HAKO Cut-away and functional models - News

Order no. 1295
cutaway model Piezo injector

The following parts have been cut away:
- fuel rod filter and high pressure channel
- low pressure channel (10 bar)
- actor module with Piezo layers
- coupler module and switching valve
- high pressure channel and throttle plate
- injection nozzle with nozzle needle

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Order no. 1296
cutaway model Piezo injector with high-pressure pump

The following parts have been cut away on the injector:
- fuel rod filter and high pressure channel
- low pressure channel (10 bar)
- actor module with Piezo layers
- coupler module and switching valve
- high pressure channel and throttle plate
- injection nozzle with nozzle needle

The following parts have been cut away on the high-pressure pump:
- pump cylinder
- fuel quantity regulation valve
- fuel channels

By turning the star grip, you see the function of eccentric cam and pump plungers.

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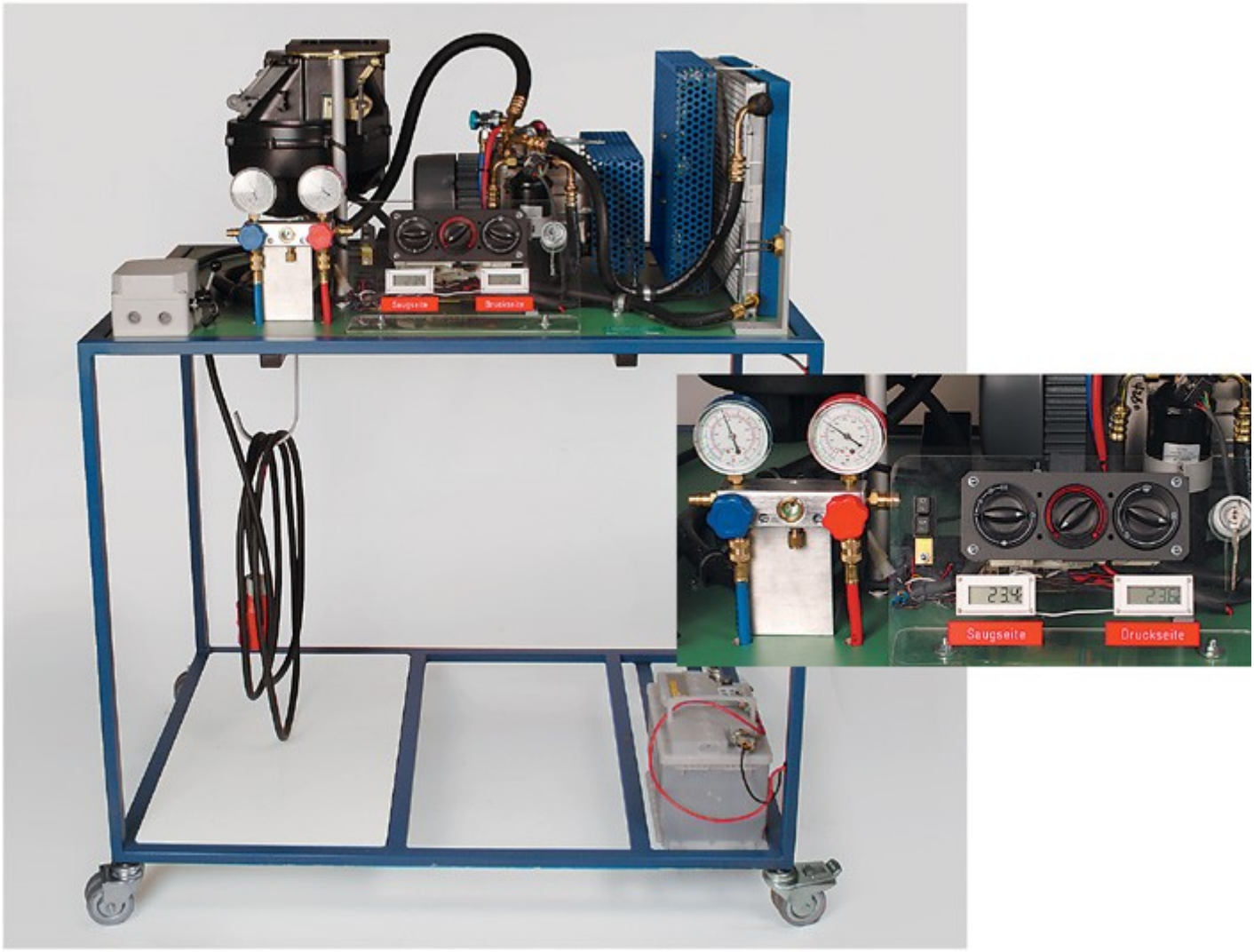
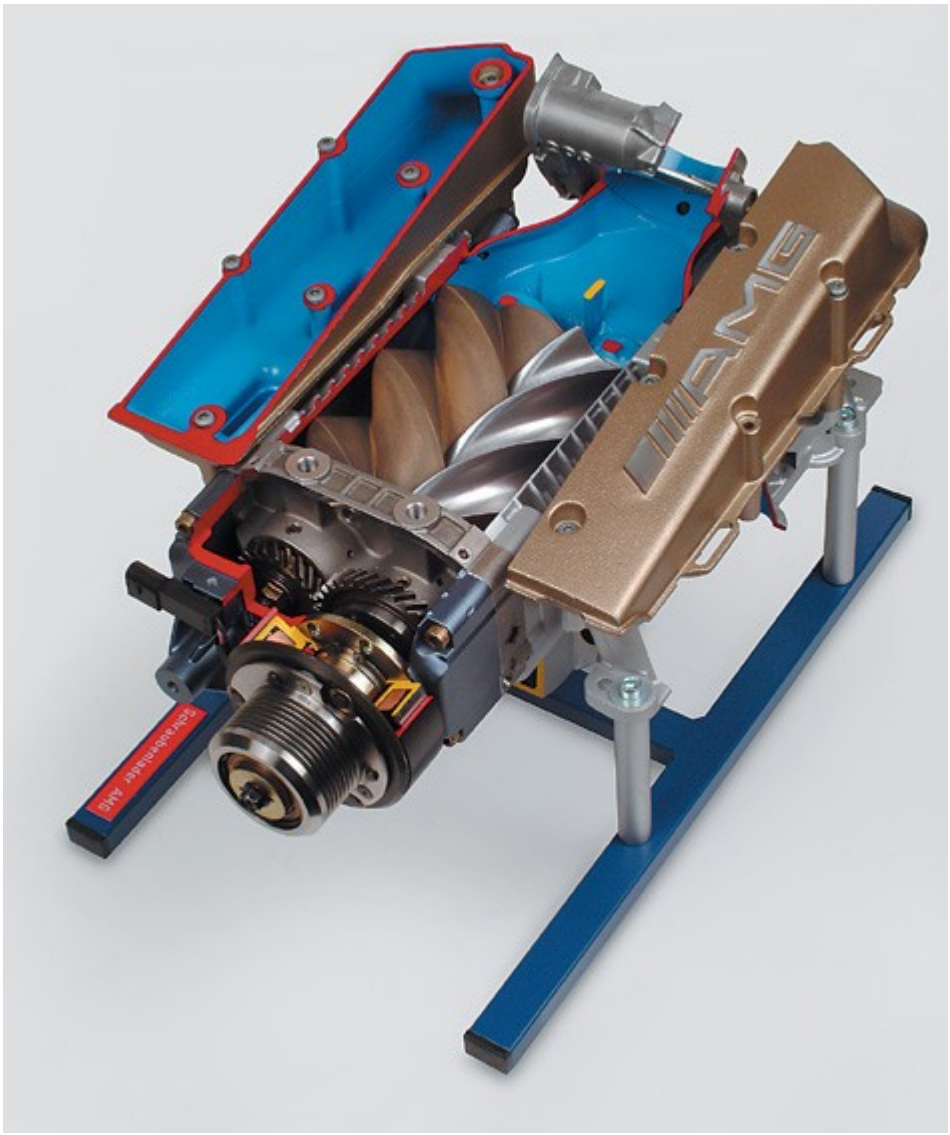


