

# Testing and Repairing Engine

The test and repair procedures for the engines of Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE are basically the same as those described for Model 190.

The following pages contain only the deviations from the basic procedures and the tables listing the measurements necessary for testing and repairing the engine.

## Crankcase and Cylinder Head

Job No.
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01-5
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### A. Cleaning, Pressure-Testing and, if necessary, Surface-Grinding of Crankcase

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE these procedures are the same as described for Model 190.

#### Machining Dimensions for Crankcase

Model	180 a, 180 b, 190, 190 b, 190 SL	220 a and 219, 220 S with $\epsilon = 7.6:1$	219, 220 S with $\epsilon = 8.7:1$ and 220 SE
Total height	238.4—238.5	213.6—213.7	213.1—213.2
Permissible stock removal	0.3		
Permissible departure from plane	in a longitudinal direction	0.05	
	in a lateral direction	0	
Permissible departure from parallelity between upper and lower separating surface in a longitudinal direction	0.1		
Test pressure with air in hot water (70° C)	2 atm.		
Distance between piston bottom and separating surface — = piston recedes + = piston projects	+ 0.3±0.25	— 0.3    +0.25 —0.35	+ 0.2    +0.25 —0.35

## B. Boring and Honing of Cylinder Bores

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE these procedures are the same as described for Model 190.

### Machining Dimensions of Cylinder Bores

Overhaul stage	180 a, 180 b 190, 190 b 190 SL	220 a, 219 220 S, 220 SE
Standard size	$\frac{85.000}{85.022}$	$\frac{80.000}{80.019}$
Intermediate stage	$\frac{85.250}{85.272}$	$\frac{80.250}{80.272}$
1st Overhaul stage	$\frac{85.500}{85.522}$	$\frac{80.500}{80.522}$
2nd Overhaul stage	$\frac{86.000}{86.022}$	$\frac{81.000}{81.022}$
3rd Overhaul stage	86.500	81.500

### Machining Tolerances of Cylinder Bores

Models 180 a, 180 b, 190, 190 b, 190 SL, 220 a, 219, 220 S, and 220 SE

Permissible degree of out-of-round	0.013
Permissible conicity	0.013
Permissible departure of cylinder bores from vertical to crankshaft axis, calculated over total height of cylinder	0.05
Permissible roughness	0.003—0.005
Average depth of corrugation	max. 50% of roughness

The pistons must be so chosen that the difference in weight of the pistons in any one engine does not exceed 4 grams and that the running clearance is 0.04 mm.

## C. Machining and Pressure-Testing of Cylinder Head

### Machining Dimensions for Cylinder Head

Model	180 a, 180 b 190, 190 b 190 SL	220 a 219 220 S 220 SE
Total height	84.8—85.0	
Permissible stock removal	1	0.8
Permissible departure from plane	in a longitudinal direction	0.1
	in a lateral direction	0
Permissible departure from parallelity between upper and lower separating surface in a longitudinal direction	0.1	
Test pressure with air in hot water (70° C)	2 atm.	

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE this procedure is the same as described for Model 190.

After machining the cylinder head separating surface, remachine the valve seats in order to ensure that the minimum distance between valve head and cylinder head separating surface is maintained (see Section F).

