaged sieve filter of an E1F sliding vane pump

Breaking off the fuel level sensor in the fuel supply model

Some fuel supply modules have a fuel level sensor that operates mechanically using a damper. Moving the fuel level sensor with your hand can break it (please refer to ➔ Fig. 78).

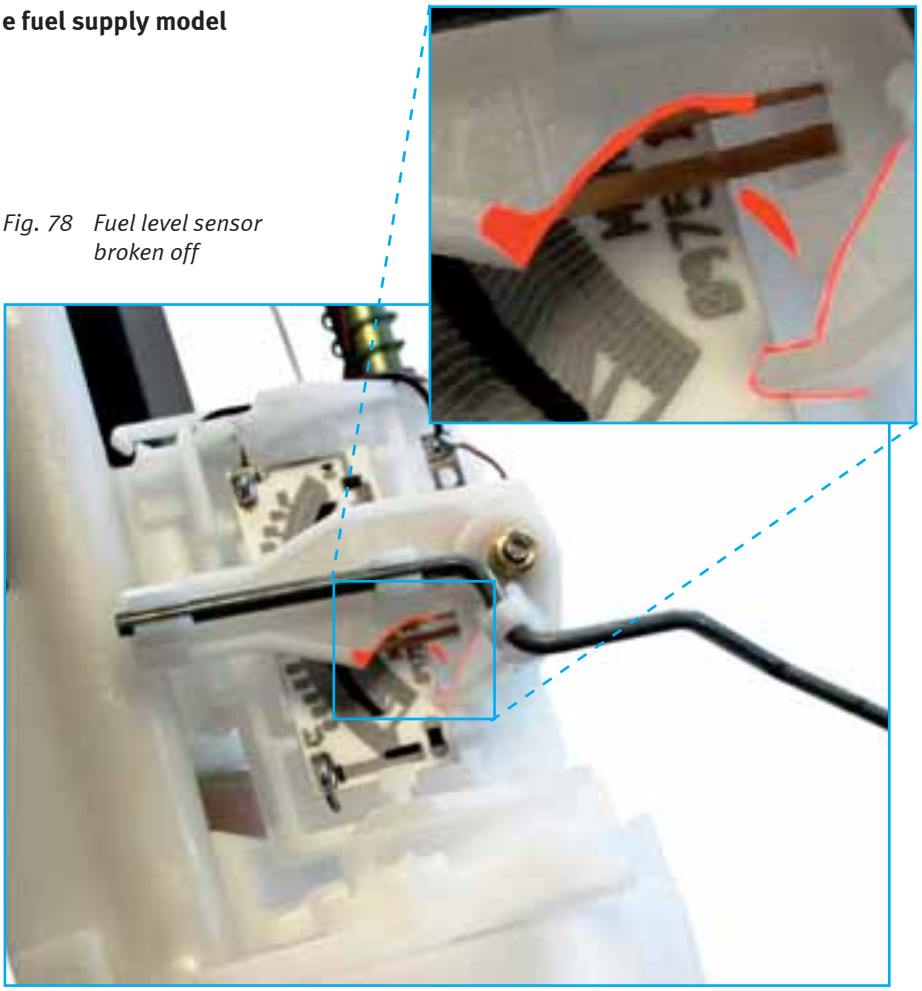


Fig. 78 Fuel level sensor broken off

Never move the arm of the fuel level sensor with your hand (please refer to ➔ Fig. 79). Danger of breaking!

Fig. 79 Never move with your hand

Bending of the fuel level sensor in the fuel supply model

The arm of the fuel level sensor can be bent by improper installation.
This can cause the fuel gauge to indicate an incorrect fuel quantity.

Before delivery, all fuel pumps undergo a quality and function check in the plant.
Such damages can occur subsequently due to improper handling.

3.6.3 Transportation damages

Transportation damages are usually easy to detect.
Outer signs are:
- Buckling and dents in the pump housing
- Broken off connections or attachments
- Dirty suction side or pressure side sockets

Pay special attention to damaged packaging to ensure that there are no transportation damages to the fuel pump itself.

Remove packaging and transportation seals, e.g. plugs in new fuel pumps, only immediately prior to installation.

