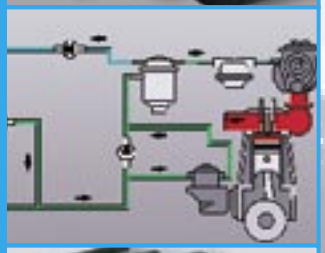
Service
Tips & Information

PIERBURG

Fuel Systems

Components and solutions for universal applications



PIERBURG

1 INTRODUCTION 4
1.1 Preface 4
1.2 Pictograms and symbols 4
1.3 Explanation of terms 5
1.4 General notes 5
1.5 Product liability 5
1.6 General notes on safety 6

2 MOST COMMON FUEL SYSTEMS 7

3 COMPONENTS 8
3.1 Overview 8
3.2 Electric all-purpose fuel pumps (EFP) 8
3.2.1 Type E1F 9
3.2.2 Type E1S 10
3.2.2.1 Comments on pre-feeder pumps 10
3.2.3 Type E3L 11
3.2.4 Accessories for pumps 12
3.2.5 Safety shut-off (12 V operation) 13
3.3 Non-return valve (NRV) 14
3.4 Fuel cut-off valve (COV/ECOV) 15
3.5 Fuel vapor separator (FVS) 16
3.6 Pressure relief valve (PRV) 17
3.7 Additional accessories for fuel systems 18
3.7.1 Selections from our catalog “Tools & Testing Instruments” 18
3.7.2 Specialist trade items 18

4 COMMON APPLICATIONS 19
4.1 General notes 19
4.2 Installation of an E1F to replace a mechanical fuel pump (gasoline engine) 20
4.3 Gasoline engine with an E1F electric fuel pump 21
4.4 Gasoline engine with two E1F electric fuel pumps 22
4.5 Backup pump for gasoline and diesel engines 22
4.6 E1F/E1S as a pre-feeder pump (diesel engine) 23
4.7 Transfer system/auxiliary tanks 24
4.8 Boat operation 25
4.9 Fuel supply in heating systems 25

5 INFORMATION ON OTHER DOCUMENTS 26

6 TOOLS AND TESTING EQUIPMENT 27

7 FREQUENTLY ASKED QUESTIONS 28

8 TROUBLESHOOTING TIPS 30

8.1 General notes 30
8.2 Malfunctions, possible causes, remedies 30
8.2.1 General malfunctions 30
8.2.2 Malfunctions after the installation of new pumps 31
8.2.3 Malfunctions particular to diesel operation 31
8.2.4 Malfunctions when replacing a mechanical fuel pump with an E1F (particularly with antique cars) 32
8.2.5 Notes on operation with biodiesel 33

9 MSI TRAINING PROGRAM

9.1 The MSI training concept 34
9.2 Scheduled courses for MSI training 34
9.2.1 For engine rebuilders 35
9.2.2 For automotive workshops 36

10 CONTACT INFORMATION 37

Subject to change and deviation from the illustrations.

Version 04.03
First printing
Article no. 8.40002.57.0

1 Introduction

Please note:
This brochure is intended only for qualified personnel.

Qualified personnel are persons who have, based on their specialist training, experience and instruction, sufficient knowledge of

- safety regulations,
- accident prevention regulations and
- guidelines and accepted rules of technology (such as standards).

1.1 Preface

Typically gasoline (petrol) or diesel fuel is required for the operation of combustion engines.
In addition to that, fuels are also used for heat generation, as is the case with heating oil. The fuels must be stored, transported, transferred and supplied to the motor or heating system.
The components used to accomplish this are referred to in general as "fuel systems". For mass production vehicles these systems as well as the corresponding components are developed and tested for specialized applications. For small series or special applications this is often not the case.
In such cases, the user puts the system together according to his needs and knowledge.
In all cases the fuel pump along with the reserve fuel container (tank) is the key component of a fuel system.
Pierburg offers a series of all-purpose pumps and components.
In the course of our technical consultation and from questions from customers, we find time and again that there are often questions related to the various systems or that avoidable problems arise due to mistakes during installation.
In this brochure we offer a multitude of information and hints to help you achieve optimal results and avoid errors.

☞ Please note:
Information regarding *fuel systems for injection engines* can be found in our brochure *"Service Tips & Info - Fuel Supply for Injection Engines"*

1.2 Pictograms and symbols

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

⚠ Indicates hazardous situations with possible injury to persons or damage to vehicle components.

Notes regarding environmental protection.

☞ Indicates useful suggestions, explanations and supplemental information for use.

→ Cross reference to another part of the document.

1.3 Explanation of terms

The table below lists **terms and abbreviations**, used in conjunction with fuel systems.

Abbreviation	Term	Definition
ACF	Activated carbon filter	Absorber for hydrocarbons in the tank ventilation system.
ACF valve	Activated carbon filter regeneration valve	Valve for controlled emptying of the ACF (“regeneration”)
COV / ECOV	Cut-off valve	(Electric) fuel cut-off valve
DCOV	Diaphragm cut-off valve	Diaphragm cut-off valve for fuel
DV	Diaphragm valve	Diaphragm valve for pressure reduction
E1F	Inline vane pump	All-purpose pumps, for details on the series see → technical data
E1S	Periphery pump	In-tank bypass channel pump, for details see → technical data
E3L	Screw pump	In-line high performance pump, for details see → technical data
EFP	Electric fuel pump	Fuel pump with an electric drive
FVS	Fuel vapor separator	A volume with a fixed or variable return, in which vapor is returned and the fuel is degassed
Inline	In-line pump	Pump in the process path
Intank	In-tank pump	Pump for installation in the tank
MFP	Mechanical fuel pump	Fuel pump with cam drive using a lever or plunger
NRV	Non-return valve	For installation in the feed and return lines. Prevents lines from running empty
PRV	Pressure relief valve	Diaphragm valve for limiting pressure

1.4 General notes

- All figure and schematics in this document are for purposes of general visualization. Specific details may differ from the current designs available.
- We reserve the right to make technical changes as part of further development without changing this brochure.
- For changes related to classification and replacement of the specified article numbers, see → the current catalog, TecDoc CD or system using TecDoc data.

1.5 Product liability

⚠ The products described in this brochure are designed, manufactured and tested especially for use in commercial and passenger vehicles.

The materials used are selected to work with fuels that meet the current European standards for fuels.
Other applications or other pumping media require additional, application-specific testing, without which we assume no liability.

1.6 General notes on safety

- For safety reasons, disassembly and installation of electric fuel pumps should only be carried out by a qualified workshop.
- Personnel responsible for refitting must read and understand this brochure before beginning the work, especially the parts pertaining to the subject of safety.
- The applicable country-specific legal provisions and relevant safety regulations must also be complied with.
- Safety equipment is not to be disabled or bypassed.

Follow the safety guidelines for the working with fuel and fuel vapors. Fuel and fuel vapors are highly flammable.

- smoking,
- open flame,
- exposed lights and
- spark-producing actions are strictly forbidden.

There must be sufficient ventilation in the work area.

- Use only fuel lines which meet the current applicable regulations.
- After work on fuel tanks, test to be sure that they are free from leaks.
- When working on the fuel system, the instructions from the vehicle manufacturer must be followed at all times
- Use only the appropriate tools for refitting work.
- Before beginning work, allow any hot components in the engine to cool down.
- Remove all packing material, fastenings and seals for transport, such as plugs, from the new fuel pumps only when they are ready to be installed.
- Install only clean parts.
- Keep the work area clean in order to ensure that no contamination gets into the fuel system.

Use personal safety equipment as needed or required by law.

Dispose of lubricants, cleaning agents and wastes in an environmentally appropriate manner.

In addition, all country-specific safety regulations must be followed.

Please note that the operating permit for the vehicle may be voided if changes are made which

- change the vehicle type approved in the operating permit,
- may lead to the endangerment of road users or
- degrade the exhaust or noise characteristics.

In case of individual changes contrary to the applicable regulations, the operating permit must be renewed after obtaining a certified evaluation from a qualified technical expert, which should be included in the vehicle‘s documentation.

2 Most Common Fuel Systems

Fuel systems are built in various ways for different applications.
Figures 1 to 3 show the design of fuel systems for the most common automotive applications.

In addition to these applications, there are many application scenarios which require a very different design and selection of parts. Details of these are described in Chapter 4, “Common Applications”.

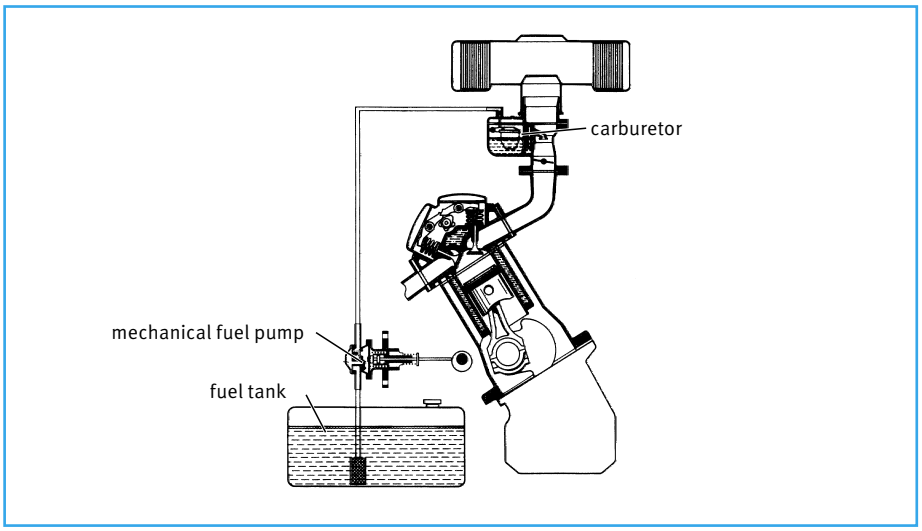


Figure 1 Fuel system of a carburetor engine (until about 1976)

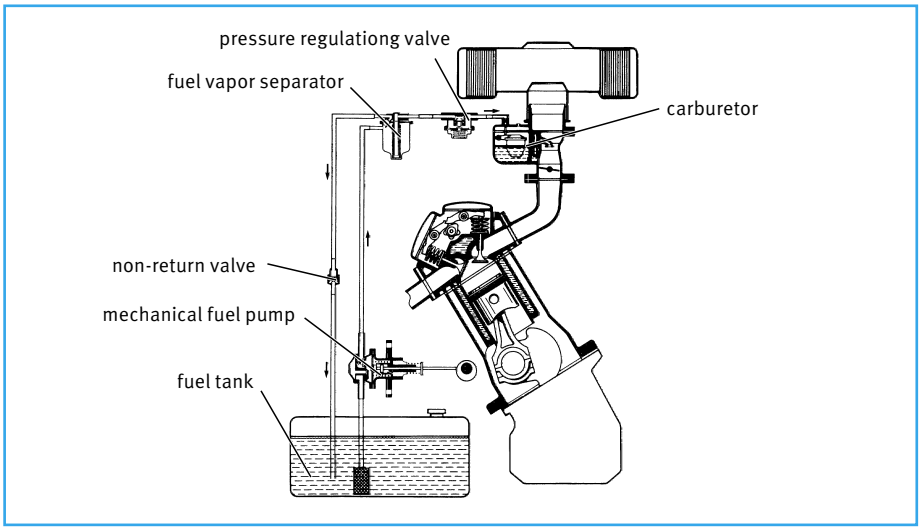


Figure 2 Design of a fuel system with expanded features (about 1976 to 1992)

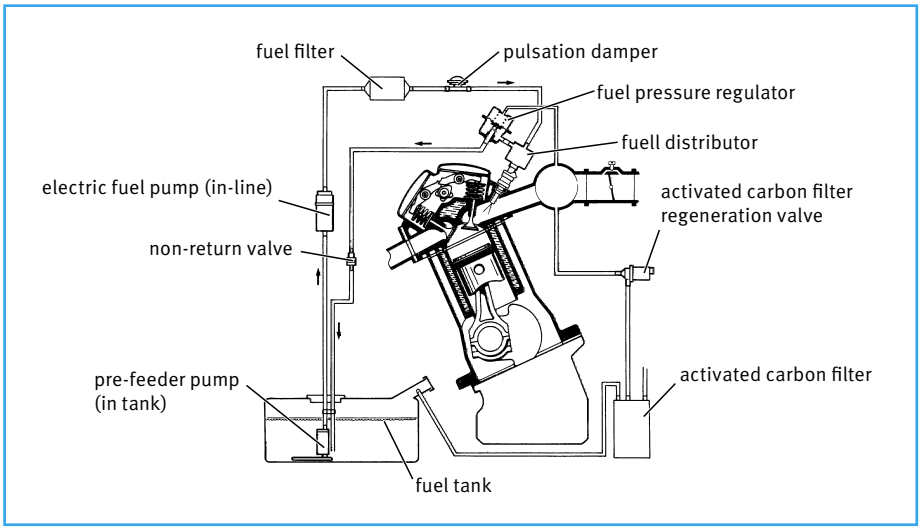


Figure 3 Fuel system for an injection engine (after about 1985)

3 Components

Components for fuel systems are described below.

