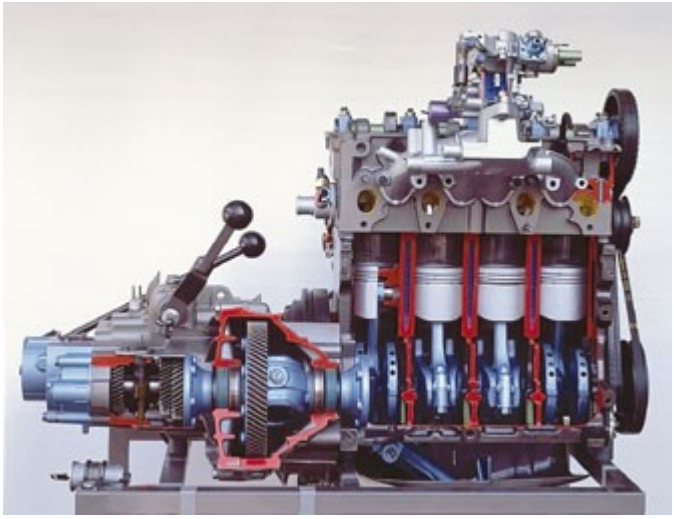
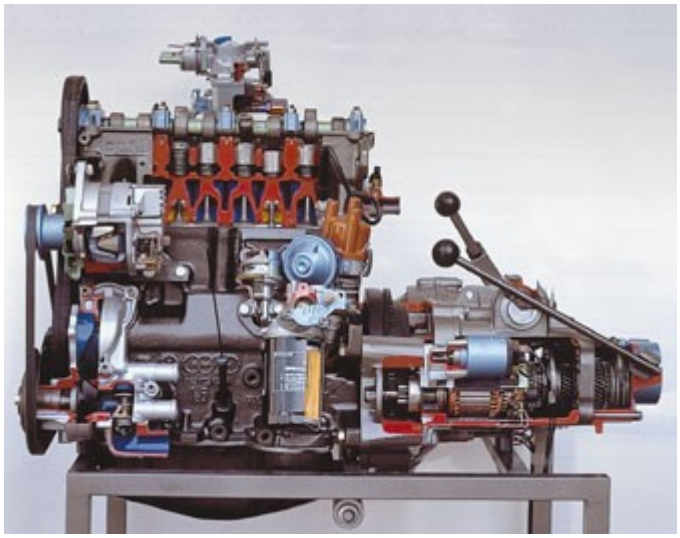
9: Petrol Engines, Engine Components, Petrol Engine Mixture Generation, Fuel Pumps, Cooling, Diesel Engines, Diesel Engine Mixture Generation, Supercharging, Lubrication





Order No. 1001
Engine of a VW GOLF with Transmission

The cutaway, an original engine of a VW GOLF with clutch and transmission, is fixed an a mobile rack. The engine with all units is driven slowly by means of an electric motor and a battery. Parts cut in this model:
- the four cylinders
- one piston
- four valves with bucket tappets and valve gear
- ignition distributor
- generator
- fuel pump
- carburetor
- oil pump
- clutch
- transmission and differential gear
- water pump with thermostat
- starter

Functions:
- the transmission can be shifted into any gear
- the starter can be engaged and disengaged by means of an ignition lock
- the clutch can be actuated
- by stopping one drive shaft, it can be shown how the differential works

This model can easily be moved into the classroom. It can be used for many teaching units and thus can replace many single models

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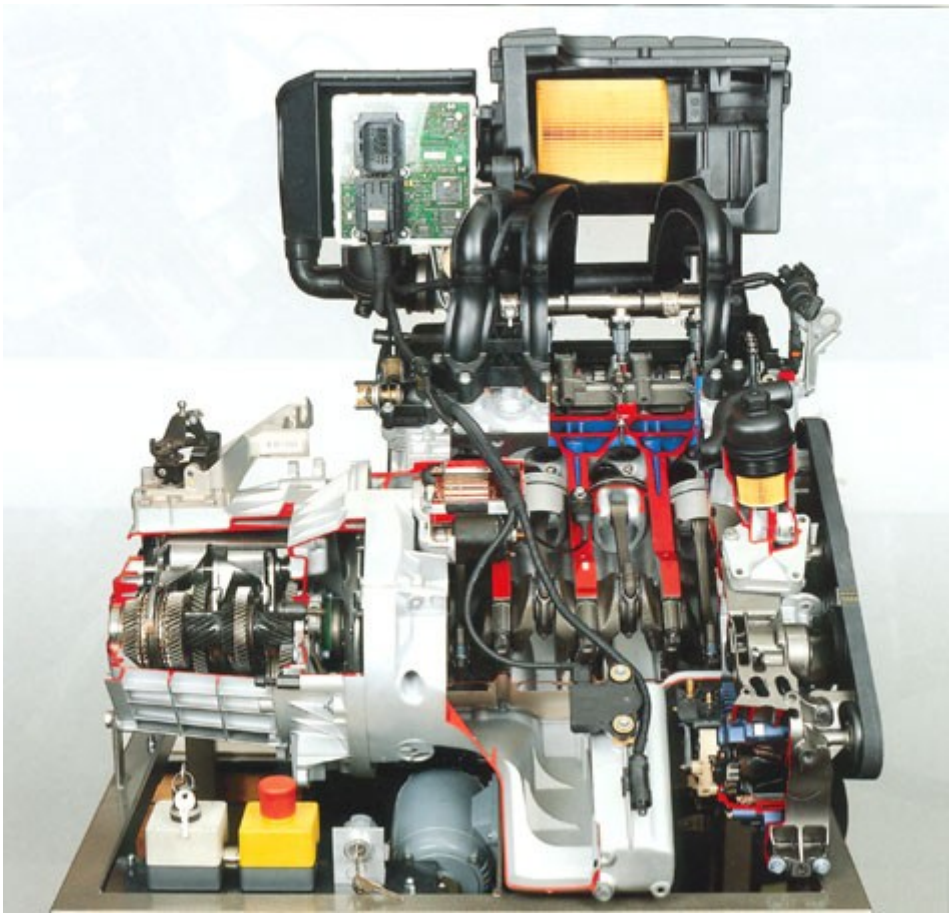
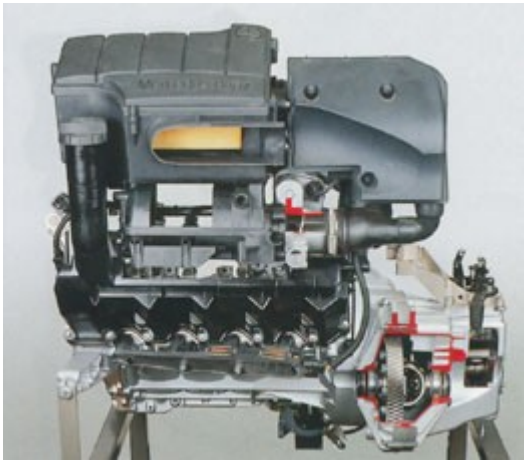


Order No. 1249
Cutaway model: Daimler Benz A Class petrol engine with injection

New construction with the latest technique.
The engine is driven by a 230V geared motor, all the assemblies also run. The starter can be engaged, the transmission shifted. The following items are cutaway: cylinder head, cylinder block, crankcase, oil pan, one piston, roller valve lever with clearance compensation element, oil pump, chain case, generator (internally ventilated), starter, intake manifold, air filter box, double ignition coil, electronic control unit, actuator, throttle valve, valve cover, oil filter, thermostat, air-mass sensor, 5-gear transmission and differential. All actuators and sensors are available and connected to the cable tree.



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HAKO cut-away models

Order No. 1186
Cylinder head - four valve engine

Roof-shaped combustion chamber with four-valve system.
Function of the valve actuation with bucket tappets.
(fine springs ensure easy actuation of the valves)
Distribution of the intake and exhaust ports.
Function of the cutaway bucket tappets.

Order No. 1230
Cylinder head - four valve mechanism

Roof-shaped combustion chamber with four-valve mechanism.
Distribution of the ducts for discharge and intake valves.
by turning the camshaft the opening and closing of the valves can be demonstrated.

Order No. 1200
Cylinder head with 3 valves

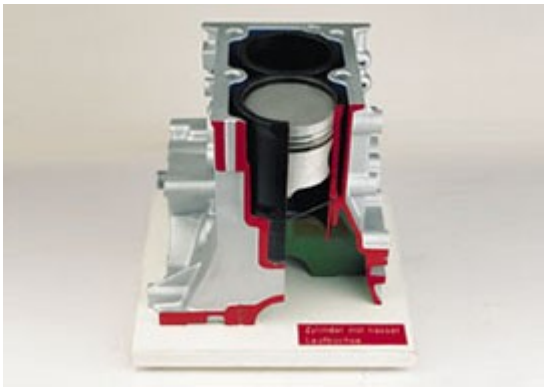
2 inlet valves with separate intake ports, one exhaust valve.
Actuation of the valves (fine springs ensure easy actuation of the valves
Roof-shaped combustion chamber with lateral spark plugs).

Order No. 1231
Daimler Benz A-Class cylinder head

A modern cylinder head with overhead camshaft. By turning the camshaft
the opening and closing of the valves can be demonstrated.
Function of the cam lever with cam followers and integrated hydraulic
clearance-compensation elements.

Order No. 1269
Cutaway model: Cylinder and cylinder head with tappet control

Valve drive via push rods and rocker arm (VW Beetle) in comparison with modern engines with top-positioned camshafts.
The following can be seen: cylinder, cylinder head, piston, rocker arm, valves, push rods and tapped tubes.

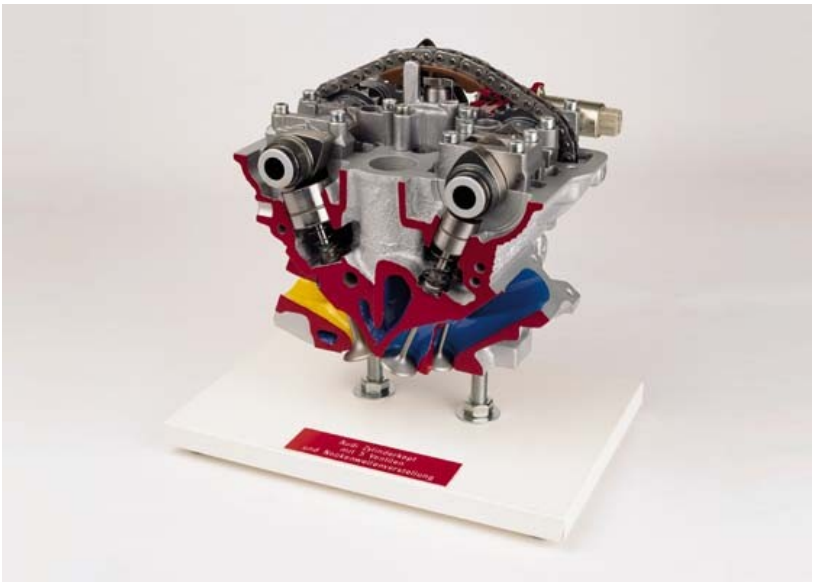


Order No. 1178
Cylinder block with wet liners

The cylinder block is cut open so that the wet cylinder liners are clearly visible. Cooling ducts (painted dark blue) and cylinder seals are easily recognized.

Order No. 1287
Cutaway model: AUDI cylinder head with 5 valves

- recognition of the arrangements of the five-valve technique
- operation of the valves by use of weaker springs
- recognition of the channels by varying colours



Order No. 1288
Cutaway model: AUDI cylinder head with 5 valves and camshaft adjustment

- recognition of the arrangements of the five-valve technique
- operation of the valves by use of weaker springs
- recognition of the channels by varying colours
- Porsche camshaft adjustment can be operated

Order No. 1290
Cutaway model: Cylinder head with vane-type camshaft adjuster

Input and output camshaft are adjusted via vane-type camshaft adjuster. Injection nozzles and spark plugs are screwed in, channels have been milled open.
The hydraulic valve tappets are easy to see. In an external rotor, an internal rotor is rotated in a clockwise (early) or ant-clockwise (late) direction by oil pressure.
The internal rotor is kept in its rest position by springs. The oil channels in the shaft and in the rotor are easily recognisable.
The solenoid coil for the control (early or late) has also been cut away.

