PIERBURG

Service
Tips and Information

Fuel supply for engines with Fuel Injection Systems

Introduction

An internal combustion engine requires fuel in order to run, and motor vehicles are thus equipped with a fuel system that keeps the engine supplied with the correct amount of fuel for all operating circumstances.

Outside factors and wear can lead to faults, and this is when a reliable servicing programme becomes necessary.

This brochure is intended to provide problem-solving tips and information for everyday use when servicing fuel injection systems.

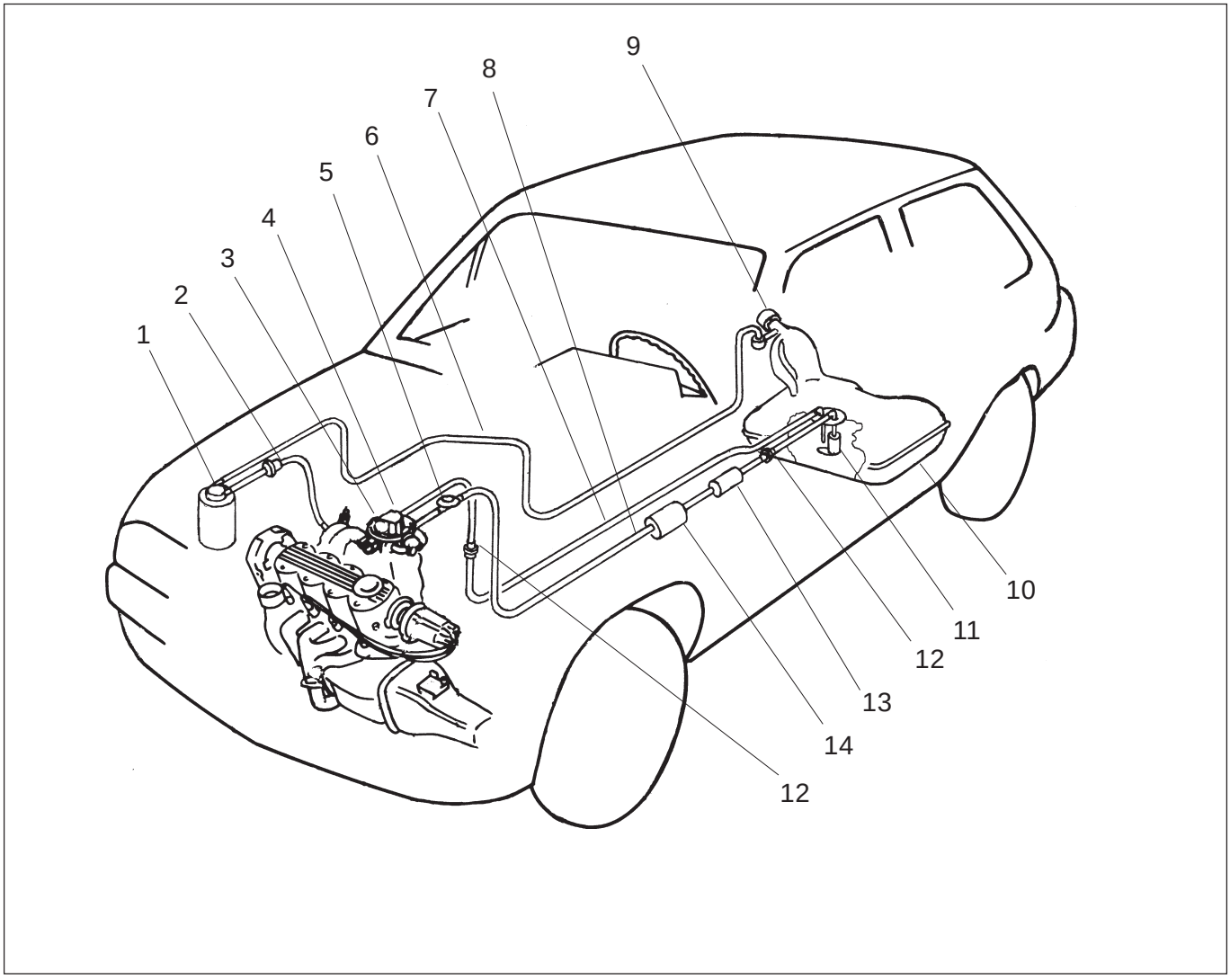

Fig. 1 Fuel system on a vehicle with single-point injection.

1. AKF container
2. AKF recirculation valve
3. Fuel pressure regulator
4. Injection valve
5. Vibrations dampers
6. Ventilation and air release
7. Fuel runback
8. Fuel flow
9. Filler trim with expansion chamber and, air release valve and gravity valve
10. Fuel tank
11. Initial feed fuel pump
12. Non-return valve
13. Fuel pump
14. Fuel filter

Contents

Service Tips and Information
Fuel supply for engines with Fuel Injection Systems

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Subject to change of illustrations and text

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Troubleshooting Tips

1. Engine

Fault	Cause	Possible origins of cause	Remedy / Observations
1.1 Engine will not start when cold/hot	No fuel from pump	Fault in electric fuel pump power supply	Error messages selected from error list Carry out actuator diagnosis (if applicable in this case) Visual examination/ calibrate
		• Fault in fuse	Examine/replace if required
		• Broken cable	Examine/repair if required
		• Defective pump relay	Examine/replace if required
		• Fault in idler contact (on older vehicles only)	Examine/repair if required
		• Control signal TD, Kl. 1, position sensor,no output signal from control system	Examine/repair if required
		• Safety cut-off activated or defective	Re-connect or replace
	No fuel from pump	Pump electrical fault	Test by measuring resistance or directly by measuring flow
		• Blockage	Replace blocked pumps
		• Earth shorting	Replace pump if shorted to earth
		• Commutator lining(carbon collector brushes)	Test pump by operating directly from battery. (Caution: connect via 20A fuse). Replace pump if it does not run.
		Pump mechanism clogged by dirt or corrosion	Renew pump and fuel filter. Clean fuel system before installing a new pump. Filter replacement normally according to following vehicle manufacturer's recommendations (service life 30-60,000 km / 20-40,000 miles). Respect flow direction indicator arrow.

This table applies only to faults caused by an anomaly in the fuel system.

Troubleshooting Tips

1. Engine (continuation)

Fault	Cause	Possible origins of cause	Remedy / Observations
1.2 Defective start-up when warm (Excessive delay)	Drop in pressure and consequent vapour locks in system	Tube leakage	Check tubes for seepage. Repair any leaks.
		Injection valve leaking	Check retaining pressure, renew valve if required
		Cold start valve leaking (if fitted)	Check retaining pressure, renew valve if required
		Pressure regulator does not shut completely	Check retaining pressure. If drop in pressure detected, test pressure regulator by blocking off runback. Replace if necessary.
		Pressure retaining valve leaking	Check valve in pump. Replace pump if necessary
		Initial feed pump not working	Check power supply/fuses. Repair any faults. Replace pump if necessary
1.3 Difficulties driving off when engine warm (engine cuts out)	Feed rate too low with engine warm	Fuel filter clogged	Visual check/renewal of filter
		Kink in feed tube (diameter reduced)	Visual check/repair fault
		Initial feed pump failure	Check power supply. Repair any faults.
		Dirt in fuel tank (clogged grille in tank or initial feed pump)	Clean out fuel tank. Replace grille and filter
1.4 Full output not reached, juddering when close to full power	Insufficient fuel pressure/ capacity	Fuel filter clogged	Check system and capacity, replace filter
		Incorrect fuel filter	Check, replace if required
		Fuel pipe crushed / kink in tube	Visual check/renewal if required
		Initial feed pump failure	Visual check/renewal if required
		Clogged grille in tank or initial feed pump	Check and clean
		Defective pressure regulator	Check, replace if required
		Tank ventilation and air release defective	Check. Clean or repair as required
		AKF filter or tube full of fuel. Tank is not vented.	Check fuel pipes, refer to vehicle manufacturer's data. Check function of AKF recirculation valve, replace if required

This table applies only to faults caused by an anomaly in the fuel system.

Troubleshooting Tips

2. Fuel consumption/filling capacity

Fault	Cause	Possible origins of cause	Remedy / Observations
2.1 Excessive fuel consumption	Fuel pressure too high	Defective pressure regulator	Check/Renew if required
		Negative pressure regulator not connected	Check. Reconnect according to diagram
		Runback pipe defective	Visual check/Repair if required
	Air-fuel control at limit / clogged (error code)	Incorrect entry of air due to defective AKF recirculating valve	Check AKF valve for functioning and leaks, replace if required
2.2 Range too low, fuel tank only partly filled	Fuel tank only partly emptied	Sucking jet pumps out of order or defective, due to insufficient pressure and runback quantity	Check pumping capacity of pump(s) and replace if required

3. Noise

Fault	Cause	Possible origins of cause	Remedy / Observations
3.1 Whistling noise	Mechanical running noise	Pump mechanism worn	Replace pump
3.2 Ticking, knocking noise	Hydraulic noise	Caused by system	Fit vibration dampers
		Defective vibration dampers	Replace vibration dampers
		Defective pressure regulator	Replace pressure regulator
		Tube diameter reduced	Visual check/replace if required
3.3 Rumbling, reverberating noise	Body vibration noise	Pump or pipes in contact with vehicle body, or in-tank pump touching tank	Check installation location / layout and correct
		Pipes incorrectly tightened	Loosen pipes (screw connections), retighten
		Pipe layout not as specified	Correct pipe layout

This table applies only to faults caused by an anomaly in the fuel system.

Troubleshooting Tips

4. Faults occurring after pump installation

The following isolated faults may occur after a new pump has been installed:

Fault	Cause	Possible origins of cause	Remedy / Observations
4.1 New pump does not supply fuel	Blown fuse	High running-in power surge; factory fitted fuse of too low a rating	Replace fuse, possibly with a fuse of a higher rating (for a short period only)
4.2 New pump produces noise	Pipes incorrectly tightened or in contact with vehicle body	Pipes deformed over time or twisted by over-tightening	Check layout and correct if required
	High resistance on thrust face	Filter clogged	Replace filter
4.3 New pump cuts out after running briefly	Pump mechanism blocked	Fuel system clogged	More than 95% of reported faults are due to dirt. If the pump fitted to the vehicle has broken down, the fuel system must always be cleaned before a new pump is fitted.

This table applies only to faults caused by an anomaly in the fuel system.

Check and measuring the fuel system

Important notes

General

All vehicle manufacturers have various types of injection systems. These instructions are a general guide for the use of the fuel injection pressure test set. The procedures outlined here are examples only.
Always follow the vehicle manufacturer's recommendations and instructions.
Test data can be taken from the repair instructions of the vehicle manufacturer, the fuel chart and manual or the injection manuals published by Autodata.