3.1 Overview

In addition to the electric fuel pump (EFP) as the primary component, there are additional components which improve the safety and function of the engine fuel supply.
In certain cases, for example, they can eliminate hot start problems.
Which components are to be used where depends on the specific application. For further details, see Chapter 4, “Common Applications”.

Term	Model/Type	Order No.
Fuel pump	E1F	➔ Table 3.2.1
Fuel pump	E1S	7.21088.62.0
Fuel pump	E3L	7.22782.50.0
Fuel check valve	for 6 mm connection	7.20469.51.0
Fuel check valve	for 8 mm connection	7.20234.52.0
Fuel cut-off valve	electric	7.22386.50.0
Fuel vapor seperator	Plastic, variable return	4.05284.50.0
Fuel vapor seperator	Metal, variable return	4.07303.12.0
Fuel vapor seperator	Metal, fixed return	7.20925.51.0
Fuel vapor seperator	Metal with pressure regulator, variable return	7.21182.50.0
Pressure relief valve	without return	7.20726.50.0*
Pressure relief valve	with return Ø 1.1 mm	7.20726.51.0*
Pressure relief valve	with return Ø 0.4 mm	7.20726.52.0*

* No longer available! For supply sources, ssee also ➔ Chapter 10

3.2 Electric all-purpose fuel pumps (EFP)

Depending on the application, fuel pumps with different pump mechanisms and drives are used. Pierburg offers three electric all-purpose pumps (types E1F, E1S and E3L) with different pump mechanisms for the various applications.

These pumps have proven themselves as the solution in many cases.

They have found use, for example
- as replacements for mechanical fuel pumps if the original pump part is no longer available.
- as a temporary solution for repairs if a special part is not available.
- as a pre-feeder pump for diesel or gasoline engines.
- as a backup pump which can be switched as needed (if the main pump fails).
- as a transfer or feed pump in transfer systems, auxiliary tanks or heating installations.

Information regarding *fuel systems for injection engines* can be found in our brochure *“Service Tips & Info - Fuel Supply for Injection Engines”* (see ➔ Chapter 5).

3.2.1 Type E1F

The most frequently used pump is the **E1F**, an inffline positive displacement pump with a vane pump mechanism, for system pressures of 0.1 to 1.0 bar and 12 or 24 V operation.
This is an allffpurpose pump that is placed in the fuel line.

Maximum suction head: 500 mm (with filled lines).
For 6 volt operation (such as with vintage cars) we recommend the E1F no. 7.21440.53.0. When operating at 6 volts, the pressure and flow rate are reduced to about half.

E1F technical data

Pierburg No.:	Curve	rated V	Stat. P at Q = 0 l/h [bar]	Flow Rate at [l/h]	System Pressure at [bar]	Installation or Connection Dim. (see → Figure 4) A	B	C	D	E	Current Draw [A]	Max. Suction Head [mm]
7.21440.51.0	1	12	0.27–0.38	95	0.10	Ø 38	133.5	84.5	Ø 8	Ø 8	≤ 2.00	500
7.21440.53.0	2	12*	0.44–0.57	100	0.15	Ø 38	133.5	84.5	Ø 8	Ø 8	≤ 2.05	500
7.21440.63.0	2	24	0.44–0.57	100	0.15	Ø 38	134.2	84.5	Ø 8	Ø 8	≤ 1.35	500
7.21440.78.0	3	12	› 1.85	95	1.00	Ø 38	141.5	91.0	Ø 12	Ø 8	≤ 4.30	500
7.21440.68.0	3	24	› 1.85	95	1.00	Ø 38	139.5	90.5	Ø 8	Ø 8	≤ 3.00	500

*) also suited for 6 V operation

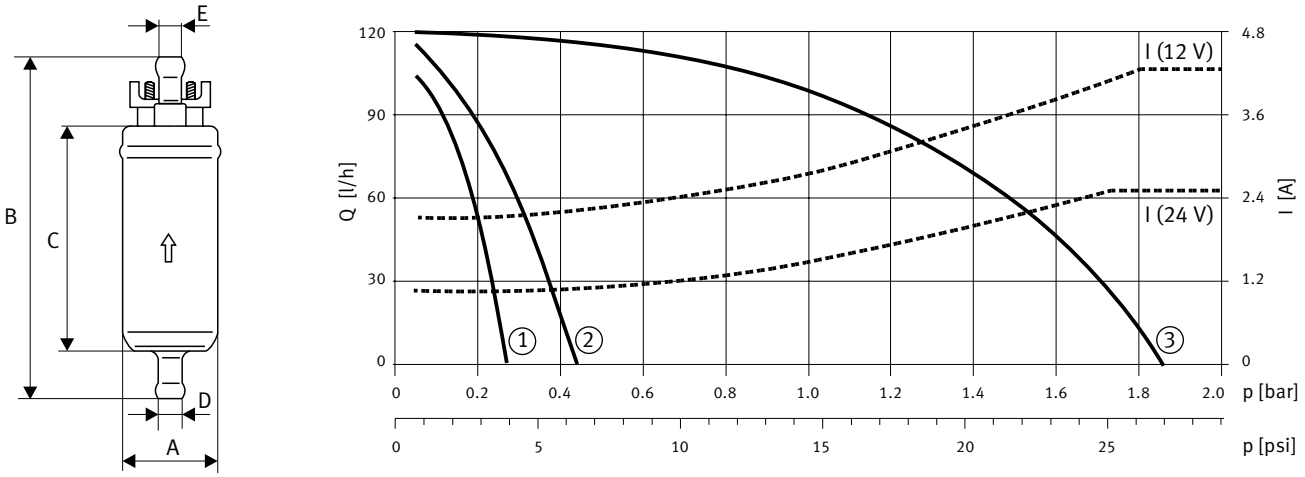


Figure 4 Electric fuel pump, type E1F, dimensions and characteristic curves

3.2.2 Type E1S

For installation in a fuel tank, there is the 12 volt version of the E1S, a flow pump with a side channel pump mechanism. This pump is preferably used as a pre-feeder pump (up to approx. 220 l/h).

☞ Maximum suction head: 0 mm
The pump must be placed in the medium to be pumped.

E1S technical data

Pierburg No.:	Rated voltage	Stat. P at Q=0 l/h	Flow Rate at	System Pressure at	Installation or Connection Dim. (see → Figure 5)					Current Draw	Max. Suction Head
	[V]	[bar]	[l/h]	[bar]	A	B	C	D	E	[A]	[mm]
7.21088.62.0	12	–	75	0.24	Ø 38	100	75.3	Ø 9.5	Ø 19	2.00	0

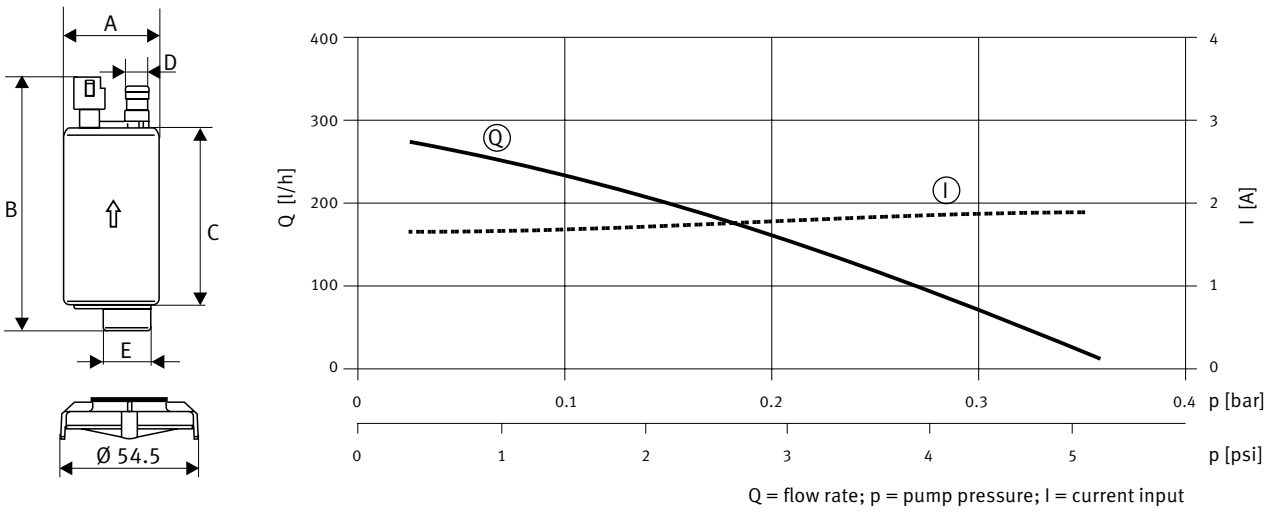


Figure 5 Electric fuel pump, type E1S, dimensions and characteristic curve (including prefilter)

3.2.2.1 Comments on pre-feeder pumps

A pressure differential arises between the fuel tank and the intake side of in-line fuel pumps.
It is dependent on
- the “free cross section” (internal diameter) of the intake line,
- the viscosity of the medium to be pumped and
- the flow rate.

As a result of this pressure differential, the vacuum which occurs may cause vapor bubbles to form, leading to malfunctions. Wear and tear and damage to the pump can result.
Pre-feeder pumps (such as type E1S, see → section 3.2.2) are used in order to avoid this.
Pumps of type E1S can be used as a pre-feeder pump for up to a flow rate of 220 l/h.

Pre-feeder pumps deliver the medium to the main pump at lower pressure. This prevents a vacuum from occurring on the intake side of the main pump.

Flow pumps are the typical choice for pre-feeder pumps. They are not self-priming and must therefore be placed in the tank.

☞ Installation example, see → section 4.6

3.2.3 Type E3L

The E3L pump is an in-line pump with a screw pump mechanism. This pump is particularly efficient, quiet and uses comparatively little power even at high pressures.

It is suited for system pressures up to 4 bar and has an output of up to 280 l/h (depending on pressure) with a current consumption of 8 A (for 12 V operation).

☞ Maximum suction head: 500 mm (with filled lines).