Fig. 80 Broken permanent magnet (stator)

Fuel pumps that have been dropped or damaged during installation must not be installed.

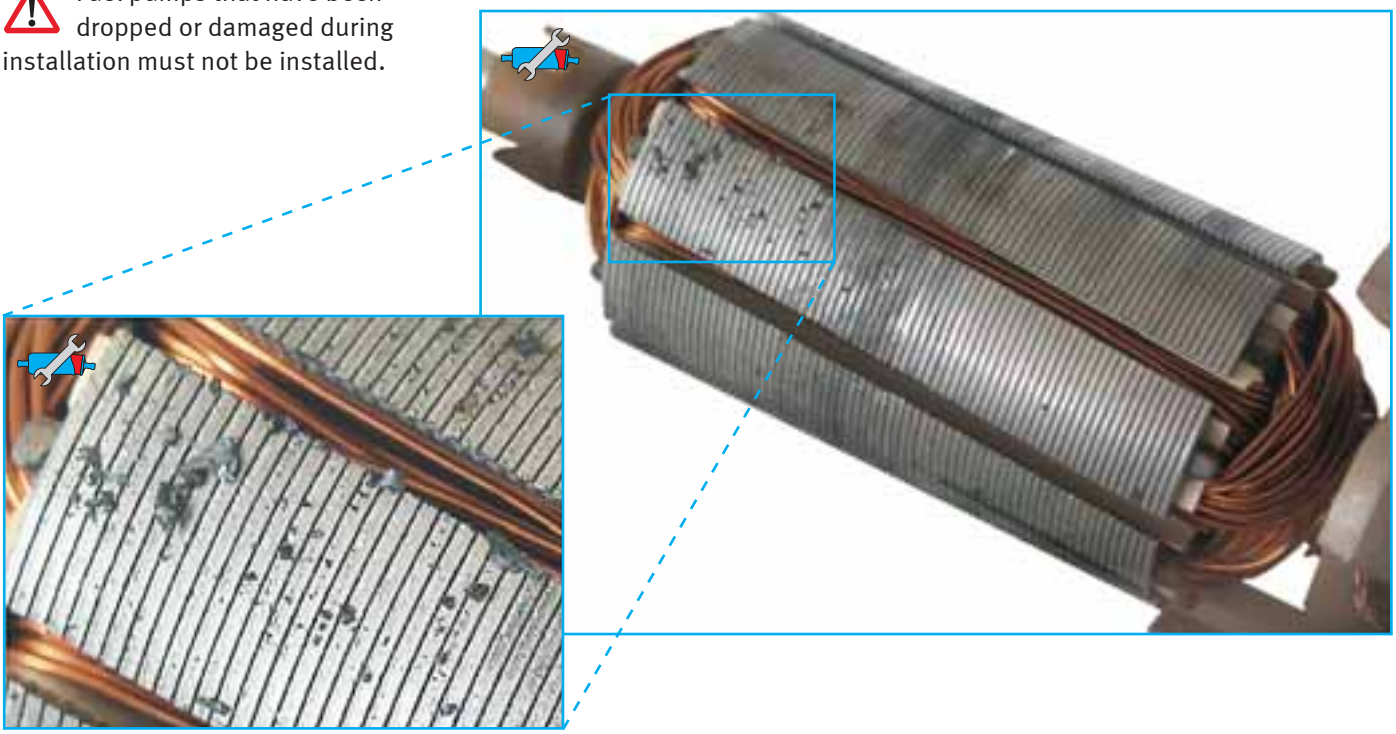


Fig. 81 Particles of a broken permanent magnet in the rotor
The permanent magnet, which surrounds the rotor in the shape of a pipe, is splintered. The fractions have blocked the pump.
This fuel pump was probably dropped during installation.

Before delivery, all fuel pumps undergo a quality and function check in the plant.
Such damages can occur subsequently due to improper handling.

