

## Disassembly, Cleaning and Assembly of Nozzle Holder and/or Injection Nozzles and Adjusting Opening Pressure

Job No.

07-18

Due to the fact that the satisfactory performance of an engine is to a wide extent depending on the faultless operation of the injection nozzles, the cleaning of the nozzles should only be done by trained personnel.

A possibly required re-grinding of the nozzles (general overhaul) can only be done in workshops provided by the firm Bosch. Nozzle needle and nozzle head have been manufactured with such precision, that special equipment and instruments are necessary for repairs, which are only to the disposal of the producing firm.

**Note:** Operating the engines in idling speed for hours will cause a relatively quick coking of the injection nozzles. Therefore, care must be taken that industrial engines, especially for fork lift operations, are not subjected to prolonged idling.

### Disassembly of Injection Nozzles and/or Nozzle Holders:

Scrupulous cleanness of the working place and the tools must be observed during the disassembly of the nozzle holder.

1. Clamp the nozzle holder only with the clamping jaws Part No. 6365890131 in the vise, so that the nozzle holder will not be distorted during the clamping (Figure 07-18/1).

If there are no clamping jaws available, clamp in the vice a suitable box wrench 24 mm wide and insert the nozzle holder.

2. Unscrew the cap nut (5) with a box spanner 27 mm wide. Take the nozzle head (2) and the nozzle needle (1) out of the cap nut (see Figure 07-18/3).

Remove the nozzle holder insert (3), the pressure bolt (4) and the tension spring (6) from the nozzle holder (7). Make sure that the nozzle head and the nozzle needle and also the individual parts of the respective nozzle assembly are not interchanged by mistake. The washer (15) can remain in the nozzle holder during the cleaning operation (see Figure 07-18/3).

**Note:** Touch only the pressure pins of the nozzle needle. Do not touch the lapped surfaces of the nozzle needle with the fingers, so that there will be no chance of corrosion (see Figure 07-18/8).