E3L technical data

Pierburg No.	Rated voltage [Volt]	Stat. P at Q=0 l/h [bar]	Flow Rate at [l/h]	System Pressure [bar]	Installation or Connection Dim. (See → Fig. 6) A	B	C	D	E	Current Draw [A]	Max. Suction Head [mm]
7.22782.50.0	12	–	280–120	- 4.00	Ø 43.5	199.5	156	Ø 9	Ø 9	8.00	500

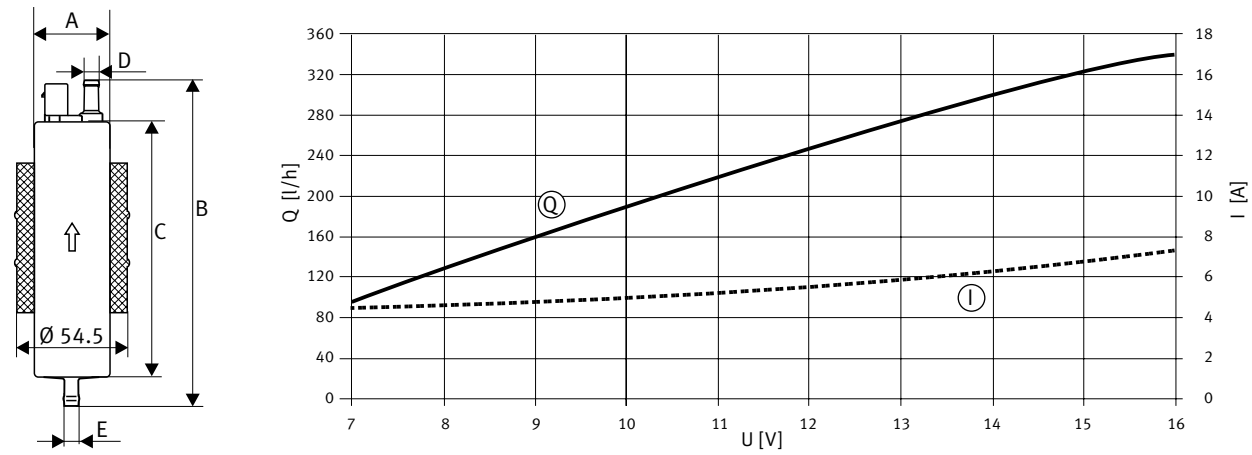


Figure 6 Electric fuel pump, type E3L, dimensions and characteristic curves (at 1.8 bar, 20°C)

3.2.4 Accessories for pumps

The following accessories facilitate installation of the pumps or improve their operational reliability.

Designation	Modell/Type/Comment	Figure	Order No.
Fixing clamp for E1F	included with the pump delivery	7	(no spare part)
Suspension	sound-proof	8	4.05303.50.0
Rocker element	Package unit, 10 piece	9	4.07414.87.0
Reducing piece	Ø 8 mm to 6 mm, package unit, 10 piece	10	4.07414.86.0
Safety shut-off	for E1F	11	4.05288.50.0

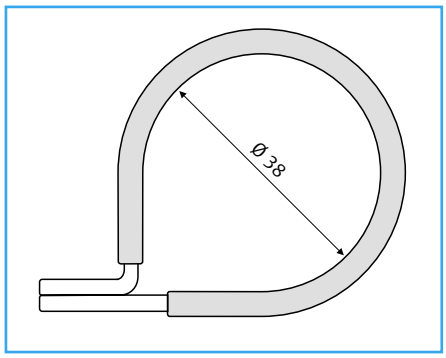


Figure 7 Fixing clamp (included with the E1F order)

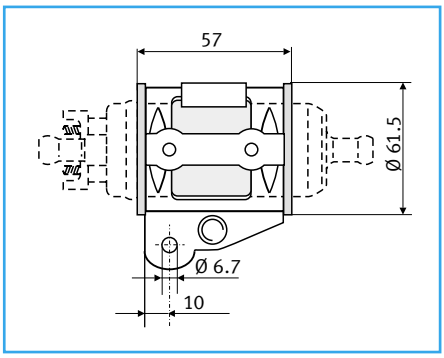


Figure 8 Suspension, sound-proof (4.05303.50.0)

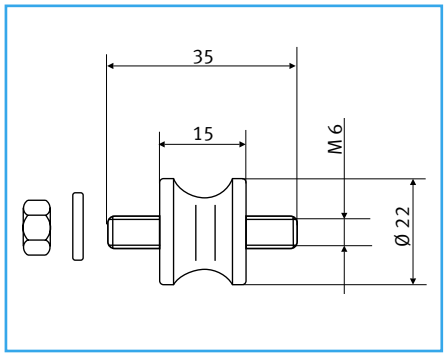


Figure 9 Rocker element (4.07414.87.0)

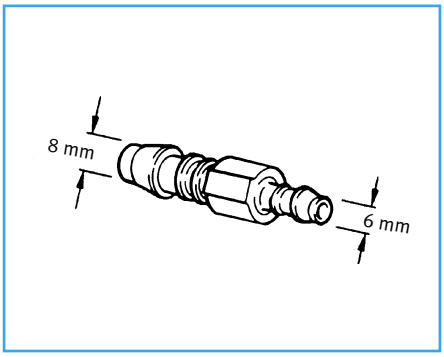


Figure 10 Reducing piece (4.07414.86.0)

See also our ➔ catalog *"Tools and Testing Instruments"*

3.2.5 Safety shut-off (12 V operation)

⚠ When installing an electric fuel pump instead of a mechanical one, for safety reasons we recommend in all cases the installation of a **safety shut-off**.

Pierburg offers a safety shut-off kit for 12 V operation.
Order No.: 4.05288.50.0

The safety shut-off switches off the electric fuel pump if the engine of the vehicle stops and the ignition remains on (e.g. the motor died or there has been an accident).

☞ The safety shut-off can only be used in vehicles with
- a 12 volt battery and
- grounding of the negative battery contact to the vehicle body.

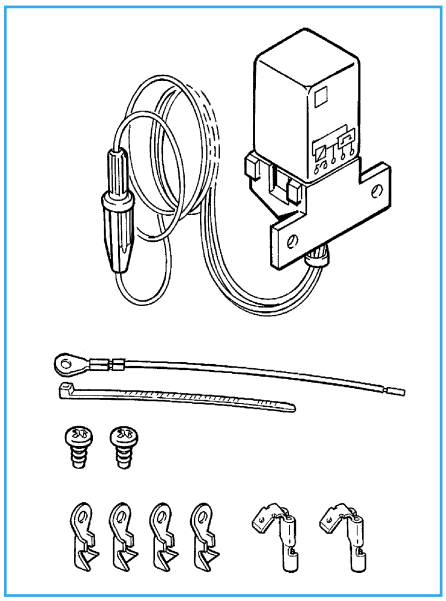


Figure 11 Safety shut-off (parts included)

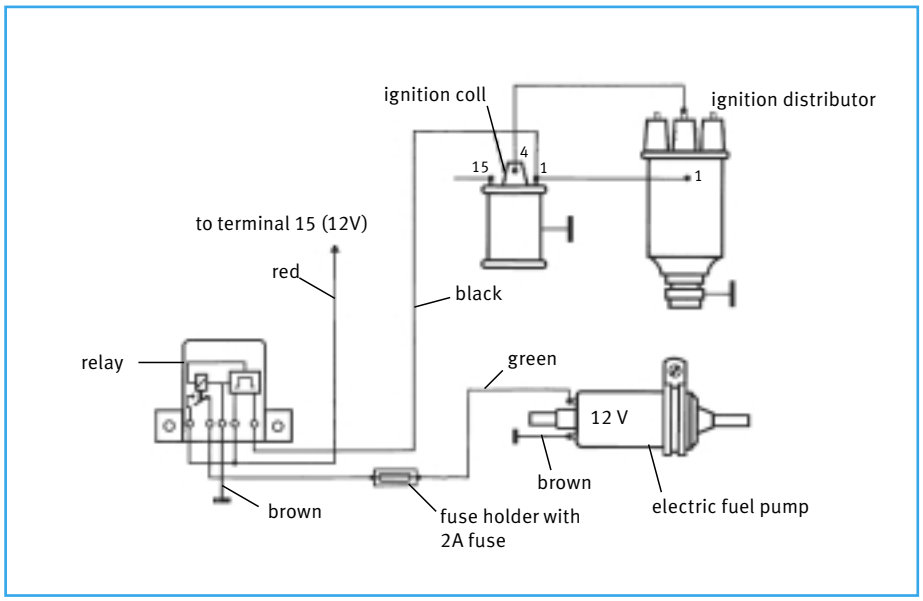


Figure 12 Safety shut-off (wiring diagram)

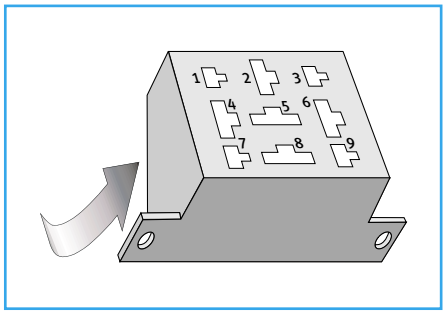


Figure 13 Safety shut-off (pin assignment relais base)

Pin assignment (see ➔ Figure 13)

Pin No.	Cable Color	Terminal on Relay No.
2	red	30
4	black	31b
5	brown	31
6	red	15
8	green	87

☞ For additional information such as installation, connection and functional testing, see ➔ *"Service Information SI 0016/A"*

3.3 Non-return valve (NRV)

Non-return valves are used in various parts of fuel systems.

For additional information and details, see ➔ *"Service Information SI 0044"*

Application examples for non-return valves
(For further details, see ➔ Chapter 5)

- **NRV in the supply line**

They prevent line voids not only for carburetor engines, but for injection and diesel engines as well.
The installation (between the tank and pump, near the tank), also as a retrofit, reduces starting problems, because the engine fuel lines are already filled when the engine starts.

- **NRV in both supply lines**

For multiple pumps, regardless of whether they have a parallel or separate power supply, in order to avoid uncontrolled supply circulation.

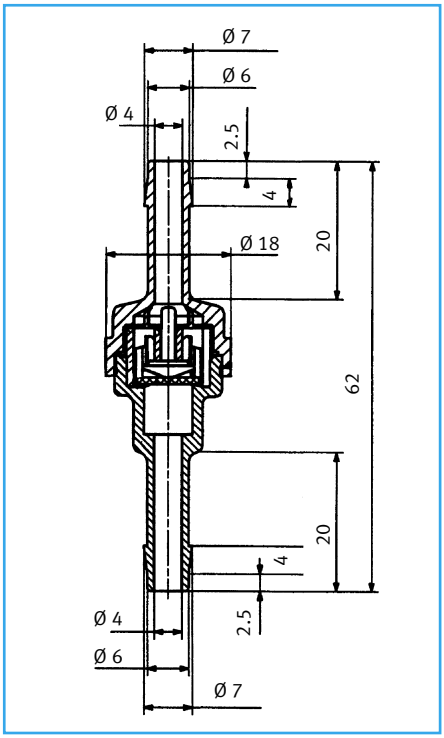


Figure 14 Non-return valve, 6 mm (7.20469.51.0)

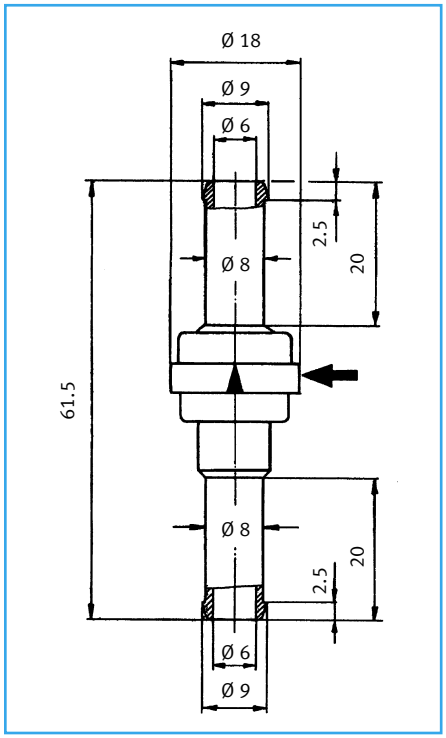


Figure 15 Non-return valve, 8 mm (7.20234.52.0)

- **NRV in the return line**

- Used as a safety valve near the tank in order to prevent it from draining if a line ruptures.
- Used near the carburetor or before the fuel vapor separator, to avoid flooding the float chamber from the return line if the vehicle tilts sharply.

- **NRV in the intake line**

For diesel engines, an auxiliary tank or transfer system, the **NRV** prevents emptying of the intake line. In some cases another **NRV** must be placed on the tank end of the fuel line.

3.4 Fuel cut-off valve (COV/ECOV)

Fuel cut-off valves are used in the supply line.