## Compression Ratio and Capacity of Compression Chamber

Model	180 a	180 b	220 a 219 <sup>1)</sup> 220 S <sup>1)</sup>	219 <sup>2)</sup> 220 S <sup>2)</sup>	220 SE	220 a <sup>3)</sup> 219 <sup>3)</sup> 220 S <sup>3)</sup>	190 SL <sup>4)</sup>	190 SL <sup>5)</sup>	
Com- pression ratio	maximum	7.0:1	7.25:1	7.8	9.0	8.8	7.1	8.8	9.2
	standard	6.8:1	7.0:1	7.6	8.7	8.7	6.8	8.5	8.8
	minimum	6.6:1	6.8:1	7.35	8.4	8.4	6.5	8.25	8.45
Total compression chamber capacity with cylinder head fitted in cm <sup>3</sup>	78.5—84.5	76—82	53.5—57.5	45.5—49.5	46.9—49.5	61.0—65.0	60.3—66.3	57.8—63.8	
Compression chamber capacity in cylinder head with valves and spark plugs fitted in cc	70.3—71.3	68.5—69.5	44.3—45.3	36.4—37.4	36.4—37.4	51.2—52.2	51.7—53.7	49.3—51.3	
Height of compression chamber in cylinder head	18 ± 0.3	18 ± 0.3	18 ± 0.3	18 ± 0.3	18 ± 0.3	18 ± 0.3	18 ± 0.3	18 ± 0.3	

<sup>1)</sup> On Model 219 up to Engine End No. 75 04347, on Model 220 S up to Engine End No. 75 09083.

<sup>2)</sup> On Model 219 with standard clutch as from Engine End No. N 75 04348, with hydraulic automatic clutch as from Engine End No. Z 75 00002.

On Model 220 S with standard clutch as from Engine End No. N 75 09084, with hydraulic automatic clutch as from Engine End No. Z 75 00008.

<sup>3)</sup> Engines with lower compression as an optional extra, on Models 220 a and 219 according to SA 10037, on Model 220 S according to SA 10187.

<sup>4)</sup> Up to Engine End No. 65 03803.

<sup>5)</sup> As from Engine End No. 65 03804.

## D. Checking and Replacing Valve Guides

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE this procedure is the same as described for Model 190.

On the first cars of Models 190 SL, 219, and 220 S shouldered valve guides were installed, which were later replaced by valve guides with a snap ring (to prevent axial displacement) of the type used on all cars of Models 180 a, 180 b, and 220 SE (Figs. 01-5/1 and 01-5/2). All cars of Model 220 a have shouldered valve guides as standard parts.

When repairs are carried out, the shouldered valve guides can without modification be replaced by valve guides with a snap ring.

On Model 220 SE the exhaust valve sealing system is the same as on the other models, but the inlet valve is sealed by a silicone sealing ring (see Fig. 01-4/25). For this reason, the top of the inlet valve guide has been redesigned (Fig. 01-5/3).

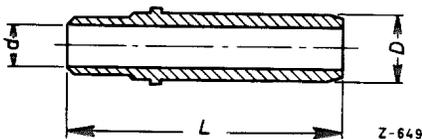


Fig. 01-5/1  
1<sup>st</sup> Version with  
shoulder

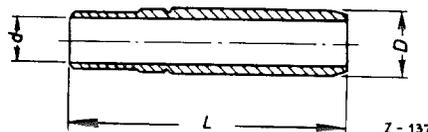


Fig. 01-5/2  
2<sup>nd</sup> Version with  
snap ring

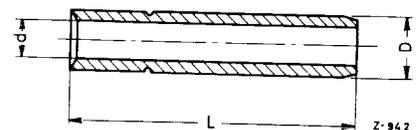


Fig. 01-5/3  
Inlet valve guide  
Model 220 SE

## Dimensions of Valve Guides and Bores in Cylinder Head

Model 180 a, 180 b, 190, 190 b, 190 SL, 220 a, 219, 220 S and 220 SE

Part-No.	Overhaul stage	Color code	External diameter D	Internal diameter d		Length L		Bore in cylinder head	Force-fit oversize in cylinder head
				In-let	Ex-haust	In-let	Ex-haust		
Inlet 121 050 00 24 180 050 02 24 <sup>1)</sup> Exhaust 121 050 16 24 <sup>3)</sup>	Standard size	—	$\frac{14.013}{14.007}$					$\frac{14.000}{14.006}$	
		red	$\frac{14.019}{14.013}$					$\frac{14.006}{14.012}$	
		white	$\frac{14.025}{14.019}$					$\frac{14.012}{14.018}$	
Inlet 121 050 02 24 180 050 03 24 <sup>1)</sup> Exhaust 121 050 22 24 <sup>3)</sup>	1 <sup>st</sup> Overhaul stage	red	$\frac{14.225}{14.207}$	$\frac{9.000}{9.015}$	$\frac{10.000}{10.015}$	67 <sup>2)</sup>	57	$\frac{14.200}{14.218}$	+ 0.007
Inlet 121 050 03 24 180 050 04 24 <sup>1)</sup> Exhaust	2 <sup>nd</sup> Overhaul stage	white	$\frac{14.425}{14.407}$					$\frac{14.400}{14.418}$	