Order no. 1307
Function model air-conditioning

This system is an extension of our model no. 1237. In addition, pressures and temperatures can be read off on this system.
The air-conditioning is driven by a 400V, 3-phase electric motor. The system has been filled with coolant and can be operated without additional devices. The 12V and the 400V switch can be locked.



Order no. 1298
cutaway model screw compressor with charge-air cooling

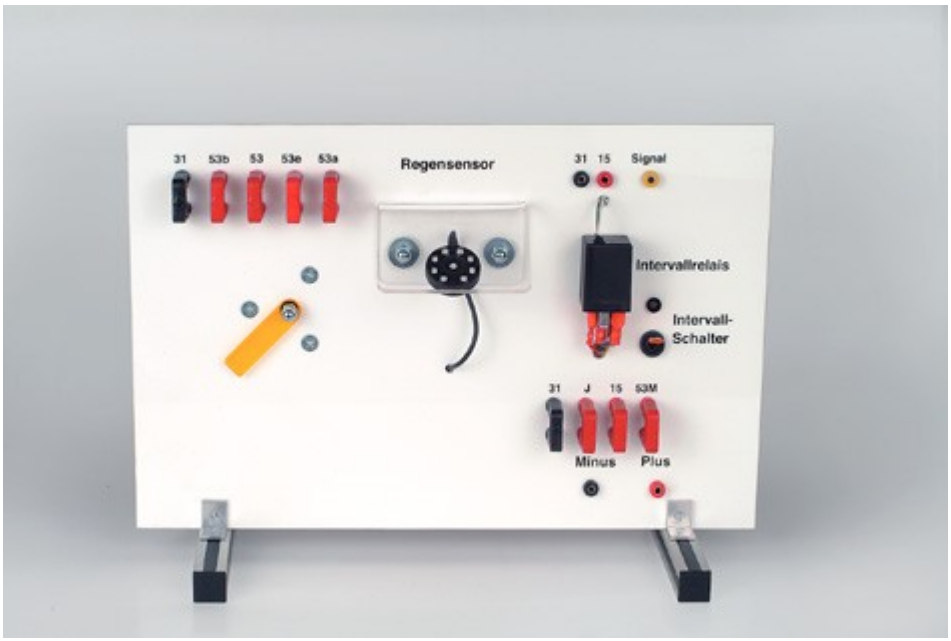
High performance compressor of the firm AMG
Easily visible: the two screw spindles, driven via a magnetic clutch and gear wheels.
The charger runs at 12'000 RPM. At the bottom of the charger is the cutaway charge-air cooler with water channels.

Order no. 1299
cutaway model screw compressor without charge-air cooling

High performance compressor of the firm AMG
Easily visible: the two screw spindles, driven via a magnetic clutch and gear wheels.
The charger runs at 12'000 RPM.

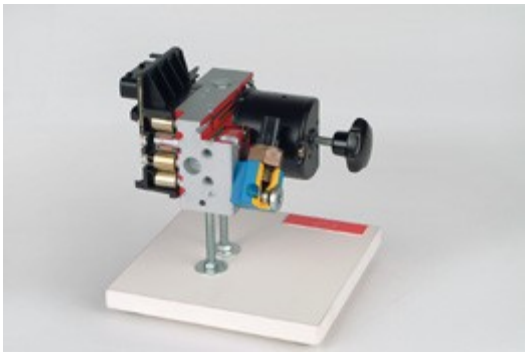
Order no. 1301
cutaway model electrical rack- and pinion steering

Functions:
- sequence of movements in steering gear
- ratio in steering gear
- support of the steering forces by an electric motor



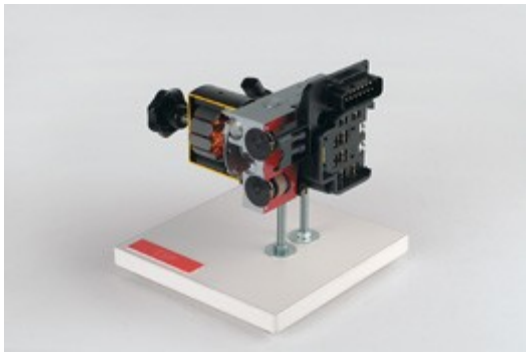
Order no. 1304
Function model: Rain sensor with wiper motor

- connection of the function model to 12V power-pack
- operation of the interval switch
- spraying of the sensor with water
- wiper motor runs in interval operation
- measurements: trigger signal, voltage supply, current and voltage measurements



Order no. 1302
cutaway model: Hydraulic unit ESP

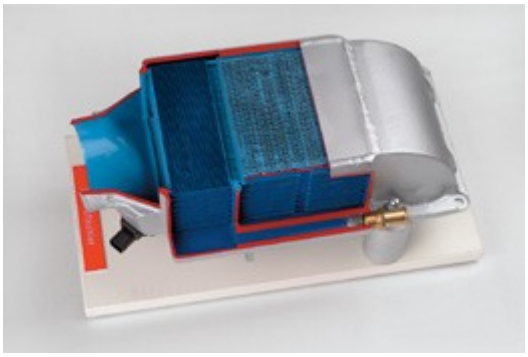
The following parts have been cut away:
- electric motor of the high-pressure and return pump
- plungers of the pump move when the electric motor turns



- solenoid valves
- transmitter for brake pressure

Order no. 1303
Hydraulic coupling, automatic transmission

The following have been cut away:
- coupling housing
- coupling plunger
- return spring (disk spring)
- steel and friction lamellas



Order no. 1300
Charge-air cooler

This charge-air cooler is an air/water heat exchanger with a separate coolant circulation. The water and air channels have been cut away and painted accordingly.