Depending on the control, they are used as follows:
- Drain locks to prevent fuel running out when the motor is turned off.
- Safety shut-offs
- Anti-theft devices

There are two valves available currently:

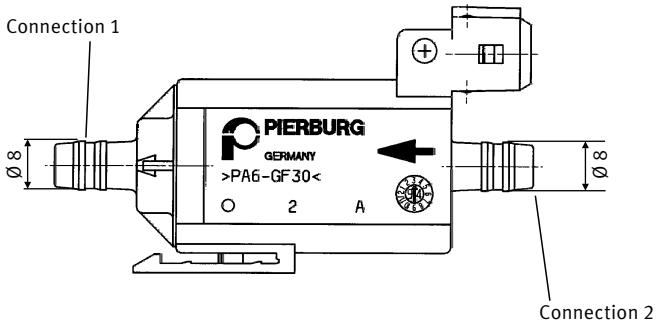


Figure 16 Fuel cut-off valve (7.22386.50.0)

Technical data

Rated voltage	12	[V]
Pull-in voltage	8	[V]
Connections	2, Ø 8	[mm]
Flow rate at 0.3 bar	≤ 100	[l/h]
Length	78.5	[mm]

- The valve is closed in an unpowered state
- Connection 1 is the pressure inlet.
- Mounting with a clip or custom bracket supplied by the customer.

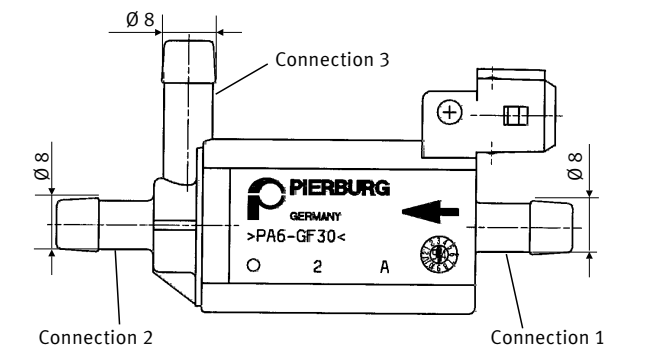


Figure 17 Fuel cut-off valve (7.22687.07.0)

Technical data

Rated voltage	12	[V]
Pull-in voltage	8	[V]
Connections	3, Ø 8	[mm]
Flow rate at 0.3 bar	≤ 100	[l/h]
Length	85	[mm]

- Without power the path between connections 1 and 3 of the valve is open.
- Without power the path between connections 2 and 3 of the valve is closed.
- Connection 2 is the pressure inlet.
- Connection 3 is the pressure outlet

☞ When used as a cut-off valve, connection 1 must be securely closed.

3.5 Fuel vapor separator (FVS)

In an open fuel system with high temperatures in the engine compartment, gas bubbles can form in the carburetor, the lines and the fuel pump.
These gas bubbles occur as a result of residual heat, particularly with the engine shut off, but also when idling without cooling. The consequences are idling problems and difficulties starting ("vapor lock") with the engine hot or cold.
Fuel vapor separators are an effective means of dealing with this problem, and they are easy to retrofit.

However, if one is not already present, a fuel return line must be installed.

The fuel vapor separator should be mounted as close to the carburetor as possible.
The fuel vapor separator should be mounted at the same height as the carburetor.

Fuel vapor separators are small fuel reserve containers with three connections:
- inflow (inlet),
- outlet (to the carburetor) and
- return to the tank.

There are four important variants for fuel vapor separators.
(See ➔ Figures 18 to 21.)

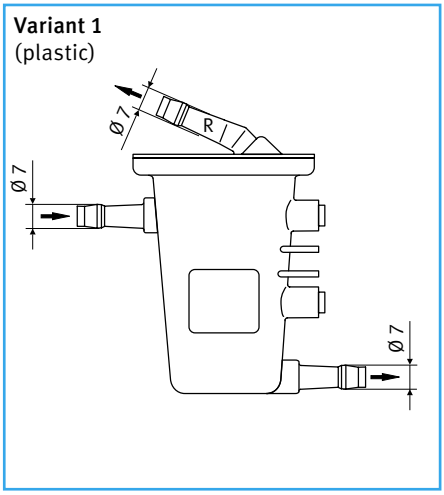


Figure 18 Fuel vapor separator 4.05284.50.0

• **Variant 1** (Figure 18)
with variable return via a ball valve. The valve is open when *vapor* is present. The vapor can flow to the tank, and the system is quickly filled with fuel. With *fluid* present, the valve reduces the return quantity. The fuel supply is ensured even under full load.

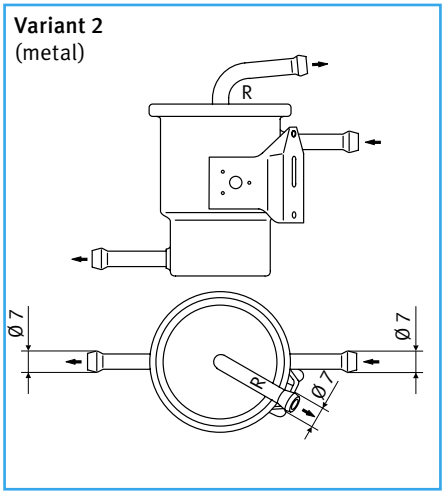


Figure 19 Fuel vapor separator 4.07303.12.0

• **Variant 2** (Figure 19)
is largely the same as Variant 1 but is made of metal.

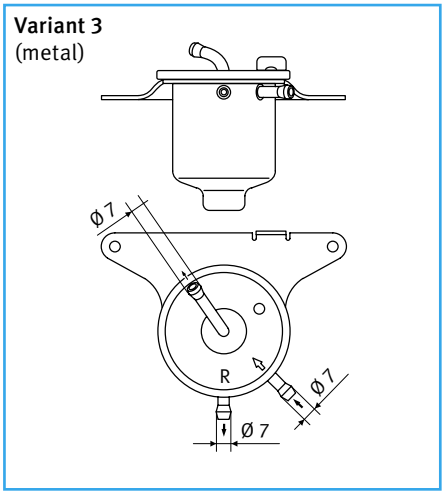


Figure 20 Fuel vapor separator 7.20925.51.0

• **Variant 3** (Figure 20)
has a larger fuel container with a fixed jet in the return.
This allows larger amounts of fuel to be kept near the carburetor and pre-degassed. When starting with a hot engine, only degassed fuel enters the float chamber, avoiding foaming that may cause vapor lock in the engine.

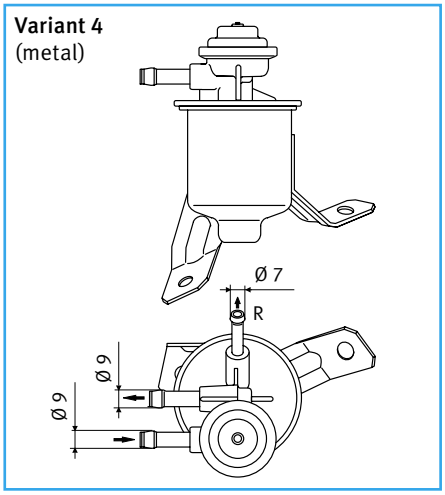


Figure 21 Fuel vapor separator 7.21182.50.0

• **Variant 4** (Figure 21)
has a combination of features from variants 1 and 3 - a fuel container with variable return as well as an integrated pressure regulator.
This version allows the use of particularly high-performance fuel pumps and is the most effective solution for fuel supply problems due to temperature.

3.6 Pressure relief valve (PRV)

Pressure relief valves reduce the fuel pressure to about 35 to 45% of the inlet pressure. They are installed in the supply line before the carburetor. There are PRVs with and without return.

When using a fuel vapor separator, only pressure relief valves without a return may be used.

The use of a pressure relief valve has three advantages.

1. The level in the float chamber remains largely constant.
2. Foaming of the fuel is prevented when starting the engine hot.
3. Fuel pumps with higher pressure and greater delivery rates can be used.

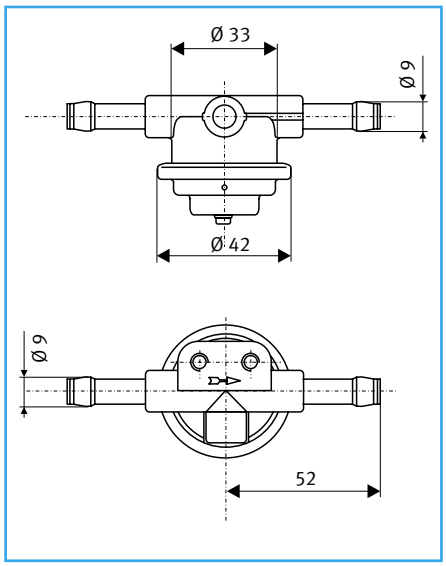


Figure 22 Pressure relief valve without return (7.20726.50.0*)

Fuel inlet pressure: approx. 0.3 bar
Fuel outlet pressure: approx. 0.13 bar

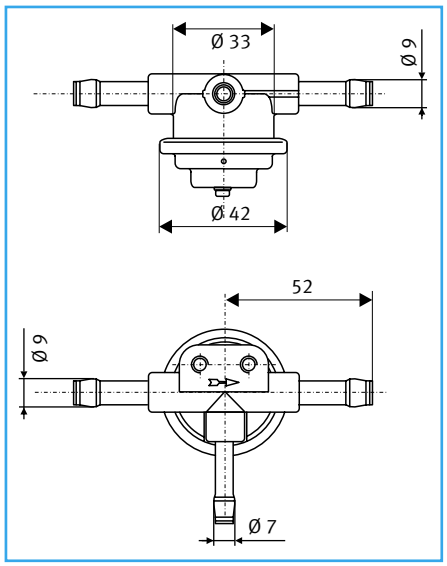


Figure 23 Pressure relief valve with return (7.20726.51.0*)

Fuel inlet pressure: approx. 0.3 bar
Fuel outlet pressure: approx. 0.13 bar

* No longer available! For supply sourcess, see also → Chapter 10

3.7 Additional accessories for fuel systems

In this chapter you will find additional accessories to make refitting easier and increase operational reliability.

3.7.1 Selections from our catalog *"Tools & Testing Instruments"*

We offer the following accessories for installation.

Article	Quantity	Order No.
T-piece 6 mm Ø	10 units	4.07413.99.0
Y-piece 6 mm Ø	10 units	4.07413.98.0
Tee 8 mm Ø	10 units	4.07414.01.0
Y-piece 8 mm Ø	10 units	4.07414.00.0
Fuel hose (rubber) 5.5 mm Ø	20 m	4.07371.05.0
Fuel hose (rubber) 7.5 mm Ø	20 m	4.07371.06.0
Assortment of hose connectors and clamps	*	4.00005.01.0
Filter sieve		4.00030.80.0

*) Contents sorted, 285 connectors and 80 clamps

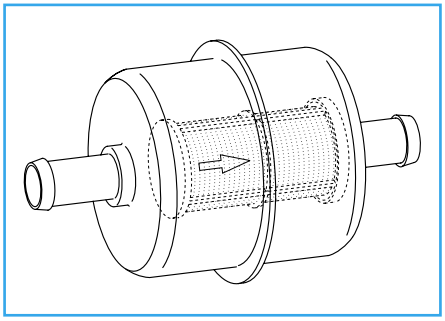


Figure 24 Filter sieve

3.7.2 Specialist trade items

In addition, we recommend that the following commercially available accessories be used.

- Fuel line (plastic, white) Ø 6 mm
- Fuel line (plastic, black) Ø 6 mm
- Bulkhead fitting, straight DS-K 6L
- Elbow bulkhead fitting DS-L 6L
- Bulkhead fitting, straight DS-K 8L
- Elbow bulkhead fitting DS-L 8L

⚠ Use only fuel lines which meet the current applicable regulations!