Note: The part numbers refer to valve guides with a snap ring.

<sup>1)</sup> Inlet valve guide for Model 220 SE

<sup>2)</sup> Length of inlet valve guide for Model 220 SE = 65.5 mm.

<sup>3)</sup> The previous Exhaust Valve Guides 121 050 01 24 (standard size), 121 050 04 24 (1<sup>st</sup> overhaul stage), and 121 050 05 24 (2<sup>nd</sup> overhaul stage) with a length L = 58 mm can be used up.

### Thrust Collars for Valve Springs

When installing the thrust collars, please note that in the case of shouldered valve guides thrust collars with a dimension  $a = 2.2 + 0.2$  mm are installed, and in the case of valve guides with a snap ring, thrust collars with a dimension  $a = 1.1 + 0.2$  mm (Fig. 01-5/4).

Under special circumstances thrust collars with the dimension  $a = 2.2 + 0.2$  mm can be used for valve guides with a snap ring, **but on no account should thrust collars with the dimension  $a = 1.1 + 0.2$  mm be used for shouldered valve guides.**

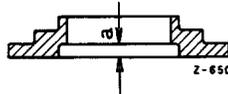


Fig. 01-5/4

Dimension  $a = 2.2 + 0.2$  mm for shouldered valve guides  
Dimension  $a = 1.1 + 0.2$  mm for valve guides with a snap ring

In the case of inlet valve guides for Model 220 SE (injection engine) with sealing ring and sealing ring retainer, the thrust collars have been replaced by a plain washer (see Fig. 01-4/25).

## E. Replacement of Valve Seat Rings

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE this procedure is the same as described for Model 190.