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Order no. 1297
Aluminium rim

Easily visible:
- well base, rim shoulder and rim flange
- balancing weights and valve
- wheel offset on the moving scale can be read off directly

Order no. 1305
Function model spreading

When the wheel is turned, you recognise the lifting of the vehicle
(on the ball). If you press the ball, the turned wheel immediately
goes into the straight ahead position.

negative camber

positive camber

large spreading angle

Order no. 1306
Function model axle geometry (Castor offset, camber, toe-in and spreading)

The following can be changed and demonstrated on the model:
- the wheel camber (negative, zero - and positive), the spreading, the castor offset and the steering offset
- enlargement of the camber in an enlargement of the castor offset
- change of the steering offset if the spreading and camber are changed

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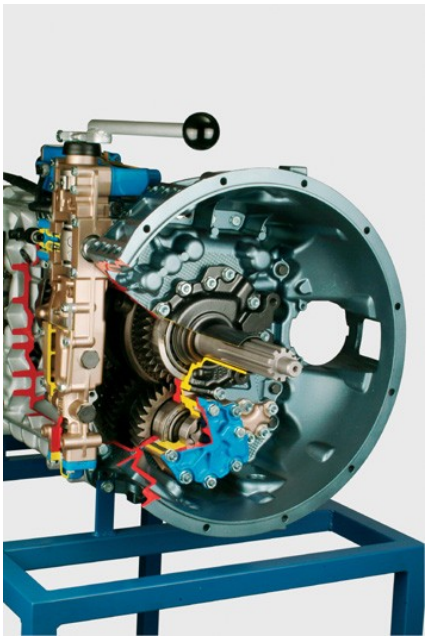
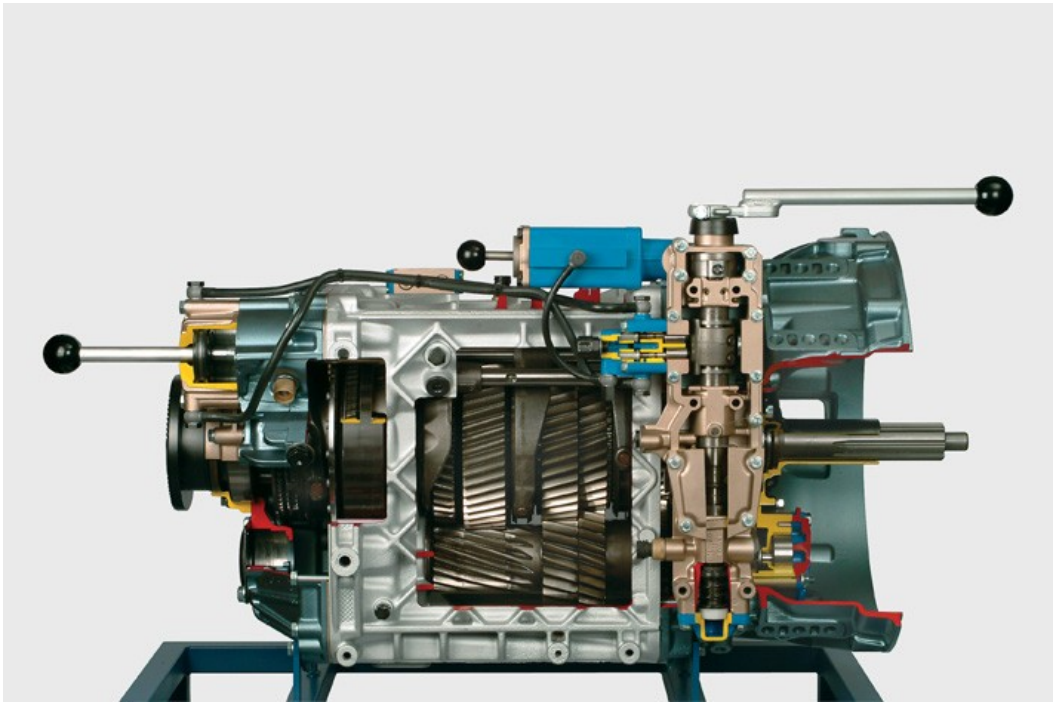
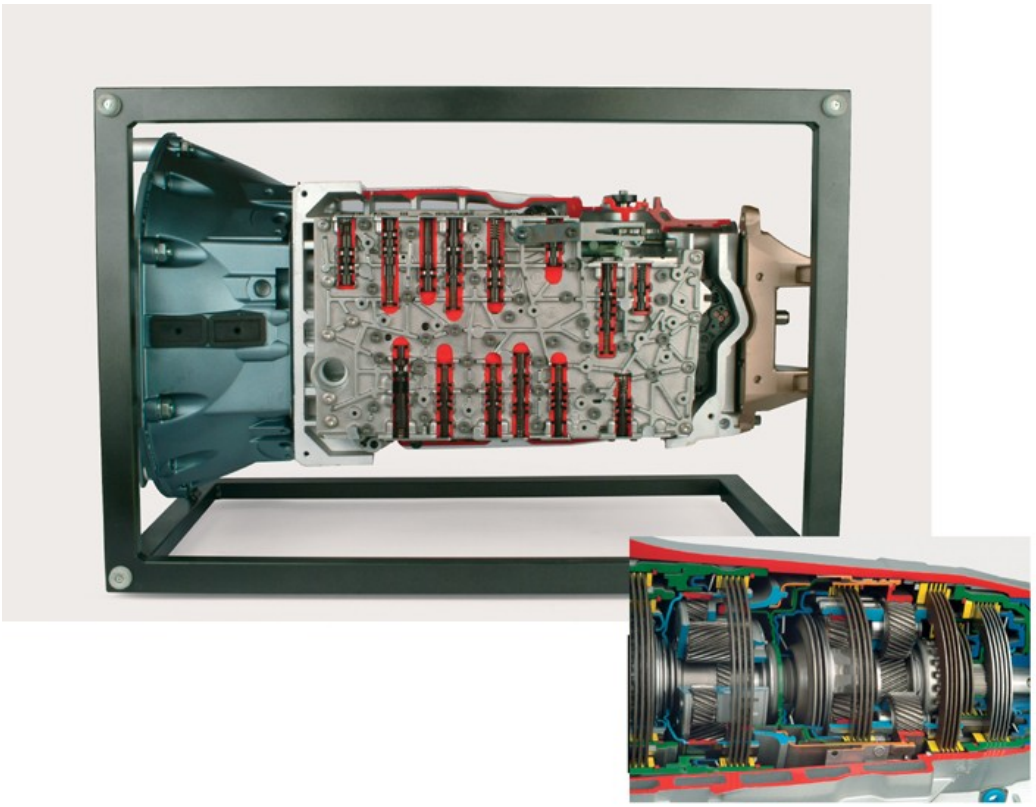
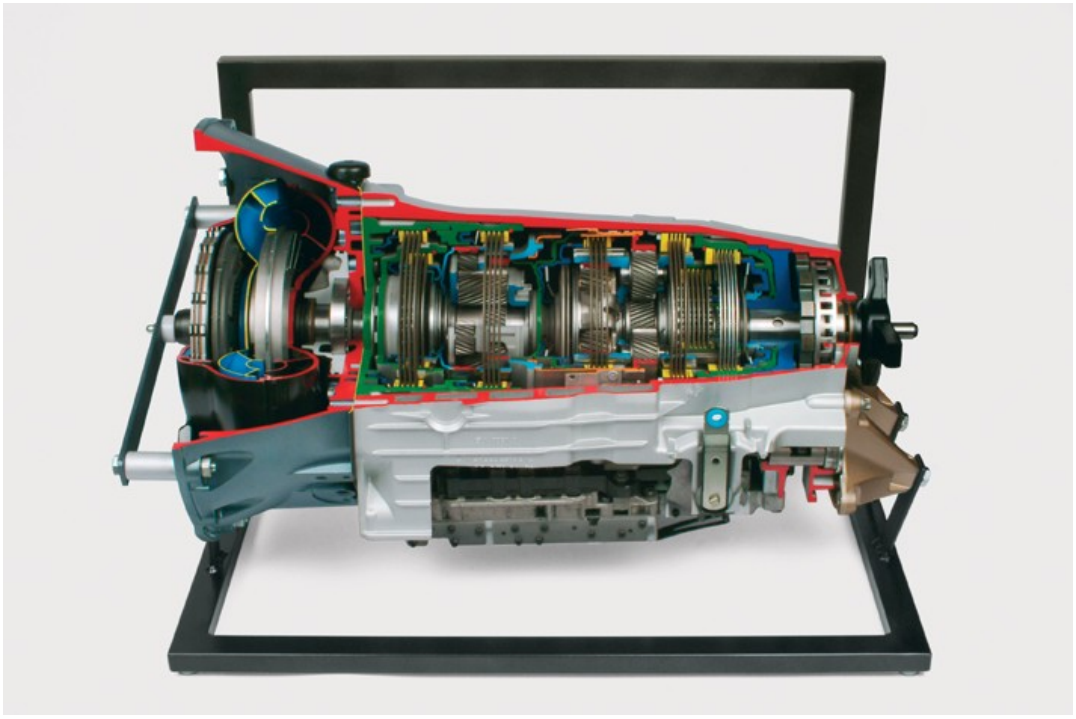