Safety

Attention

- Vehicle emissions and fuel vapours are harmful to your health! When working in closed areas, always activate the ventilation or vapour evacuation system.
- Fuel and fuel vapour are easily inflammable. Therefore don't smoke and avoid any open flames or sparks. Keep a fire extinguisher in the vicinity ready for use.
- When working aroud the engine compartment, pay particular attention to the following:
  - rotating parts (ventilator, belt, alternator etc.)
  - hot components (exhaust gas manifold, engine, radiator)
  - components that carry an electrical current (cable, ignition system, battery)
  - tools: don't leyve any tool in the engine compartment
- In order to prevent any damage, connect or disconnect electrical lines of the ignition and injection system only when the ignition is switched off.
- Fuel injection systems are under pressure. Disconnect connections and hoses only when the engine is not running and the ignition is switched off. Collect any fuel that leaks. Wear protective glasses if necessary.
- Before starting to work on a vehicle make sure that no gear is engaged and the parking brake is pulled.
- After completing your work on the fuel system, always check for leakage.

Cleanliness

Contamination, in particular in injection systems, causes malfunctions. In order to prevent this from happening, the following recommendations should be followed:

- Thoroughly clean the area and the environment of a connection before removing it.
- Place removed components in a clean arey and cover them properly.
- When interrupting your work, cover/close up any open or desassembled components.
- Install only clean components.
- Remove any packing or transprotation containers, for instance plugs in new fuel pumps, only immediately before installation of the component.
- Do not use compressed air when working with open or exposed fuel systems.
- In case of any damage that has been caused by contamination, clean the fuel system before installing any new components or equipment.

Miscellaneous

In case of faults in the fuel supply system and before measuring any pressure, do the following:

- Check the battery voltage and the fuses.
- Check whether or not the fuel pump starts running when switching the ignition on.
- Check fuel lines for proper placement.

Check and measuring the fuel system

Fuel injection pressure test set

Description

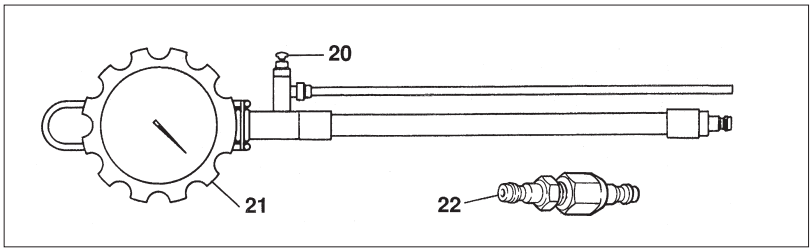
- The fuel injection pressure test set can be used universally for virtually all injection systems.
- The set ist supplied in a stable case.
- Calibrated manometers with double scale:
  1) Measuring range from 0 to 10 bar / 0 to 150 psi.
  2) Measuring range from 0 to 2 bar / 0 to 30 psi.
  It is protected by a fuel-resistant cover and is equipped with a hanger and a ventilation valve.
- The three-way adapter with control valve permits many types of checks with open or closed valves.
- Compact fast couplingt on all adapters and hoses.

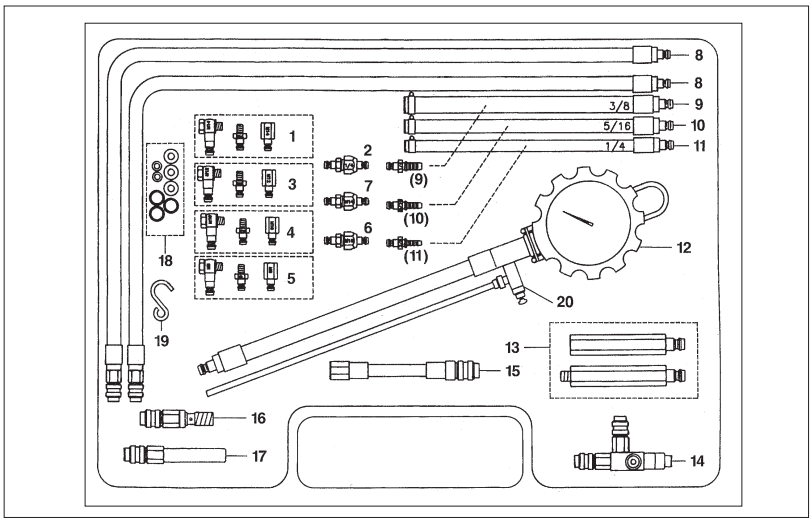
System manufacturer	System type	System manufacturer	System type	Vehicle manufacturers using the system described above include:	
Bosch	K-, KE-, L-, LH-, Mono-Jetronic, Motronic und Monomotronic	Mitsubishi	ECI-Mult	Alfa Romeo	Opel
		Nippon Denso	EGI - EGI - S	Audi	Peugeot
		Nissan	ECCS	BMW	Porsche
		Renix/Bendix	SPI, R	Citroen	Renault
Fenix	1B, 3B, 4	Rover	M.E.M.S. SPI	Fiat	Rover
Ford	CFI, EEC 4, EFI		PGM-FI	Ford	Saab
	SEFI	Siemens	MS 40, Simtec,	Honda	Seat
GM	Multec-S		Simos	Hyundai	Skoda
	Multec-M	Subaru	SPFI, MPFI	Jaguar	Subaru
Hella	MPFI	Suzuki	EBE	Lancia	Suzuki
Hitachi	MPI	Toyota	TCCS	Mazda	Toyota
Honda	FI	VW	Digijet, Digifant	Mercedes-Benz	Vauxhall
Lucas	CU 15, CUX EFI	Weber/Marelli	SPI, SEFI, MIW	Mitsubishi	Volvo
				Nissan	VW

Scope of delivery

Fuel injection pressure test set 4.07360.51.0

Fig. no.	Pierburg ref.	Title
1	4.07360.26.0	M14 adapter kit
2	4.07360.38.0	1/4" adapter kit (conic)
3	4.07360.25.0	M12 adapter kit
4	4.07360.24.0	M10 adapter kit
5	4.07360.23.0	M8 adapter kit
6	4.07360.39.0	M16 adapter kit (conic)
7	4.07360.40.0	M14 adapter kit (conic)
8	4.07360.32.0	Hose 550 mm
9	4.07360.28.0	House coupling 3/8"
10	4.07360.29.0	House coupling 5/16"
11	4.07360.31.0	House coupling 1/4"
12	4.07360.37.0	Monometer D - 10 bar with hose
13	4.07360.27.0	M8 adapter kit (long version)
14	4.07360.34.0	3-way adapter
15	4.07360.33.0	Adapter for Opel
16	4.07360.35.0	M12 x 1.25 adapter
17	4.07360.36.0	Adapter for Ford
18	4.07360.41.0	Seal kit
19	3.45219.99.0	Hook
20	4.07360.47.0	Bleading valve with hose
21	4.07360.43.0	Manometer 0 - 2 bar with hose
22	4.07360.44.0	M14 adapter for Rover





Check and measuring the fuel system

Measurements

1. Measurements on vehicles with "K-Jetronic"

1.1. Main system pressure

- The three-way adapter should be installed between the fuel distributor and the warm-up control unit.
- Before doing this, depressurise the system.
- In order to depressurise the system, always remove the upper plug (upper chamber of the fuel distributor) first.

- Connection "A" towards the fuel distributor.
- Connection "B" towards the warm-up control unit.
- Close the contorl valve on the three-way adapter.
- Disconnect the pump relay and connect the cable connections termial 30 and terminal 87 with an auxiliary cable with an integrated 20 A fuse.
  Switch on the ignition. The fuel pump should start running now.
- Before taking measurements, depressurise the system by pressing the button on the bleeding valve of the manometer. Collect the fuel leaking out of the drainage hose in a suitable container.
- Read the main system pressure on the manometer; for the respective data, refer to the manufacturer's specifiction.

1.2 Control pressure

- The fuel pump should be running.
  - Open the control valve "D" on the three-way adapter.
  - Read the control pressure on the manometer.
  - For pressures "cold" - "warm": refer to the manufacturer's specification.

1.3 Retaining pressure/ remaining pressure

- Close the control valve "D" on the three-way adapter.
- Switch the ignition on; the fuel pump should be running now.
- Switch the ignition off after a maximum of 3 to 5 seconds.
- Read the retaining pressure after 10 or 20 minutes. For the restpective data, refer to the manufacturer's specification.

1.4 ATTENTION!

Before removing the three-way adapter, depressurise the system by pressing the button on the bleeding valve. Collect any fuel l leaking through the drainage hose in a suitable container.

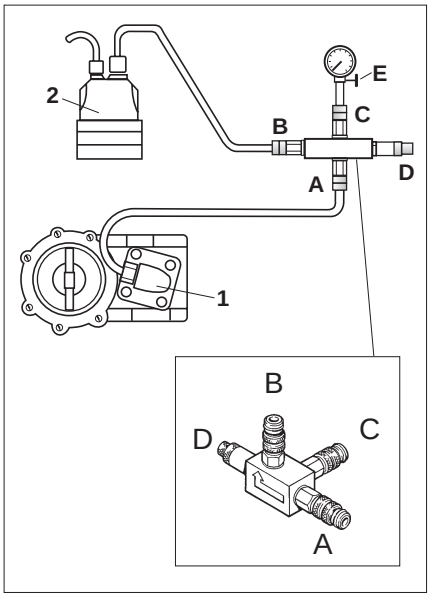


Fig. 3
A = entry
B = exit
C = manometer
D = control valve
E = bleeding valve
1 = fuel distributor
2 = warm-up control unit

Check and measuring the fuel system

Measurements

2. Measurements on vehicles with "KE-Jetronic"

2.1 Main system pressure/ upper chamber pressure

- The three-way adapter should be connected to the fuel distributor between upper and lower chamber.
- Before doing so, carefully remove the upper special connection or the connection towards the cold-start valve on the fuel distributor. This depressurises the system.

- Connect connection "A" to the special test connection, in the lower chamber of the fuel distributor.
- Connect connection "B" to the special test connection, in the upper chamber, or the connection of the cold-start valve, of the fuel distributor.
- Open the control valve "D" on the three-way adapter.
- Disconnect the pump relay and connect the cable connections terminal 30 and terminal 87 with an auxiliary cable with an integrated 20A fuse.
- Switch the ignition on; the fuel pump should be running now.
- Before taking measurements, depressurise the system by pressing the button on the bleeding valve of the manometer. Collect any fuel leaking out of the drainage hose in a suitable container.
- Read the main system pressure on the manometer; for the respective data, refer to the manufacturer's specification.

2.2 Pressure differential/lower chamber pressure

- Close the control valve "D" on the three-way adapter.
- Remove the multiple plug from the pressure actuator on the fuel distributor.
- Switch the ignition on; the fuel pump should be running now.
- Read the pressure differen tial on the manometer. For the respective data, refer to the manufacturer's specification.
- Switch the ignition off.