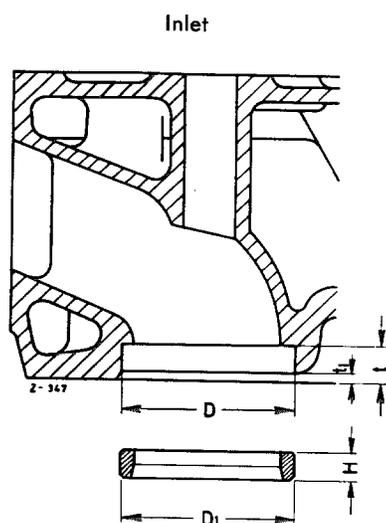


Fig. 01-5/5

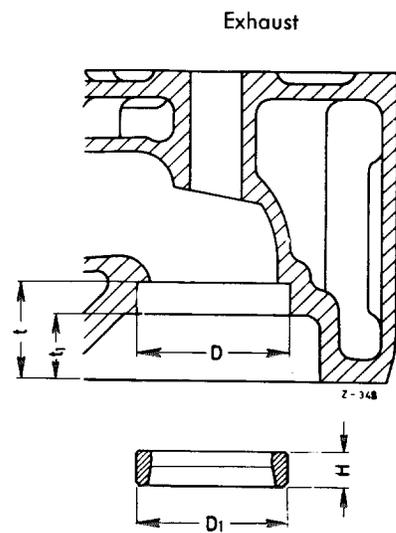


Fig. 01-5/6

### Dimensions of Cylinder Head Bores and Valve Seat Rings

Valve seat rings		Inlet			Exhaust	
Model		180 a, 180 b, 190 SL	220 a and 219 220 S with $\epsilon = 7.6:1$	220 SE and 219, 220 S with $\epsilon = 8.7:1$	180 a, 180 b, 190 SL	220 a, 219, 220 S 220 SE
Part number	Standard size	121 053 02 31	180 053 01 31	180 053 05 31	121 053 02 32	180 053 07 32
	1st Overhaul stage	121 053 03 31	180 053 02 31	180 053 06 31	121 053 03 32	180 053 08 32
Base bore "D" in cylinder head	Standard size	$\frac{48.000}{48.016}$	$\frac{44.000}{44.016}$	$\frac{43.000}{43.016}$	$\frac{42.000}{42.016}$	$\frac{39.000}{39.016}$
	1st Overhaul stage	$\frac{48.500}{48.516}$	$\frac{44.500}{44.516}$	$\frac{43.500}{43.516}$	$\frac{42.500}{42.516}$	$\frac{39.500}{39.516}$
Diameter "D <sub>1</sub> " of valve seat ring	Standard size	$\frac{48.106}{48.090}$	$\frac{44.150}{44.140}$	$\frac{43.100}{43.090}$	$\frac{42.100}{42.090}$	$\frac{39.100}{39.090}$
	1st Overhaul stage	$\frac{(49.300)^1}{48.600}$ $\frac{48.590}{48.590}$	$\frac{(45.300)^1}{44.650}$ $\frac{44.640}{44.640}$	$\frac{(44.300)^1}{43.600}$ $\frac{43.590}{43.590}$	$\frac{(43.300)^1}{42.600}$ $\frac{42.590}{42.590}$	$\frac{(40.300)^1}{39.600}$ $\frac{39.590}{39.590}$
Height "H" of valve seat ring	Standard size	$\frac{8.00}{7.91}$	$\frac{6.80}{6.71}$	$\frac{7.70}{7.61}$	$\frac{9.50}{9.41}$	$\frac{9.00}{8.91}$
	1st Overhaul stage	$\frac{8.00}{7.91}$	$\frac{6.80}{6.71}$	$\frac{7.70}{7.61}$	$\frac{9.50}{9.41}$	$\frac{9.00}{8.91}$
Depth in cylinder head	t	$\frac{10.00}{10.10}$	$\frac{8.50}{8.60}$	$\frac{9.70}{9.80}$	$\frac{27.50}{27.60}$	$\frac{27.00}{27.10}$
	t <sub>1</sub>	2	$\frac{1.2}{1.3}$	$\frac{1.2}{1.3}$	$\frac{17.70}{18.30}$	$\frac{18.00}{18.30}$
Force-fit oversize of valve seat ring		0.074 to 0.100	0.124 to 0.150	0.074 to 0.100	0.074 to 0.100	0.074 to 0.100

<sup>1)</sup> Rough-turned diameter. Re-turn or regrind the valve seat ring to make sure that the prescribed force-fit oversize is always maintained.

## F. Machining Valve Seats in Cylinder Head

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE this procedure is the same as described for Model 190.

### Machining Dimensions for Valve Seats in Cylinder Head

Model	180 a, 180 b, 190 190 b, 190 SL	220 a, 219 220 S, 220 SE
Valve seat width	1.25—1.75	1.25—2
Valve seat angle in cylinder head	90°—30'	
Permissible out-of-round of valve seat	0.05	
Backing-off of valve seat	120° or 150°, or with backing-off cutter minimum 0.1	

### Permissible Depth of Valve Disk in Relation to Cylinder Head Separating Surface

Models 180 a, 180 b, 190, 190 b, 190 SL, 220 a, 219, 220 S, and 220 SE

for new valve seats				for reconditioned valve seats			
Minimum distance for new valves		for reground valves		for new valves		Maximum distance for reground valves	
Inlet	Exhaust	Inlet	Exhaust	Inlet	Exhaust	Inlet	Exhaust
0.8	16	1.3	16.8	1.8	17.2	2.3	18