HAKO cut-away models

Order No. 1289
Vane-type camshaft adjuster

In an external rotor, an internal rotor is turned in a clockwise or ant-clockwise direction by oil pressure (early or late opening of the valves)
The internal rotor is kept in its rest position by springs
The control channels in the shaft and in the rotor are easily recognisable.
The solenoid coil for the control (early or late) has also been cutaway.

Order No. 1233
Daimler Benz camshaft adjustment

The adjustment piston is moved by means of a lever.
The inbuilt coarse thread causes the camshaft to turn against the camshaft timing gear and the intake valve opens 20 to 30 degrees earlier.
The change-over is effected by control piston, which is actuated electro magnetically.

Order No. 1281
Camshaft adjustment, Porsche

- Drive of the outlet camshaft via a rotary button
- Drive of the inlet camshaft via a control chain
- Holding the outlet camshaft with the help of a set screw
- With the help of a push bar, the hydraulic piston can be displaced and the adjustment of the inlet camshaft read off directly on a scale
- The function of the chain tenser is easily recognised
- The hydraulic piston and the piston of the solenoid valve are cut away

HAKO cut-away models

Order No. 1254
Model board: Two-wheel technique

This model board enables a comparison of car engine components and two-wheel technique. The following components have been cutaway:
Moped cylinder with piston, generator, starter, four-stroke single-track piston, 1 segment of a complete cylinder head with 16 valves. The following are also on the model board: ignition coil, camshaft, one-cylinder engine, camshaft four-cylinder with 16 valves, crankshaft with connecting bar and rolling bearing, camshaft with clearance compensation, connecting bar and rocker arm.

Order No. 1187
Piston model case

Modern pistons, cut open in parts
Various pistons, including:
AT piston, autothermatic piston, full-skirt piston, duotherm piston
ring-carrier piston, piston for two-stroke engines,
ring locks, piston pins, piston rings.

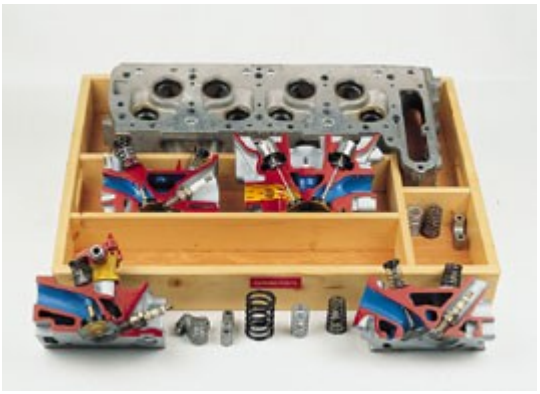
Order No. 1232
Connecting rod model case

2 connecting rods with pistons and piston pins.
Divided and undivided connecting rods.
Steel and aluminium connecting rods.
Connecting rods with straight and offset divided big end.
Connecting rods with smooth, toothed, pinned and broken big end.

HAKO cut-away models

Order No. 1205
Crank shaft model case

- crankshaft of a four, five and six-cylinder engine
- crankshaft of an opposed-cylinder engine and a half-crankshaft of a
Mercedes Class A engine with cutaway oil duct
The crankshafts can all be mounted on the steel stands and turned for
demonstration purposes.



Order No. 1214
Cylinder head model case

- cutaway model of a cylinder head with 2 valves in sequence
with 2 rocker arms
- cutaway model of a cylinder head with 2 valves (transverse arrangement)
- cutaway model of a cylinder head with 3 and 4 valves
- whole cylinder head without valves
- camshaft bearing and various valve springs

Order No. 1188
Camshafts model case

- Built-up, forged and cast camshafts
- Camshafts for 4-, 5-, 6-cylinder engines
- Camshafts for four-valve engines
- Camshafts for flat engines
- cutaway cams
- Various camshaft bearings

HAKO cut-away models

Order No. 1124
Model case, valves

- valve manufacture, from blank stage to finished part
- different types of valves
- special valves (sodium-filled and hard-faced valves)
- valve accessories

Order No. 1206
Valve timing model case

Camshaft timing by means of:
Spur gears, simple and double chains, toothed belt
hydraulic chain tensioner with tensioner blade
camshaft, shaft with 4 rocker arms,
follower and valve lever, (one with clearance compensation)
hydraulic tappet, cut away tappet, guide tubes and camshaft mounting.

Order No. 1253
Cutaway model: Two-stroke moped engine

The following have been cutaway: cylinder head, cylinder, crankcase, carburetor, transmission and air filter, carburetor and clutch can be operated ...

... with the help of the starting lever, the crankshaft with the connecting rod and the piston can be put into motion with the clutch pulled.

Order No. 1245
Single-vane vacuum pump

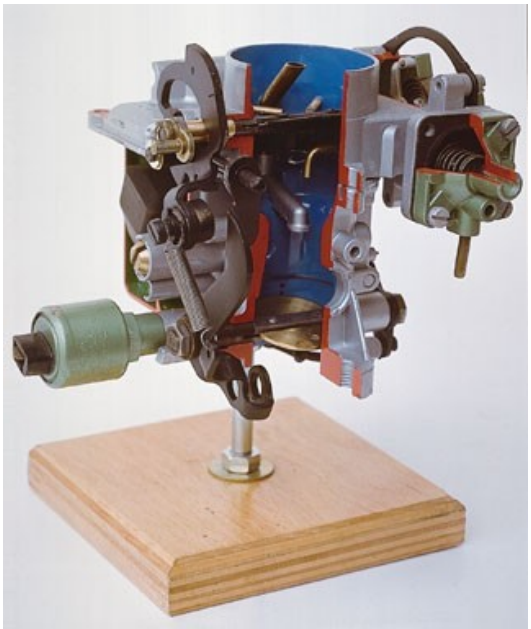
On order to supply a vacuum for brake boosters, vacuum pumps are used in both diesel and, increasingly, in Otto engines. The pump has very simple and robust set-up and nevertheless has very high capacity. If the rotor is turned, the enlargement and reduction of the working area can be seen particularly well, as can the contact of the slide shoes in each position of the vane. The pressure and suction valve and the oil duct are cut open.

Order No. 1010
Balancing model for crankshafts

- by putting on, taking off or changing the position of different counter-weights, a static or dynamic unbalance of crankshafts can be shown
- proper selection and positioning of the weights cause a true running

Order No. 1006
Downdraft carburetor

- parts cut in this model: mixing chamber, float chamber, float-needle valve, idle-speed channel, accelerator pump, pull-down and automatic choke



- all parts can be easily moved

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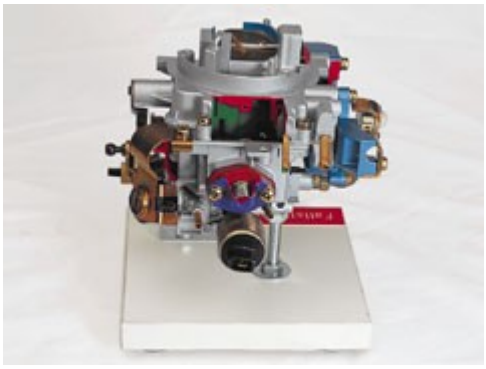
HAKO cut-away models

Order No. 1027
Downdraft carburetor 1B1

Possible demonstrations:
function of throttle butterfly, choke butterfly, float with valve needle, ...

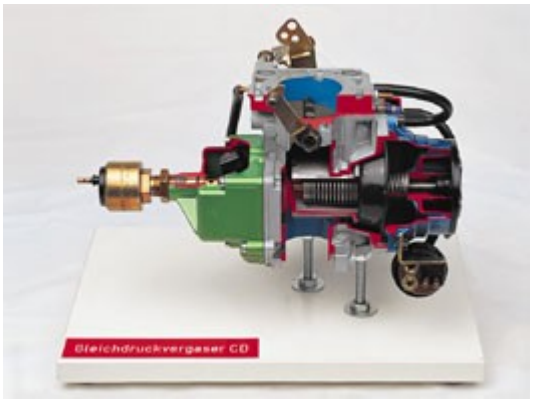


... automatic choke, pull down device, accelerator pump, idle mixture
cut-off valve, idle-speed and idle-mixture adjusting screw

Order No. 1029
Twin-choke downdraft carburetor

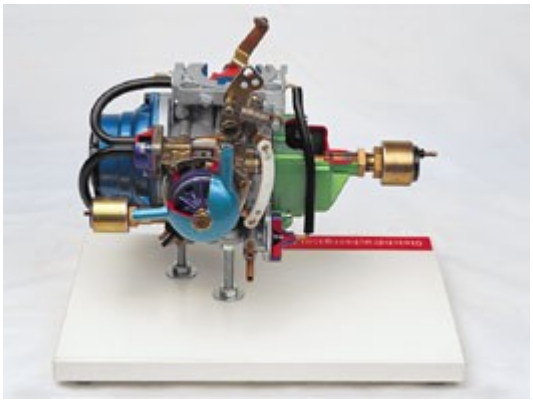
Possible demonstrations:
- throttle butterflies open simultaneously

- function of choke butterflies, throttle butterflies, float with valve
needle, pull down device, accelerator pump and idle-speed stop

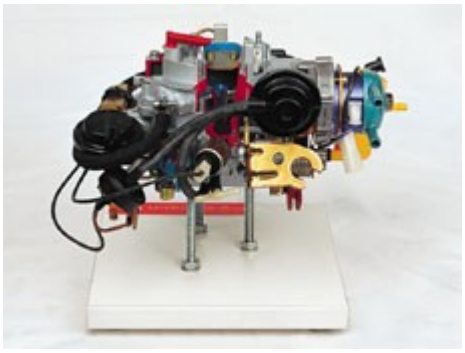


Order No. 1032
Constant vacuum carburetor

Possible demonstrations:
- function of vacuum piston with jet needle



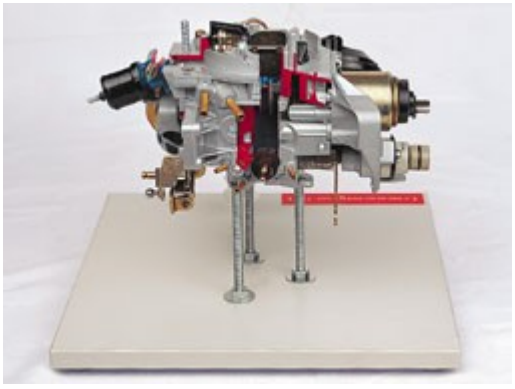
- functions of damper piston, throttle butterfly, float with valve needle,
fuel adjusting screw and idle-mixture cut-off valve
- particular characteristics of the variable airflow cross-section



Order No. 1028
Two stage carburetor

Possible demonstrations:
- stage 1 throttle butterfly is actuated mechanically
- stage 2 throttle butterfly is closed as long as stage 1 is not completely opened

- stage 2 is opened pneumatically by a vacuum control system
(simulated by a spring model)
- function of float, float valve, automatic choke, accelerator pump and choke butterfly



Order No. 1033
Electronic system carburetor

Function of:
choke valve regulator, solenoid valves, potentiometer, corrector needle, throttle valve regulator, float, float needle valve, throttle valve ...

... and idle-mixture adjusting screw

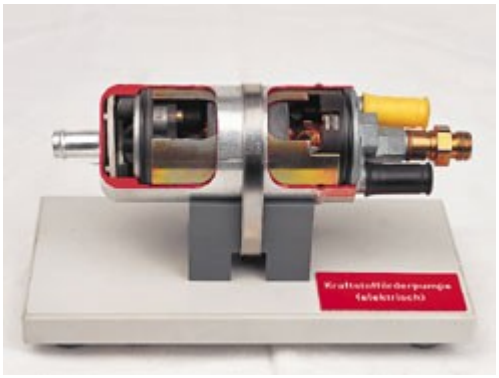
Order No. 1099
Carburetor test

4 similar or different carburetors prepared for dismantling and assembly (single downdraft carburetor, dual-barrel carburetor, register carburetor, Stromberg carburetor).