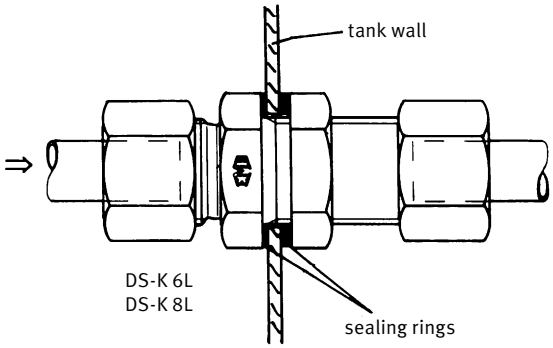


Figure 25 Straight bulkhead fitting

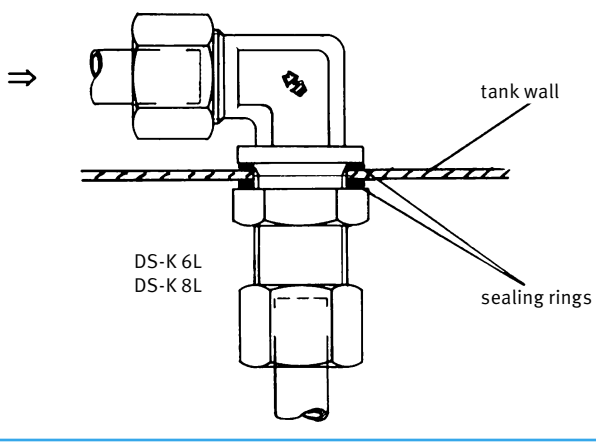


Figure 26 Elbow bulkhead fitting

4 Common Applications

In sections 4.2 to 4.9 of this chapter, the most common applications and installation scenarios for fuel system pumps and components are described, taken from the range of applications of our customers.

First, however, section 4.1 presents some general information which must be taken into account.
Depending on the application we strongly recommend running tests to ensure that the fuel system functions reliably.

The comments on the illustrations (application-specific notes) apply only to the application being shown.

4.1 General notes

In order to ensure operational reliability, the following must be considered when designing fuel systems, particularly with respect to the installation of the electric fuel pump:

- The pumps of type **E1F** and **E3L** are in-line pumps. They are **placed in the line**.

- The **E1S**, an in-tank pump, may only be installed **in the tank**.

- All modern pumps are driven electromotively. The engines “run wet”, which means that the fuel passes through the drive and serves as a coolant at the same time.
  There must always be a flow to maintain proper function and cooling.
  Generally this can only be achieved with a return line.
  The pumps are electrically wired such that they feed continuously when there is current available.
  With low or no throughput, the current consumption increases, but little cooling takes place.
  The consequences of this are vapor formation in the pump, problems with the fuel supply for the engine, and subsequent excessive wear on the pump.
  A return is needed to avoid this.

- In contrast to modern pumps, mechanical pumps or older electromagnetic models switch off when the target pressure is reached and turn on again when the pressure drops. Diaphragm or piston pumps work even at higher suction heads. Larger pressure heads on the other hand are a problem.

- For modern electric pumps the reverse is true; they pressurize well. **Suction heads** however **should be avoided**. They may cause the pump to run dry.

⚠ Dry running very quickly causes damage to the pump mechanism. To avoid this, the pumps must be mounted low (“wet”, under the fluid level), near the tank. This avoids intake bottlenecks.
If this is not possible, an E1S should be placed in the tank as a pre-feeder pump (see ➔ section 3.2.2.1).

- With periphery pumps like the E1S, there is a direct relationship between voltage, RPM, pressure and fluid delivery rate.

⚠ **A stable voltage supply is a prerequisite for trouble-free operation.**

- Positive displacement pumps are sensitive to contamination. Contamination causes wear and tear, in some cases even jamming of the pump mechanism and shutdown of the pump motor. The power consumption increases, cooling fails and the pump is destroyed. To avoid this, a filter sieve must be placed in the fuel line before the pump on the intake side. This filter should have a sufficiently large filtering surface (depends on the application) and a porosity of 60 to 100 μm (microns). Paper filters are not suitable.

⚠ When used with diesel engines, the sieve insert must be removed from the pump connection tube on the intake side.

Please turn the page. Continued on page 20.

- When retrofitting an electric fuel pump, it is necessary to install a safety shut-off (see ➔ section 3.2.5).

As long as the ignition is switched on, the pump delivers fuel.
In order that the carburetor does not flood if the engine shuts down or fuel spill if a line ruptures, we recommend the **installation of safety shut-off** 4.05288.50.0! (See ➔ *Service Information "SI 0016/A"*)
The safety shut-off ensures that the fuel pump will be cut off **when the engine is not running**.

- Use only fuel-proof materials for exposed parts (such as rubber seals).
- Take care during installation that no materials are put together that can cause contact corrosion. Thus, for example, the pump housing (made of aluminum) may not come in contact with galvanized surfaces.

Follow the safety guidelines in ➔ section 1.6.

4.2 Installation of an E1F to replace a mechanical fuel pump (gasoline engine)

Older vehicles with gasoline engines usually have a mechanical fuel pump driven directly by the engine.
Figure 27 shows a fuel system of the type built until about 1976 for a carburetor engine, consisting of the tank, mechanical fuel pump and carburetor.
If the mechanical fuel pump is replaced by an E1F, the system must be extended accordingly, as shown in Figure 28.

Figure 28 shows the fuel system with a retrofitted E1F electric fuel pump, expanded to include a filter sieve, fuel vapor separator, pressure relief valve and non-return valve.
This design, albeit with mechanical fuel pumps, was standard for most carburetor engines after about 1980.
Installation of an E1F in such a system is possible without additional retrofitting.

Application-specific notes:
The return can be run parallel to the supply line.
The discharge into the tank should be via a "bulkhead fitting" (see ➔ section 3.7).
If possible it should be mounted on a cover for the tank (for example the cover of the tank sensor).
The outlet for the fuel return line should be down below the normal level in the tank. If no fuel vapor separator is used, the return must be calibrated with a jet so as to ensure the fuel supply even at at full load.
The mechanical Pump can be bypassed or removed. If it is removed, the opening on the engine side must be sealed oil-tight.
If it is bypassed, the inlet and outlet should be connected with a piece of hose to prevent contamination from getting in.

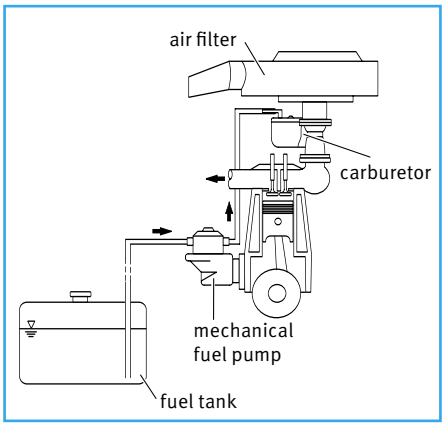


Figure 27 Fuel system of a carburetor engine (until about 1976)

If it is desired to keep the "original" look (for example with antique cars), the pump can remain in the system and have the flow pass through it, as long as it does not leak or hinder the flow of fuel.

However this can lead to heat build-up and the formation of vapor bubbles.

With older carburetors having an inadequately sized floater gauge, installation of a pressure relief valve is recommended. This is also the case for installation of an E1F with higher performance.

Keep in mind the general comments in ➔ section 4.1.

In 6 volt systems, the pump runs at half the RPM. The fuel throughput and pressure are then only about half that found for 12 volt operation.

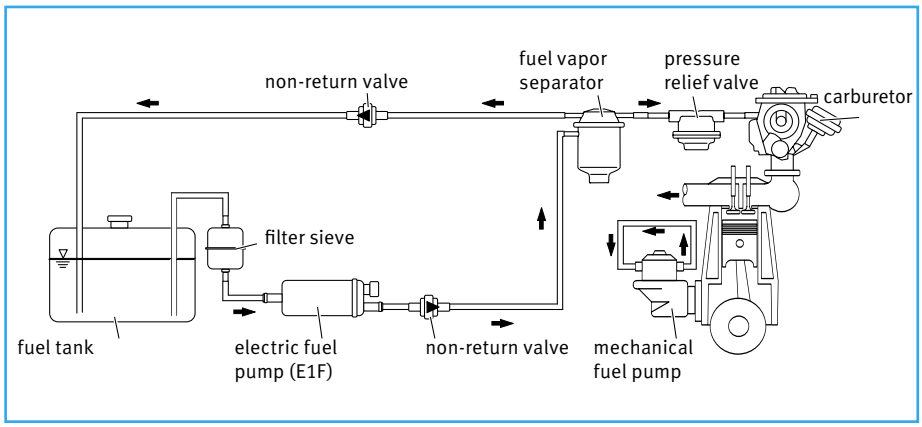


Figure 28 Fuel system with retrofit E1F electric fuel pump

Exercise caution when working on the fuel supply.
There is a danger of explosion!

Follow all applicable safety regulations. Do not allow contamination to get into the system.

We recommend the installation of the safety shut-off 4.05288.50.0!
See ➔ section 3.2.5

4.3 Gasoline engine with an E1F electric fuel pump

Vehicles with a carburetor engine in which, due to their particular design, the length of the lines or high temperatures, problems with the fuel supply may occur oten are equipped with an electric fuel pump as standard equipment.
In many cases, the original pump can be replaced with an E1F without difficulty.
In these cases, installation of a fuel vapor separator, pressure relief valve and non-return valve are also recommended if these are not already part of the system.

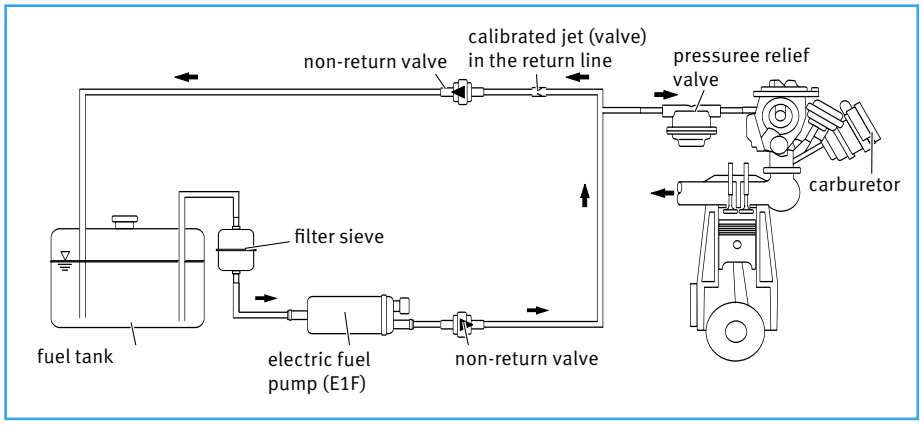


Figure 29 Fuel system with an electric fuel pump (gasoline engine)

Figure 29 shows a fuel system for a carburetor engine with an electric fuel pump (E1F), pressure relief valve and two non-return valves.
The return is “calibrated” or restricted with a jet (1.0 to 2.0 mm depending on the requirements of the engine at full load). For pressure relief valves with calibration, the return is connected to the pressure relief valve.

We recommend the installation of the safety shut-off 4.05288.50.0!
See ➔ section 3.2.5.

Keep in mind the general comments in ➔ section 4.1.

4.4 Gasoline engine with two E1F electric fuel pumps

Figure 30 shows a carburetor engine operated with two electric fuel pumps. The pumps are connected in parallel. This arrangement is appropriate for very high fuel demand or for safety reasons in special vehicles. In the latter case, the pumps are controlled separately.

The return is “calibrated” or restricted with a nozzle (1.0 to 2.0 mm, depending on the requirements of the engine at full load).
For pressure relief valves with calibration, the return is connected to the pressure relief valve.

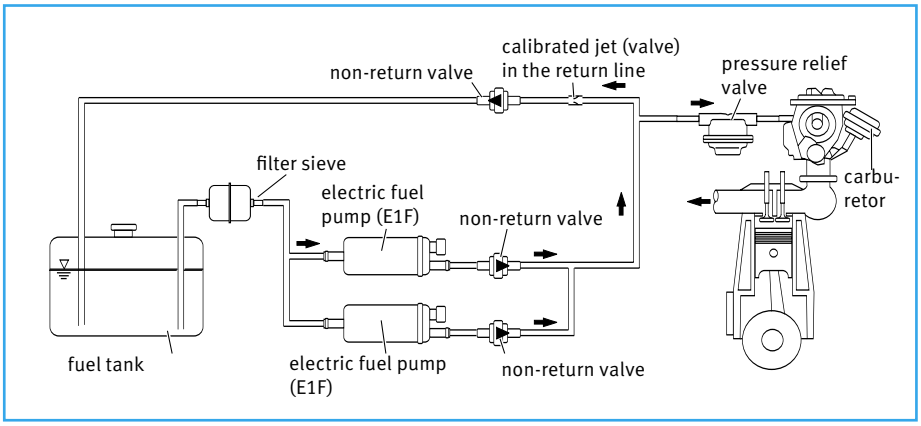


Figure 30 Carburetor engine with two E1F electric fuel pumps (gasoline engine)

Keep in mind the general comments in ➔ section 4.1.
If the fuel line from the tank has an internal diameter less than 10 mm, it is a good idea to support the delivery by installing a pre-feeder pump (such as type E1S).