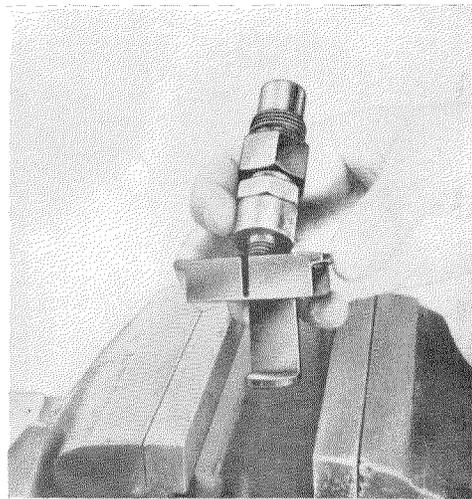


Figure 07-18/1

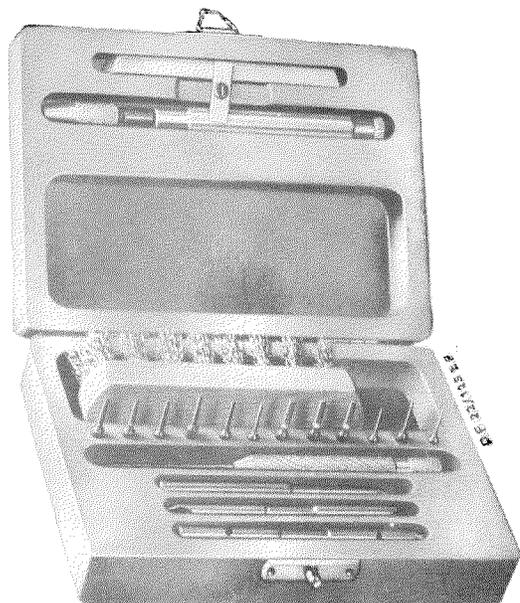


Figure 07-18/2



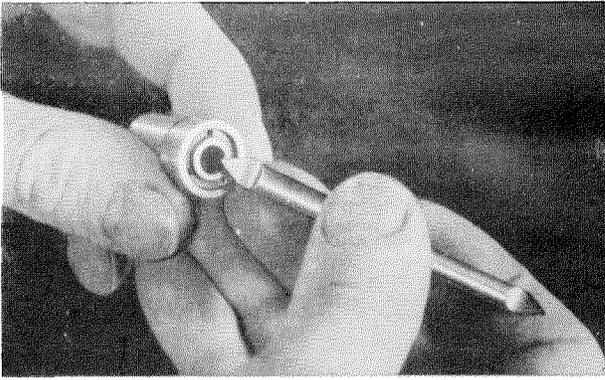


Figure 07-18/5

nozzle needle. During the turning of the cleaning needle apply little pressure only.

The spray hole in the nozzle mouth is now cleaned with a spray hole cleaner. As can be seen in Figure 07-18/6, the spray hole should never be cleaned from the outside, but from the inside outwards (because the spray hole cleaner will be properly guided this way).

5. The nozzle needle can be cleaned with a sharp-edged piece of hard wood soaked in diesel fuel. If the contour of the nozzle needle is heavily coked, the pressure bolt (13) of the nozzle needle can be clamped in a suitable chuck of a lathe or a drill press. Then clean the spray pin (8), the throttle pin (9) and the needle seat surface (10) with a sharp-edged piece of hard wood soaked in oil (Figure 07-18/7 and 07-18/8).

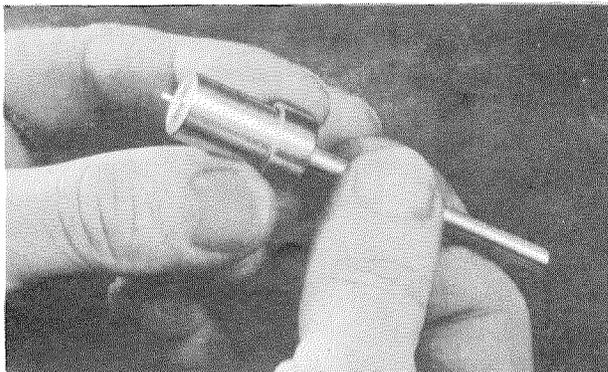


Figure 07-18/6

## 6. Visual Check (only on used nozzles)

Used nozzles must be visually checked after the cleaning operation.

- a) Check nozzle needle for worn or rough needle seat and for worn or damaged spray pin.
- b) Check nozzle head for worn or coked seat (observe with lighted magnifier EFAW 25 B) and out-of-round spray hole.

Faulty nozzles should be renewed. They can also be obtained through the exchange system of the firm Bosch.

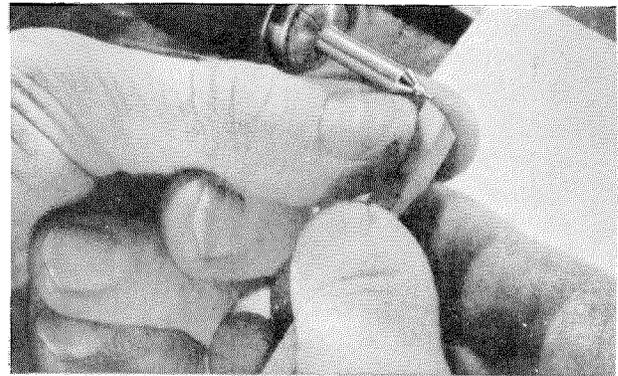


Figure 07-18/7

## 7. Sliding Test

A sliding test must be conducted with used nozzles after the visual check but also with new nozzles.

Check operating ease of nozzle needle in nozzle head. Submerge nozzle needle and nozzle head separately in filtered diesel fuel. Then put the nozzle needle into the nozzle head. While holding the nozzle head in a vertical position the nozzle needle pulled out approx. one third must slide back on its seat by its own weight (gravity test).