Order no. 1308
Truck transmission ZF-ECOSPLIT

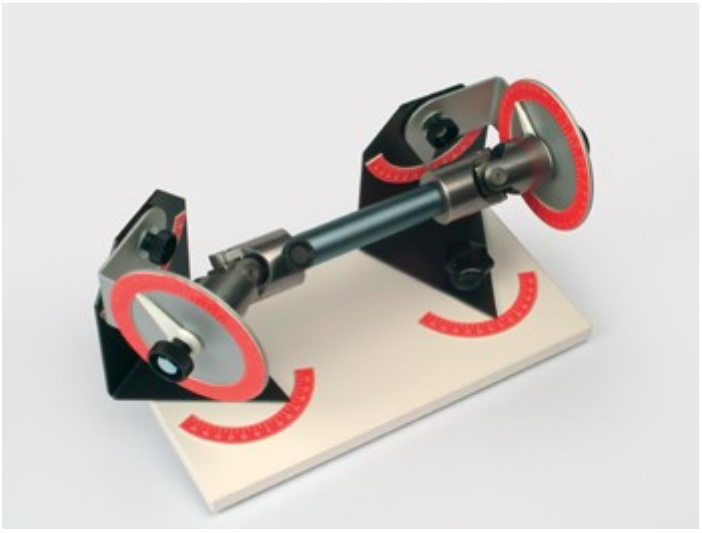
The transmission has 4 forward gears and one reverse gear. By a different transmission onto the countershaft, the split group makes it possible for 4 further
gears each to be found between the 4 other gears to be shifted. A planetary gear train acts as a rear-mounted group, with the result that the 8 gears can
used in fast mode or in slow mode. In this way, a total of 16 gears are available. The rear-mounted group and the 4 basic gears are shifted mechanically
on the model, the split group pneumatically. Transmission input shaft, main shaft, countershaft and reverse gear, the control forks with gearshift linkage,
pneumatic cylinder and the rotor oil pump are very easy to see. As the transmission has a weight of about 320 kg, it has been fitted on a trolley.

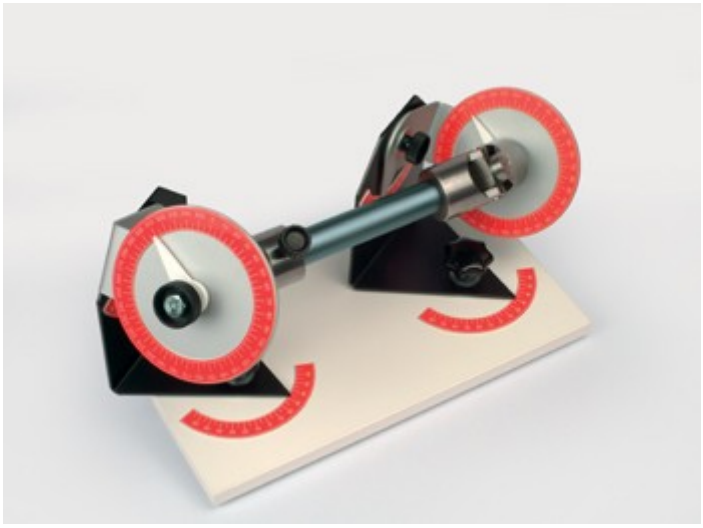




Order no. 1310
Daimler Chrysler 7-gear automatic transmission

With the 5th generation of Mercedes Benz automatic transmissions, the following is achieved: high shifting comfort, lightweight construction, fuel savings
and increased driving enjoyment. The transmission can be turned easily both from the drive and also from the output side. The following are visible:
All 7 hydraulic couplings, converter with lock-up clutch, Ravigneaux planetary gear train and 2 simple planetary gear trains, disk springs, parking lock (it
can be activated and released), hydraulic control, range selector (can be shifted), solenoid valves and many small construction parts.