We recommend the installation of the safety shut-off 4.05288.50.0!
See ➔ section 3.2.5

4.5 Backup pump for gasoline and diesel engines

For applications with particularly difficult conditions of use or involving safety considerations (such as redundancy in all-terrain vehicles or other special vehicles), it is recommended to install a second fuel pump which can be switched in to serve as an “emergency pump” if needed.
This strategy may also apply to construction equipment, power systems and boats.
In such cases it does not matter whether the main pump is a mechanical or an electric fuel pump. Depending on the system pressure an E1F or an E3L is used.

Figure 31 shows a fuel system with an E1F as an switchable backup pump.

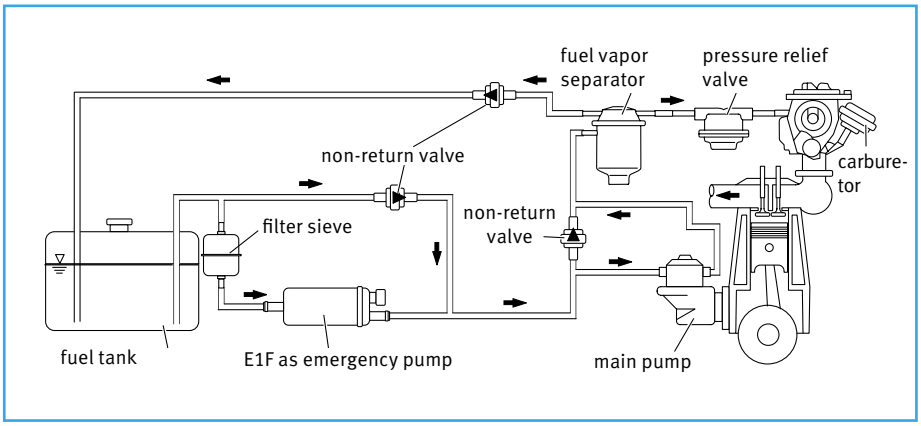


Figure 31 Fuel system with an E1F as a switchable backup pump (emergency pump)

Application-specific note:
The backup pump muss be connected so that both pumps can draw and deliver freely.

We recommend the installation of the safety shut-off 4.05288.50.0! See ➔ section 3.2.5
Suction or flow delivery of one **pump through another electric pump is not possible**.

Please refer to the technical data when selecting the pump (see ➔ section 3.2).
Keep in mind the general comments in ➔ section 4.1.

4.6 E1F/E1S as a pre-feeder pump (diesel engine)

Figure 32 shows the standard equipment fuel system for a diesel engine with an in-line injection pump and attached mechanical fuel pump (MFP) as a pre-feeder pump.

For information regarding pre-feeder pumps, see also ➔ section 3.2.2.1

Figure 33 shows the same system as Figure 32 with an electric pre-feeder pump. Instead of the mechanical pre-feeder pump an E1F is used here. In addition, a filter has been put in the intake line in front of the E1F. In place of the E1F an E1S can be used in the tank.

Application-specific note:
The filter must have a porosity of 60 to 100 μm (microns) and an area sufficient to handle the expected amount of particulate (such as Pierburg filter sieves, see ➔ section 3.7.1)

For diesel operation, the sieve insert in the pump intake (intake connection) be removed before starting operation.

Figure 34 shows a possible electric connection method load for a pump of type E1F in a diesel engine.

Please turn the page. Continued on page 24.

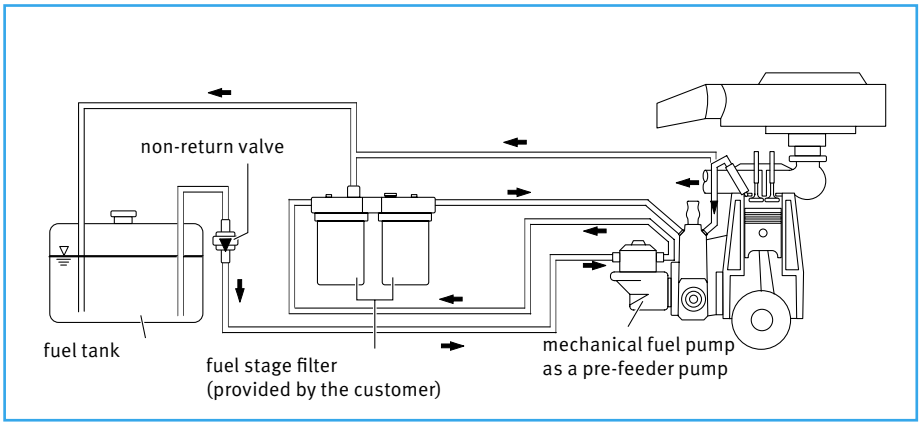


Figure 32 Diesel engine with in-line injection pump and attached pre-feeder pump (MFP)

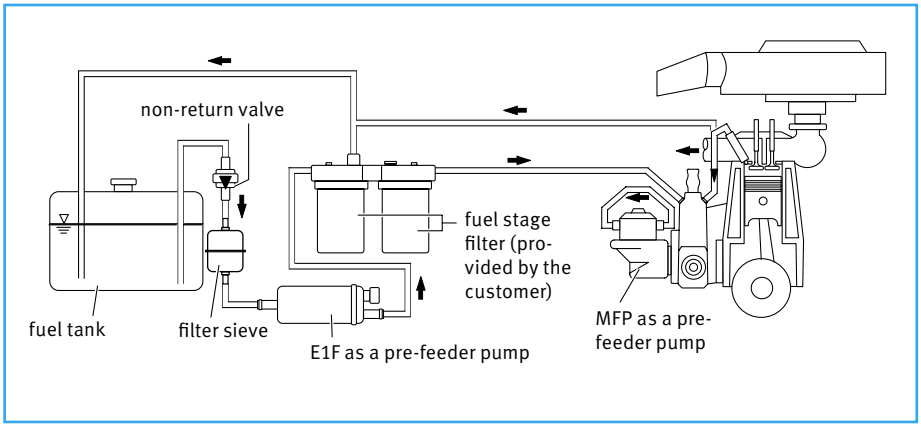


Figure 33 Diesel engine with in-line injection pump and attached pre-feeder pump (E1F)

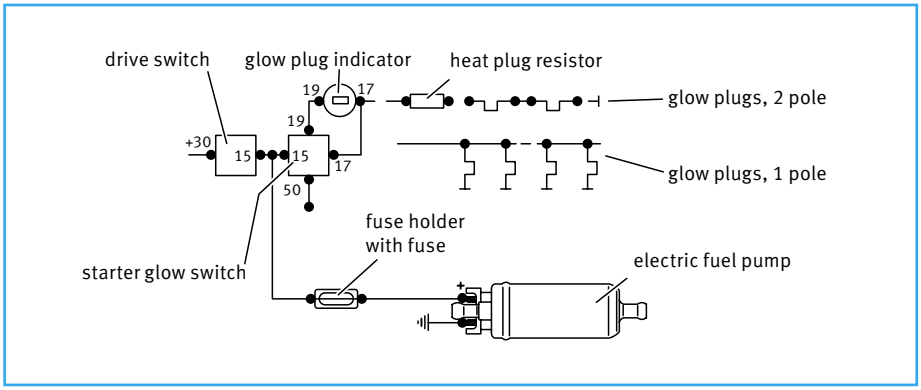


Figure 34 Electrical connection for an E1F (diesel engine)

Figure 35 shows an installation example for a pre-feeder pump.

After work on fuel tanks, test to be sure that they are free from leaks.
Use only fuel-proof materials for exposed parts (such as rubber seals). Take care during installation that no material combinations are used that can cause contact corrosion (such as aluminum with galvanized surfaces).

Keep in mind the general comments in ➔ section 4.1.

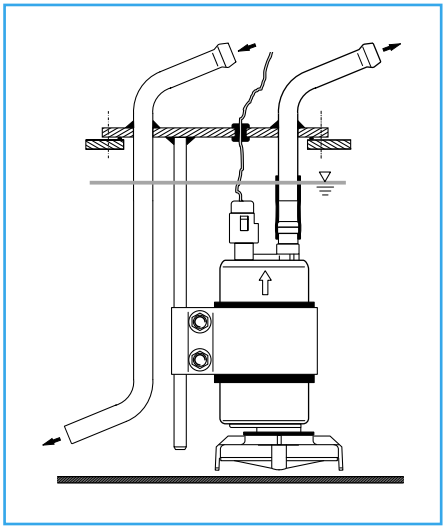


Figure 35 Installation example for an in-tank pre-feeder pump.

4.7 Transfer system/auxiliary tanks

Long-distance commercial vehicles are frequently equipped with auxiliary tanks. During travel, fuel is transferred as required from the auxiliary tanks to refill the operating tank.

Figure 36 shows a fuel system with auxiliary tank, in which two electric fuel pumps are used for transferring large volumes into the operating tank.

Keep in mind the general comments in ➔ section 4.1.

For larger delivery volumes or higher pressures, an E3L can be used instead of an E1F (only with 12 volt operation).

Ensure that the pumps do not run dry.
Dry running will quickly lead to destruction of the pumps.

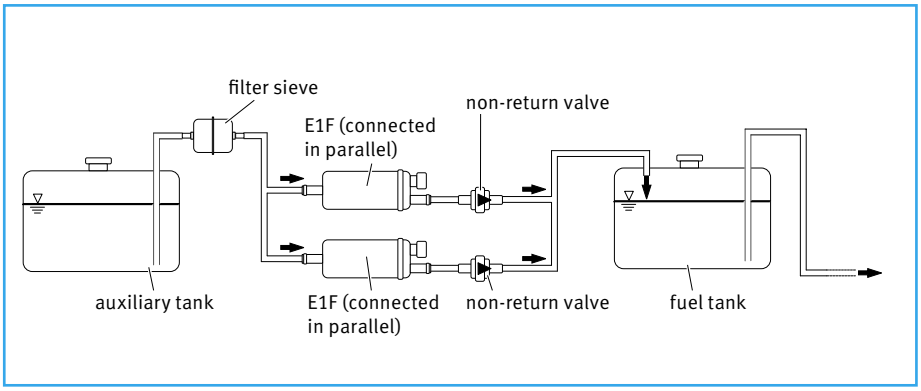


Figure 36 Fuel system with auxiliary tank

4.8 Boat operation

For use in boots, installation of an E1F can be done as shown in Figures 28 and 33. At higher fuel pressure and/or higher output an E3Lis to be used.

⚠ Water in the fuel system leads to damage and subsequent destruction of the pump.
The housing of the fuel pumps is not salt water proof!
We recommend the installation of the safety shut-off 4.05288.50.0!
See ➔ section 3.2.5

☞ Please refer to the technical data when selecting the pump (see ➔ section 3.2).

For use in boat engines, a water separator is recommended in addition to a filter sieve. Before storage for the winter the entire system should be purged of water.

Keep in mind the general comments in ➔ section 4.1.

4.9 Fuel supply in heating systems

Figure 37 shows a heating oil tank in which the heating oil is fed to an intermediate tank or the combustion unit using an EFP.

⚠ It must be ensured that the pump does not run dry. Dry running will quickly lead to destruction of the pump.

☞ Keep in mind the general comments in ➔ section 4.1.

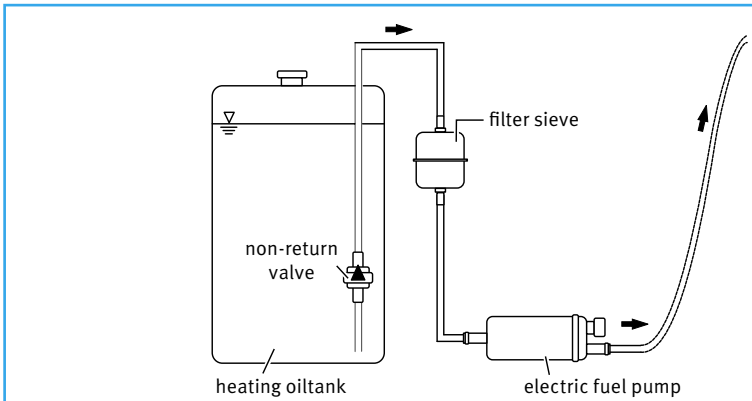


Figure 37 Heating oil deliver with an electric fuel pump

5 Information on Other Documents

The following additional information is available on the subject of "fuel supply". The documents are updated and expanded on an on-going basis.