4 Diagnostic instructions

Symptoms

When there are damages to the fuel system, almost always the same symptoms occur:
– Fuel pump does not run
– Fuel pump makes noises
– Fuel pump delivery rate is too low
– Delivery pressure too low
– Smell of fuel
– Fuel escape/leak
– Engine misfire
– Reduced engine power

Reasons

The reason is often dirty or watery fuel and often poor quality fuel itself (please refer to ➔ Section 3).

Causes

As already described in the preceding sections, these impurities can have many causes.

For this reason you will find the possible causes summarised again in this section.

Damages that can be seen only by opening and thus destroying the fuel pump are marked *in colour* in the table.

Legal note:
The staff of a workshop may not open a fuel pump that is still under warranty or returned due to complaints on their own.
If you, as an employee of a workshop or parts distributor, open a fuel pump that has been returned due to a complaint, the guarantee will expire automatically.

Damages due to dirt

Claim/complaint	Appearance of damage	Possible causes	Remedies/remarks
– Pressure not reached – Insufficient delivery rate – Excessive noise in the fuel pump – Engine misfire – Pump breaks down	– Plugged prefilter, filter or sieve – *Pumping mechanism scorched by dry running*	– Impurities in the fuel tank from outside (e.g. while filling the tank) – Ageing of the fuel by long periods of disuse (formation of deposits) – Failure to adhere to maintenance schedule (filter change) – Defective fuel quality – Old, porous fuel hoses – Water damages – Impurities and water due to a frayed fuel tank vent hose or due to improper retrofitting of a fuel tank vent hose.	– Measure pressure and delivery rate – Clean/replace plugged sieve filter on suction side – Install prefilter – Rinse entire fuel system with clean quality fuel. – Replace fuel pump – Use quality fuel – Possible installation of an additional filter/sieve in the filler neck – Adhere to maintenance intervals (filter change)
– Pump breaks down.	– *Debris in the pump* – *Scraping/scratch marks in the moving parts of the pump* – *Debris in the pump*	– Damaged prefilter, filter or sieve – Dirty prefilter, filter or sieve	– Replace pump and fuel filter; – Clean fuel system before installing new pump; – Replace filter basically according to the information given by the vehicle manufacturer; (Observe arrow for flow direction)
– Pressure not reached – Insufficient delivery rate – Excessive noise in the fuel pump – Engine misfire – Pump breaks down	– *Film in the pump*	– Use of poor quality materials from which vulcanisation accelerator, additives or softeners can dissolve	– Use quality material

Water damages

Claim/complaint	Appearance of damage	Possible causes	Remedies/remarks
– Pressure not reached – Insufficient delivery rate – Excessive noise in the fuel pump – Engine misfire – Pump breaks down	– Lime and rust deposits on the fuel pump – *Lime and rust deposits in the fuel pump* – Plugged prefilter, filter or sieve – *Pumping mechanism scorched by dry running* – *corrosion*	– Leaks in the fuel system – Filling the fuel tank in the rain – Leaky or missing fuel cap gasket – Missing fuel cap – By aeration holes of pneumatic valves that are exposed to splashed water, e.g. valves in the ACF system. – Water condensation in the tank: – Garage vehicles – Fuel quality – Quality standards not maintained – Fuelling from drums/containers – Poorly managed tank systems – Biodiesel	– Rinse entire fuel system with clean quality fuel – Remedy leaks in the fuel system – Replace fuel pump – Use quality fuel – Fill the fuel tank when the vehicle is not going to be used for longer periods of time

Poor fuel quality

Claim/complaint	Appearance of damage	Possible causes	Remedies/remarks
– Pressure not reached – Insufficient delivery rate – Excessive noise in the fuel pump – Engine misfire – Pump breaks down	– Lime and rust deposits on the fuel pump – *Lime and rust deposits in the fuel pump* – Plugged prefilter, filter or sieve – *Pumping mechanism scorched by dry running* – corrosion – Resin-like sticking or blockages in the fuel system – Corroded gaskets and plastic parts – *Burnt carbon brushes* – *Deposits on commutators have an insulating effect*	– Poorly managed tank systems – Ageing fuel – Defective fuel quality – Biodiesel	– Visual inspection, odour check – Rinse entire fuel system with clean quality fuel. – Clean/replace plugged sieve filter on suction side – Replace fuel pump – Use quality fuel that meets the applicable standards – Replace the fuel filter and possibly the injection valves