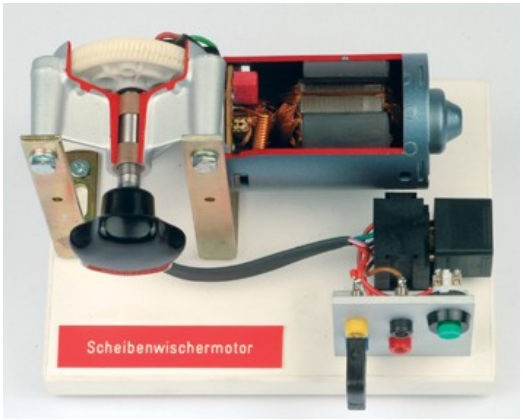


Order no. 1312
Function model, universal joints

If universal joints are driven without bending of a part of the shaft, they run with a constant rotary movement. If a bent universal joint is used, an uneven movement results, there is advance or retard on the output side. This can be demonstrated very graphically on the model by the two scales on the drive and the output side being read. If the drive and the output side. are bent at the same angle, the advance and retard precisely compensate one another and the output side runs evenly again compared with the drive side. If one joint is offset against the other on the model, for example by 90 degrees, this again results in a strong unevenness. This also happens in practice when drive shafts are put back in the wrong position after repairs.

Order no. 1311
Sprag-type clutch, automatic transmission

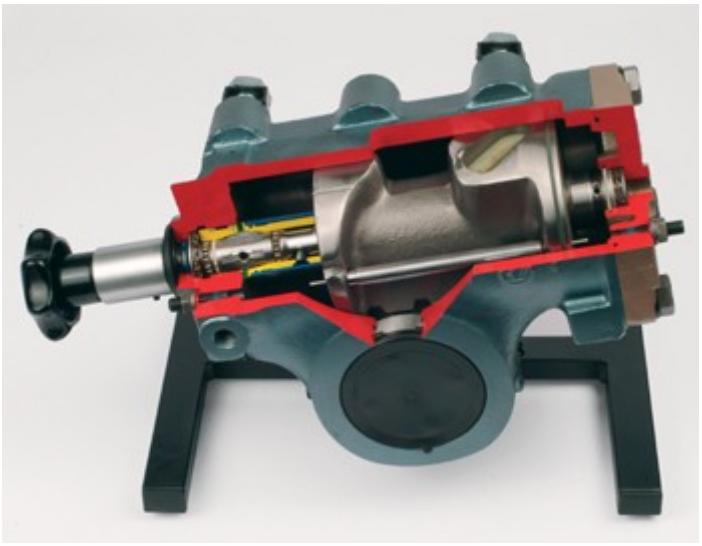
In automatic transmissions, they have the task of holding certain parts in one direction of rotation and releasing them in the other direction, for example in planetary tear trains and in the torque converter. When the shaft turns, one sees how the sprags move and block or release depending on the direction of rotation.

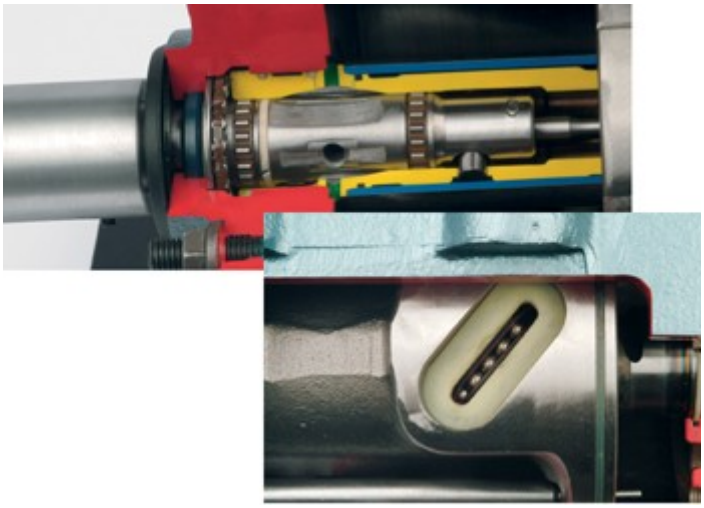


Order no. 1309
Function model windscreen wiper motor

The following are easy to recognise on the cutaway model:
- Armature with carbon brushes
- Field (comprising permanent magnets)
- Worm on the armature shaft
- Worm gear of nylon of the wiper shaft
- Strip conductors for limit switching

Functions:
- Allow the motor to run by pushing the button
- Limit switching when the button is let go of
- Current measurement in idling and under load

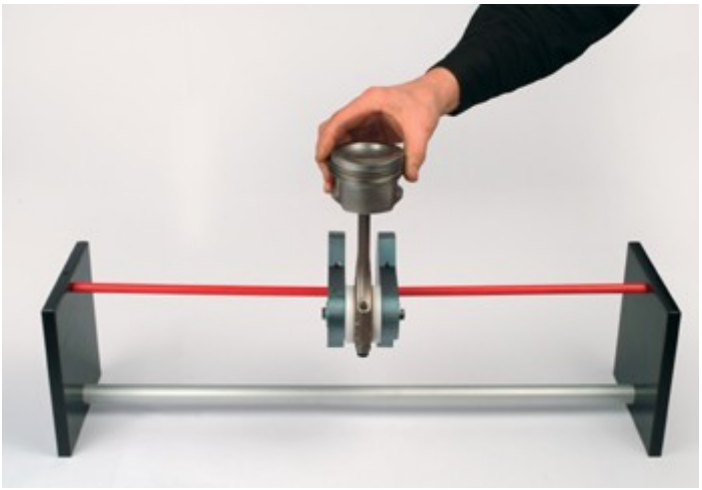


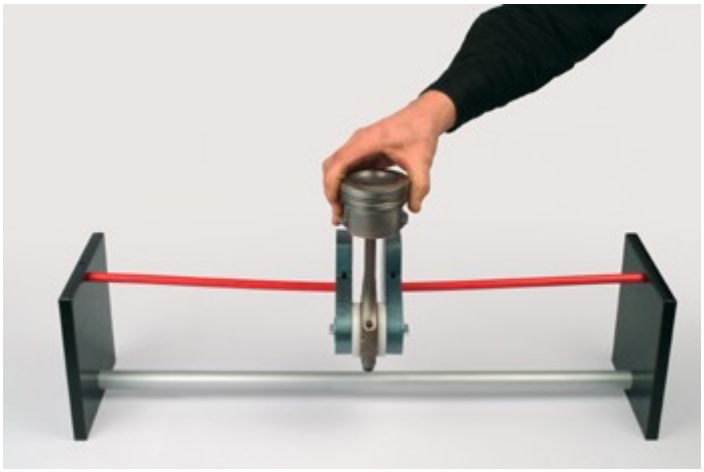


Order no. 1313
Truck ball nut, hydraulic steering gear

Our steering gear is a truck ball nut hydraulic steering, type ZF Servocom.
When the steering spindle is turned with the help of the cross button, the
steering nut plunger is displace in the housing cylinder.

The steering shaft makes a pivoting movement. When the steering spindle is
turned, one sees the function of the hydraulic control with the torsion bar,
rotary valve, control jack and radial grooves. The following can also be seen:
steering stop valve, ball nut plunger with toothing, steering-sector shaft and
the balls in the cutaway ball cage.





