

Modification: Description Removal and Installation of Flywheel eliminated.

A. General

Expanding bolts serve the purpose of pressing highly stressed machine members against each other under the pressure of an initial tightening force. However, while tightening with the torque wrench some of the tightening torque is lost in the threads and on the screw contact surface. At similar tightening torque the initial tightening force of an expanding bolt decreases with the increase of the torque losses. Since these losses depend on the condition of the contact surfaces and on lubrication, they are hard to check. At high specific tightening torques the initial tightening force is therefore automatically subject to major deviations.

These instability factors can be widely prevented by a combined tightening to an initial tightening torque and according to an angle of rotation torque. With this method the expanding bolt is first pre-tightened by means of a torque wrench to a given tightening torque until properly held and the expanding bolt is then again tightened to the specified angle of rotation torque by means of a rigid angle of rotation wrench. The initial torque plus the angle of rotation torque is determined in such a manner that the expanding bolt is loaded up to the flow limit (yield limit).

Since the influence of friction losses is practically almost nil, the method permits a very low dissipation of the desired initial tightening force, so that the initial tightening capacity of an expanding bolt can be fully exploited.

To obtain uniform control, the angle of rotation for all screw connections tightened acc. to an angle of rotation has been set to $90^{\circ} + 10^{\circ}$. The tightening value (initial tightening torque in kpm/angle of rotation in angle degrees) is written, for example $4 + 1/90^{\circ} + 10^{\circ}$.

The bolts are tightened in two steps:

1. Initial tightening to specified tightening torque with torque wrench.
2. Added tightening to specified angle with angle of rotation wrench.

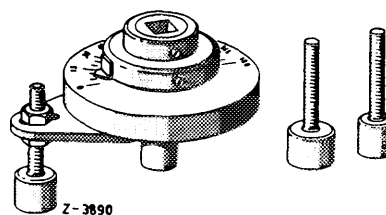


Fig. 03-1/1

Angle of rotation wrench 115 589 02 13 00 for tightening connecting rod and flywheel fastening bolts

If no angle of rotation wrench is available, the bolt or nut can also be tightened to the specified angle in one step by means of a standard socket wrench with tommy bar (Fig. 03-1/8). The angle should be estimated as accurately as possible, mark starting and end position with chalk or a felt pencil.

Never use yielding torque wrench for tightening according to angle of rotation, since this will automatically result in angle errors.

Prior to positioning the bolts and nuts lubricate threads and contact surface well. Use only perfect socket wrenches for tightening. Since tightening acc. to angle of rotation results in higher torques than applied up to now, worn out or badly applied wrenches will slip much easier than before.

On the engines of our passenger car models the connecting rod bolts and the flywheel fastening bolts are tightened to an angle of rotation. On the flywheel fastening bolts the tightening according to angle of rotation begins with the series, on connecting rod bolts as from the following chassis end numbers:

Model	Chassis End No.
200 D/8	031 607
220 D/8	068 855
200/8	028 650
220/8	031 059
230/8	016 652
250/8 Sedan	020 678
250/8 Cp.	000 227
250 E/8	000 040

B. Reuse of Expanding Bolts

When tightening to an angle of rotation, an expanding bolt will suffer a permanent distortion.

When an expanding bolt is reused, be sure to measure the minimum expanding shaft diameter with an edged vernier gauge (Fig. 03-1/2). If the minimum dia. of the expanding shaft as stated in the tables is attained, the bolts must be replaced.

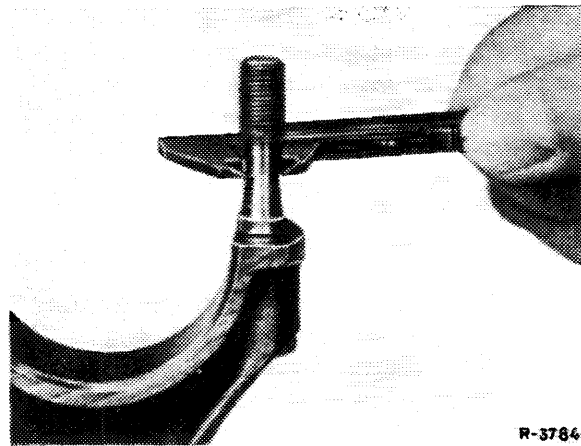


Fig. 03-1/2

C. Reuse of Connecting Rod Bolts

To decide about the reuse of a connecting rod bolt, only that part of the expanding shaft need be measured which is visible upon removal of connecting rod cap. Deformation will occur only at this point.

Knock connecting rod bolts out of connecting rod only if they must be replaced.

The newly developed connecting rod bolts are exclusively for tightening to an initial tightening torque followed by tightening acc. to angle of rotation. Tightening these bolts only according to

a tightening torque is not enough. On the other hand, for the bolts tightened up to now according to a specified tightening torque, the procedure will remain the same. Prior to tightening connecting rod bolts on all engines it is required to check each time whether the pertinent bolts should be tightened acc. to angle of rotation torque or acc. to tightening torque.

The identifying characteristics of the bolts of 4-cylinder engines are the diameter of the expanding shaft (in addition, the bolts for angle of rotation torque are cadmium-plated and passivated yellow), for the bolts of 6-cylinder engines the identification

is in the bolt head (refer to following table "Differentiating Characteristics").