Order No. 1084
Mechanical fuel pump

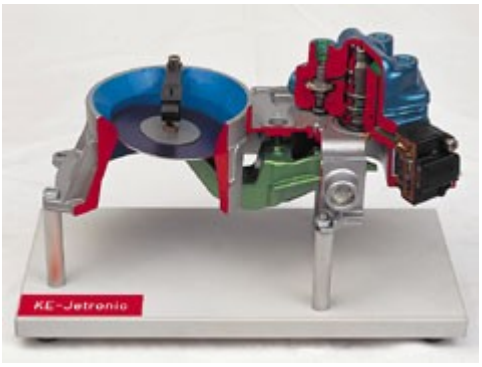
Function of diaphragm, push rod and valves
suction and pressure stroke
variable delivery.

HAKO cut-away models



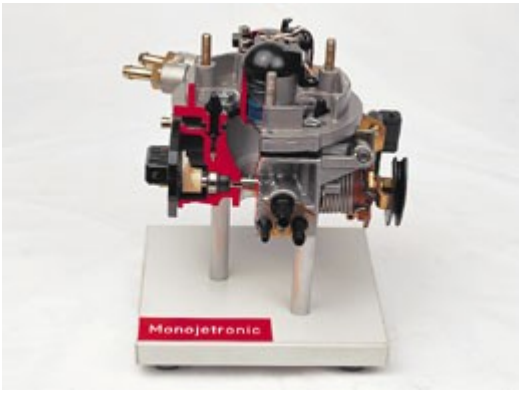
Order No. 1017
Electric fuel pump

Possible demonstrations:
- the pump runs when connected to a 12V battery
- the pump can be taken apart
- the roller-cell pump has a Plexiglas cover so that all parts are visible



Order No. 1021
Mixture control unit of KE-Jetronic

Possible demonstrations:
- shifting of air-flow sensor plate
- displacement of control plunger
- function of differential pressure valves, idle-speed control device and idle-mixture adjusting screw



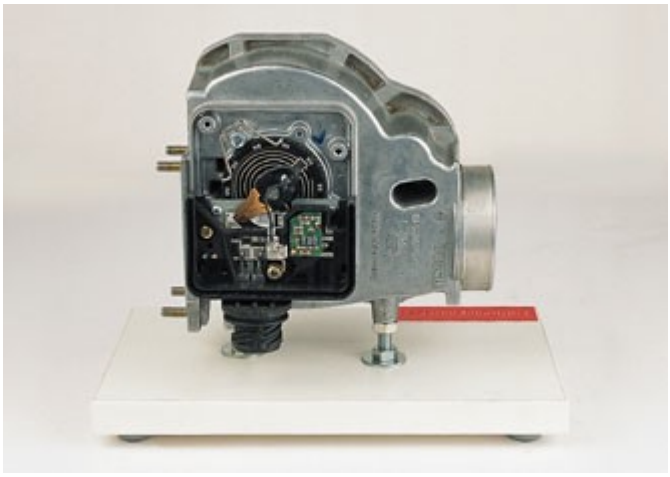
Order No. 1022
Monojetronic

Function of speed regulator, central injection valve, throttle blade, throttle-blade actuator with control motor and potentiometer.

HAKO cut-away models

Order No. 1183
Air-flow sensor

The air-flow sensor flap and compensation flap are clearly visible behind the Plexiglas housing and can be moved back and forth.



Can be seen from behind the potentiometer and the IC.

Order No. 1184
Hot film air-mass sensor

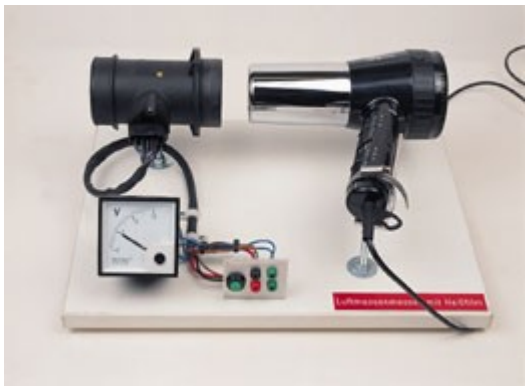
The ceramic layer with sensor element (film resistance) can be seen in the cutaway plastic housing.

Order No. 1210
Air-flow sensor with platinum heating filament

Inside the cutaway plastic housing the platinum heating filament, the precision resistor and the temperature compensation resistor can be seen in the inner tube. The printed circuit board with its hybrid circuit can be seen at the back on the cutaway housing.

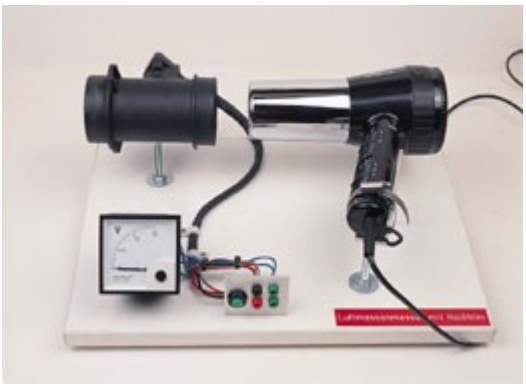
Order No. 1111
Catalytic converter

Metal housing of a new catalytic converter cut-open to show both ceramic casings. In addition, cut-open honeycomb showing the tubing inside the ceramic casing.



Order No. 1244
Air-mass sensor with hot film

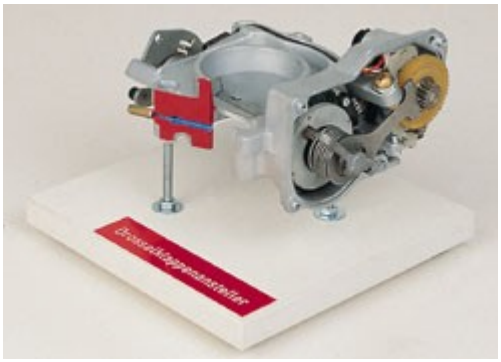
(with compensation of the suction tube vibrations) With the help of a hair-dryer with 2 cold and 2 hot levels, the function of an air-mass sensor with hot film can be demonstrated. The output signals can be read off directly on the voltmeter. In addition, 2 jacks for the connection ...



... of an additional measuring device are provided. This hot film air-mass sensor is part of the latest generation. It compensates the vibrations in the suction tube and only measures the air flowing in one direction. This can be demonstrated by turning the air-mass sensor 180 degrees, the device does not show any reaction.

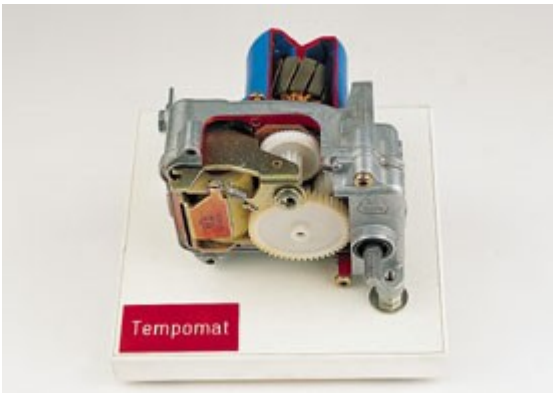
Order No. 1123
Functional model lambda probe (EGO sensor) with electrical probe heating

Probe light-off time with and without electric heating. The enclosed gas burner allows for demonstration of the millivolt meter and lambda control:
- rich mixture: little air, yellow flame, high lambda voltage
- lean mixture: a lot of air, blue flame, low lambda voltage



Order No. 1126
Throttle jacking device

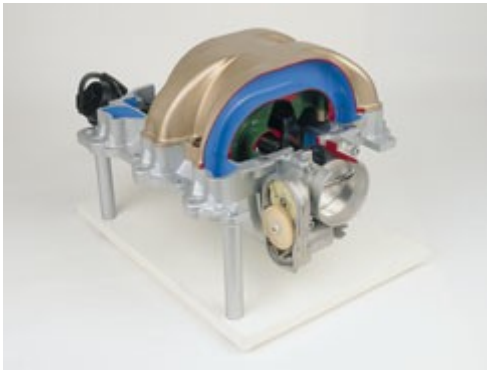
- throttle jacking via a controlled electric motor and gear wheels with gear rack
- function of the idle switch
- function of the throttle potentiometer



Order No. 1165
Actuator for cruise control

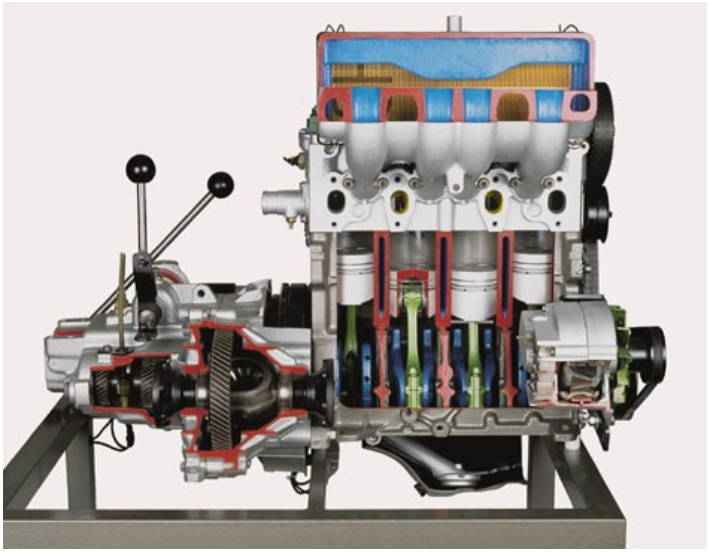
Function of the control motor.
Attraction of the operating magnet.
Transmission via toothed gears.
Rotation of the spindle to control the accelerator pedal setting.

HAKO cut-away models



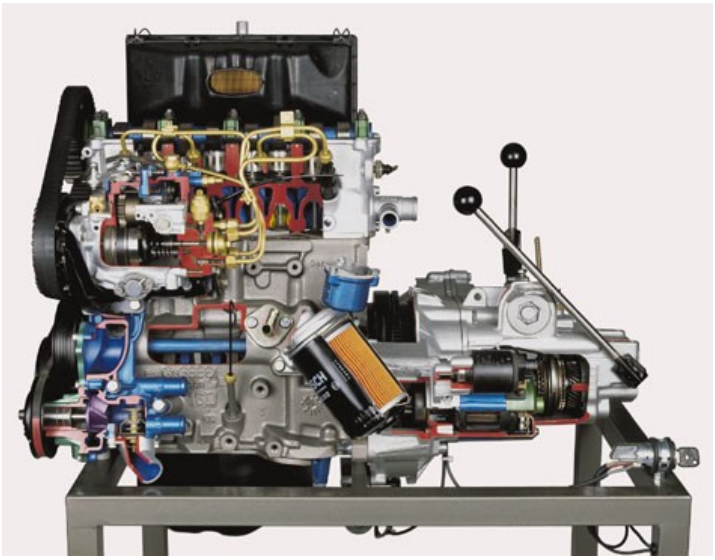
Order No. 1280
Switch-over induction system
The following can be demonstrated:

- Function of the vacuum cell (it can be moved with the connected injector)
- Actuation of the switch-over flaps via the vacuum cell
- Opening and closing of the various switch-over flaps
- The various fresh gas paths can be recognised easily by corresponding colouring
- Function of the throttle flap with electronically actuated control motor



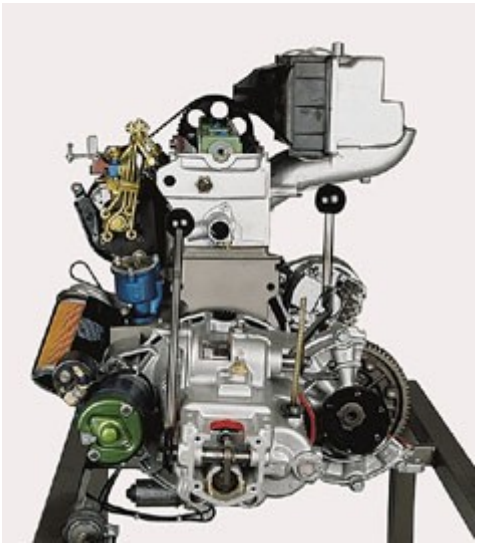
Order No. 1065
Diesel engine of a VW Golf with transmission