Incorrect use

Claim/complaint	Appearance of damage	Possible causes	Remedies/remarks
– Pressure too high or too low	– none	– Incorrect selection	– Select correct pump
– Pressure not reached – Insufficient delivery rate – Excessive noise in the fuel pump – Engine misfire – Pump breaks down	– Dissolved rubber parts – Plugged prefilter, filter or sieve – *Stuck pumping mechanism*	– Improper use	– Proper use
– Pressure not reached – Insufficient delivery rate – Excessive noise in the fuel pump – Engine misfire – Pump breaks down	– Lime and rust deposits on the fuel pump – *Lime and rust deposits in the fuel pump* – Plugged prefilter, filter or sieve – *Pumping mechanism scorched by dry running* – *corrosion* – *Sticking*	– Pumping of improper liquids (e.g. water)	– Proper use
– Pressure not reached – Insufficient delivery rate – Excessive noise in the fuel pump – Engine misfire – Pump breaks down	– *Pumping mechanism scorched by dry running*	– Improper installation – Pump installed too high	– Adhere to installation conditions – Select a proper, protected installation location

Mechanical damages/installation errors

Claim/complaint	Appearance of damage	Possible causes	Remedies/remarks
– Decreasing delivery rate – Reduction of delivery rate – Smell of fuel – Leakage in the pump	– Pump leaks at cover – Markings do not match (please refer to ➔ Fig. 69)	– improper installation/removal: Lock nut not locked when pump connection line was tightened	– Replace pump – When the connection lines are being tightened, the hexagonal bolt of the fuel pump cover must be locked in place to prevent "twisting". The markings (see ➔ Fig. 70, arrow) must match and must not be twisted – Adhere to tightening torques
– Pump does not pump.	– Electric connections damaged	– Improper installation/removal: Electric connections damaged	– Replace pump – Be careful when connecting the electric connections – Adhere to tightening torques
– Decreasing delivery rate – Reduction of delivery rate – Smell of fuel – Leakage in the pump	– Fuel connection leaky/damaged	– Improper installation/removal: Fuel connection damaged	– Replace pump – Be careful when tightening the connection lines
– Decreasing delivery rate – Reduction of delivery rate – Smell of fuel – Leakage in the pump	– Pump leaks – Pitting – Corrosion in the locations of the mounting clamps	– Improper installation/removal: Contact corrosion by incorrect combination of materials	– Replace pump – Avoid zinc platted mounting clamps

Further malfunctions with similar symptoms

Possible causes	Remedies/remarks
– Pressure regulator defective	– Check pressure and regulation function – Replace faulty pressure regulator – Check fuel system
– Fuel tank aeration/ventilation not OK – ACF filter or lines filled with fuel	– Check and clean or repair if necessary – Check lines (pay attention to information given by vehicle manufacturer) – Check ACF regeneration valve for functioning
– Voltage supply to EFP faulty – Fuse defective – Line interruption – Pump relay defective.	– Visual inspection – Measure the voltage supply – Check and replace if necessary – Check and correct any errors – Check and replace if necessary
– Error in injection valve functioning – Incorrect injection times – Incorrect injection direction – Leaky injection valves	– When the engine is off use a suitable instrument to check the HC value in the intake manifold. – Check Injection times, injection signal and impermeability – Clean valves or replace if necessary
– The lambda probe is dirty or has deposits due to bad combustion or leaded fuel – The lambda probe responds too sluggishly, i.e., the lambda control tends to be too “rich”. – The lambda probe is damaged by exhaust gas temperatures that are too high as a result of a faulty mixture formation or ignition misfires – The electric earth connection is not OK	– Check lambda probe and contacts
– The fuel system has two fuel pumps connected one after another, one of which is defective	– Check both fuel pumps for functioning

☞ You will find further installation and diagnostic instructions, especially with respect to retrofitting electric fuel pumps, in the brochure *Service Tips & Info Fuel systems – components and solutions for universal applications* [6].

5 Tools and testing instruments

MSI Motor Service International offers a series of tools and instruments as required for work on fuel systems.