Turn the nozzle needle and repeat the procedure. If the needle does not fall inspite of most thorough cleaning, the nozzle must be replaced (see Note n. p.)

**Note:** Only in exceptional cases, if no spare nozzle is available, the point of contact on the stem of a jamming nozzle needle or the seat surface on the needle of a leaking nozzle can be lapped with the lapping compound Bosch **FT 26 V 2** to restore operating ease and tight sealing respectively. The lapping must be limited to the lowest required measure necessary to restore proper function of the nozzle! Thoroughly clean the two parts after this operation.

Nozzles with damaged seat surfaces or excessive play of the needle due to long operational periods must be replaced. (Excessive play of the needle means loss through leakage and therefore reduced engine output.)

**Nozzle needle and nozzle head are mated and form always one single unit.** Each nozzle needle has only one single nozzle head which fits correctly and vice versa. Neither needle nor nozzle must therefore be exchanged separately, but must always be replaced together.

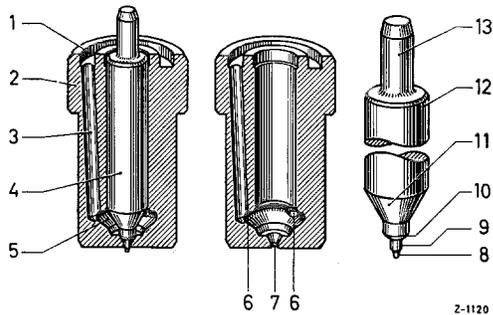


Figure 07-18/8

- |  |                        |
|--|------------------------|
| 1 Annular groove                           | 7 Nozzle mouth         |
| 2 Nozzle head                              | 8 Spray pin            |
| 3 Inlet hole                               | 9 Throttle pin         |
| 4 Nozzle needle                            | 10 Needle seat surface |
| 5 Pressure chamber                         | 11 Pressure shoulder   |
| 6 Mouth of inlet holes in pressure chamber | 12 Needle stem         |
|  | 13 Pressure bolt       |

## 8. Installing Injection Nozzle in Nozzle Holder:

All parts must again be rinsed in clean diesel fuel before assembly. In addition, make sure that the ground sealing surfaces of nozzle holder, nozzle holder insert and nozzle head are perfectly clean and not damaged. During the installation

of the nozzle holder in the cylinder head, make sure that the old gasket between nozzle head and pre-combustion chamber is always replaced by a new gasket Part No. 636 017 01 20.

New and reconditioned injection nozzles are supplied with a coat of anti-corrosion grease. Therefore, before assembly wash the nozzles in clean gasoline and check operating ease of nozzle as described in Pos. 7.

Then mount the nozzle holder (7) in the clamping jaws Part No. 636 589 01 31 or in a box wrench (24 mm wide) (see Pos. 1 and also Figure 07-18/1). Install the washer (15) in the nozzle holder (7), if the washer had been removed (see Figure 07-18/3).

Insert the pressure spring (6) and mount the pressure bolt (4) on the pressure spring, so that the short neck faces towards the spring. Mount the nozzle holder insert (3) with the annular groove facing downwards on the pressure bolt (4) (see Figure 07-18/3).

Mount the nozzle head (2) with nozzle needle (1) on the nozzle holder insert (3). Then screw by hand the cap nut (5) to the nozzle holder (7).

Tighten the cap nut (7) with the torque wrench to a torque of 7 to 8 mkg. A too tightly secured cap nut can cause distortion of the nozzle head and jamming and/or sticking of the nozzle needle.

## Testing and/or Adjusting of the Nozzle Opening Pressure and Checking the Spray Pattern of the Nozzle DNO SD 211 or DNO SD 2110, Model OM 636 and/or DNO SD 151 or DNO SD 1510, Model OM 621:

If the opening pressure of a removed nozzle must be tested or newly adjusted, this can only be done on a nozzle test stand or nozzle tester. Connect the injection nozzle installed in the nozzle holder with the Bosch Hand Test Stand EFEP 60 A, Part No. 000 589 14 27 (Figure 07-18/9). The employed injection line should have an inner dia. of 2 mm and a length of approx. 750 mm.