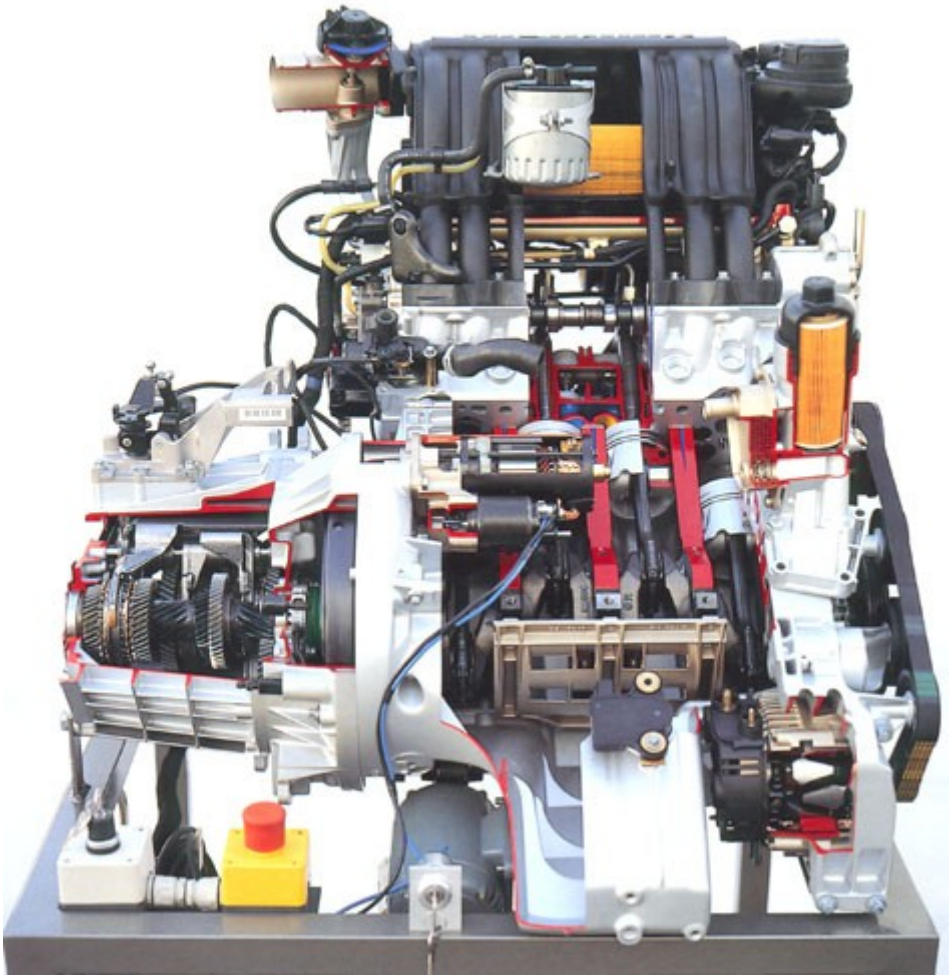
The cutaway, an original engine of a VW Golf with clutch and transmission, is fixed on a mobile rack. The engine with all units is driven slowly by means of an electric motor and a battery. Parts cut in this model: -
the four cylinders
- one piston
- four valves with bucket tappets and valve gear
- generator
- oil pump
- clutch
- transmission and differential gear
- water pump with thermostat
- starter
- distributor injection pump
- injection nozzle



Functions:
- the transmission can be shifted into any gear
- the starter can be engaged and disengaged by means of an ignition lock
- the clutch can be actuated
- by stopping one drive shaft, it can be shown how the differential works his model can easily be moved into the classroom.

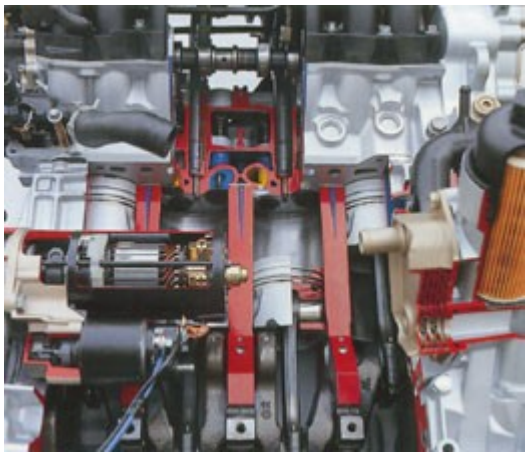
It can be used for many teaching units and thus can replace many single models.

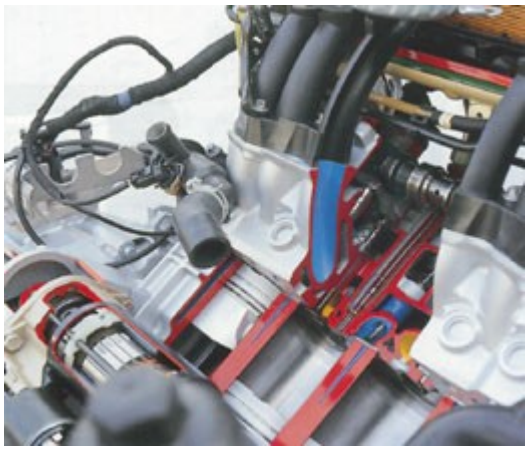




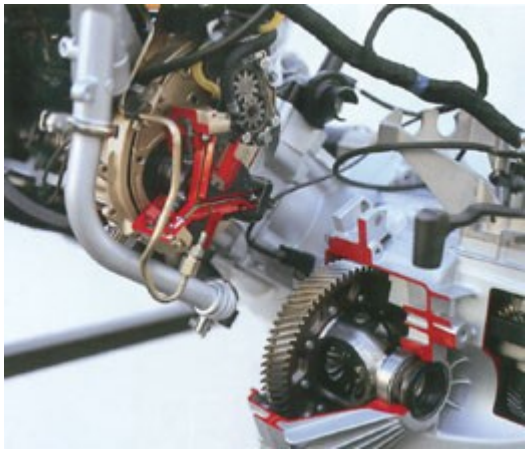
Order No. 1250
Cutaway model: Daimler Benz A Class diesel engine with common rail technique

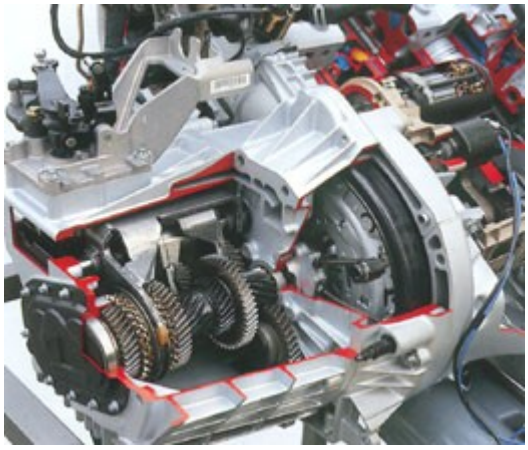
A superlative engine with the latest technique.
The engine is driven by a 230V geared motor, all the assemblies also run. The start can be engaged, the transmission shifted. The following items are cutaway: cylinder head (with 16 valves), cylinder block, crankcase, oil pan, one piston with cooling duct, oil injection cooling for pistons, hydraulic valve tappet, oil pump, chain case, generator (internally ventilated), starter, exhaust gas re-circulation valve, turbocharger, intake manifold, air filter box, high-pressure pump, one injector, feed pump, rail manifold, valve cover, air-mass sensor, oil filter with heat exchanger, thermostat, modern single-vane vacuum pump, 5-gear transmission and differential. All actuators and sensors are available and connected to the cable tree.

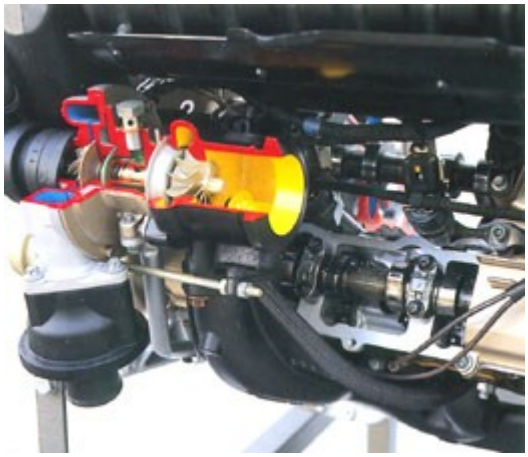


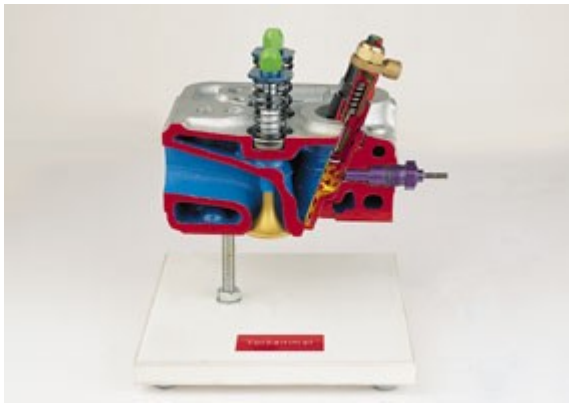


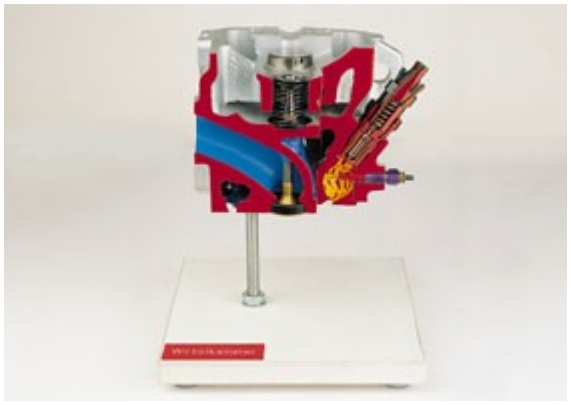
HAKO cut-away models











Order No. 1170
Cylinder head with pre chamber

- function of the valves
(fine springs enables smooth operation)
- Function of the cut up injection nozzle
- function of the glow plug
- function of the pre chamber

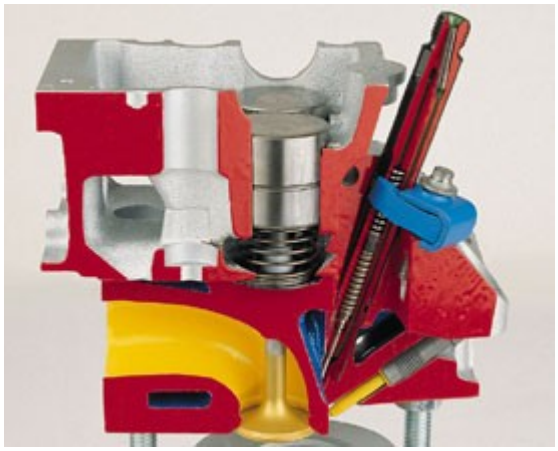
Order No. 1171
Cylinder head with swirl chamber

- function of the valves and bucket tappet
(fine springs enables smooth operation)
- Function of the cut up injection nozzle
- function of the glow plug
- function of the swirl chamber

HAKO cut-away models

Order No. 1172
Cylinder head - direct injection engine

Modern PC cylinder head (Daimler Benz C-class) with two-spring injection nozzle and bowl-in piston. Function of the valves and bucket tappet (fine springs enable smooth operation).



Function of the cut up injection nozzle. Function of the hydraulic valve tappet and the glow plug.

Order No. 1108
Diesel cylinder

- function of the valves
- function of the cut up injection nozzle and of the glow plug

- function of the swirl chamber and of the connecting port

Order No. 1167
MAN direct injection with bowl-in piston

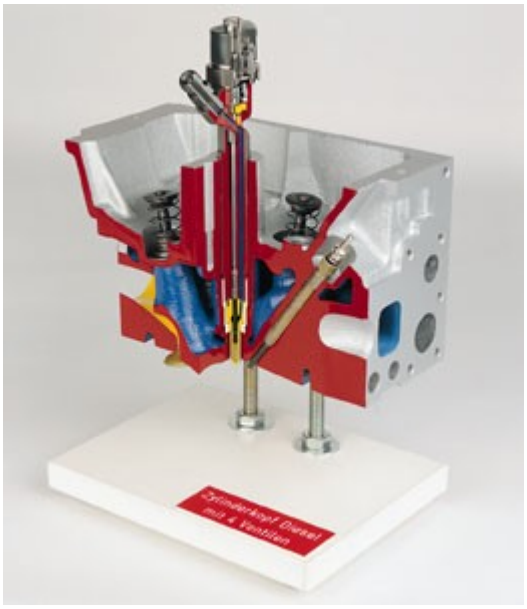
- function of the rocker and valves (fine springs enable smooth operation)
- function of the cut up injection nozzle

- function of the bowl-in piston
- function of the air-cooled cylinder

HAKO cut-away models

Order No. 1259
Cutaway model: Four-valve cylinder head,

diesel direct injection, lorry
This heavy Daimler Benz four-valve cylinder head with direct injection is made of gray cast iron. The valves can be operated easily by installing thinner springs. In the middle of the head is the cutaway injection nozzle. Further, there is a decompression valve between the valves.