2.3 Retaining pressure/ remaining pressure

- Open the control valve "D" on the three-directional valve.
- Switch the ignition on. The fuel pump should be running now.
- Switch the ignition off after maximum of 3 to 5 seconds.
- Read the retaining pressure after 10 or 20 minutes. For the respective data, refer to the manufacturer's specification.

2.4 ATTENTION!

Before removing the three-way adapter, depressurise the system by pressing the button on the bleeding valve. Collect any fuel leaking through the drainage hose in a suitable container.

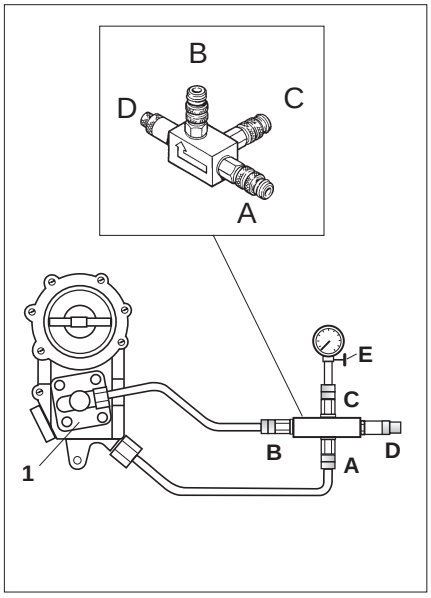


Fig. 4
A = entry
B = exit
C = manometer
D = control valve
E = bleeding valve
1 = fuel distributor

Check and measuring the fuel system

Measurements

3. Measurements on vehicles with electronic multi-point injection systems, like Bosch-L/LH-Jetronic, Motronic, MPI, HMPI, EFI or Digifant.

- With these systems, the test method ist mostly identical.
- Some vehicles are provided with special test connections on the fuel distribution tube in fornt of the main system pressure regulator.

3.1 Checking the main system pressure

- Carefully disconnect the fuel line at a suitable location. This depressurises the system.
  - Connect connection "A" on the three-way adapter in the direction of the filter.
  - Connect connection "B" on the three-way adapter in the direction of the injectors/fuel distribution tube, control vlave "D" open.
  - If the vehicle is provided with a test connection, only the connection "In" on the three-way adapter ist used. In this case the control valve remains closed.
- The main system pressure can be checked with the engine either running or not running.

3.1.1 With the engine not running.

- Disconnnect the pump relay and connect the cable connections terminal 30 and terminal 87 with an auxiliary cable, including a fuse (20A).
- Switch the ignition on; the fuel pump should be running now.
- Beforetaking measurements, depressurise the system by pressing the button on the bleeding valve of the manometer. Collect any fuel leaking out of the drainage hose in a suitable container.
- Read the main system pressure on th manometer; for data, refer to the manufacturer's specification.

3.1.2 With the engine running

- Leave the engine running: read the main system pressure on the manometer. For the respective data, refer to the manufacturer's specification.

3.2 Retaining pressure/ remaining pressure

- Leave the fuel pump or the engine running; switch off after 3 to 5 seconds.
- Read the retaining pressure according to the manufacturer's specification in various time intervalls (e.g. 3 minutes and 5 minutes) on the manometer.

3.3 Checking the main system pressure regulator

- At the end of the fuel distribution tube you will find the main system pressure regulator. If it is suspected that the main system pressure is not correct, it should be checked as follows:
  - Leave the engine of the fuel pump running; read the main system pressure.
  - Close the recirculation line; the pressure in the system should increase sharply; now measure the "delivery pressure".
  - Read the level on the manometer and compare with the manufacturer's specification (if the pumpin pressure is indicated).
  - Open the recirculation line again.
  - Disconnect the vacuum hose on the diaphragm side of the pressure regulator. Read the pressure and record the respective value.
  - Using a manual vacuum pump, set a pressure diffe rential of 500 mbar - the manin system pressure should fall. Read the measuring value and compare it with the previous pressure value. Pressure differential approximatly 0.5 bar.

3.4 ATTENTION!

Before removing the three-way adapter, depressurise the system by pressing the button on the bleeding valve. Collect any fuel leaking through the drainage hose in a suitable container.

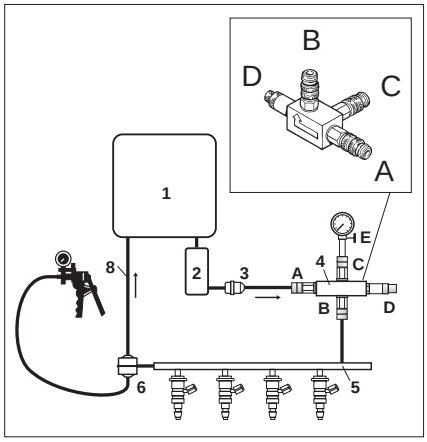


Fig. 5
1 = fuel tank
2 = fuel pump
3 = filter
4 = 3-way adapter
5 = fuel distribution pipe
6 = vacuum connection
7 = system pressure regulator
8 = recirculation line
A = entry
B = exit
C = manometer
D = control valve
E = bleading valve

Check and measuring the fuel system

Measurements

4. Measurements on vehicles with single-point injection systems, like Bosch Mono-Jetronic or Opel Multec and Weber CFI

- Connect the three-way adapter to the fuel entry of the injection unit.
- Carefully disconnect the connection at the fuel entry point. This depressurises the system.

4.1 Main system pressure

- Connect the connection “A” to the three-way adapter in the direction of the filter.
- Connect the connection “B” from the three-way adapter to the injection unit.
  The main system pressure can be checked with the engine either running or not running.

4.1.1 Engine running

- Leave the engine running.
- Before taking measurements, depressurise the system by pressing the button on the bleeding valve of the manometer. Collect any fuel leaking out of the drainage hose in a suitable container.
- Read the main system pressure on the manometer; for the respective data, refer to the manufacturer’s specification.

4.1.2 Engine not running

- Disconnect the pump relay and connect the cable connection terminal 30 and terminal 67 with a cable including a fuse (20A).
- Switch the ignition on; the fuel pump should be running now.
- Read the main system pressure on the manometer. For the respective data, refer to the manufacturer’s specification.

4.2 Retaining pressure/ remaining pressure

- Leave the engine or the fuel pump running for 3 to 5 seconds. Compare the pressure drop after 5 or 10 minutes with the manufacturer’s specification.

4.3 ATTENTION!

Before removing the three-way adapter, depressurise the system by pressing the button on the bleeding valve. Collect any fuel leaking through the drainage hose in a suitable container.

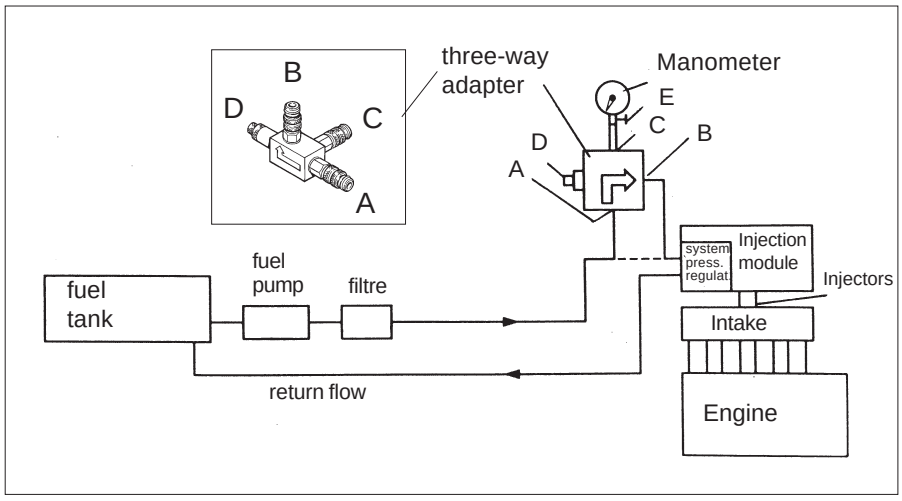
5. Measuring the pumping quantity

- When checking injection systems, apart from pressure levels also measure the pumping quantity of the electrical fuel pump.

- In order to do so, we recommend you use a commercially available measuring glass with a capacity of 2,000 cubic centimetres.

- Remove and separate the fuel line at a suitable location, generally the recirculation line behind the main system pressure regulator. (Follow the vehicle manufacturer’s instructions).
- Hold the separated fuel line or, if necessary, the auxiliary line, into the measuring glass.
- Disconnect the pump relay and connect the cable connections terminal 30 and terminal 87 with an auxiliary cable with an integrated 20 A fuse.
- Switch the ignition on. The pump should be running now.
- Collect the fuel in the measuring glass and read the pumped quantity after 10 to 15 seconds (follow the manufacturer’s instructions). (For the respective data, refer to the manufacturer’s specification).
  (Recommended level: 1.5 to 2.0 l in 10 seconds).

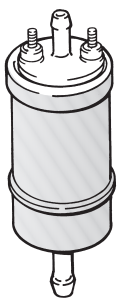
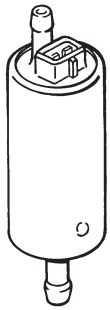
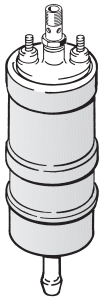
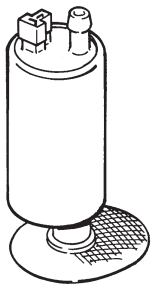
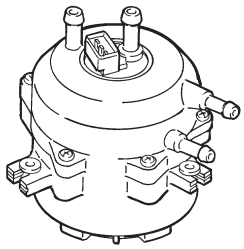
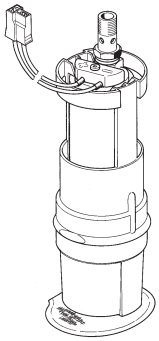
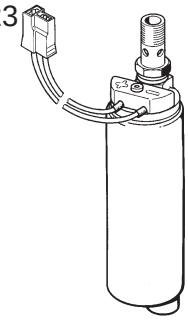
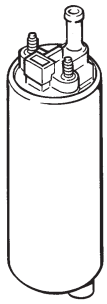
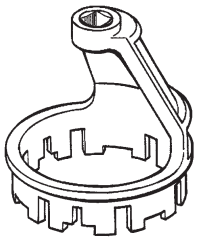
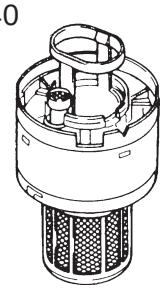
A = entry
B = exit
C = manometer
D = control valve
E = bleading valve
Fig. 6



Test value tables

1. There may be a brief surge in power consumption when a pump is run initially.
2. The exact system pressure values for each vehicle should be obtained from the vehicle manufacturer's documentation or the vehicle data. These pressures may vary slightly with the values given in the table.
3. The exact reference to vehicle and replacement part should be taken from either the current TECDOC-CD catalogue concerned or from TECDOC database systems.