Only clean test oil or filtered diesel fuel must be used in the test stand. During the testing of an injection nozzle make sure **that your hand does not come into the jet of the spraying nozzle**. The jet will penetrate deep into the flesh and destroys the tissue. The fuel mixing with the blood can cause blood poisoning.

In order to check whether the nozzle is not distorted press down the handle of the nozzle tester several times quickly and forcefully. If the nozzle needle has the proper operating ease, the nozzle must buzz with a high whistle.

### 1. Testing Opening Pressure of Injection Nozzle:

Slowly force down the hand pump lever (1 stroke per second) while the manometer is switched on and determine at the manometer the opening pressure during opening and/or beginning of spraying of the nozzle; the cleaned nozzle must buzz distinctly during spraying (see Figure 07-18/9).

**Caution!** While the manometer is on increase the pressure only slowly and still more important, release only slowly, because the manometer can otherwise be damaged.

The opening pressure of new nozzles should be 115 atm. and of used nozzles at least 100 atm. The difference in opening pressure within one set of nozzles for any one engine should not be more than 5 atm. The opening pressure depends on the initial tension of the pressure spring and is adjusted with washers (ground steel discs) which are installed at the top end between pressure spring and nozzle holder.

The washers are available 1.0 to 1.8 mm thick in steps of 0.05 mm each. An increase of initial tension of 0.05 mm increases the opening pressure by approx. 3.0 atm. Also see Pos. 8, Installing Injection Nozzle in Nozzle Holder.

**Note:** For fork lifts or built-in engines, especially those operated indoors, the opening pressure can in certain cases be increased up to 150 atm. to still further reduce exhaust smoking.

### 2. Checking Injection Nozzle for Leaks:

Press the pump handle slowly downwards, so that the needle of the manometer indicates a pressure 20 atm. less than the adjusted opening pressure. If no drop leaves the nozzle mouth, the nozzle is tight.

**Note:** If the leak cannot be eliminated by thorough cleaning of the seat surfaces of nozzle head and nozzle needle, the nozzle must be replaced (also see Cleaning Injection Nozzle, Note of Paragraph 7).

If the nozzle leaks at the thread of the cap nut, do not try to eliminate the leak by additional tightening of the cap nut. If the nozzle holder insert (3) does not seal properly, it can be leveled on either side (see Figure 07-18/3) with lapping compound on a surface plate, the same is true for the front end of the nozzle holder (7). Sometimes it will even be sufficient if the nozzle holder insert is only turned and the cap nut is again tightened according to instructions.

### 3. Spray Pattern and Buzzing Test:

During this test **the pressure gauge** must always be **switched off** by closing the stop cock.

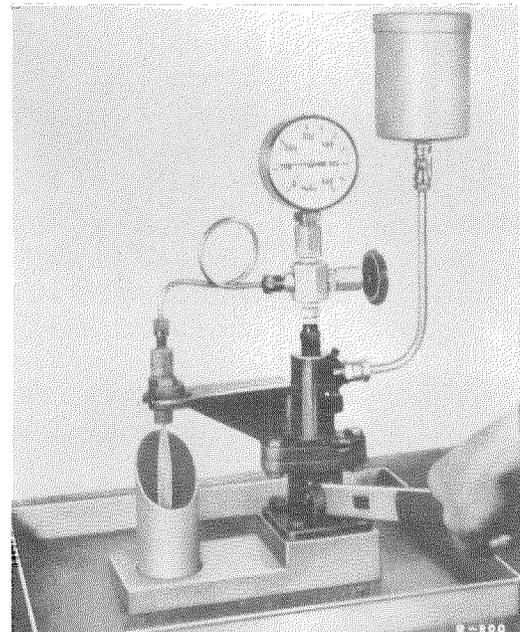


Figure 07-18/9

Uniform Spray Pattern (Proper nozzle)

### a) Testing **uncleaned** Nozzles

In order to judge the performance of the injection nozzles in the engine they must be tested before the cleaning, just as they are removed from the engine.