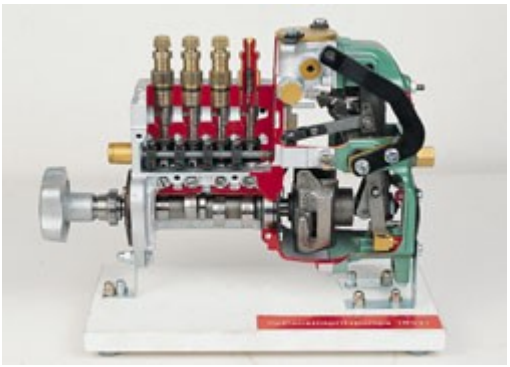


Order No. 1268
Cutaway model: Cylinder head, diesel direct injection, with four-valve technology

Modern cylinder head, diesel engine, direct injection with four-valve technology.
Function of the cutaway common-rail injector and the sheathed-element heater plug.

Order No. 1138
Inline pump with RSF flyweight governor

- function of the RSF governor
- displacement of the piston rod
- torsion of all pump plungers
- by turning the camshaft one can see the stroke of all pump plungers
- function of the pressure valves



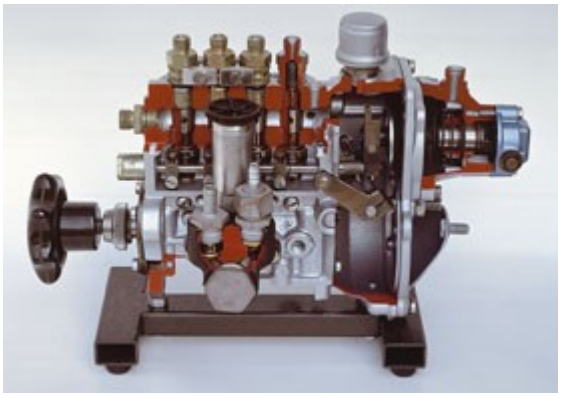
Order No. 1141
Inline pump with RSV flyweight governor

- function of the RSV governor (variable speed governor)
- displacement of the piston rod
- torsion of all pump plungers
- by turning the camshaft one can see the stroke of all pump plungers
- function of the pressure valves

HAKO cut-away models

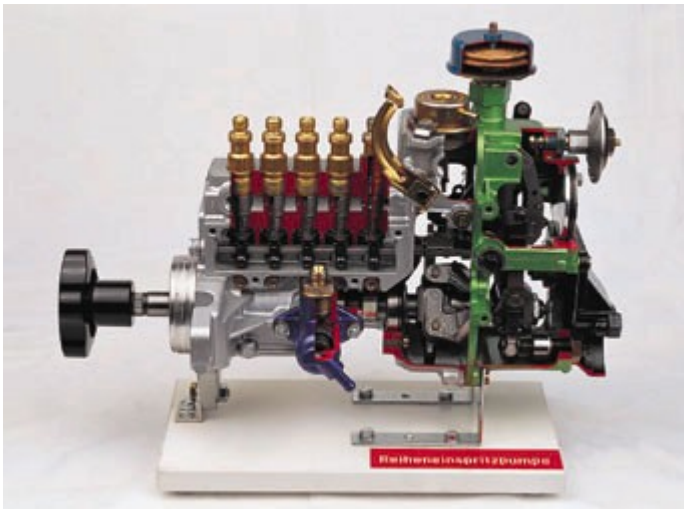
Order No. 1145
Inline pump with RQV flyweight governor

- function of the RQV governor (variable speed governor)
- displacement of the piston rod
- torsion of all pump plungers
- by turning the camshaft one can see the stroke of all pump plungers
- function of the pressure valves



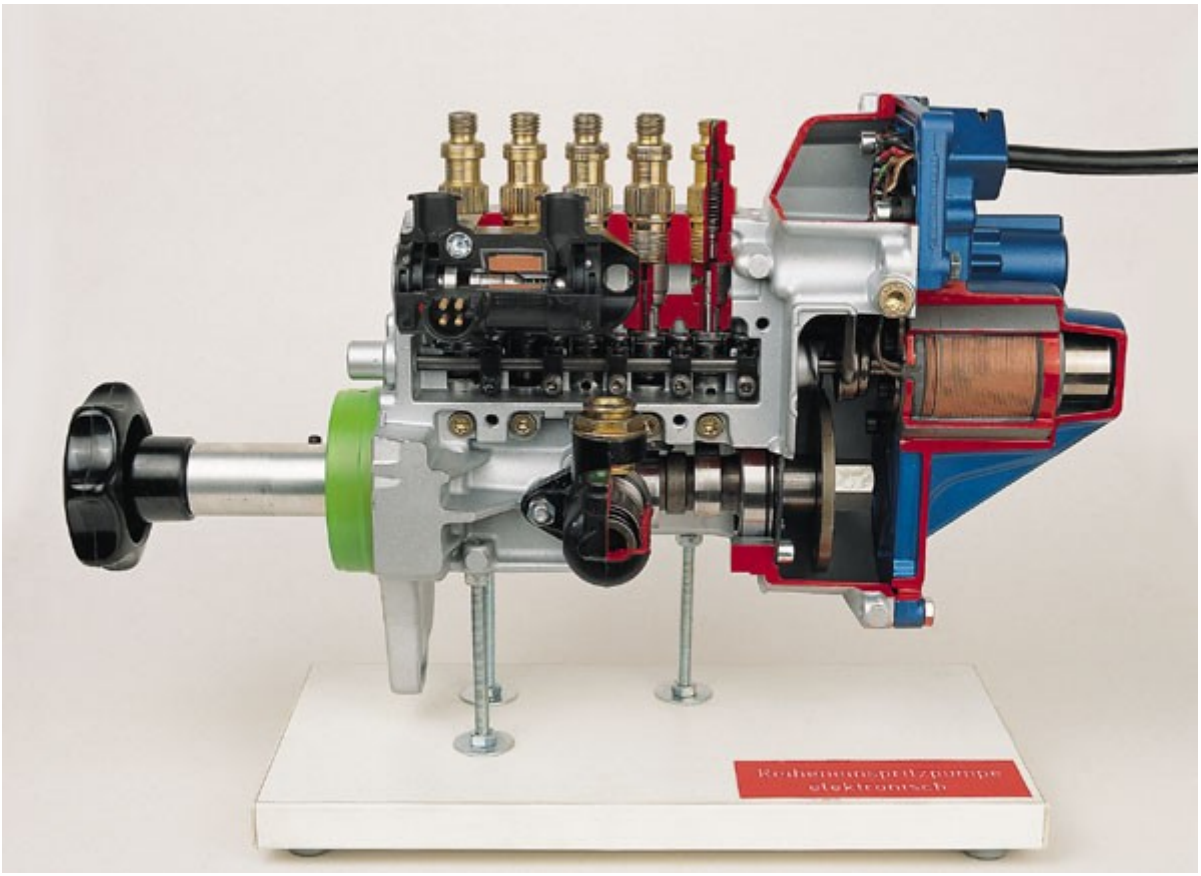
Order No. 1008
Inline pump with vacuum governor

- function of the vacuum governor
- displacement of control rod
- rotation of the pump plungers
- stroke of pump plungers
- function of pressure valves
- function of supply pump



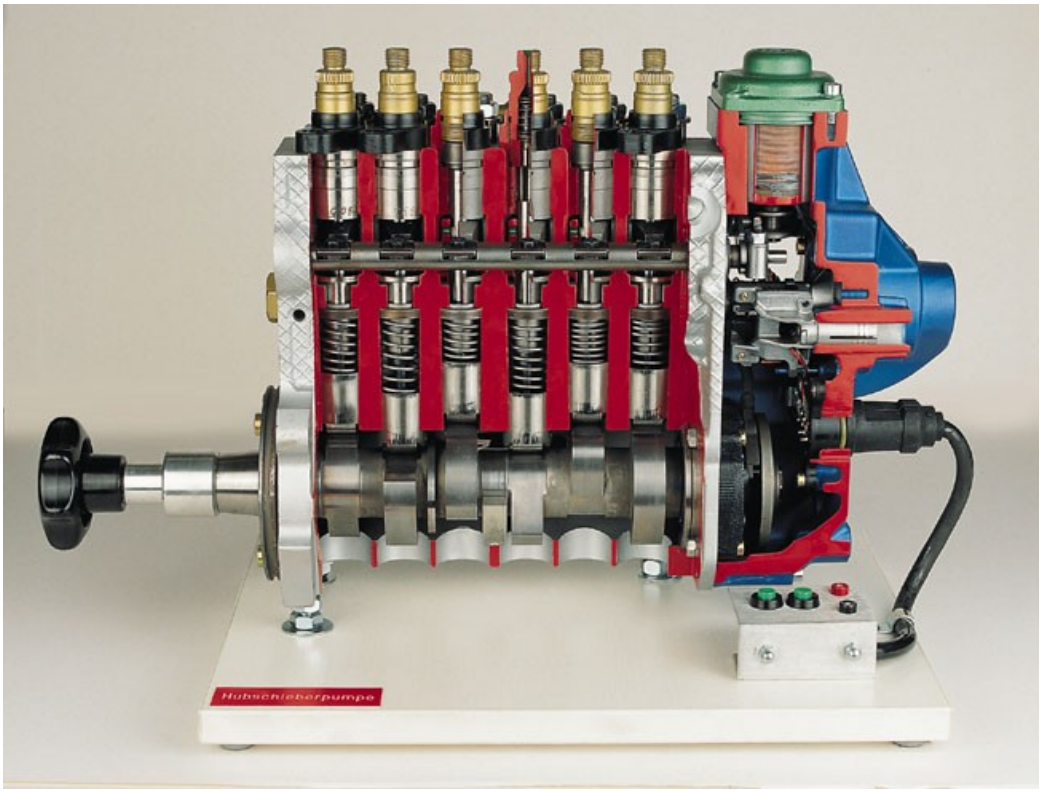
Order No. 1009
Inline fuel-injection pump with centrifugal governor

- function of centrifugal governor
- displacement of control rod
- rotation of the pump plungers
- stroke of pump plungers
- function of pressure valves
- function of supply valves
- function of supply pump



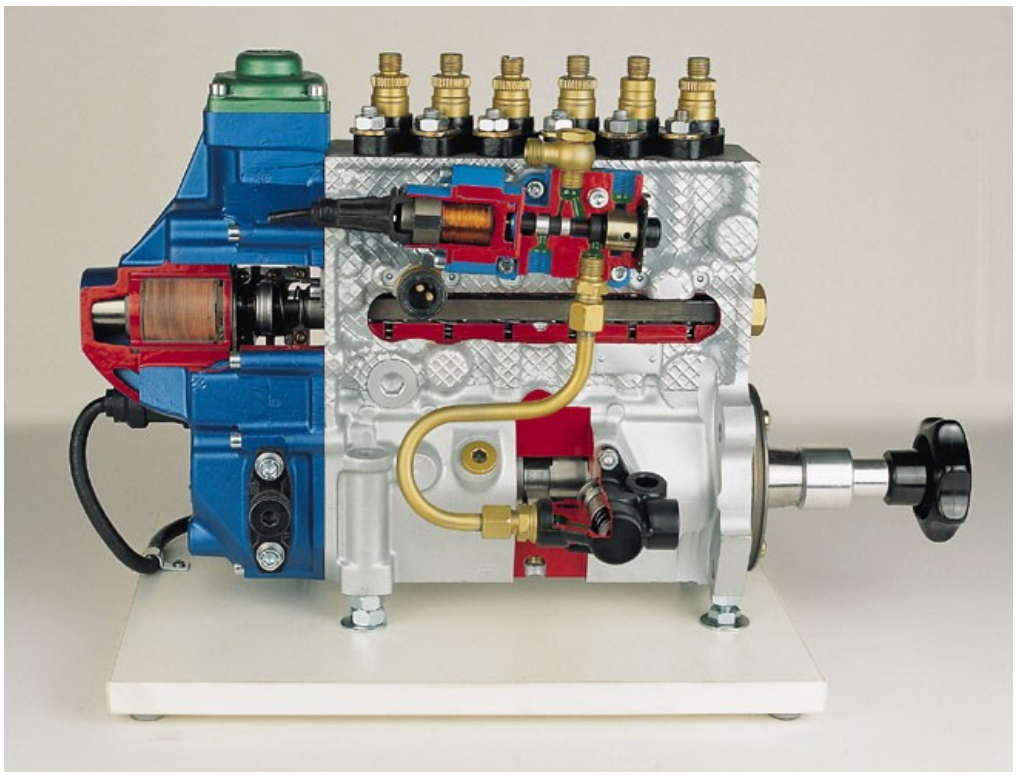
Order No. 1179
Inline type injection pump with electronic control

Connection to a 12V power supply enables the volume control by the operating magnet to be visually demonstrated.
Further functions: Emergency-stop valve, control travel sensor, pressure valves, feed pump, position sensor and pump pistons.