Vehicle	Fuel pump type	Pierburg No.	Nominal voltage Volt	System pressure bar	Feed rate l/h	Power consumption at system pressure A
Alfa Romeo	in-line	7.21287.53.0	12	3	100	6
	in-line	7.21565.50.0	12	3	100	6
Audi/VW	in-tank	7.18259.50.0	12	4	110	9
	in-tank,	7.21088.05.0	12			2
	initial	7.21088.06.0	12	0,24	75	3
	pump	7.21088.52.0	12			3
	in-line	7.21287.53.0	12	3	110	6
	in-line	7.21538.00.0	12	1,1		
		7.21538.50.0	12	1,1	80	2,8
	in-tank	7.21651.00.0				
		7.21651.01.0	12	6,5	100	16
		7.21651.02.0				
		7.21651.05.0				
		7.21651.06.0				
		7.21651.07.0				
		7.21651.08.0				
		7.21651.09.0				
		7.21651.11.0				
		7.21651.50.0				
		7.21651.60.0				
	in-line	7.21659.50.0	12	6,5	110	12
		7.21659.52.0				
		7.21659.62.0				
	in-tank	7.21917.00.0	12	6,5	100	16
		7.21917.01.0				
		7.21917.02.0				
		7.21917.03.0				
	pump	7.21868.00.0	12	3	115	4,8
	reserve	7.21868.01.0				
	with pump	7.21926.00.0				
		7.21926.01.0				
		7.21926.50.0				
		7.21926.51.0				

		Fuel pumps, design formats and accessories		
Observations	**Illustration**	1 	2 	3 
	1			
	3			
Observe Si 0018	24			
Initial feed pump, see also TI 201	5			
	1	4 	5 	18 
	2			
Important: Observe si 0008, si 0009, si 0032	22, 23, 39, 40	22 	23 	24 
	4	39 	40 	
Connect mounting unit (not illustrated; no part), includes pump (Fig. 23) upper part of storage housing and fuel pipe.	See observation			
Pump (not illustrated) for pump reserve (Fig. 18)	See observation			
See si 0023	18			

Test value tables

Vehicle	Fuel pump type	Pierburg No.	Nominal voltage Volt	System pressure bar	Feed rate l/h	Power consumption at system pressure A
Audi/VW	semi-	7.22042.00.0		1,2	80	3
	in-tank	7.22042.01.0		3	100	5,2
		7.22042.50.0	12	1,2	80	3
		7.22042.51.0		3	100	5,2
	in-tank	7.22542.00.0				
		7.22542.01.0	12	6,5	100	16
VW	Swirl pot (with pump) Pierburg numbers refer to swirl pot	7.21981.50.0				
		7.21981.52.0		4		6
		7.21981.53.0				
		7.21981.54.0	12	3	90	5
		7.21981.55.0				
		7.21287.59.0		1,2		2,8
BMW	in-line	7.21287.53.0	12	3	100	6
	in-line	7.21659.50.0				
		7.21659.62.0	12	6,5	110	12
	in-tank	7.21833.01.0			130	8,5
		7.21833.03.0	12	3,5	160	11
	in-tank	7.21913.00.0	12	3,5	130	8,5
		7.21913.50.0				
	in-tank	7.22013.04.0	12	3,5	135	7
	in-tank	7.22292.50.0	12	3,5	130	9
	in-tank	7.22395.00.0	12	3,5	135	7
	in-line	7.22782.00.0	12	2	180	6
Citroen	in-line	7.21287.53.0	12	3	100	6
	in-line	7.21565.50.0	12	3	100	6
	in-line	7.21659.50.0	12	6,5	110	12
Daewoo	in-line	7.21287.53.0	12	3	100	6
Ferrari	in-line	7.21659.52.0	12	6,5	110	12
		7.21659.60.0				
Fiat	in-line	7.21287.53.0	12	3	100	6
	in-line	7.21565.50.0	12	3	100	6
Ford	in-line	7.21565.51.0	12	3	100	6
	in-line	7.21659.52.0				
		7.21659.60.0	12	6,5	110	12
		7.21659.62.0				

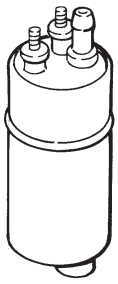
Observations	Illustration
Observe Si 0004	19
Complete mounting unit (not illustrated; no part), includes pump (Fig. 28) upper part of storage housing and fuel pipe.	See observation
1. For details, see 0021 2. 7.21981.53.0 replaced by .50.0 7.21981.54.0 replaced by .52.0 3. All pumps are supplied complete as gyrating head only	28
	1
	4
	6
See si 0005	20
	7
See si 0006	21
	8
	9
	1
	3
	4
	1
	4
	1
	3
	3
	4

1

3

4

6



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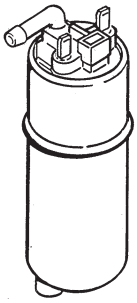

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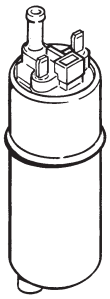

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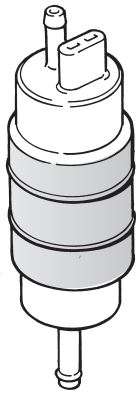

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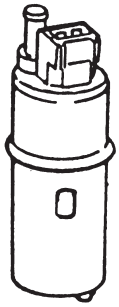

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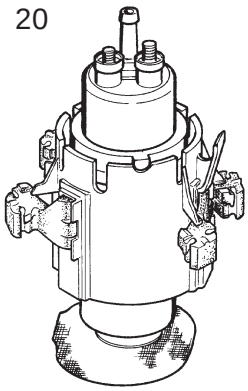

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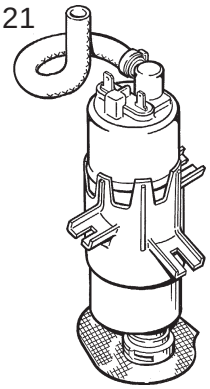

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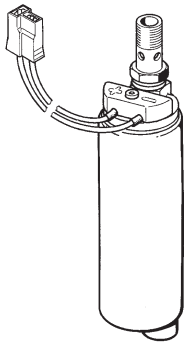

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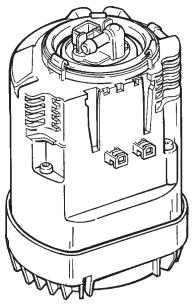


Test value tables

Vehicle	Fuel pump type	Pierburg No.	Nominal voltage Volt	System pressure bar	Feed rate l/h	Power consumption at system pressure A
Jaguar	in-line	7.21287.53.0	12	3	100	6
	in-line	7.21565.52.0	12	3	100	6
	in-line	7.21960.02.0	12	4	100	8,5
	in-line	7.22071.00.0	12	3	100	7
	in-line	7.22328.00.0	12	4	100	8,5
Lancia	in-line	7.21287.53.0	12	3	100	6
MB	in-line	7.21283.00.0	12	4	130	4
	in-line	7.21565.51.0	12	3	100	6
	in-line	7.21659.52.0	12	6,5	110	12
		7.21659.53.0				
		7.21659.60.0				
		7.21659.62.0				
	in-line	7.21682.00.0	12	4	130	4
		7.21682.50.0				
		7.21682.60.0				
	in-line	7.21810.00.0	12	4	80	9
		7.21810.50.0				
	in-line	7.21960.00.0	12	4	100	8,5
		7.21960.01.0				
		7.21960.05.0				
		7.21960.51.0				
	in-line	7.22020.00.0	12	4	80	12
		7.22020.50.0				
	in-line	7.22156.00.0	12	4	100	8
		7.22156.01.0				
		7.22156.50.0				
	in-line	7.22262.00.0	12	4	80	9
	in-line	7.22359.00.0	13,5	4	130	8,5
	intank in-tank-module	7.22378.00.0	13,5	3,5	95	9,5
	in-line	7.22473.00.0	13,5	4	130	8,5
	in-line	7.22573.00.0	13,5	4	130	8,5
	intank in-tank-module	7.22810.00.0	13,5	3,5	95	9,5
		7.22810.10.0				
		7.22810.50.0				

Observations	Illustration
	1
	3
As in Fig. 10, but without rubber sheath	See observation
	3 (without screw neck)
	10
	1
	11
	3
	4
	12
As in Fig. 26, but without mounting and with fixed delivery connection. See also si 0007	See observation
As in Fig. 25, but with fixed delivery connection. See also si 0014	See observation
See si 0007	26
See si 0014	25
As in Fig. 26, but with fixed delivery connection. See also si 0007	See observation
	13
See si 0033	27
	14
	15
See si 0033	27

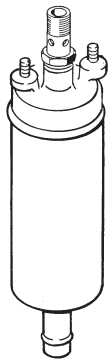
1

3

4

10

11



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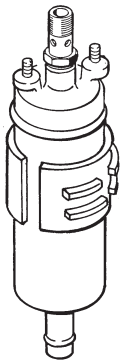

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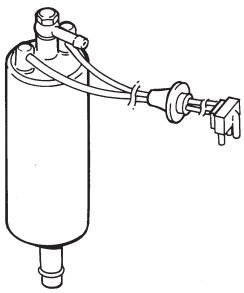

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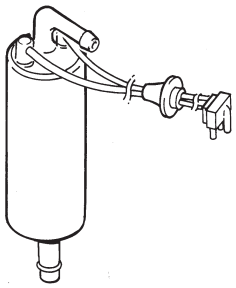

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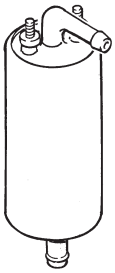

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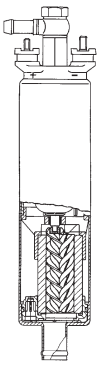

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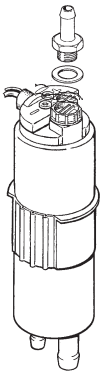

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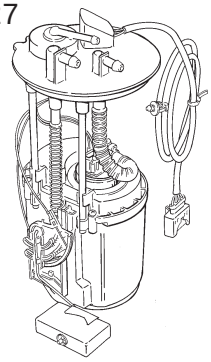
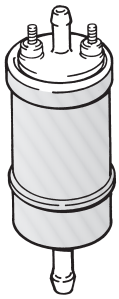


Test value tables

Vehicle	Fuel pump type	Pierburg No.	Nominal voltage Volt	System pressure bar	Feed rate l/h	Power consumption at system pressure A
Opel	in-line	7.21287.53.0	12	3	100	6
Peugeot	in-line	7.21287.53.0	12	3	100	6
	in-line	7.21565.50.0	12	3	100	6
	in-line	7.21659.60.0	12	6,5	110	12
		7.21659.62.0				
Porsche	in-line	7.21287.53.0	12	3	100	6
	in-line	7.21565.50.0	12	3	100	6
	in-line	7.21659.62.0	12	6,5	110	12
Renault	in-line	7.21287.53.0	12	3	100	6
	in-line	7.21565.50.0	12	3	100	6
	in-line	7.21659.62.0	12	6,5	110	12
Rolls-Royce	in-line	7.21659.50.0	12	6,5	110	12
		7.21659.60.0				
Rover	in-line	7.21287.53.0	12	3	100	6
Seat	Semi-in-tank	7.22042.00.0	12	1,2	80	3
		7.22042.01.0		3	100	5,2
		7.22042.50.0		1,2	80	3
		7.22042.51.0	12	3	100	5,2
Steyer	in-line	7.21805.00.0	12	0,7	160	12
Volvo	in-line	7.21565.50.0	12	3	100	6
		7.21565.52.0				
	in-line	7.21659.50.0	12	6,5	110	12
		7.21659.54.0				
		7.21659.62.0				
	in-line	7.22120.00.0	12	3	95	7,5
VW	**siehe Audi / VW - Seite 14 - 17**					