You will find further tools and testers in the catalogue "Tools and Testing Instruments" [7] and in the online-shop on our web site: **www.msi-motor-service.com**

5.1 Fuel pressure tester

With this tester a precise check can be made of the fuel pump and system pressure regulator, and all common injection systems can be checked for leaks.

- Calibrated manometer dual scale bar/psi
  0–2 bar (0–30 psi), special for central injections;
  0–10 bar (0–150 psi) for all other systems.
- Different connections and a 3-way adapter suitable for the most common injection systems
- Compact quick release couplings on all adapters and hoses.
- Supplied in a special case with comprehensive instructions for measuring the different systems.

For further information, please refer to ➔ Product Information PI 0005, PI 0007 and Service, Tips and Info Fuel Supply for Injection Engines [5].

Fig. 82 Fuel pressure tester 4.07360.51.0

Fig. 83 Application of fuel pressure tester 4.07360.51.0

5.2 Fuel pump tester

With this instrument electric fuel pumps can be tested for functioning and leaks regardless of the vehicle in a simple way.
For shops, service and workshops.

Power supply: 12 V DC, from vehicle battery or separate power supply.

Scope of delivery:
– Tester complete (without test liquid or power supply),
– Connection cable,
– Accessories and
– Operating instructions.

For further information please refer to
➔ Product Information PI 0014

The instrument consists of
– a display unit and
– a lower part for test liquid (test oil) and sample.

The following are integrated into the display unit
– a voltmeter,
– an ampere meter,
– a manometer and
– a flowmeter

The instrument is suitable for the following measurements:
– Delivery rate (volume flow) for system pressures from 0.2–6.5 bar
– Static pressure (for E1F pump series)
– Holding pressure (leak test) (not for E1F pump series)
– Power consumption

Fig. 84 Application of fuel pump tester 4.07370.60.0

Technical data

Height:	950 mm
Width:	405 mm
Depth:	350 mm
Weight (filled):	29 kg
Test liquid:	Test oil acc. to ISO 4113
Filling amount:	Approx. 9 l or approx. half the height of the pan
Voltage:	12 V *)
Current:	20 A *)
Internal fuses:	25 A

*) To operate, the instrument must be connected to an external power source (stabilised DC).

Quantity	Designation	Dimensions/remarks
1	Fuel pump tester	HxWxD 590 x 405 x 350 mm
1	Operating instructions	
2	Connection cable	
2	Hexagon socket screws	To lock the upper part of the instrument into position
1	Accessory kit consisting of:	Article no. 4.07370.14.0
	1 Screw connection	M10 x 1; M12 x 1.5
	1 Cap nut	M12 x 1.5
	1 Screw connection	M12 x 1.0; 8 mm connection
	3 Conical nipples	10.2 x 14 x 1.2 mm
	3 Conical nipples	12.2 x 16 x 1.5 mm
	2 Reducer	Ø 8 – 6 mm; plastic
	1 Fuel hose	approx. 15 cm long
	1 Hollow-core screw	M12 x 1.0
	1 Ring connection	Ø 12 mm ; 8 mm connection
	1 Hose clips	Ø 14

Test procedure

The test is taken according to Fig. 85 “Test procedure”.
The fuel pump must be checked according to the test steps for the respective system pressure:
– 0.2–1 bar,
– 1.1–3 bar and
– 3.1–6.5 bar.

The instrument may be operated only with test liquid in accordance with ISO 4113.
In the operating instructions you will find a list of source addresses.

There you will receive the corresponding safety datasheet according to 91/155/EEC.
Combustible fuels may not be used.