- **Catalogs**
- Fuel supply article no. 8.40002.47.0
- Tools & Testing Instruments article no. 50 003 931-02
- MSI Training Program article no. 50 003 646

- **Brochures**
- Service, Tips & Info *"Fuel Supply for Injection Engines"* article no. 8.40002.37.0

- **Products information PI**
- PI 0005 "Fuel pressure tester"
- PI 0007 "Add-ons for the fuel pressure tester"
- PI 0013 "Electric fuel pump E1F"
- PI 0014 "Fuel pump tester"
- PI 0015 "Electric in-tank fuel pump E1S"
- PI 0016 "Diesel-resistant electric universal pump E3L" (for system pressures up to 4 bar)

- **Service Information SI**
- SI 0016A "Safety shut-off for electric fuel pumps"
- SI 0044 "Fuel non-return valves"
- SI 0062 "Installation of an electric fuel pump E1F to replace a mechanical fuel pump".
- SI 0063 "Installation of an electric fuel pump E1F as a backup pump"

- **Installation instructions for electric fuel pumps** (included with the products)

- **Installation instructions for safety shut-off** (included with the product)

- **Publication 002/2002 "E1F - a pump for many applications"**

- **Publication 003/2002 "A pump solution for antique cars"**

Product information (PI) and service information (SI) are found on the Pierburg CD (article no. 8.40002.62.0) or as a collection in "Folder I" (article no. 8.40002.03.0). They can also be downloaded free of charge from our Web site www.msi-motor-service.com

There you will also find additional information on the subject.
Pierburg sales and service information can also be obtained from your local Pierburg distributor or ordered on our Web site.

6 Tools and Testing Equipment

No special tools are needed for installing or removing the pumps described. Pierburg offers tool and instruments that are needed for working on fuel systems.

For testing and troubleshooting a fuel system, we recommend the **fuel pressure tester 4.07360.51.0**, (see ➔ Figure 38) which includes various connectors and a 3-way adapter suited for the most popular injection systems.

The two calibrated manometers are equipped with a dual scale for measurement over a range of 0 to 2 bar or 0 to 10 bar. There are special testing instructions for the various injection systems.

☞ For more information see ➔ *Product Information PI 0005, PI 0007 and Service, Tips and Information "Fuel supply for injection engines".*

Another tool is our **fuel pump tester 4.07360.60.0** (see ➔ Figure 39). This unit provides a simple way of testing the functionality and seals of electric fuel pumps independently of the vehicle. The feed units, pre-feeder, in-tank and in-line pumps can all be tested.

☞ For more information see ➔ *Product Information PI 0014*

Additional tools and testing equipment will be found in our ➔ catalog *"Tools and Test Instruments"* as well as in the online shop on our Web site: www.msi-motor-service.com

Figure 38 Fuel pressure tester 4.07360.51.0

Figure 39 Fuel pump tester 4.07360.60.0

7 Frequently Asked Questions

In the following section we have listed some of the questions we often encounter in the field.
In addition to brief answers to these questions, you will find references to additional information available from us that give more details on the corresponding subject.

The following abbreviations are used:
SI Service Information
PI Products Information
See also ➔ Chapter 5 “Information on Other Documents”.

Questions	Answers	Additional Information
Which pump should I use as a replacement pump	The pressure and flow rate of the replacement pump should correspond to that of the original pump as closely as possible.	➔ PI 0013, 0015, 0016 ➔ SI 0062, 0068 ➔ Catalog: *“Fuel Supply”*
How high is the flow rate of the pump? How high is the pump pressure? How high is the current consumption of the pump?	See ➔ technical data in sections 3.2.1–3.2.3	➔ PI 0013, 0015, 0016 ➔ SI 0062, 0063, 0064
What do I do with the existing mechanical pump when retrofitting with an E1F electric fuel pump?	By-pass it, hook the inlet and outlet to each other or remove it and seall the connection flange on the engine to prevent oil leakage.	➔ SI 0062, 0063 ➔ Section 4.1 ”General notes“
How high a suction head can the pumps attain?	Type E1F max. 500 mm (with filled lines). Type E3L max. 500 mm (with filled lines). Type E1S 0 mm (**pressure only!**)	➔ SI 0062, 0063, 0064
Does the E1F electricc fuel pump switch off if the float chamber of the carburetor is full?	No, the pumps feed as long as they receive current. However the pumps have an overflow valve that opens when the target pressure is reached. This applies for pumps only up to ‹ 0.6 bar. **Pumps with higher pressure may only be operated in a system with a return line.**	➔ SI 0062, 0063 ➔ Section 4.1 “General notes”
Does the pump also operate at 6 volts in antique cars?	Yes, but at lower RPM. Thiss also results in lower pressure and flow rate.. For 6 volt operation (such as with vintage cars) we recommend the E1F no. 7.21440.53.0.	➔ SI 0062, 0063
Can the pump also be used on older English vehicles where the voltage is supplied via the body?	Yes. However the electrical connection must be set up accordingly (positive connection of the pump to the body). **The applicable legal provisions and relevant safety regulations must also be followed.**	**The safety shut-off cannot be used in this case.**
Is a safeety shut-off necessary?	Depending on the regulations of the country in question it may be mandatory.	➔ SI 0016/A ➔ Section 3.2.5
Is a return line necessary?	A return is not mandatory, but for maintaining trouble-free function, especially when running hot, a return line is essential.	➔ SI 0062, 0063 ➔ Chapter 4. “Common Applications”
Can the pump run “dry” (without fuel) for a short time?	**Fundamentally: NO!** All pumps run “wet”, i.e. fuel passes through them. The pumped medium also provides lubrication and cooling. Dry running will quckly lead to destruction of the pump.	➔ Section 4.1 “General notes”

Questions	Answers	Additional Information
Is a fuel filter necessary?	Yes. A prefilter (filter sieve) should be placed in the fuel line before the pump on the intake side. Porosity of 60 to 100 μm (microns) and particularly for diesel operation a large filter area (such as Pierburg filter sieves, see ➔ section 3.7.1).	➔ SI 0062, 0063 ➔ Section 4.1 “General notes”
Does a 24 volt pump have a longer service life than a 12 volt pump?	No.	
The intake port of the pump has a filter - what about it?	This little filter is a protective filter. It can be left on for gasoline operation. However it must be removed for diesel operation, because the higher viscosity of diesel engine at low temperature can lead to problems.	➔ Section 4.1 “General notes”
Is it possible to pump through an existing pump?	If it is desired to keep the “original” look (for example with antique cars), a **mecanical pump** can remain in the system and have the flow pass through it, as long as it does not leak or hinder the flow of fuel. **Electric fuel pumps**, which are designed as positive displacement pumps, **cannot be in the pumping path.**	➔ Publication 003/2002 “A pump solution for antique cars” ➔ SI 0062, 0063 ➔ Section 4.1 “General notes”

If you have additional questions, please contact us at:

Phone +49 21 33 - 2 67 - 1 67
Fax +49 21 33 - 2 67 - 1 11
E-Mail technical.servicePG@msi-motor-service.com

8 Troubleshooting Tips

Below you will find a table with tips for troubleshooting. This table only applies to malfunctions whose causes are found in the fuel system.

8.1 General notes

Only cases considered here are those which could arise in the special applications previously described. The emphasis is on pumps of the E1F series, simply because of their prevalence.

☞ Malfunctions in injection engines with "standard" equipment are handled in our ➔ brochure *"Service Tips & Information, Fuel Supply for Injection Engines"*.

8.2 Malfunctions, possible causes, remedies

Because this brochure in intended for qualified personnel, malfunctions and causes which should be familiar to persons of this background are not discussed.

8.2.1 General malfunctions

Sympton	Malfunction	Possible Cause	Remedy/Comments
Engine cannot start cold/warm	No flow from the pump	Voltage supply to the EFP is faulty.	Visual inspection. Test the voltage supply.
		Bad fuse.	Check and replace if necessary.
		Disruption in the line.	Check and correct any problems found.
		Defective pump relay.	Check and replace if necessary
		Electrical malfunction in the pump.	Check by measuring resistance or direct current.
		Ground (earth) fault	Replace the pump if there is a ground fault.
The engine starts briefly, then dies.	No flow from the pump.	Safety shut-off not working properly.	Check the safety shut-off for proper function. Check connections, cables and ignition signal.
		Fuel filter/filter sieve clogged.	Check fuel pressure and flow rate, replace filter.
Best performance not achieved, shaking under full load.	Fuel pressure/flow rate too low.	fuel filter/filter sieve clogged.	Check fuel pressure and flow rate, replace filter.
		Fuel line pinched/bent.	Inspect visually, replace as needed.
		Faulty tank ventilation.	Check tank ventilation and clean or recondition as needed.

8.2.2 Malfunctions after the installation of new pumps

Symptom	Malfunction	Possible Cause	Remedy/Comments
No flow from the new pump.	Voltage supply faulty.	Fuse burned out.	Replace the fuse.
New pump makes noise.	Higher resistance on the pressure side.	Filter clogged.	Replace the filter.
	Improper installation.	Resonance	Check the mounting.
New pump stops after running briefly.	Pump mechanism jammed.	Contamination in the fuel system.	If the pump in the vehicle has failed due to contamination, it is absolutely necessary that the entire fuel system be cleaned before installing a new pump. More than 95% of all complaints are caused by contamination.
	Commutator deposit	Unsuitable medium to be pumped (see ➔ section 8.2.5).	Replace the pump.

8.2.3 Malfunctions particular to diesel operation

Symptom	Malfunction	Possible Cause	Remedy/Comments
The engine misfires.	The flow rate is too low (often after just a short time running). This can occur particularly with biodiese (see ➔ section 8.2.5).	The filter in the intake port is clogged or was not removed.	Remove the filter.
		The filter sieve is clogged.	Clean or replaced the filter sieve.
		Incorrect filter sieve (paper filter)	Install a filter sieve with larger filtering surface (100µm porosity).
		Contamination in the tank or fuel system.	Clean the fuel system.
		Contamination in the tank system, especially with above-ground systems (for example yard tanks).	Clean the tank system. If using biodiesel, disinfect (if necessary).
Engine won't start.	Fuel pump delivers no fuel or stops after running a short time.	The intake side is completely clogged. The pump mechanism is jammed due to contamination. The pump housing or electric components are corroded. Commutator deposit, carbon deposits and material damage as a result of improper medium pumped.	Eliminate the cause. Replace the pump. Only pump the fluids permitted. Occurs particularly with biodiesel (see ➔ section 8.2.5).
The engine won't start after not running a short time.	No flow from the fuel pump.	The pump mechanism is stuck due to unsuitable fluid medium.	Replace the pump. Only use permitted fluids.
Fuel leaks.	The pump housing is corroded through.	Improper material for mounting caused contact corrosion.	Replace the pump and use appropriate mountings.
	Seals are damaged.	Unsuitable pumping medium (see ➔ section 8.2.5).	Replace the pump.
Engine or heater (small consumer) misfires or won't stop.	Amount of fuel/combustion material too low.	The flow rate is too high or the branch to the consumption point is not good. This can lead to a *vacuum stream effect* in the branch connection, which interferes with the supply flow.	Reduce the flow rate and consequently the flow to the consumption point at the branch connection (for example with a valve in the supply line or bypass between the supply and return line).