Observations	Illustration
	1
	1
	3
	4
	1
	3
	4
	1
	3
	4
	4
	1
See si 0004	19
	16
	3
	4
	17

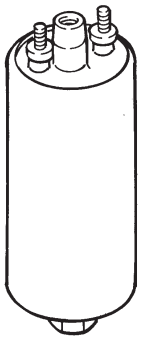
1



3

4

16



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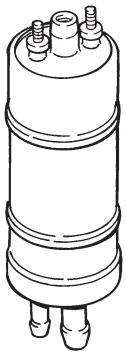

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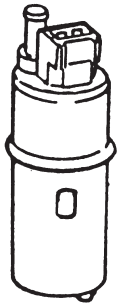

Technical data and design layout of Universal Pumps E2T/E3T

	Fig.-No.	Part-No.	Nominal-voltage (V)	Stat. press. at Q = 0 l/h (bar)	Volume flow (l/h)	System-pressure at (bar)	Mounting or connection dimensions (mm) „A"	„B"	„C"	„D"	„E"	Power consumption max. (≤ A)
E2T	7a	7.21287.53.0	12	4,5 - 7,5	100	3,0	Ø 52	160	115	Ø 12	Ø 8	< 6 A at 3,0 bar
	7b	7.21565.50.0					Ø 52	190	115	Ø 12	M12 x 1,5	
		7.21565.51.0								Ø 15		
		7.21565.52.0								Ø 12	M14 x 1,5	
E3T	7c	7.21659.50.0	12	8 - 12	100	6,5	Ø 60	210	133	Ø 12	M12 x 1,5	< 12 A at 6,5 bar
		7.21659.52.0								Ø 15		
		7.21659.53.0					Ø 52					
		7.21659.54.0					Ø 60	198		Ø 12	M16 x 1,5	
		7.21659.60.0						Ø 210		Ø 15	M12 x 1,5 interior thread	
		7.21659.62.0								Ø 12		

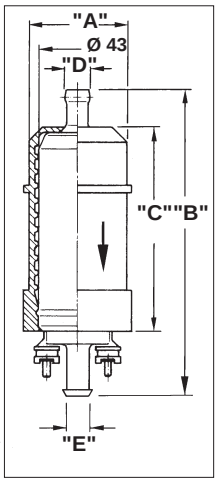

Fig 7a **E2T**

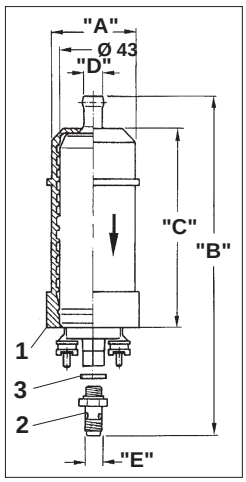

Fig. 7b **E2T**

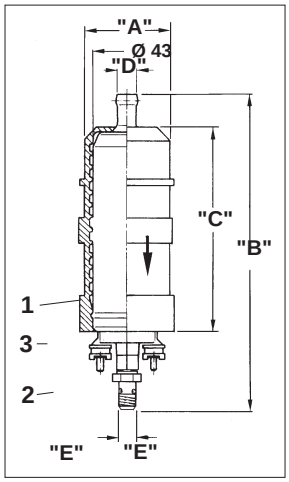

Fig. 7c **E3T**

Key to Fig. 7
1 - rubber sheath
2 - Screw neck
3 - Sealing ring

Design:
Wet construction
Self-priming gear principle

Suction height:
max. 500 mm

Electrical connection:
Screw connection M4 (+ pole)
Screw connection M5 (- pole)

Temperature:
- 40º C to +120º C
  storage temperature lager
- 40º C to +80º C
  (briefly 100º C)
  operating temperature

Rubber sheaths provide additional reduction in noise levels

Broadcast interference suppressed

Fuse rating: IP55A

Fitting position: any

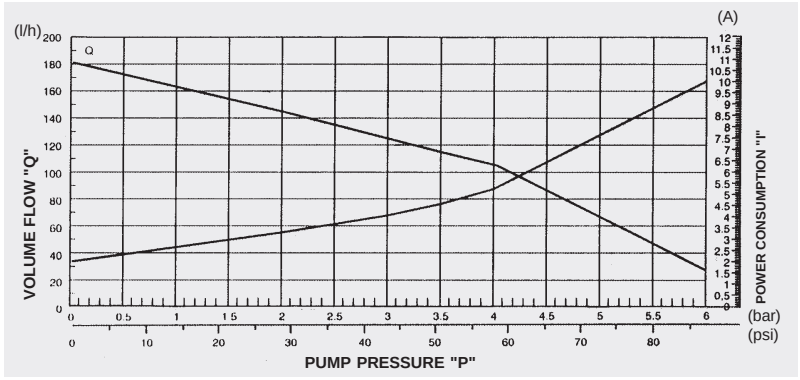

Fig. 8

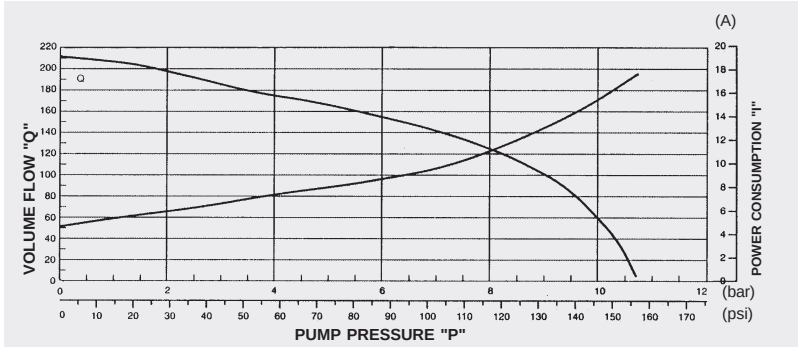

Fig. 9

Brief description

Fuel system designs

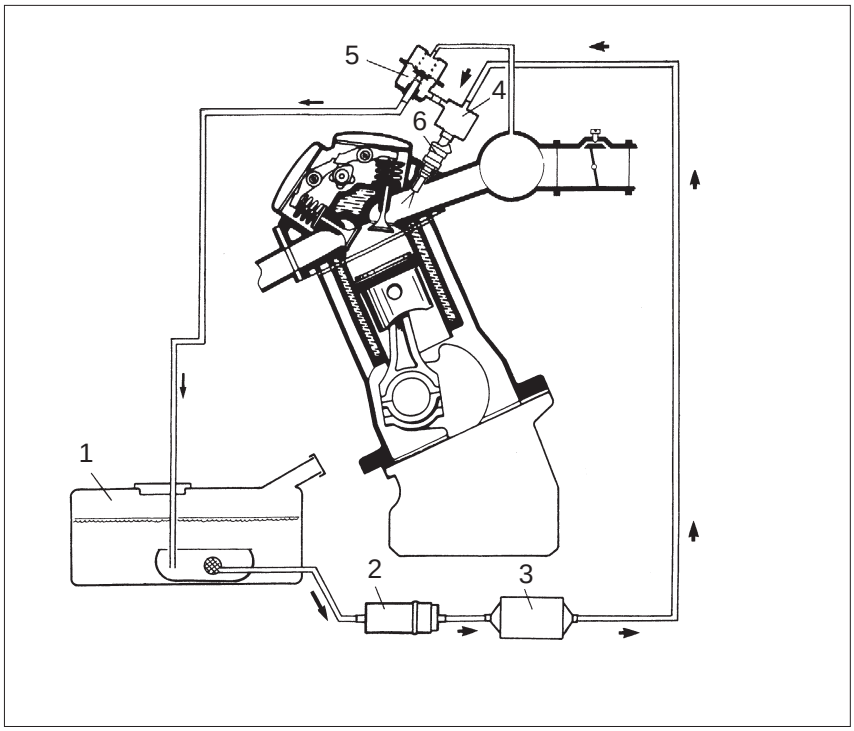

Fig. 10
1. Fuel tank
2. Electric fuel pump
3. Fine filter
4. Fuel distributor
5. Pressure regulator
6. Injection valve

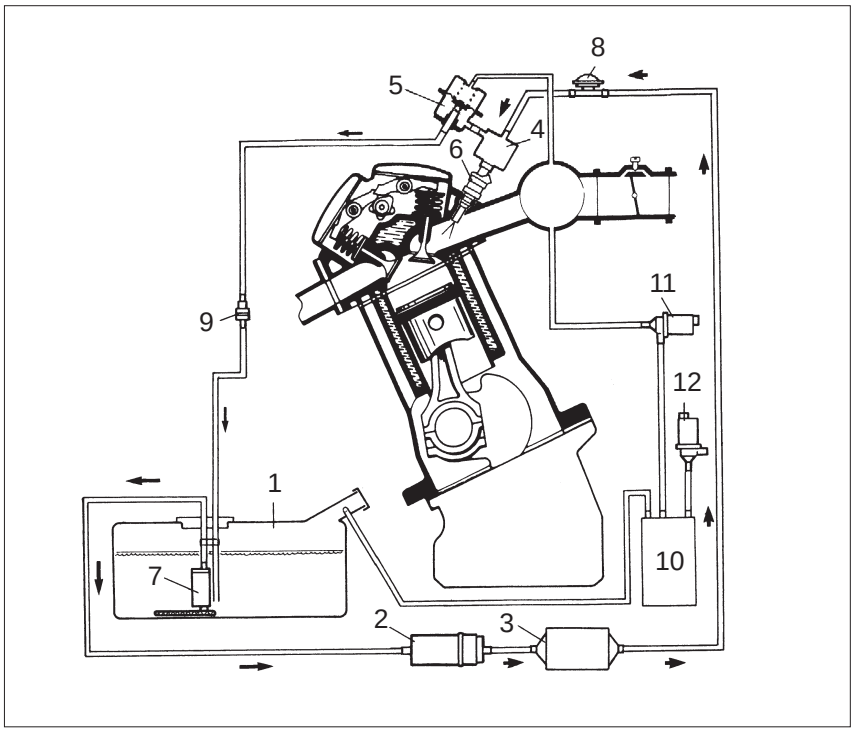

Fig. 11
7. Initial feed pump
8. Vibration damper
9. Non-return valve
10. AKF filter
11. AKF recirculating valve
12. AKF shutoff valveTank ventilation and air release, pressure sensor (not illustrated)

Fig. 10 shows the layout of components in a typical injection engine system.