As already said in section A, the angle of rotation for all screw connections which are tightened acc. to an angle of rotation has been unified. The connecting rod bolts are therefore also tightened to

$90^{\circ} + 10^{\circ}$. The initial tightening torque has been increased from 2.5 kpm to $4 + 1$ kpm. The bolts which were tightened up to now at an angle of rotation of 180° minus 20° , may be tightened to $4 + 1/90^{\circ} + 10^{\circ}$ during reassembly, provided the minimum diameter on expanding shaft has not yet been attained.

Differentiating Characteristics

	Tightening torque	Angle of rotation torque	Remarks
4-Cylinder engines expanding shaft diameter (new bolt)	8.8 - 0.1 mm	8.4 - 0.1 mm	Difference is in expanding shaft diameter, as well as in surface protection of bolt

6-Cylinder engines

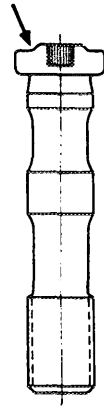


Fig. 03-1/3

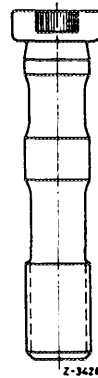


Fig. 03-1/4

Difference is in bolt head

Dimensions and Tightening Torques

Connecting rod bolt for angle of rotation torque	4-Cylinder engines	6-Cylinder engines
MB Part No.	615 038 02 71	108 038 02 71
Threads	M 10 x 1	M 11 x 1
Diameter when new	8.4 - 0.1 mm	9.0 - 0.1 mm
Minimum dia. 1)	7.2 mm	7.8 mm
Initial tightening torque		$4 + 1$ kpm
Angle of rotation torque		$90^{\circ} + 10^{\circ}$

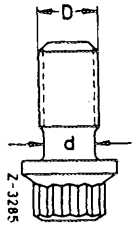
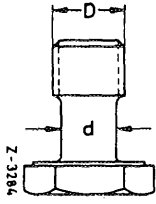
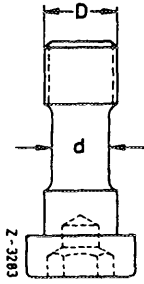
1) Bolts are no longer used when the minimum dia. has been attained.

D. Reuse of Flywheel Fastening Bolts

The flywheel fastening bolts of the 4-cylinder models which were tightened to an angle of rotation of $60^\circ + 10^\circ$ up to now, are now tightened to $90^\circ + 10^\circ$. The initial tightening torque has been retained. Bolts previously already tightened to an angle of rotation

of $60^\circ + 10^\circ$ can be readily tightened to an angle of rotation of $90^\circ + 10^\circ$, provided the minimum diameter on the expanding shaft has not yet been attained.

Differentiating Characteristics and Dimensions

On engines with manual transmission		On engines with automatic transmission			
					
Fig. 03-1/5		Fig. 03-1/6		Fig. 03-1/7	
MB Part No.	615 032 05 71	621 032 00 71	108 032 01 71	108 990 03 19	108 990 04 19
Thread diameter	M 10 x 1	M 10 x 1	M 12 x 1	M 10 x 1	M 12 x 1
Expanding shaft dia. (when new)	8.5-0.2	8.0-0.2	9.2-0.2	7.7-0.2	9.2-0.2
Minimum dia. 1)	8.1	7.6	8.8	7.3	8.8
Installed in engines	200/8 220 D/8 220/8 220 D/8	230/8	250/8 250 E/8	200/8 200 D/8 220/8 220 D/8 230/8	250/8 250 E/8

1) Bolts are no longer used when the minimum dia. has been attained.

Tightening Torques

Model	200 D/8 to 250 E/8
Initial tightening torque	3 + 1 kpm
Angle of rotation torque	$90^\circ + 10^\circ$

Note: The flywheel of 4-cylinder engines is attached to the crankshaft with 12 bolts without location by means of a set pin. Flywheel and crankshaft are balanced together. Be sure that during assembly the flywheel is again in the same position in relation to the crankshaft. For this purpose, the flywheel and the crankshaft are marked with an "0", a notch or a red dot, depending on type of transmission and the pertinent series (Fig. 03-1/8).

Prior to removing the flywheel, check whether one of the markings is in place; if not, apply mark subsequently.

The flywheel of the 6-cylinder engines has a 6-bolt connection with set pin.

When a new flywheel is installed, balance statically acc. to old flywheel.

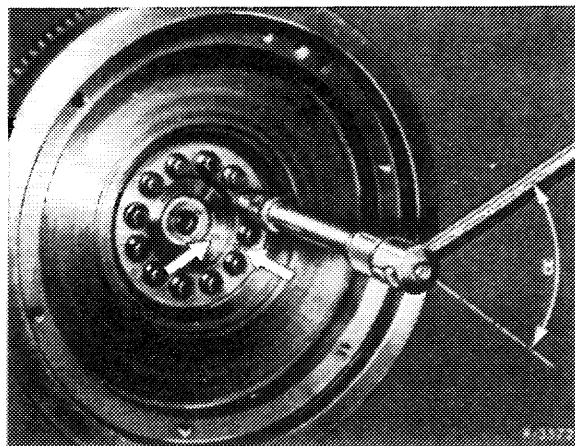


Fig. 03-1/8