8.2.4 Malfunctions when replacing a mechanical fuel pump with an E1F (particularly with antique cars)

Symptom	Malfunction	Possible Cause	Remedy/Comments
After installation of an E1F the engine dies when idling and restarts with difficulty or smokes (due to too much lubrication). Higher fuel consumption.	The carburetor is flooding.	The pump pressure is too high (float needle valve is “overpressured”) or the float is too small.	Use a pump with lower pressure. Install a return line. Install a pressure relief valve or fuel vapor separator with a pressure relief valve. Repair the carburetor.
The engines dies after starting hot and is difficult to restart.	Fuel is sprayed from the carburetor in the filter, and the engine floods.	Foaming of the fuel in the float chamber as a result of too fast supply flow.	Install a fuel vapor separator and if necessary also a pressure relief valve.
The engine misfires, even though two fuel pumps are used.	The flow rate is insufficient.	Incorrect configuration of the pumps (pumps are connected in series).	Configure the pumps in parallel. Install a non-return valve to prevent supply circulation problems (see ➔ section 3.6)
		The cross section of the fuel line on the intake side is too small.	see ➔ section 4.4
Engine misfires, stops.	Pump fails prematurely.	Wear and tear in the pump due to contamination in the pump mechanism or incorrect placement.	Replace the pump and correct the problem (contamination/ location). For installation information see also: ➔ SI 0062 und 0063 ➔ Installation examples in Chapter 4
Engine misfires.	Flow rate too low.	Improper installation location, for example in the engine compartment (the pump draws). The lines are too long. The open cross section is too low. The pump is mounted too high (the pump draws).	Install the pump low, below the fuel level (“wet”) See also: ➔ SI 0062 und 0063 ➔ Installation examples in Chapter 4
		The pump feeds through the mechanical fuel pump (in cases where the mechanical pump is kept on the engine as “original equipment”)	Reduce pressure losses: clean the inside of the mechanical fuel pump, perhaps remove valves and filters from the mechanical fuel pump.
The pump makes noise when idling and gets hot. The engine misfires.	The pump delivers fuel, but too little is consumed (low throughput, idle consumption), or there is a restriction on the pressure side (flow is hindered).	At low throughput the delivery pressure and current consumption increase. Because the pumps are cooled by fuel flowing through them, this causes the pump to get hot. Vapor bubbles form and lead to wear and tear on the pump. The supply flow becomes irregular.	Install a return line, if necessary a fuel vapor separator. Correct the restriction in the line.

8.2.5 Notes on operation with biodiesel

Operation with biodiesel can lead more frequently and quickly to damage and malfunctions than is the case with fossil fuels.

- **Typical damages are:**
- Seals swell or disintegrate
- Fuel hoses swell or disintegrate
- Diaphragms and valve inserts disintegrate
- Deposits clog the filter and jam the pump mechanism
- The pump mechanism is stuck after not running for a while
- Deposits on the commutator have an insulating effect
- Carbon brushes burn off after a short time in service
- The pump housing is corroded
- Contact corrosion destroys metal parts

- **The reasons for this are:**
- The biofuel used does not meet standards.
- Biofuels are subject to aging.
- Under unfavorable conditions, uncontrolled changes can occur very quickly and cause damage.

- **Remedy:**

Only use fuels which meet the applicable stadards (such as DIN EN 14214) at the time of their use.

Biofuels may only be used in systems if all components/ devices of these systems have been approved for biofuels.

9 MSI Training Program

Our training courses provide independent workshops and engine rebuilders with first-hand information, helping to ensure their competitiveness for the future.

9.1 The MSI training concept

The number of new components and modules developed for use with engines is constantly increasing. Systems are extended in design and function, electronically controlled, networked and monitored. Without the corresponding expertise, purposeful work on modern engines is hardly possible. The risk of error is too great. The MSI training concept was developed for engine rebuilders and automotive repair shops. Through various fundamental courses it offers employees of these companies to get practical information about the current state of the technology.

9.2 Scheduled courses for MSI training

- **The MSI training brochure for engine rebuilders and automotive workshops**

Article No.	Language
50 003 648	German
50 003 646	English

Figure 40 MSI training brochure

9.2.1 For engine rebuilders

Training courses (includes a hands-on segment)

Engine reconditioning: trucks
- Short block and cylinder head machining

Engine reconditioning: passenger cars
- Short block and cylinder head machining

Special course 1: engine reconditioning for trucks (Mercedes)
- Actros, engine series OM 500
  Short block and cylinder head machining

Special course 2: engine reconditioning for trucks (Mercedes)
- Atego, engine series OM 900
  Short block and cylinder head machining

Training course for precision tooling machines
- Machinist training for short block and cylinder head repair

Special courses
- Crankshaft welding and grinding
- Other topics, content and emphases can be arranged individually.

Seminars (without a hands-on part)

Machining
- Boring, honing and brush honing of grey cast engine blocks
- Reconditioning aluminium engine blocks - General
- Reconditioning aluminium engine blocks - Alusil machining

Product training
- Product training covering the design and function of each fuel system product group such as pistons, piston rings, engine bearings, cylinder liners, valves, valve guides, valve seat inserts and filters.

Installation training
- Basic seminar covering the installation of each fuel system product group such as pistons, piston rings, engine bearings, cylinder liners, valves, valve guides and valve seat inserts.

From the field for the field
- Training covering practical examples of engine damage and causes of damage with respect to pistons, cylinder liners, engine bearings, piston rings and valves

Other seminars
- Engine running-in
- New engine designs (gasoline/diesel)
- Oil consumption (in preparation)
- Other topics, content and emphases can be arranged individually.

9.2.2 For automotive workshops

• **Training courses** (includes a hand-on segment)
On board diagnosis (OBD, EOBD) - integrated engine monitoring and diagnosis
- Design, function, specifications and technology
- Reading faults and interpreting codes
- Previous experience
- Malfunction diagnosis in the engine and its environment
Exhaust emission testing courses* (updated for the latest legislation for vehicles up to 7.5 t allowed total weight).
- introductory course
- update course
Special courses
- The topics, content and emphases can be arranged individually.

*) Only for staff of Pierburg service centers

• **Seminars** (without a hand-on part)
Module 1: OBD, EOBD - integrated engine monitoring and diagnosis
- Scope and function, specifications and technology, fault codes and test modes
- OBD monitored Pierburg products
Module 2: Fuel supply and service
- Design and function of modern fuel systems, fuel pumps,pressure regulators and valves
- Possible problems, causes and remedies
- Testing of a system on injection engines using a fuel pressure tester
Module 3: Vacuum supply
- Vacuum pumps are safety components
- Design, application, feature and service
- Testing vacuum pumps with the vacuum pump tester
- Identifying and correcting possible malfunctions and their causes
Module 4: Emission reduction
- Exhaust gas recirculation and secondary air system design.
- Components in the system: EGR valves, SL pumps, function and control.
- Possible malfunctions, checking components and functions.
- To what extent is OBD helpful? Interpreting fault codes correctly.

All MSI training courses (for automotive workshops and for engine rebuilders) are offered at our customer service school in Neuss, in Neckarsulm or also at the customer's site.
By request technical seminars for owners, buyers, inside and outside sales personnel can be given.

Additional information regarding our training can be found in our training catalog, or questions can be directed to our e-mail address:
training@msi-motorservice.com

10 Contact Information

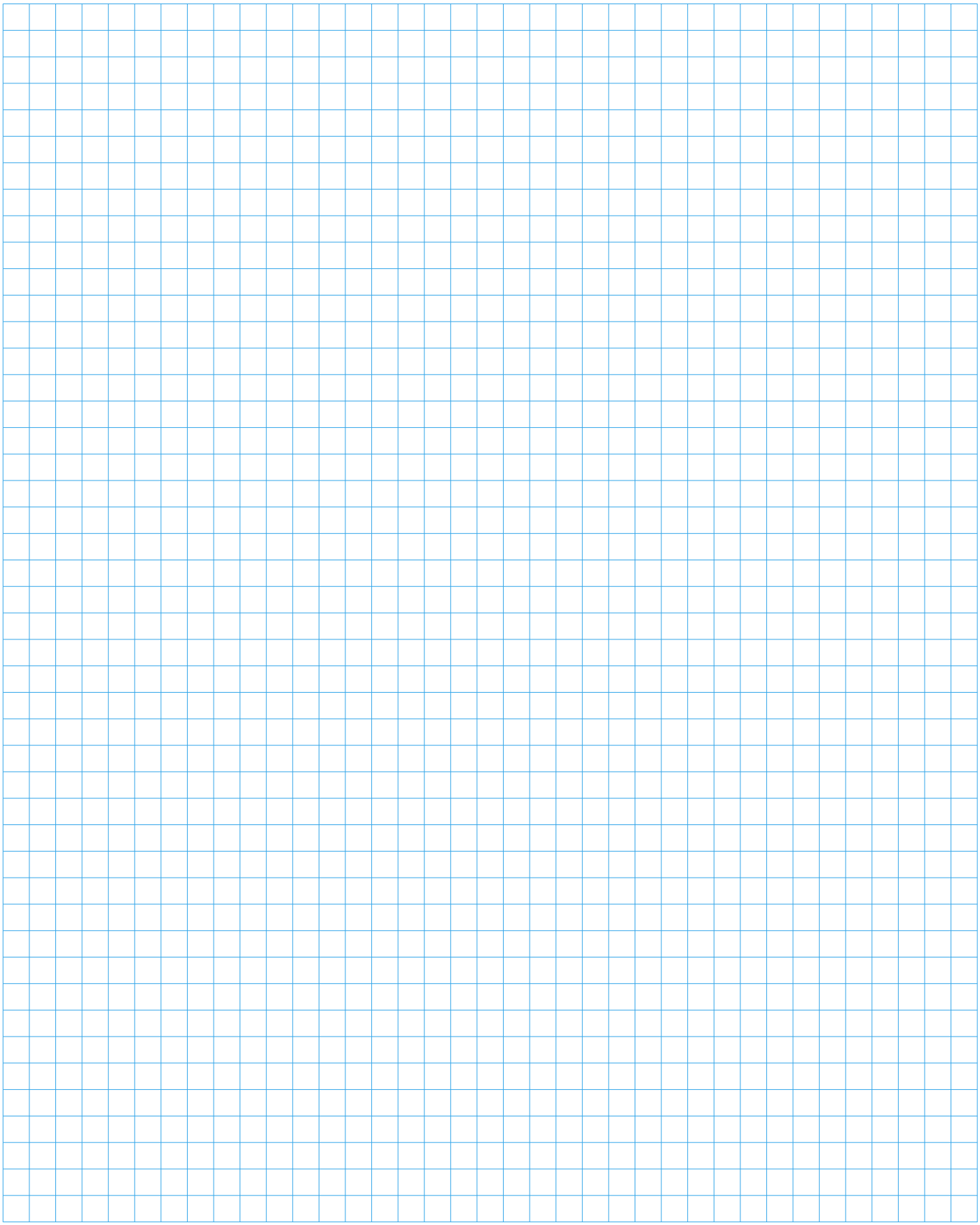
Please note:
Local contact information for Pierburg products can be found on our Web site www.msi-motor-service.com under “Contact › Contacts world-wide” or by calling us.

Product information (PI) and service information (SI) are found on the Pierburg CD (article no. 8.40002.62.0) or as a collection in “Folder I”. They can also be downloaded free of charge from our Web site www.msi-motor-service.com

For changes related to classification and replacement of the specified article numbers, see → the current catalog, TecDoc CD or system using TecDoc data.

For questions regarding **antique car applications**, please contact:

Bosch Car Service Küppers
Rurstrasse 44
52441 Linnich, Germany
Telephone +49 (0)2462 1404
Fax +49 (0)2462 5342
E-mail kueppersboschcarservice@t-online.de



MOTOR SERVICE INTERNATIONAL

KOLBENSCHMIDT PIERBURG

MSI Motor Service International GmbH

Hamburger Strasse 15
D-41540 Dormagen
Phone +49 21 33 - 2 67 - 1 00
Fax +49 21 33 - 2 67 - 1 11

Untere Neckarstrasse
D-74172 Neckarsulm
Phone +49 71 32 - 33 33 33
Fax +49 71 32 - 33 28 64

info@msi-motor-service.com
www.msi-motor-service.com

Technical Market Service

Phone +49 21 33 - 2 67 - 1 67
Fax +49 21 33 - 2 67 - 1 11

technical.servicePG@msi-motor-service.com

8.40002.57.0 04/03

4 028977 411366