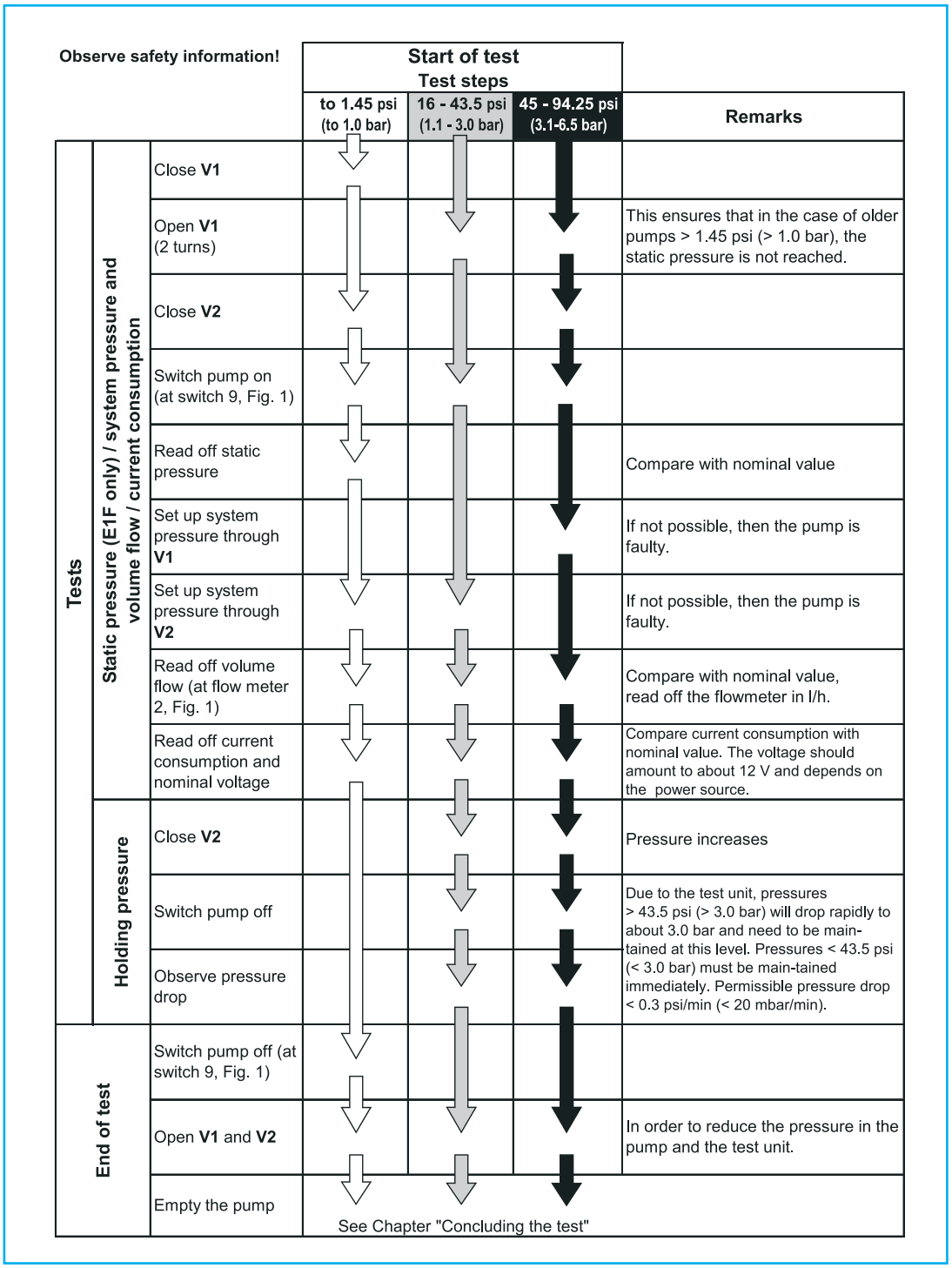


Fig. 85 Test procedure for fuel pump tester (excerpt from the operating instructions)

5.3 Special tool for electric fuel pumps

For removing and installing in-tank fuel pumps.
For many Audi vehicles (80/100/200/Avant/Quattro/A6) built from 08/1984 onward.
For further technical information and applications, please refer to ➔ *Pierburg Service Information SI 0008/B and SI 0032/A*.

Fig. 86 Special tool application

Fig. 87 Special tool 4.07360.22.0

5.4 Mounting tool for fuel pump (BMW 5 and 6 series models)

This is a tool for removing/installing fuel pump 7.22013.02.0 for the BMW 5 (E39) and 5 (E39) touring series (except M5 and diesel models).