Order no. 1314
Function model crankshaft

It is often difficult to make the special kinds of strain on a crankshaft
understandable for the pupils. The main kinds of strain, torsion and ...

... flexion can be demonstrated graphically on the model. If you push the plunger
down by hand (e.g. work cycle), you see the flexing and the distortion of the
crankshaft quite clearly as a function of the force applied.

Order No. 1317
ZF active steering

This system essentially comprises a rack-and-pinion power steering, a planetary transmission, an electric motor, some sensors and a control unit. The additional degree of freedom makes continuous variation of the steering ratio as a function of the situation possible. Depending on the driving situation, the effective steering angle on the wheel is therefore smaller or larger than the one which the driver sets on the steering wheel.

Functions:

- Turn the steering wheel (star handle), function of the rotary sleeve valve, the gear rack is displaced, the piston moves. In this context, the stepped planetary wheels and the sun gear move in the housing, as the worm gear has been locked by the electromechanical block via the worm.
- If the electromechanical block is unlocked (via an electromagnet, here by lifting the anchor), the handle of the electric motor can be turned. Now, the worm gear turns and the drive pinion moves the gear rack. The planetary transmission adds or subtracts an adjustable engine angle to the angle set by the driver. The sum of these two angles then acts on the drive pinion, which generates the steering angle.
- Function of the electromagnetic valve on the Servotronic 2 rotary sleeve valve.
- Connection of the oil lines, function of the rack-and-pinion piston.

Order No. 1319
Cylinder head with direct petrol injection (GDI)

This is a Mercedes cylinder head with 4 valves. One valve had to be cutaway in order to show the injection valve and the spark plug.

The following can be shown:

- Function of the 3 remaining valves
- Function of the hydraulic valve tappet
- Function of inlet and outlet channels
- Function of the cutaway GDI injector with Teflon ring (bottom, on the nozzle body), nozzle module, piezo-actor module, coupler module, fuel intake (high pressure), O-ring (leakage line) and electrical connection

Order No. 1316
Rear light with LED's

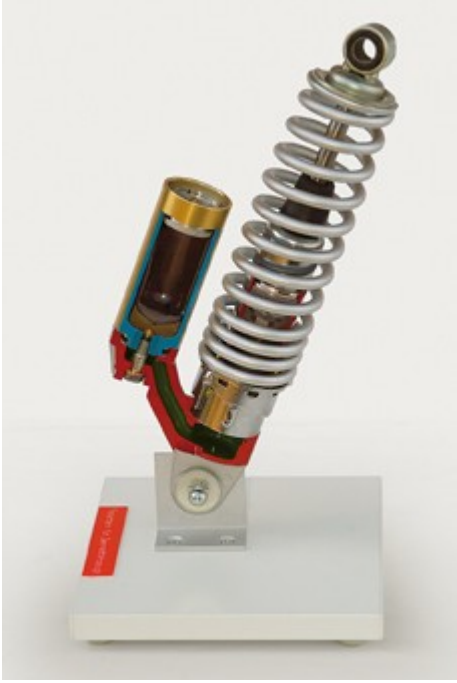
In the housing, a certain number of diodes have been switched together to form a construction unit in accordance with the necessary lighting strength and the required light colour. As a result of this multiple provision, the probability of failure of the overall function is minimised.

Benefits:
LED's consume considerably less current, have reached their maximum luminosity after about 2 milliseconds and have a service life of about 10'000 hours.

Demonstration:
- Connection to a 12 Volt mains with the help of the black and red jacks
- Operation of the indicator (green key)
- Operation of the brake light (green key)
- Operation of the rear light (green key)
- Measurement of the current flowing in each case with the help of the bridge

Order No. 1318
Side-valve four-stroke engine

This is a unit engine with the camshaft positioned at the bottom..
Functions:
- Turn the star handle (crankshaft), the piston moves up and down
- The camshaft at the bottom is driven and opens the valves
- Intake, compression, working and ejection
- Function of the magnetic ignition with interrupter or breaker less
- Starting of the engine via manual starter
- Function of air filter, carburettor (with floater and throttle valve), exhaust silencer, fuel tank, fuel tap, oil tank, crankcase ventilation
- On the camshaft, there is a centrifugal advance device, which turns the throttle valve in the carburettor via a linkage, in order to regulate the speed



Order No. 1325
Suspension strut for two-wheel vehicles

In two-wheel vehicles, single-tube shock absorbers are frequently used. A suspension strut with a progressive spring has been used. Blowing or discharge of nitrogen into/out of the compensation container changes the attenuation (hard, soft).

The following can be shown:

- Compression by pressing on the suspension strut
- Device to change the spring hardness by turning the stepped sleeve on the bottom of the suspension strut or adjusting nut
- Movement of the cutaway work piston with finned valves for the pusher and tractor phase
- In the cutaway compensation container, the cutaway dividing piston (rubber membrane), in which the gas cushion can be found, can be seen

Order No. 1315
Diesel particulate filter (soot filter)

The particulate filter comprises a beehive-shaped ceramic body (silicon carbide). It is sub-divided into a number of small channels arranged in parallel, which have been positioned alternately. The exhaust gas contains the following gases: carbon monoxide, carbon dioxide, nitrogen oxides, hydro-carbons, sulphur dioxide, as well as soot particles and an additive. The additive, which is mixed into the fuel in fine traces, lowers the ignition temperature of the carbon from 650 to 500 degrees.

Demonstration:

- The ceramic body, surrounded by fibre materials and steel wool, is in the metal housing
- On the cutaway part and also on the front and face surfaces, one recognises the alternately closed and opened channels
- Gas particles can escape through the pores of the side walls into the adjacent tubes, whereas soot and additive, as a result of their size, remain in the middle tube
- After about 500 to 700 kilometres of driving, there is regeneration (the soot is burnt off). With the help of pressure sensors in front of and behind the filter and of the exhaust gas temperature, the time when regeneration is necessary is calculated. Now, the filter is empty again.

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Order No. 1321
High-pressure pump for engines with direct petrol injection (GDI)

The necessary high pressure is generated by a 3-plunger radial-piston pump with the following features:
Compact construction, stainless steel housing with integrated quantity control valve, shut-off attenuator, fuel-lubricated, max. fuel pressure of 200 bar.
The knurled screw can be used to drive the high-pressure pump and one sees how the pump pistons work.
The eccentric shaft is guided on the drive side by a roller bearing and opposite by a plastic friction bearing (fuel-lubricated).
Also cutaway: fuel return with shut-off attenuator, quantity control valve with magnetic coil and filter.