More modern systems may also be fitted with the components shown in Fig. 11.
Depending on use, fuel pumps are located in the fuel pipe (Fig. 10), in the fuel tank (Fig. 12) or in what is referred to as the pump reservoir (Fig. 13).

The may be used individually (Fig. 10), with initial feed pump (Fig. 11) or as a complete pump set with two pumps working in series (Fig. 14). With saddle tanks (Fig. 15), or tanks of similar design, sucking jet pumps are used in order to empty all parts of the tank.

Note: SPI (single point injection) systems are not fitted with a fuel distributor and normally have only one injection valve.

Brief description

Fuel system designs

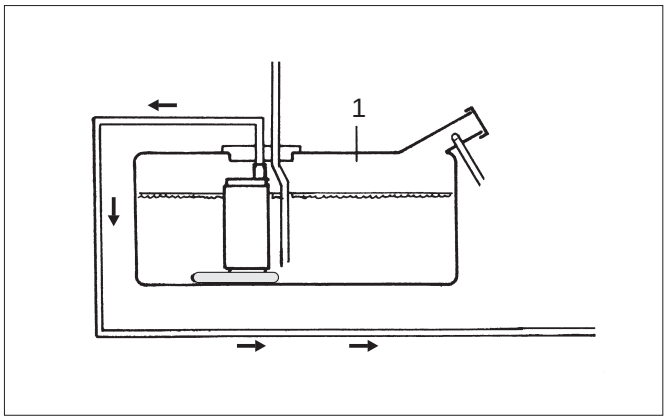

Fig. 12 In-tank pump

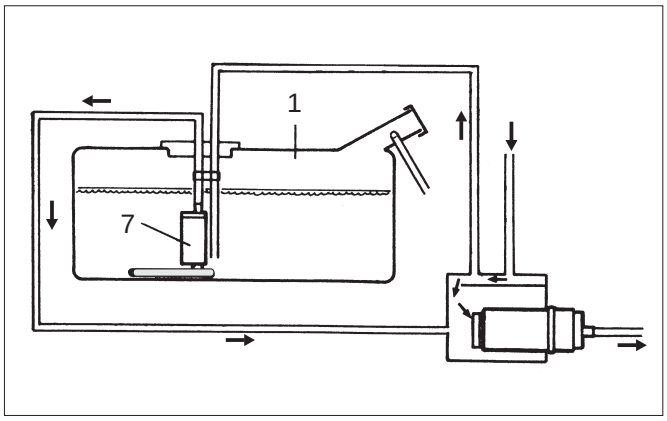

Fig. 13 Semi in-tank pump in pump reservoir with additional initial feed pump

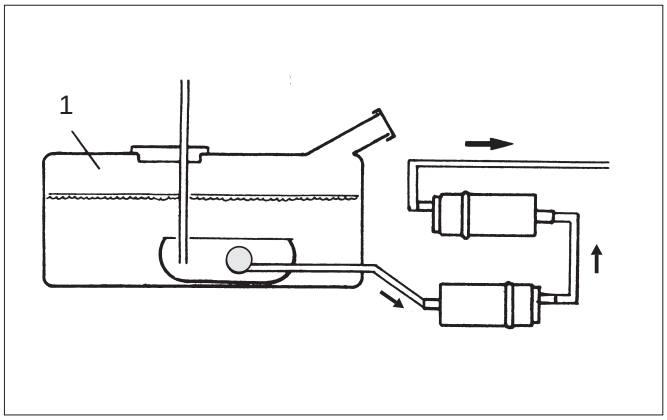

Fig. 14 Pump set

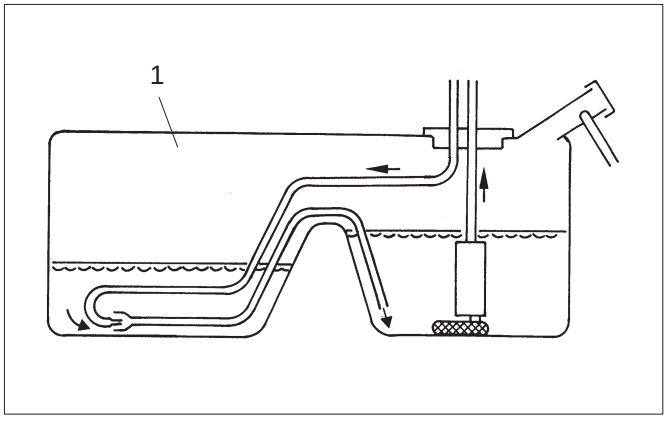

Fig. 15 In-tank pump connected to sucking jet pump

Brief description

Function

When the engine is being started, the fuel pump is activated and continues supplying fuel for as long as the starter switch is connected. Once the engine starts, the pump remains activated and continues supplying fuel. If the engine does not start, or stops with the ignition still activated, a safety switch shuts down the fuel pump.

In order to protect the injection system - especially the injection valves - the fuel is channelled through a fine filter fitted downstream.

Fuel is fed in equal quantities to each injection valve by the fuel distributor. The volume of the distributor is sufficient to avoid pressure variations caused by the action of the valves.

A pressure regulator fitted to the system controls pressure and maintains a constant difference between fuel pressure and inlet pipe pressure. This ensures that the injection quantity is determined solely by the time the injection valve remains open. The regulator is located in the fuel distributor outlet, and is partly integrated in the distributor.

The fuel is injected into the inlet pipe via the injection valve. With MPI (multi-point injection) systems, each cylinder has its own injection valve. The valves are located in the inlet pipe, just upstream of the corresponding inlet valve. (Fig. 16)

With SPI systems, the fuel is injected centrally via one valve, or very occasionally two valves. (Fig. 17).

SPI systems work with system pressures of 0.8-1.2 bar; MPI systems such as L-Jetronic with pressures between 2.5 and 4 bar; systems such as K-/ KE Jetronic with pressures of up to 6.5 bar.

Depending on the type of injection system, pumps are used operating with fuel pressures of 1.8 - 10 bar = 180-1000 kPa. The feed rate of these pumps is approximately 95 -160 l/h.

The high supply performance of these pumps ensures that the engine is provided with sufficient fuel in all operating circumstances.

In systems fitted with sucking jet pumps to empty the tank, it is important to ensure that there is a sufficient back-flow rate to run the sucking jet pump.

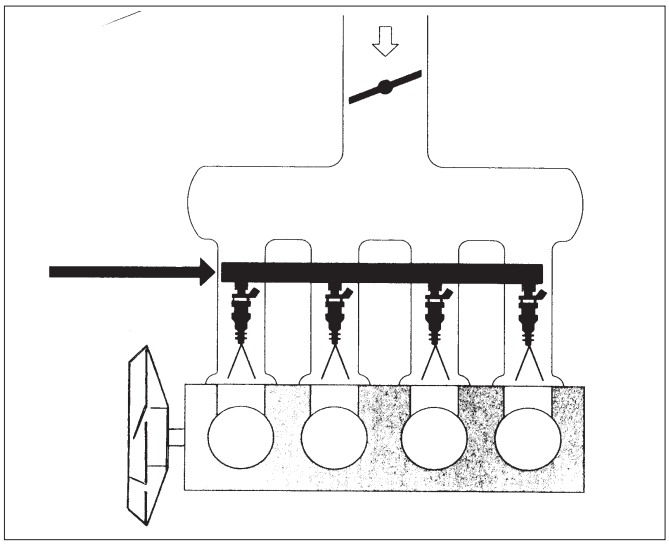

Fig. 16 MPI system

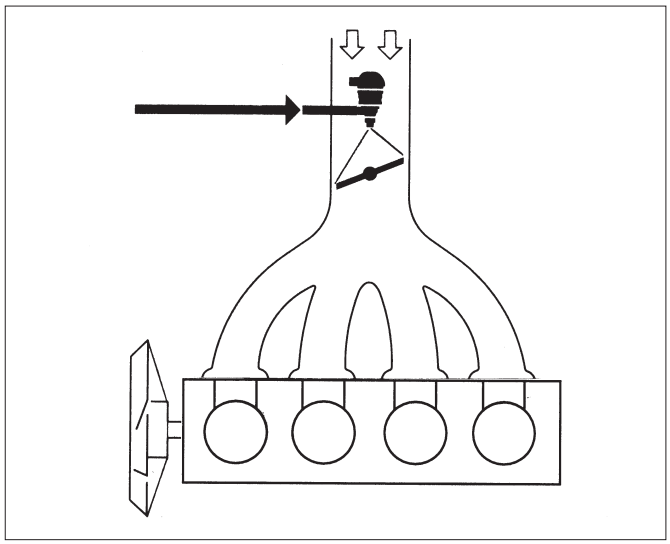

Fig. 17 SPI system

Fuel pumps

Only electrically operated fuel pumps are used with injection motors. Depending on the type of use, different pump mechanisms are used, either singly or in combination, along with motors of various capacities.

Fig. 18 shows the pump mechanisms available from Pierburg, along with motors and combination possibilities.