With this inexpensive and environmentally friendly solution, it is no longer necessary to replace the entire fuel pump together with its mounting. Only the fuel pump itself is replaced.

How to use the tool is explained step by step in detail in the Service Information SI 0068 as well as in the installation instructions included with the replacement fuel pump by MSI.

Fig. 88 Mounting tool 4.00063.00.0

Fig. 89 Mounting tool application

6 Annex

6.1 Sources and Further Reading

[1] *Technische Filterbroschüre (Technical Filter Booklet)*
MSI Motor Service International
50 003 596-01 (German)
50 003 596-02 (English)

[2] *Biodiesel*
Marcus Taupp
Bayerische Julius-Maximilians-Universität Würzburg
Institut für Pharmazie und Lebensmittelchemie
Lehrstuhl für Lebensmittelchemie
(Julius Maximilian University of Bavaria at Würzburg
Institute of Pharmaceutics and Food Chemistry, Food Chemistry Chair)
Prof. Dr. P. Schreier

[3] *Chemie der Kraft- und Schmierstoffe (The Chemistry of Fuels and Lubricants)*
Prof. (Emeritus) Dr. A. Zeman
Universität der Bundeswehr München - Fachbereich Maschinenbau - Umwelttechnik und Chemie
(German Federal Armed Forces University, Munich – Engineering Faculty – Environmental Studies and Chemistry)

[4] *Emission Control & OBD with Pierburg Products (Edition 2005)*
MSI Motor Service International
50 003 960-01 (German)
50 003 960-02 (English)
50 003 960-03 (French)
50 003 960-04 (Spanish)
50 003 960-09 (Russian)

[5] *Fuel Supply for Injection Engines*
(Edition 1998)
MSI Motor Service International
8.40002.36.0 (German)
8.40002.37.0 (English)

[6] *Fuel Systems – Components and Solutions for Universal Applications*
(Edition 2004)
MSI Motor Service International
8.40002.56.0 (German)
8.40002.57.0 (English)
8.40002.58.0 (French)

[7] *Tools & Testing Instruments*
(Edition 2006)
MSI Motor Service International
50 003 931-01 (German)
50 003 931-02 (English)
50 003 931-03 (French)
50 003 931-04 (Spanish)
50 003 931-09 (Russian)

6.2 Technical Information

Service - Tips & Information
Emission Control & OBD
with PIERBURG products

Article no.	Language
50 003 960-01	German
50 003 960-02	English
50 003 960-03	French

Article no.	Language
50 003 960-04	Spanish
50 003 960-09	Russian

Service - Tips & Information
Electric Fuel Pumps
Models, Damages, Reasons

Article no.	Language
50 003 885-01	German
50 003 885-02	English
50 003 885-03	French

Article no.	Language
50 003 885-04	Spanish
50 003 885-09	Russian

Service - Tips & Information
Fuel Systems
Components and Solutions for Universal Applications

Article no.	Language
8.40002.56.0	German
8.40002.57.0	English
8.40002.58.0	French

Service - Tips & Information
Fuel Supply for Injection Engines

Article no.	Language
8.40002.36.0	German
8.40002.37.0	English

Service - Tips & Information
Vacuum Pumps

Article no.	Language
8.40002.39.0	de-en-fr-es-it

Catalogue
Tools & Testing Instruments

Article no.	Language
50 003 931-01	German
50 003 931-02	English
50 003 931-03	French

Article no.	Language
50 003 931-04	Spanish
50 003 931-09	Russian

6.3 Wall charts

Wall chart
OBD & PIERBURG
On board diagnosis and PIERBURG products
840 x 549 cm (DIN A1)

Article no.	Language
50 003 961-01	German
50 003 961-02	English

Wall chart
OBD & Secondary Air System
Finding and correcting errors
420 x 594 cm (DIN A2)

Article no.	Language
50 003 969-01	German
50 003 969-02	English

Wall chart
OBD & Exhaust Gas Recirculation System
Finding and correcting errors
420 x 594 cm (DIN A2)

Article no.	Language
50 003 971-01	German
50 003 971-02	English

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