For this purpose press the handle 3 or 4 times **slowly** downwards, approx. **1 stroke per second**. The buzzing of the nozzle should then be heard or felt.

The spray pattern should be almost symmetrically around the axis of the nozzle and without tributary jets (Figure 07-18/9).

If this is not the case, do not immediately remove the nozzle from the nozzle holder, but clean first the face of the nozzle head on a level piece of hard wood soaked in diesel fuel and furnished with a groove or a small hole. After that clean the nozzle through 4 to 6 quick and short strokes of the pump handle. Then, as mentioned above, press the pump handle 3 or 4 times slowly downwards (1 stroke per second). During this operation the buzzing of the nozzle **should** be heard or felt, the spray pattern must be closed in the direction of the nozzle axis and be without tributary jets (see Figure 07-18/10 and 07-18/11).

If the test requirements cannot be fulfilled after taking these measures, the injection nozzle must be disassembled and cleaned.

### b) Testing a cleaned Nozzle Buzzing Test

Press down the pump lever once to twice per second, the nozzle should then buzz audibly or perceptibly. If the test speed is increased, the buzzing stops. The test oil then leaves the nozzle with a hissing noise. Only during a faster handle speed (approx. 2 to 3 strokes per second) the nozzle buzzes with a high whistle.

#### Testing Spray Pattern

Before reaching the high-pitched whistle the spray can be stringy and unatomized, but this will be of no importance in this range. An evaluation of the spray pattern will therefore be only possible during a **fast**

pressing-down of the pump handle (**2 to 3 strokes per sec.**) The spray must then be closed and well atomized (buzzing during full stroke of nozzle needle) (see Figure 07-18/10).

If the spray is too wide, stringy and not closed, the nozzle is incorrect (see Figure 07-18/11).

The testing of a new nozzle is conducted in the same way as of a cleaned nozzle.

If the test requirements are not met after thorough cleaning of the nozzle head and nozzle needle, the nozzle must be replaced.

**Note:** For engines subject to excessive Diesel knock or heavy exhaust smoke, install, if possible, injection nozzles DNO SD 2110 part No. 000 017 16 12 in the case of the OM 636, or injection nozzles DNO SD 1510 part No. 000 017 28 12 in the case of the OM 621; these nozzles have a slightly larger aperture.

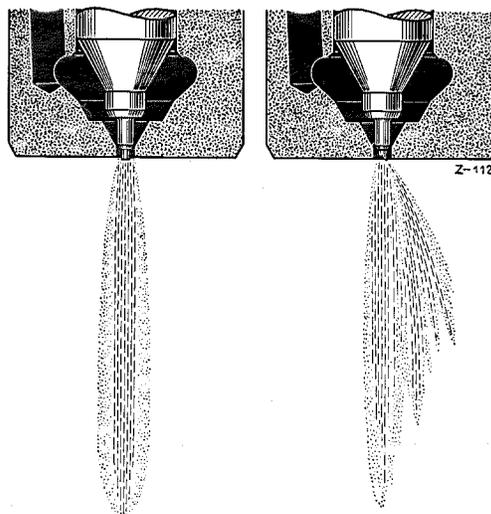


Figure 07-18/10

Figure 07-18/11

Correct spray pattern, spray closed and well atomized

Spray too wide, stringy and not closed (nozzle incorrect)

#### Testing the Opening Pressure and/or Injection Pressure of the installed Injection Nozzle with the Injection Pump mounted on the Engine and the Bosch Peak Pressure Tester EFEP 66 A:

With the help of the peak pressure tester EFEP 66 A supplied by the firm Bosch the opening pressure of the injection nozzles can be checked while the nozzles are still

installed in the engine. For this purpose install the peak pressure tester as shown in Figure 07-18/12).