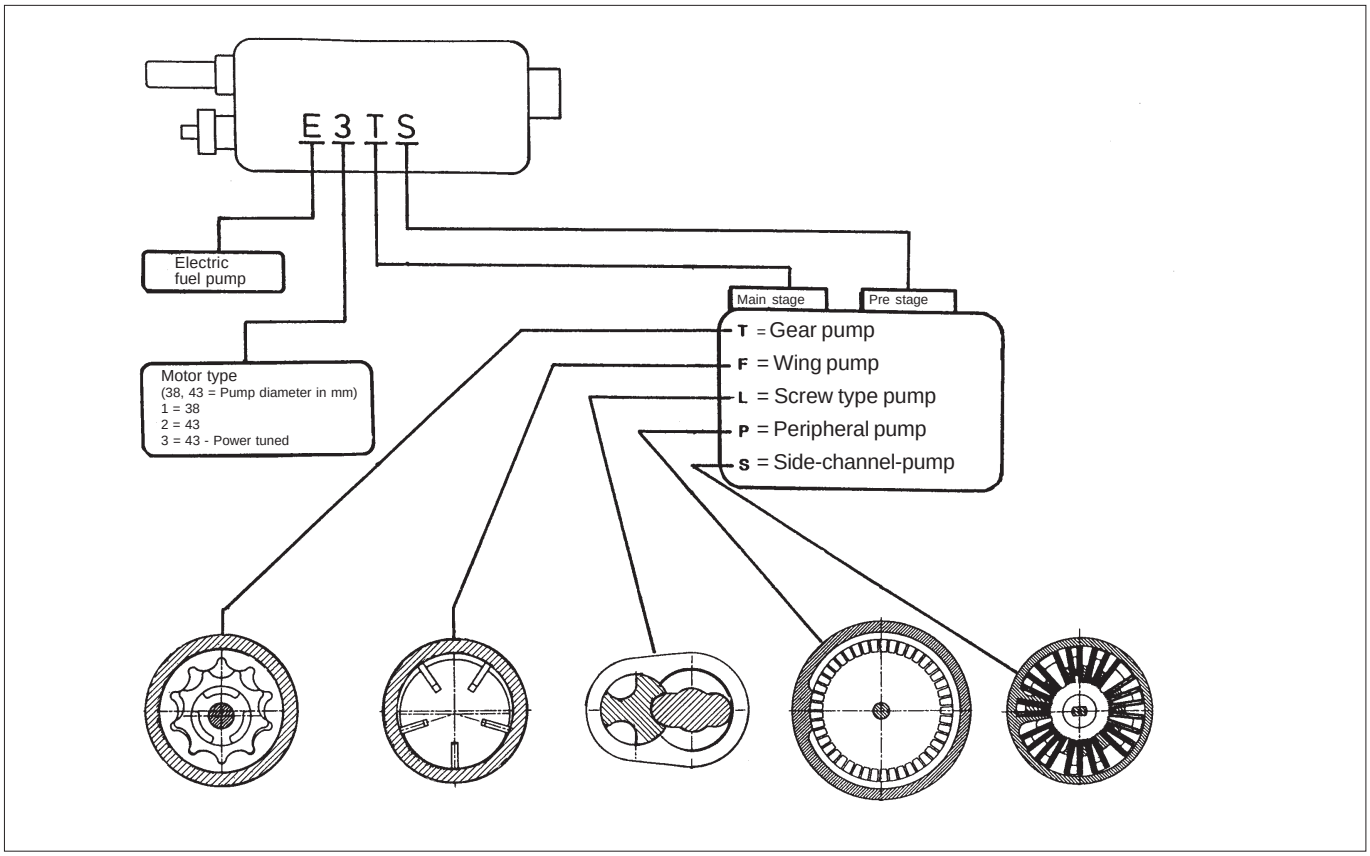

Fig. 18

Geared, wing unit and screw pumps are positive-displacement pumps. They are self-priming.

Peripheral and side-channel-pumps are flow pumps. They are not self-priming, and are therefore ”wet”, i.e. installed inside the fuel tank.

Sucking jet pumps are used, in addition to electrical fuel pumps, with saddle tanks (and other tanks shaped to take advantage of available space).

These sucking jet pumps are fitted in the bottom of the tank (Fig. 19 and 15), in the backflow pipe. Fuel returning from the motor is compressed by the sucking jet pump and thus entrains fuel into the fuel collector.

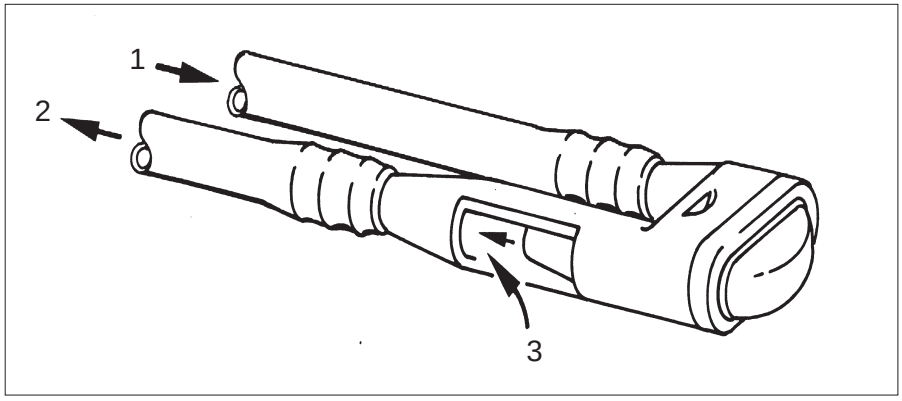

Fig.19 Sucking jet pump
1. Fuel from motor (backflow pipe)
2. Fuel to collector
3. Fuel inlet (from tank)

System components

Pressure regulator

The pressure regulator (Fig. 20) determines the system pressure. In SPI systems, the pressure regulator is built into the central injection unit.
In MPI systems, it is located either at the outlet of the fuel distributor or behind the distributor itself (Fig. 21) and is connected to the inlet pipe.
An adjustment is made via the inlet tube pressure to ensure that the injection feed rate depends solely on the amount of time the valves remain open.

There are special cases where the connection to the inlet pipe is merely fitted as an outlet for use in the event of membrane defects.

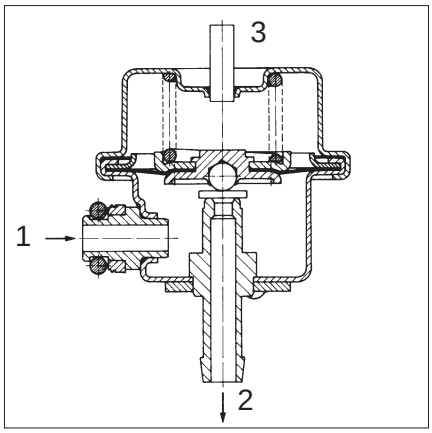

Fig. 20 Pressure regulator
1. From fuel distributor
2. Backflow
3. Negative pressure inlet pipe

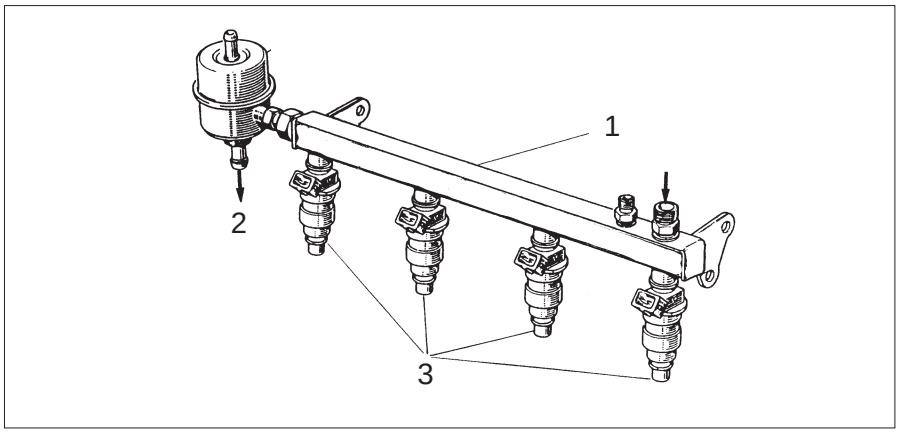

Fig. 21
1. Fuel distributor
2. Backflow
3. Injection nozzles

Vibration dampers

Pressure surges and resonance may arise between the fuel tank and pressure regulator, which can lead to vibration noise. Vibration dampers (Fig. 22) permanently prevent this noise and can be added after installation. (Si 0001).

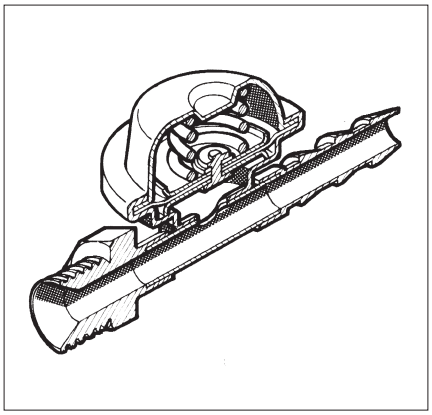

Fig. 22

Non-return valves

Non-return valves (Fig. 23) fulfil many functions within the fuel supply system. They provide reliability, damage prevention and convenience.
They prevent, for example:

- long start-up times due to the feed or backflow pipes emptying completely with the motor off and resting on a slope.
- fuel leaks caused by broken fuel pipes

Non-return valves are simple to fit after installation. They are marked with the direction of flow.

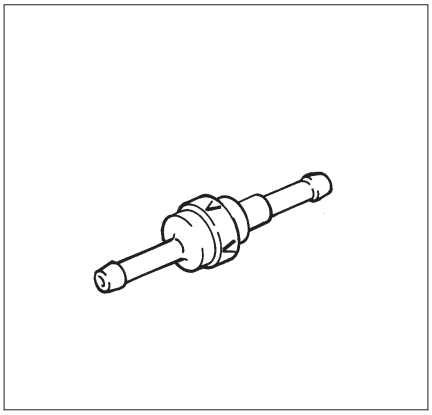

Fig. 23

AKF systems

(Fuel evaporation prevention systems)

Fuel evaporation occurs when tank temperatures exceed 30ºC, resulting in HC emissions, which are controlled by law.

Modern vehicles are fitted with a prevention system which provides permanent reduction of these emissions. This system consists of an activated charcoal chamber (AKF filter), pipes and a regenerative valve. Two valves may be used in certain cases.

In AKF systems, fuel vapour produced in the tank is channelled into the active charcoal chamber. The activated charcoal retains the fuel and allows the air to escape. The tank is ventilated, and air released, via the activated charcoal filter.

The storage capacity of the activated charcoal is limited and it must therefore be regenerated. This is carried out via a tube leading to the inlet pipe, where advantage is taken of the difference between atmospheric pressure and the much lower pressure in the inlet pipe. Air drawn in from outside flows through the activated charcoal and into the inlet pipe, flushing the stored fuel out and taking it away to be burnt. This flushing, or regenerative, flow is a fuel mixture whose composition cannot be controlled. It may range from fresh air to a highly rich fuel-air mixture. The regenerative flow is, in either case, an interference factor for fuel-air mixture adjustment.

To prevent excessive influence on the fuel-air mixture adjustment, the regenerative flow is channelled via a valve, the regenerative or AKF valve, which doses the flow to the inlet

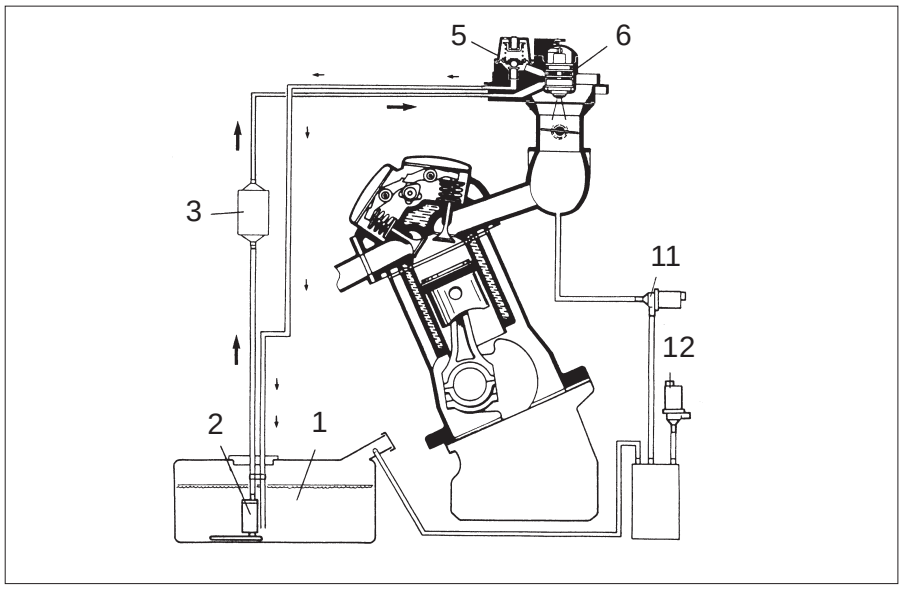

Fig. 24
1- Fuel tank
2- Fuel pump (in-tank)
3- Fine filter
5- Pressure regulator
6- Injection valve
10- AKF filter
11- AKF valve (regenerative valve)
12- AKF shutoff valve

When fuel-air control is inactive, regeneration is only carried out within a limited range.
Faults in the regenerative valve can lead to interference with correct operation.
In conjunction with OBD systems, the entry of fresh air to the activated charcoal is controlled via an additional valve - the AKF shutoff valve

(Fig. 27) The regenerative valve is then opened and the entire system pressure rises to that of the inlet pipe. A pressure sensor in the tank determines the current pressure and thus detects any leaks. Leaks in excess of 1mm^2 produce an error message which appears as a fault warning.