Order No. 1320
Injector for engines with direct petrol injection (GDI)

The benefit of these injectors is that they switch extremely quickly and thus inject minimum quantities of fuel, which makes multiple injection (3) possible. As all the parts of the injector are multiple laser-welded, it is not possible to cutaway these parts any further..
The following can be shown:
- Cutaway injector housing and interior housing
- Teflon ring for sealing in the cylinder head
- Nozzle module
- Coupler module
- Fuel flow (high pressure)
- O-ring to seal the leakage line
- Electrical connections for voltage supply to the piezo-actor module

Order No. 1322
Common rail injector with magnetic coil at the bottom

In this new construction, the magnetic coil and the valve body have been moved to the bottom compared with injectors used up to now and are positioned directly above the nozzle needle. The long and sluggish pressure rod is no longer needed. In this way, quick gearshift times, also with solenoids, are possible. In addition, a spiral-shaped groove has been milled into the nozzle needle, resulting in a optimum injection jet of fuel when it leaves the injection nozzle.
The following is seen in the cutaway of the injector:
Injector housing with cap nut, nozzle body with nozzle needle, high-pressure canal, pressure spring, valve body, solenoid, fuel feed, edge-type filter and electrical connection.

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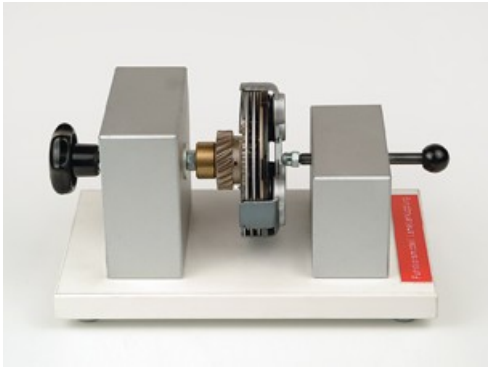
Order No. 1323
Double-acting compressed air cylinder

Compressed air cylinders are often used in commercial vehicles, for example to shift mechanical transmissions on commercial vehicles. They are also used in the compressed air brakes of commercial vehicles as piston membranes or as combined cylinders. One sees the cutaway cylinder area and the two compressed air connections. The working piston can be pushed back and forth easily.



Order No. 1324
Multi-disk clutch

This kind of clutch is mainly used in two-wheel vehicles. It comprises a number of friction disks with external toothing and steel disks with internal toothing alternately arranged behind one another.
The necessary application pressure is generated by coil or diaphragm springs. Our model has been installed in a Vespa.

Functions:
- Turning of the clutch in the engaged state: flow of force
- Pressing the clutch: clutch has now been released
- Turning the clutch in the released state: flow of force interrupted

Order No. 2001
Vacuum and pressure pump

Aluminium version, reversible from vacuum to pressure measures. For the use in various fields on the automotive testing sector. One hand operated, all metal version. High quality compound gauge with robust protection rubber cap, dual precision scale, minus-range -1...0 bar/760mmHG, plus-range from 0...+3 bar/42 psi, graduation 0.05 bar. With bilateral conical brass adapter and 4 connecting adapters made out of plastic. Including 120 ml collecting tank. Supplied in robust plastic case.

Applications vacuum range:
- vacuum meter sensor check
- exhaust gas recirculation valve check
- throttle valve check
- fuel pressure regulator check
- vacuum modulator check (automatic transmissions)
- servo-assisted brake check

Applications pressure range:
- injection pump diaphragm check
- turbo charging pressure check
- exhaust valve check

Order No. 2002
Tractor tester for testing the tractor's plug socket

The tester is fitted with load resistors. LEDs for individual functions and 5 m (16.4 ft) cable provided for use in the workshop and maintenance garage.
- plug 13-pole, 12 V (ISO 11446)
- integrated load resistors for flashers and rear fog lamp

Test functions:
flashers, brake lights, tail lights, reversing light, rear fog lamp.

Order No. 2003
Multimeter in shock protected thermoplastic case with rotary switch

3½ digit illuminated digital display. Possibility to connect clamp-on current probe (0 ... 400 A). Including test leads.

Testing capability	Range	Accuracy	Resolution
Direct voltage(DC)	0 mV...1000 V	± 0.5% + 2 dig.	0.1 mV
Alternating voltage(AC)	0 mV...1000 V (40...400 Hz)	± 0.75% + 3 dig.	0.1 mV
Direct current (DC)	0 µA...10 A	± 1.0% + 2 dig.	0.1 µA
Alternating current (AC)	0 µA...10 A	± 1.0% + 5 dig.	0.1 µA
Resistance	0...10 MOhm	± 0.5% + 3 dig.	0.1 Ohm
Capacity	0.01 nF...100 µF	± 2.5% + 10 dig.	1 pF
Frequency	0.5 Hz...10 MHz	± 0.02% + 2 dig.	0.001 Hz
Continuity test	X		
Diode test	X		
IEC 1010 CAT.III	1000 V		

Order No. 2004
Clamp-on current probe

for testing direct and alternating currents up to a maximum of 400 A. Measuring ranges, 0...40 A and 40...400 A. Adapter opening width 52 mm (2¼"), with red/black leads for connection to multi tester (order no. 2003). Supplied complete with battery.

Order No. 2007
Master kit, Common-rail return flow tester

With graduated plastic measuring beaker (120 ml) in an aluminium holder, including 1 m highly flexible, fuel resistant plastic tube. With replaceable connectors, suitable for all-purpose use. Supplied complete with a connector for each of the following injector manufacturers:

- BOSCH (Piezo valve)
- BOSCH (solenoid valve)
- DELPHI (solenoid valve)
- DENSO (solenoid valve)
- VDO (Piezo valve)

Order No. 2005
Refractometer

for the testing/evaluation of
- radiator coolant
- battery acid
- AdBlue quality
Suitable for coolant additives such as: SONAX, G 11, G 12, G 12 Plus (VW), Superplus 2000 (Ford)

For testing coolant, a light/dark dividing line is shown on the scale, up to which the temperature (in °C) of the coolant is protected.

For testing battery acid, the acid concentration is displayed in kg/l and, in turn, broken down into grades such as
TOP UP/ACCEPTABLE/SATISFACTORY. An adjustable eyepiece permits adjustment to the visual acuity of the user. Supplied in a carton pack complete with sampling pipettes.