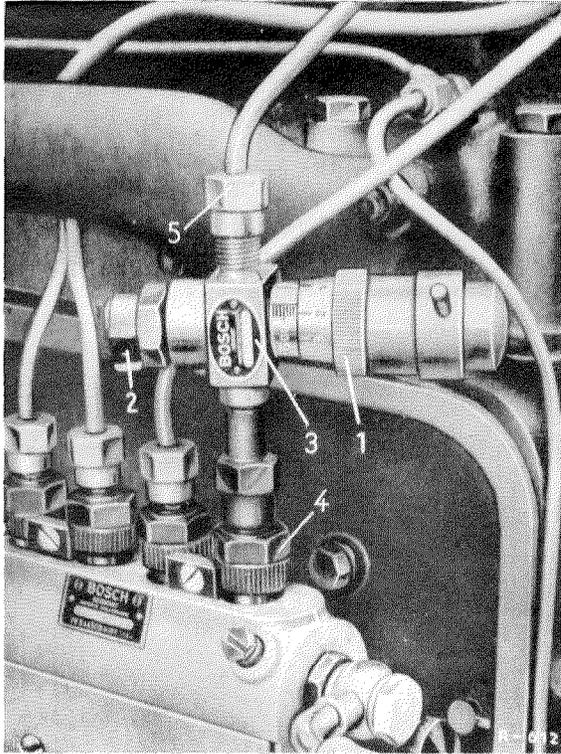


Figure 07-18/12

- |                                     |                        |
|-------------------------------------|------------------------|
| 1 Adjusting ring<br>(adjusting nut) | 3 Peak pressure tester |
| 2 Relief valve                      | 4 Pipe connector       |
|                                     | 5 Injection line       |

The pressure spring installed in the peak pressure tester is so designed, that one turn of the adjusting screw (1) causes a change in opening pressure of the valve of 100 atm. The circumference of the adjusting screw is subdivided by 10 line marks. A pressure of 10 atm. can therefore be determined directly and the values in between can be estimated with adequate accuracy.

In order to test the opening pressure of the injection nozzle remove the injection nozzle to be tested. Then mount the peak pressure tester (3) on the connector (4) of the injection nozzle to be tested and connect the peak pressure tester to an injection line (5) provided for this test with an inner diameter of 2 mm and a length

of 750 mm. Then connect the injection nozzle to be tested to the injection line in such a way **that injury through the nozzle jet is impossible**. The jet of a discharging nozzle penetrates deeply into the flesh of the finger or the hand and destroys the tissue. The fuel mixing with the blood can cause blood poisoning.

Now adjust the adjusting ring (1) to approx. 130 atm. and set the cam of the respective pump element to BDC.

Pump pressure with a suitable tool (screw-driver) inserted between the lock nut and the adjusting screw of the roller tappet (Caution! Do not damage spring retainer.) During the pressure-pumping turn back the adjusting ring until the relief valve in the peak pressure tester opens and the fuel is simultaneously discharged at the hole (2) of the relief valve and the nozzle. The value determined at adjusting screw and scale indicates the opening pressure of the nozzle.

The maximum discharge pressure of the individual injection pump elements can be measured as follows:

Disconnect the pressure lines and/or injection lines at the injection pump. Connect the peak pressure tester with connector for injection line closed by a cap plug and set the adjusting ring to approx. 200 atm. (see Figure 07-18/12). Now pump pressure with a suitable tool inserted between the lock nut and the adjusting screw of the roller tappet of the respective element (Caution, do not damage spring retainer). During pressure-pumping turn back the adjusting ring until the relief valve in the peak pressure tester opens and the fuel is discharged through the hole (2) of the relief valve. The determined value indicated by the adjusting screw and the scale corresponds to the maximum discharge pressure of the injection pump element being tested. Test all elements. The maximum discharge pressure should not be less than 150 atm.