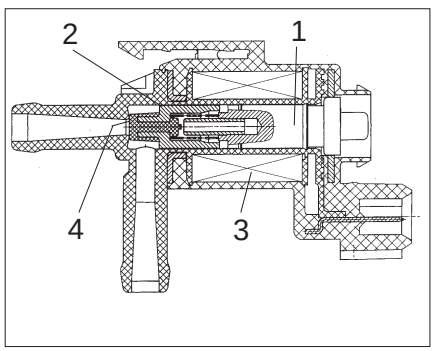

Fig. 25 AKF valve (Pierburg)

1. Core
2. Keeper and valve plate
3. Coil
4. Valve seat

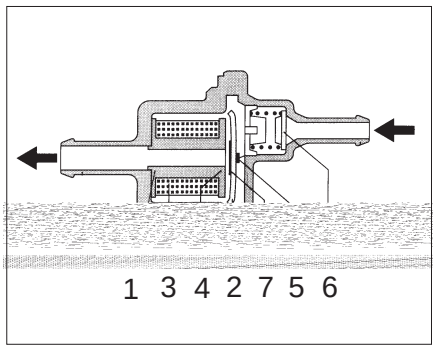

Fig. 26 AKF valve (from other manufacturer)

1. Core
2. Keeper and valve plate
3. Coil
4. Valve seat
5. Plate spring
6. Non-return valve
7. Sea

AKF-systeme

AKF shutoff valves have a considerably larger cross section than regenerative valves. Shutoff valves function as open/shut valves.

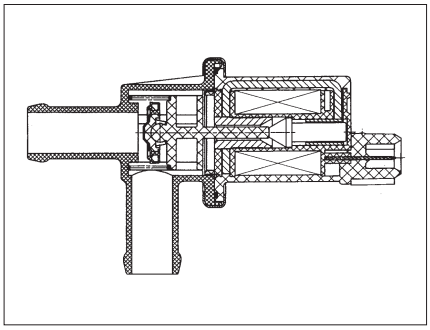

Fig. 27 AKF shutoff valve

Frequently asked practical questions

The following questions often arise during technical consultations

Questions	Replies
Where can i find the fuel pump I'm looking for?	In the Pierburg catalogue "Fuel pumps" 2/400 - 100.4, on the TECDOC CD (electronic car-parts catalogue) and/or on TECDOC database systems.
I can't find the fuel pump/vehicle in the catalogue. Can I use a different pump X?	• A qualified "yes", if the customer is a workshop (or professional fitter), the pump data are clear and the installation position has been tested successfully. • For over-the-counter sales to amateurs, "no". The customer should bring the old pump - whose details are known - as a pattern to be matched to a comparable Pierburg pump.
How much power does it consume?	Tight initial fit can lead to considerably higher-than-normal power consumption during the running-in period. In certain cases, a fuse of the next rating up should be fitted as a short-term (approx. 10 min.) measure.
Important! Do not forget to replace the original fuse. Can I connect a fuel pump with an O-system (without decrease and with closed backflow) to a pressure gauge, for example?	Only briefly. Use of an O-system causes the pump to heat up rapidly, because: 1. There is no cooling from the volume flow. 2. The pump, operating at 28A and 12V, produces 336W - leading to further heating. The pressure limiting valve (if fitted) also opens, and this can lead to functioning faults in older pumps.
How long can a fuel pump be allowed to run dry?	30 sec max. Pumps should basically never be allowed to run dry.
How high is the feed rate?	See table(s) on pages 14-21, table on page 8 of "Fuel Pumps" catalogue or PI 5/400-104.1.
How can I measure the feed rate?	At backflow behind pressure regulator, using a measuring jar.
What's the fuel pressure?	See table(s) on pages 14-21, table on page 8 of "Fuel Pumps" catalogue or PI 5/400-104.1.
How high can a fuel pump draw?	Max. 200cm. The suction height should however not exceed 50cm. Pumps must not be allowed to run dry.

Overview of further information literature

The following material is available for information on the subject of ”fuel supply”.

Title	Reg. No.	
• ”Fuel Pumps” catalogue	2/4 00-100.4	
• ”pi” product information		
- Electrical fuel pumps	5/4 00-104.1	
- Fuel pressure testing device - pi 0005 (Replaces pi 5/20 00-503.2) 5/20 00 - 503.4		
- Extension pieces to pressure testing device 4.07360.50.0	5/20 00-503.3	
• Operating instructions for pressure testing device	3.45222.130	
• Servicing Tips and Information”Engine fuel injection supply systems”	6/4 00-100.1	**NEU**
• ”si” servicing information		
si 0001 Vibration dampers		
si 0004 Electrical fuel pump for VW		
si 0005 Electrical fuel pump for BMW - replacement		
si 0006 Electrical fuel pump for BMW - replacement		
si 0007 Electrical fuel pump for MB - new application		
si 0008 Electrical fuel pump for Audi - new application		
si 0009 Electrical fuel pump for Audi - replacement		
si 0014 Electrical fuel pump for MB - new application		
si 0015 Fuel pressure regulator various vehicles		
si 0016 Safety shutoff for electrical fuel pumps		
si 0018 Electrical fuel pump for Audi - replacement		
si 0021 Replacement parts for fuel supply units		
si 0028 Electrical fuel pump for MB - replacement		
si 0031 Mechanical fuel pump for MB - replacement		
si 0032 Electrical fuel pump for Audi - replacement	New for ‘98	**NEU**
si 0033 Electrical fuel pump for MB - new application	New for ’98	**NEU**

You can find further information on the following subjects:

- Fuel supply
- Negative pressure supply
- Air supply and
- Reduction of pollutants

In the collected information ”Engine Components” Cat. No. 8.40000 82.2

These documents can be updated to 1998 with the 1998 annual supplement, Cat. No. 8.40000 85.8, obtainable for a nominal fee from Pierburg publications wholesalers.
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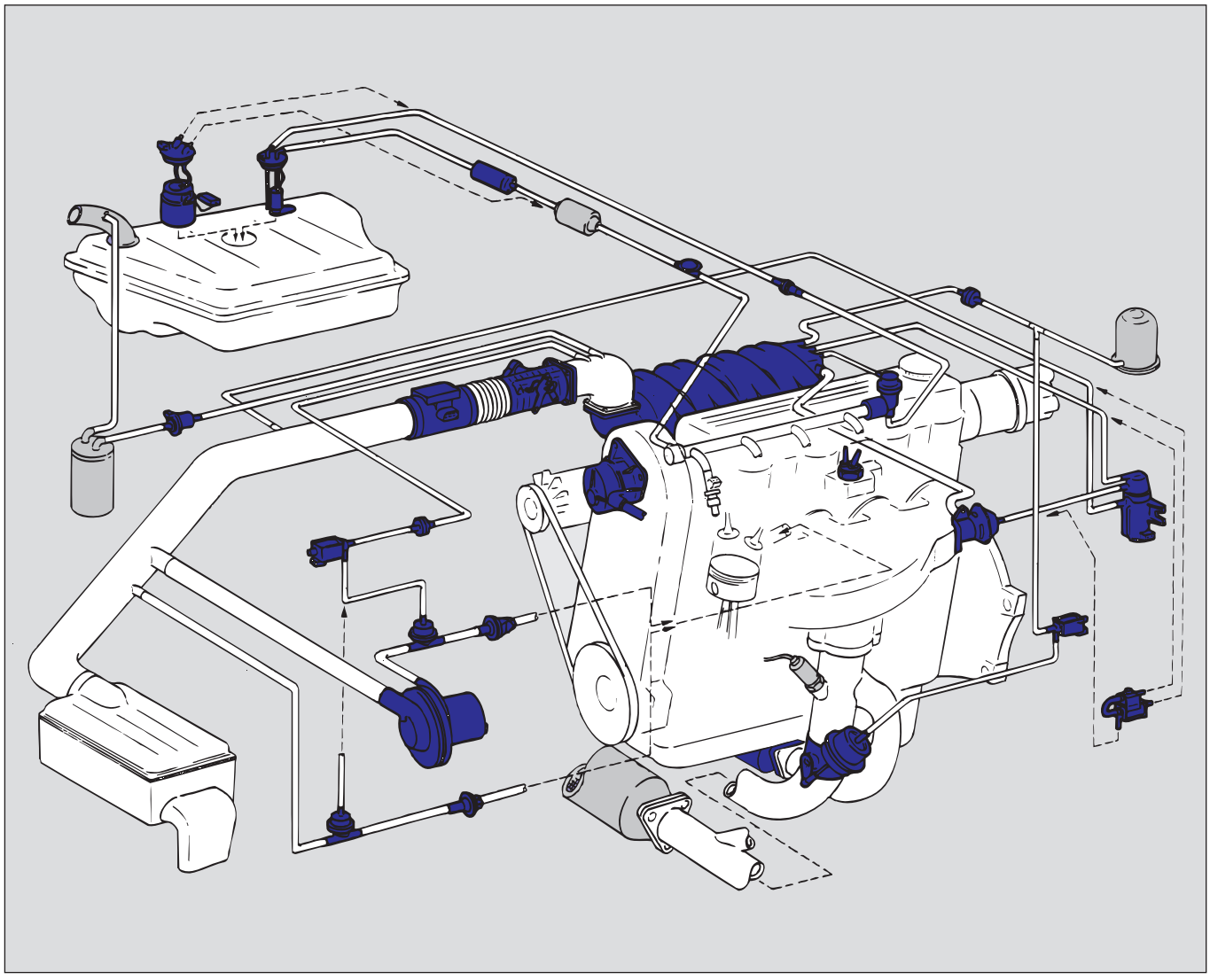

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