Order No. 2006
Tester for testing petrol and diesel fuel injectors

for opening pressure, spray pattern and leaks. Special design in aluminium with base plate; precision pressure gauge, with protective rubber cap and double scale 0...600 bar / 0...8700 psi. Displacement 35cm³, splash proof liquid container (330 cm³) made of plexiglas. The drag pointer of this type tester registers the injection pressure and stays in that position. As a result, it is not necessary to observe the injector spray pattern and the pressure gauge at the same time. Supplied with pressure line (M12x1.5 thread, standard) and adapter M14x1.5.
Available adapters for injection testers:

Standard adapter (M14x1.5)	**Order No. 2006a**
Opel, engine types DTL + DTH (M10x1 with closed cone)	**Order No. 2006b**
VW/Audi, engine type TDI (M12x1.25)	**Order No. 2006c**

Order No. 2008
Portable brake servicing

Unit for maintenance work on braking and ABS systems and hydraulic clutches. Runs off a 12 V DC power supply (vehicle battery) and can therefore be used anywhere. A further advantage of the unit is that it cuts out automatically if the brake fluid reservoir is empty. The unit is connected to the braking system at the header tank of the master brake cylinder with the adapter. Depending on the type of vehicle, other adapters are available.
The working pressure of the unit can be infinitely variably adjusted (0...4 bar / 0...58 Psi). It can be used:
- for brake fluids DOT 3, DOT 4, DOT 4 Plus and DOT 5
- to replace brake fluid (capacity 5 litres)
- for leak testing

Delivery specification:
1 Brake servicing unit
1 Connecting hose with quick-fit connector
1 Adapter

Order No. 2009
Test kit for checking the return flow volumes from Common-rail systems for six injectors

Suitable for use with all BOSCH, DELPHI, DENSO and VDO/SIEMENS injectors. A plexiglas container with a graduated scale permits the comparative measurement of return flow volumes from individual injectors. The container is provided with a hook, so that it can be hung up in the engine compartment. The tester is connected by adapters to the return flow pipe from the injector. The adapters, marked with the name of the injector manufacturer, can be changed over at the connecting hosepipe.

Delivery specification:
1 plexiglas measuring container with a fuel-resistant, highly flexible hose, 40 cm long
6 adapters for BOSCH injectors
6 adapters for DELPHI injectors
6 adapters for DENSO injectors
6 adapters for SIEMENS injectors
The complete kit is supplied in a plastic case

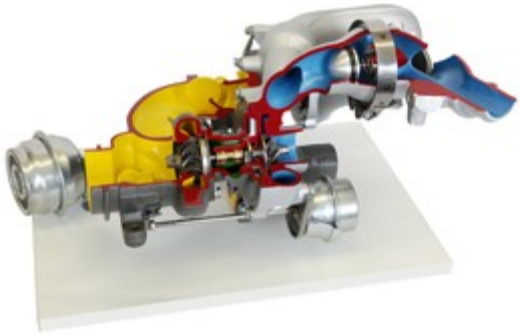
Order no. 1326
Six-speed direct shift transmission (VW)

Cutaway are: wet clutch, timing case, transmission case, main shaft, oil cooler, oil filter, oil pump. The transmission can be turned easily, the gears changed by hand and compressed air applied in part. The shift lock is functional. The function of the clutch can be demonstrated by pressing the disks together. The transmission is mounted on a table stand. Self-study booklet from VW included in the scope of supply.

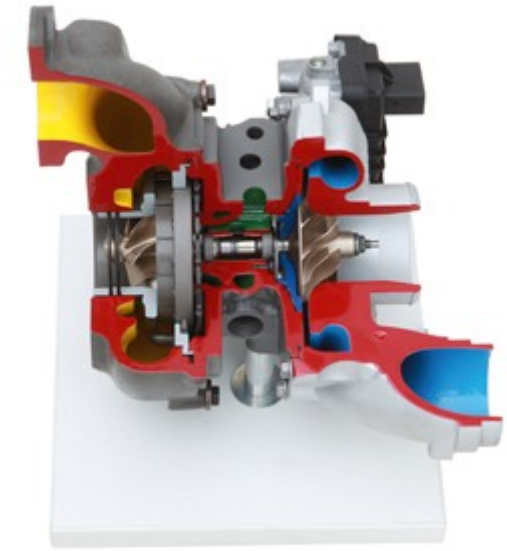
Order no. 1328
Seven-speed direct shift transmission (VW)

Cutaway are: dry clutch, timing case, transmission case, oil pump, main shaft, pressure accumulator, clutch actuation. The transmission can be turned easily, the gears changed by hand and compressed air applied in part. The shift lock is functional. The transmission is mounted on a table stand. Self-study booklet from VW included in the scope of supply.

Order no. 1327
Two-stage turbocharger (bi-turbo)
Cutaway are: both turbochargers, control flaps and the fresh-air valve.



The turbines and throttle valves can be moved. Exhaust air, fresh air and oil channels are accentuated in colour.



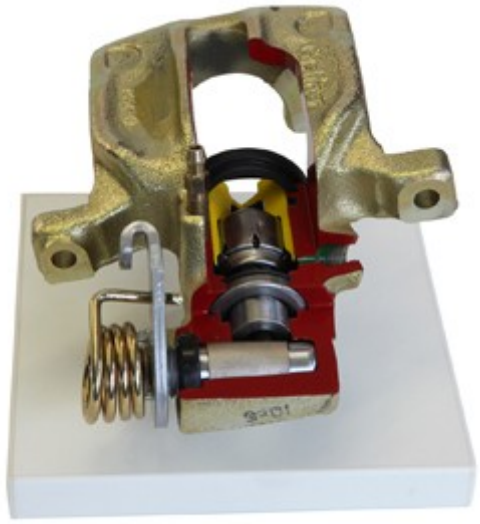
Order no. 1331
Turbocharger with ball bearing and variable vane geometry
This is a model of the latest generation of turbochargers in which the friction bearing has been replaced by two ball bearings with ceramic balls. This makes up to 300,000 rpm possible. These turbochargers have less abrasion, can transmit greater powers, suffer less from the afterworker effect and have a high charging effect even at low speeds.

Order no. 1329
Side-valve 4-stroke engine with timing wheel
Cutaway are: crankcase, cylinder, cylinder head, tank, air filter, valve timing, carburettor and ignition. The dial gauge can be used to set the upper dead centre exactly on the timing wheel, and thus determine all other piston positions. The engine can be turned easily.

Order no. 1330
Diesel-powered industrial motor
Cutaway are: engine case, cylinder, cylinder head, injection nozzle, injection pump, starter, muffler, air filter and rotor. This engine is a 1-cylinder naturally aspirated

diesel engine with balancer shaft and bottom-mounted camshaft. The engine can be turned easily.

Order no. 1332
Adjustable differential
This differential has been prepared in such a way that both the crown wheel and the bevel gear are continuously adjustable in axial direction. This allows incorrect wear patterns and excessive tooth backlash to be demonstrated.



Order no. 1333
Disc brake with parking brake
Cutaway are: brake callipers, brake piston, adjustment mechanism. The function of the parking brake can be demonstrated by turning the lever.

Order no. 1334
Dry duplex clutch
The clutch discs, cup springs and pressure plates are easy to see. Both clutch discs can be moved.

The following can be shown: function of the intermediate drive plate, flow of force from clutch 1 and 2, how the cup springs work, different sizes of clutch discs.

Changes reserved!