Order No. 1180
Pump with slide-valve control (electronically controlled)

The pump can be connected to a 24V power supply.
Button 1: Volume control by operating magnet 1. this moves the control bar
Button 2: Injection control by operating magnet 2. this rotates a shaft which moves the slide valve.
Further functions: Emergency-stop valve, control travel sensor, pressure valves, feed pump, position sensor and pump pistons



HAKO cut-away models

Order No. 1134
Feed pump, diesel (single-acting)

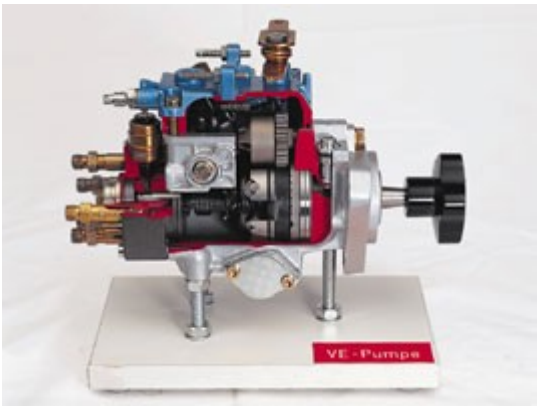
- function of the delivery plunger
- function of the 2 valves
- elastic delivery by means of the plunger spring

Order No. 1135
Feed pump, diesel (double-acting)

- function of the delivery plunger
- function of the 4 valves
- elastic delivery by means of the plunger spring

Order No. 1190
Pump element

- function of the tappet and the pump piston. Volume control by displacement of the control rod and rotation of the pump piston
- function of the pressure valve, the ducts and the spill port

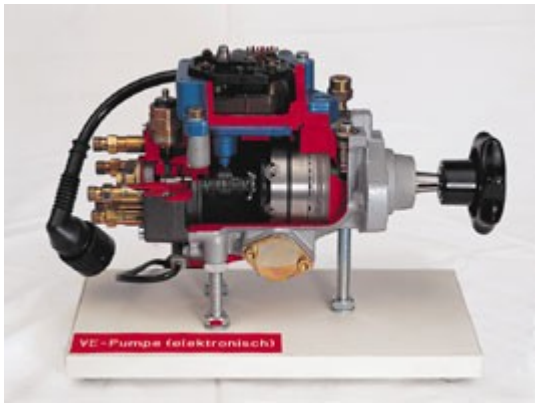


Order No. 1007
Distributor-type fuel-injection pump with centrifugal governor

- working manner of central plunger (supply and distribution of fuel)
- function of roller ring and cam plate
- functions of the mechanical governor
- function of injection timing device
- function of shut-off device
- functions of pressure valves

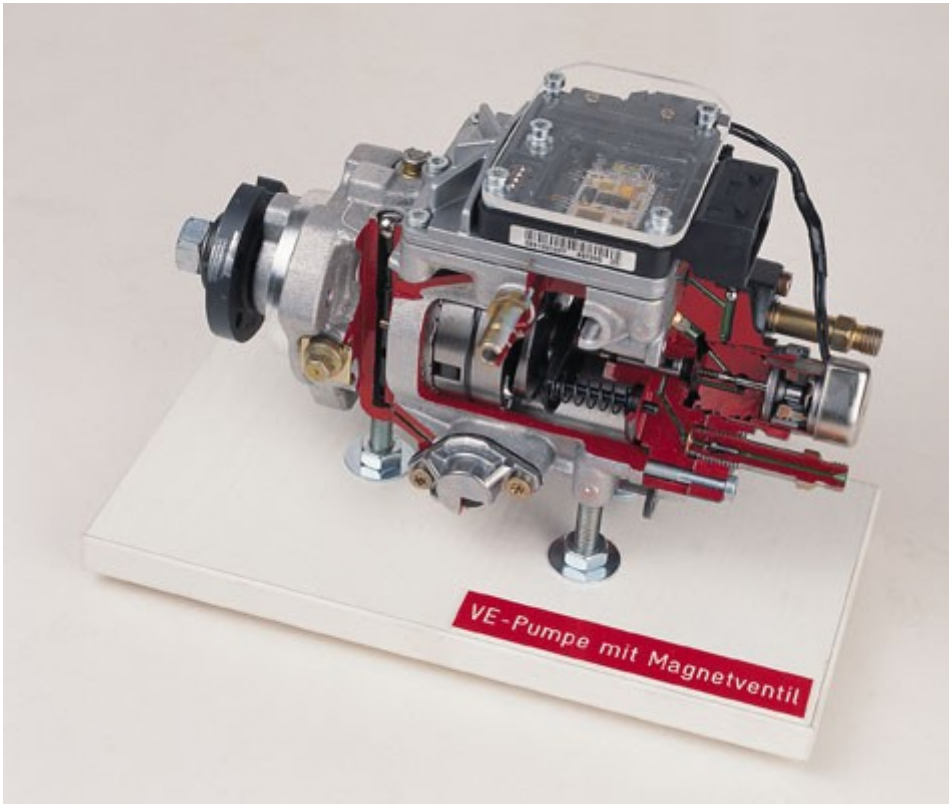
Order No. 1019
Distributor-type fuel-injection pump
with charging-pressure control

Demonstrations as for order no. 1007. In addition the function
of the charging-pressure control can be shown



Order No. 1020
Distributor-type fuel-injection pump
with electronic governor

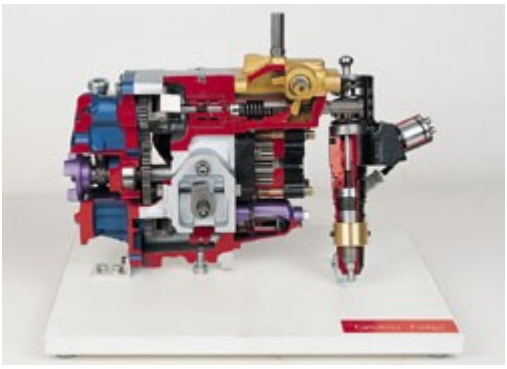
- demonstrations as for order no. 1007
- the mechanical flyweight governor is replaced by a solenoid
- the metering sleeve can be moved at the shaft of this actuator
- in addition the solenoid actuator can be actuated electrically to demonstrate fuel metering



Order No. 1242
VE pump, electronically controlled with solenoid valve VP 30 (BOSCH)

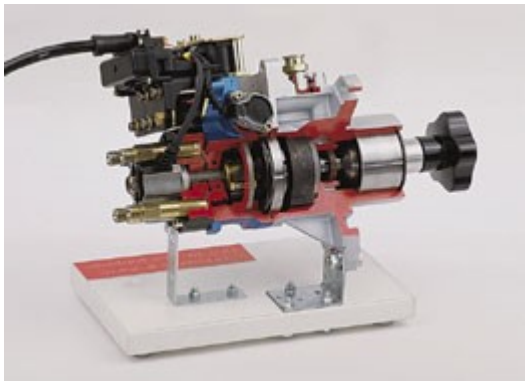
The basic set-up is similar to that of conventional VE pumps. In addition, the pump has a solenoid valve for quantity control, a digital-incremental distance measurement and its own pump control unit. The following functions can be shown: delivery and distribution through the pump plunger, injection control with coupled digital-incremental distance measurement, opening and closing of the solenoid valve and further valves. In addition, the throttle valve and the control unit can be seen.

HAKO cut-away models



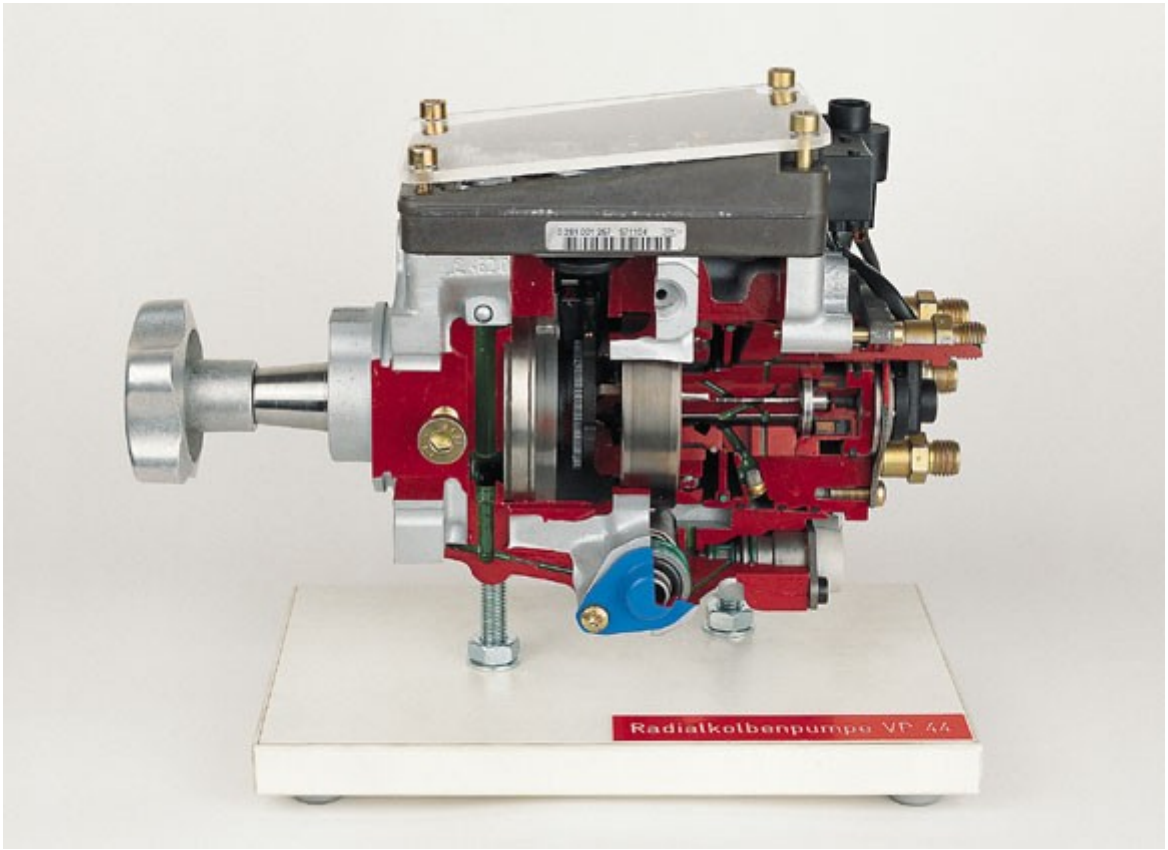
Order No. 1140
Cummins pump

- function of the VS flyweight governor
- function of the PTG flyweight governor
- function of the gear wheel pump
- function of the throttle shaft
- function of the VS throttle shaft
- function of the injector
- function of the AFC plunger



Order No. 1087
Electronically controlled LUCAS pump

Function of the high-pressure pump, distribution, injection control
and quantity control.

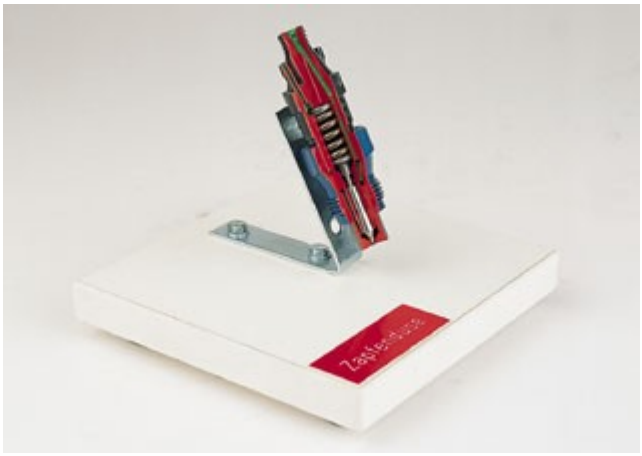


Order No. 1194
VP 44 (BOSCH) radial-piston distributor-type injection pump

All components are cut away:
Pump timing case, cam ring, injection timing device, distributor plunger, vane-type pump, solenoid valve.
The following functions can be demonstrated:
Incremental angle/time recording, fuel feed, distribution, injection timing, operation of the high pressure piston, the solenoid valve, the shut-off valve and the return flow throttling valve.

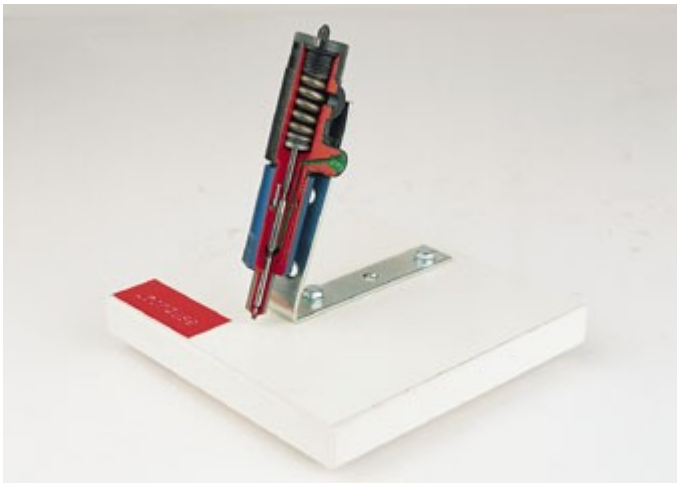
Order No. 1196
Pump - lines - nozzle

Actuation of the pump piston by means of roller tappet to achieve the high pressure.
Solenoid valve to control the rate of injection and the start of delivery.
High-pressure lines to the injection nozzle. Injection nozzle with needle and
pressure spring.



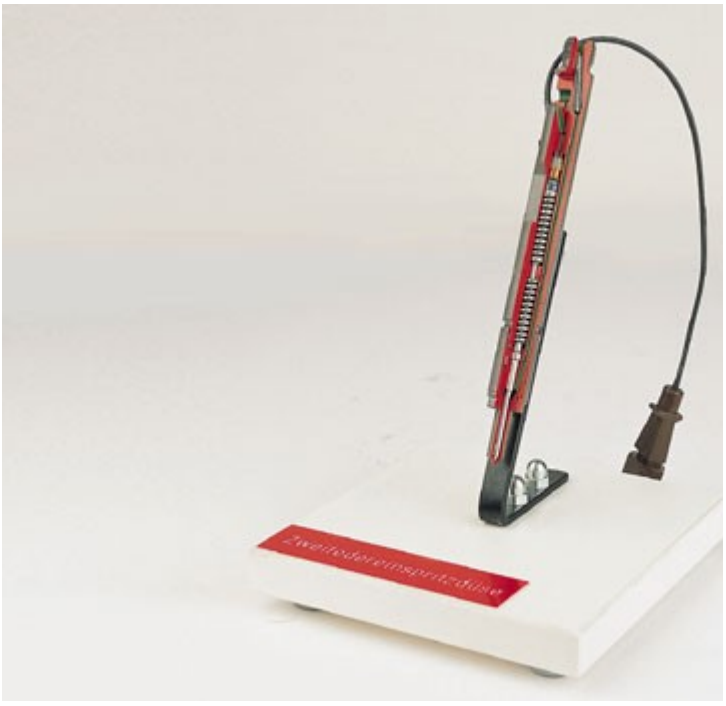
Order No. 1173
Nozzle holder with pintle-type nozzle

- function of the nozzle holder, nozzle needle, pressure pin and pressure spring
- function of the inlet and outlet ducts



Order No. 1174
Nozzle holder with hole-type nozzle

- function of the nozzle holder, nozzle needle, pressure pin and pressure spring
- function of the inlet and outlet ducts



Order No. 1176
Nozzle holder with two-spring injection nozzle

and needle-displacement sensor
- function of the nozzle holder, nozzle needle, pressure pin and pressure spring
- function of the inlet and outlet ducts
- detection of start of injection by a coil

Order No. 1227
Injection nozzle, truck

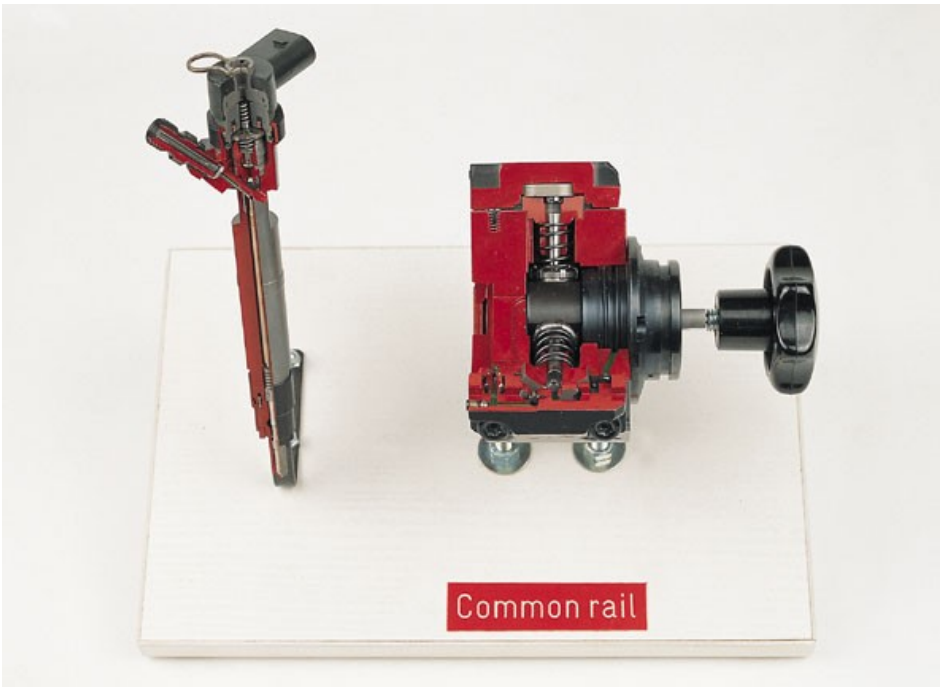
The cutaway model shows a particularly large truck injection nozzle with nozzle holder. Function of the nozzle holder, nozzle needle, pressure pin and pressure spring.
Function of the inlet and return ducts.

Order No. 1175
Nozzle holder with two- spring injection nozzle

- function of the nozzle holder, nozzle needle, pressure pin and pressure spring
- function of the inlet and outlet ducts

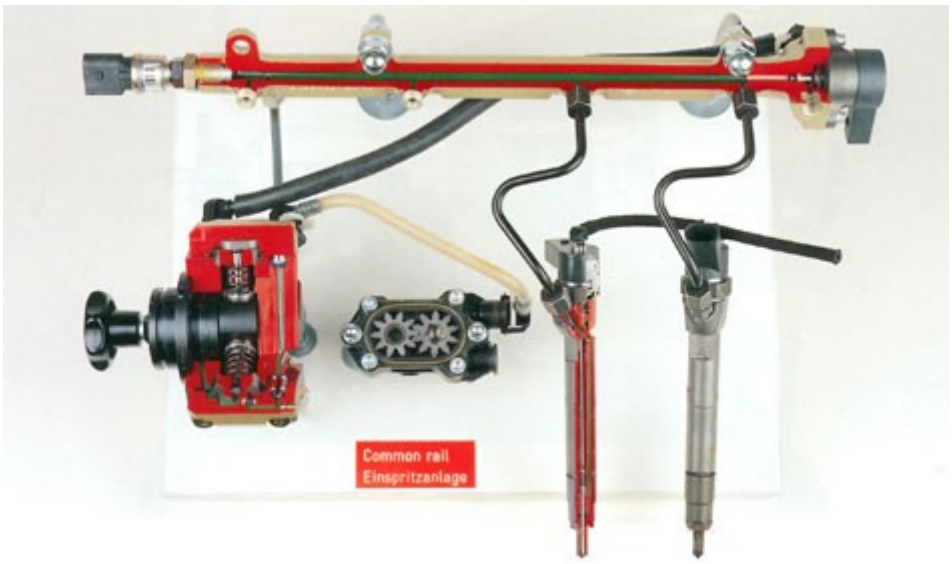
Order No. 1177
Nozzle holder with pintle-type nozzle

Four injection nozzles (order nos. 1173 and 1176) mounted on one model board.
Also a dismantled nozzle holder along with various nozzles and an uncut nozzle holder.



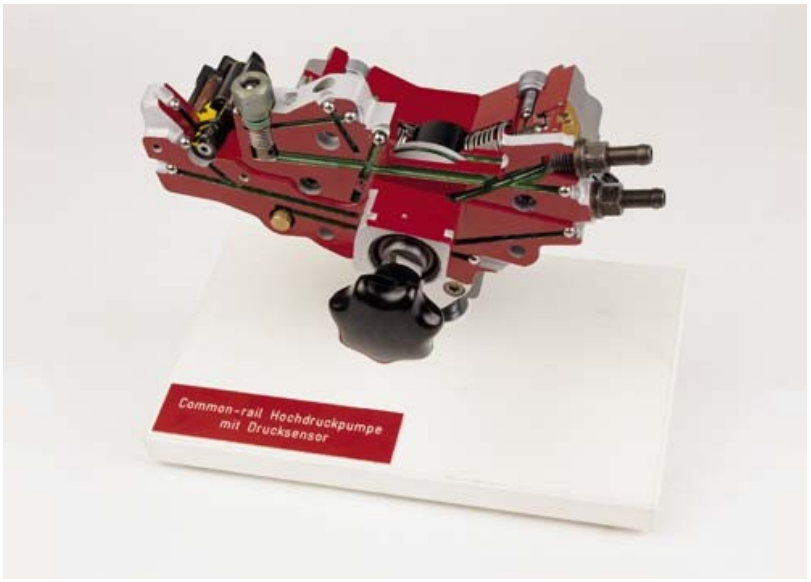
Order No. 1195
Common-rail high-pressure pump with injector

High pressure pump:
By turning the eccentric cam the operation of the pump piston can be seen. Aspiration of the fuel from the interior of the pump via a flat valve.
Discharge of the pressurised fuel via a ball valve into the collector line to the rail.
Injector: Injection nozzle, solenoid valve for volume control and for control of start of delivery.



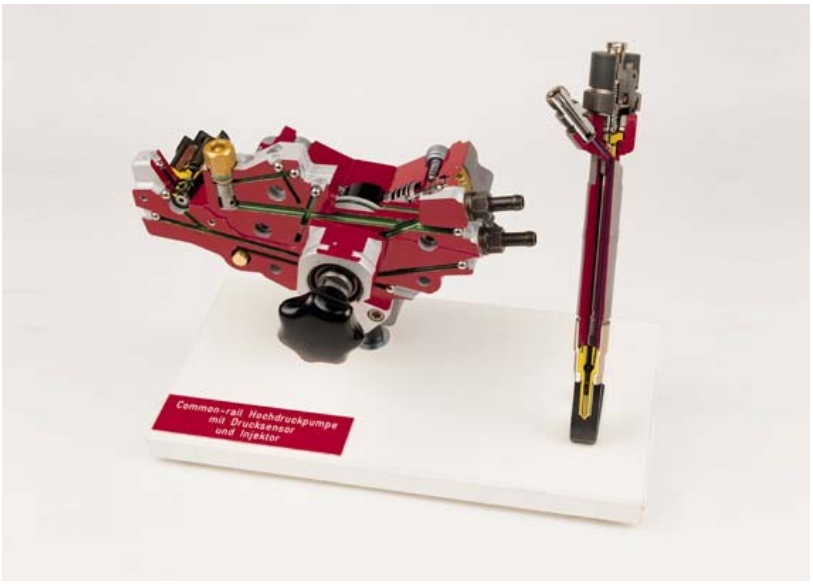
Order No. 1258
Common rail injection

On this model board, the most important elements of the common rail injection can be set up and connected to fuel lines. The fuel is fed by the feed pipe (gear wheel pump) to the high-pressure pump. By turning the clamp screw grip, you see the generation of the high pressure. From here, the fuel is pushed into the cutaway manifold and then enters the injectors (one injector cutaway). Further, the return passage of the fuel can be seen. On the left and right of the cutaway manifold, you can see the rail pressure sensor and the rail pressure transmitter.



Order No. 1291
Common rail high pressure pump with fuel-delivery regulation valve

- This high-pressure pump is the latest generation
- Pump cylinder and housing in a block
- Injection pressure: 1500 bar
- By turning the knob one sees the function of the pump plungers
- The fuel-delivery regulation valve and the fuel channels are also cutaway
- These pumps are installed in the latest Daimler-Chrysler CDI vehicles



Order No. 1292
Common rail high pressure pump with fuel-delivery regulation valve and injector

- This high-pressure pump is the latest generation
- Pump cylinder and housing in a block of hardened steel
- By turning the knob one sees the function of the pump plungers
- The pressure sensor and the fuel channels are also cutaway.
- These pumps are installed in the latest Daimler-Chrysler CDI vehicles
- The following can easily be seen in the injector: injection nozzle, solenoid valve, high and low pressure channels, feed and drain bores.

HAKO cut-away models

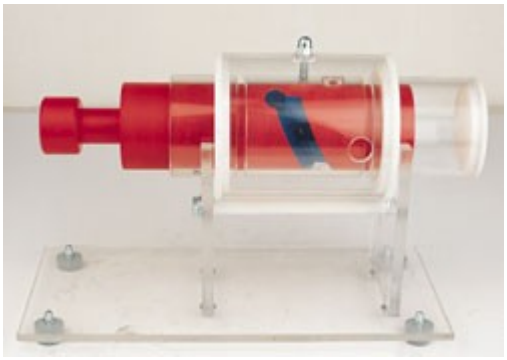
Order No. 1274
Cutaway model: Pump nozzle III

Pump tappets can be operated through the installation of a weaker spring.
Cut away a long way at the front and back with the result that all the channels and the solenoid valve are easily visible.
Good matching of colours makes the many individual parts easy to recognise.
Attention: new, more favourable price compared with the predecessors.

HAKO cut-away models

Order No. 1181
Pump tappet of an in-line pump

The functions of a modern pump tappet:
- filling the pressure chamber
- start of injection, feed, injection
- volume control by rotating the piston

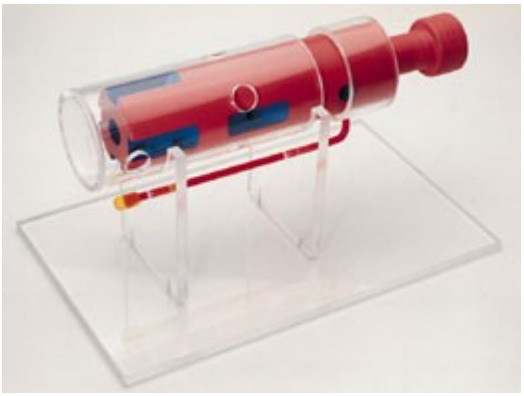


Order No. 1182
Pump tappet of a lifting-disk pump

The functions of a lifting-disk pump tappet:
- filling the pressure chamber
- start of injection, feed, injection
- volume control by rotating the plunger
- injection start control by means of the movable lifting disk

Order No. 1012
Distributor plunger

- this model is made out of acrylic glass and PVC
- fuel delivery and distribution as well as the function of a control sleeve can be shown



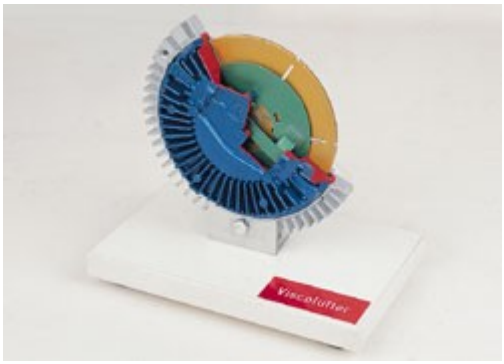
Order No. 1013
Distributor plunger (on a rack)

- order no. 1012 is fixed on a rack
- the control sleeve can be moved from the outside by means of a rod

HAKO cut-away models

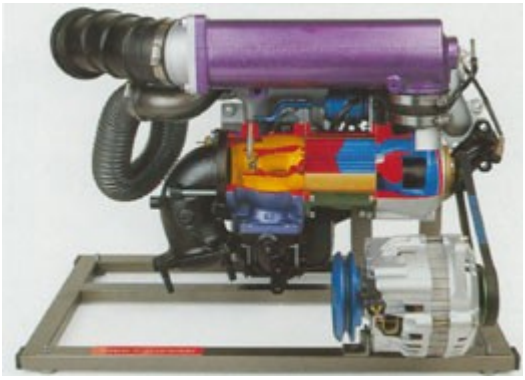
Order No. 1204
Cooling system model case

All the components of a modern water cooling system
- 2 viscous-drive fans, functional and cutaway
- electric fan with electric motor and ventilator
- water pump, cutaway, with thermostat
- expansion-element thermostat and thermo switch, cutaway
- oil cooler, one each of tubular radiator and finned radiator
- radiator cap with pressure relief valve and vacuum valve



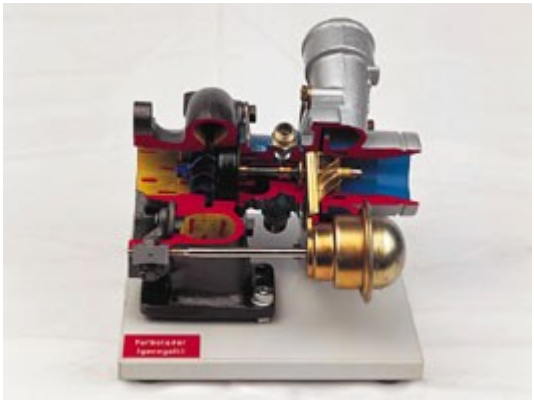
Order No. 1128
Visco blower

- function of the working chamber and oil reservoir
- function of the driving disc
- function of the bimetallic spring



Order No. 1221
Comprex (pressure-wave) supercharger

The rotor (cell wheel) is driven by a V-belt from the generator. The admission of the exhaust gas waves can be observed through the opening in the housing (to the left, marked yellow). The fresh gases are compressed in the rotor cells by the exhaust gas waves and flow through the exhaust opening (to the right, marked blue) to the inlet valves.



Order No. 1005
Exhaust turbocharger with charging pressure control

-all functions of order no. 1004 and the function of a charging-pressure control

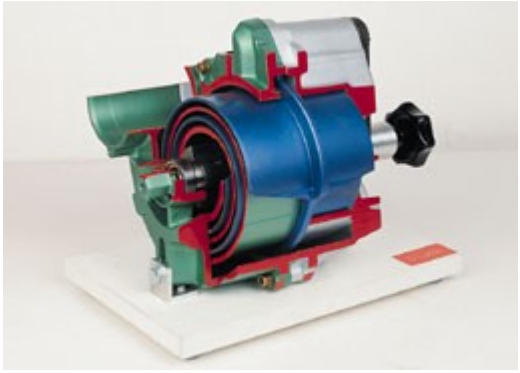
Order No. 1197
Turbocharger with variable blade geometry

Function of the turbine and blower wheels.
Adjustment of the guide vanes by means of the adjusting ring.

Charging pressure control via the vacuum cell by turning
the adjusting ring

Order No. 1267
Cutaway model: Turbo-charger with variable geometry and electrical control motor

Function of turbine and fan wheel as well as the bearings of the shaft.
Adjustment of the guide blades by an electronically actuated control motor instead of the vacuum-controlled advance used up to now.



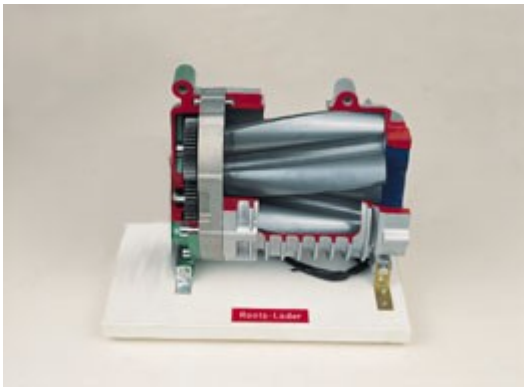
Order No. 1122
Spiral-type supercharger

- movement of the displacement spiral
- function of the drive shaft and auxiliary shaft and of the balance weights
- air compression outwards-inwards
- toothed-belt driven auxiliary shaft

HAKO cut-away models

Order No. 1151
Vane-type pump, PC

Suction and pressure effect via reduction or enlargement of the chambers.
Centrifugal force causes apex seal to fit against housing.
- function of the pressure relief valve
- function of the V-ribbed belt drive



Order No. 1239
Roots supercharger

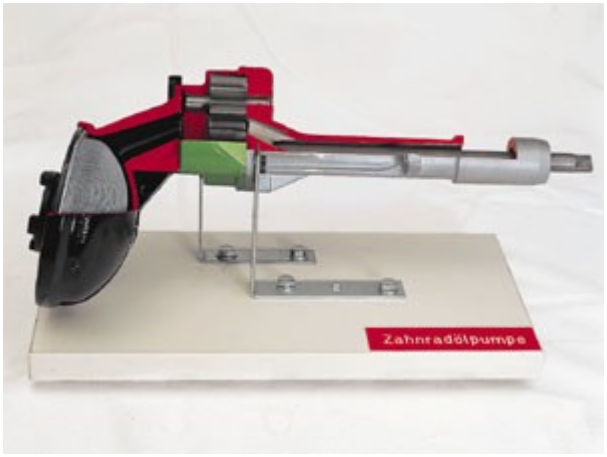
This mechanical supercharger is installed in Daimler Benz compressor sports cars. The two rotors have Three vanes each and are driven via gear wheels. The suction and compression can be shown particularly clearly.

Order No. 1152
Internal gear pump, PC

Suction and pressure effect via reduction or enlargement of the chambers.
- function of the pressure relief valve, intake port and delivery port cut away. Used as oil pump for pressure circulation lubrication and for automatic transmission.

Order No. 1150
Rotor pump, PC

Suction and pressure effect via reduction or enlargement of the chambers
- function of the pressure relief valve
- function of the timing chain drive



HAKO cut-away models

Order No. 1047
Geared pump

Demonstration:
- spur wheel function
- exec pressure valve function
- pressure and vacuum chamber function

Order No. 1189
Exhaust gas recirculation valve

- function of the cutaway diaphragm box
- function of the valve in metering the recirculated exhaust gas

Order No. 1153
Tandem hydraulic pump, PC

Hydraulic pump for 2 separate hydraulic circuits
- function of the vane-type pump
- function of the piston pump
- function of the pressure relief valve

Order No. 1143
Rotor pump, trucks

- function of the pressure relief valve
- interplay between inner and outer rotors
- suction and pressure effect via reduction or enlargement of the
chambers between the inner and outer rotor
the model can be put together with effortless ease

Order No. 1256
Cutaway model: Exhaust gas re-circulation valve II

Modern exhaust gas re-circulation valve in which the valve, the vacuum unit and the throttle valve are directly integrated in the induction pipe. The throttle valve can be operated via the vacuum unit with the help of a syringe.

Order No. 1257
Cutaway model: Exhaust gas re-circulation valve III

Modern exhaust gas re-circulation valve and the vacuum unit are directly integrated in the induction pipe. Exhaust gas re-circulation is increasingly being used nowadays in petrol engines.

Changes reserved!

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