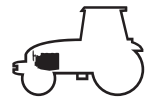




# **A2**

## **CYLINDER HEAD AND VALVES**



## Cylinder head and valves

### Local manufacturing tool

#### Injector coupling puller

A = 50 mm

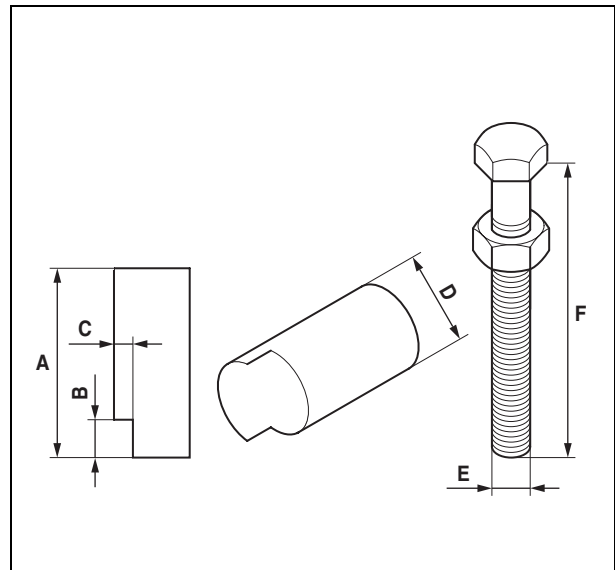
B = 10 mm

C = 10 mm

D ≥ 26 mm

E = 22 x 250

F = 120 mm (Subhead)



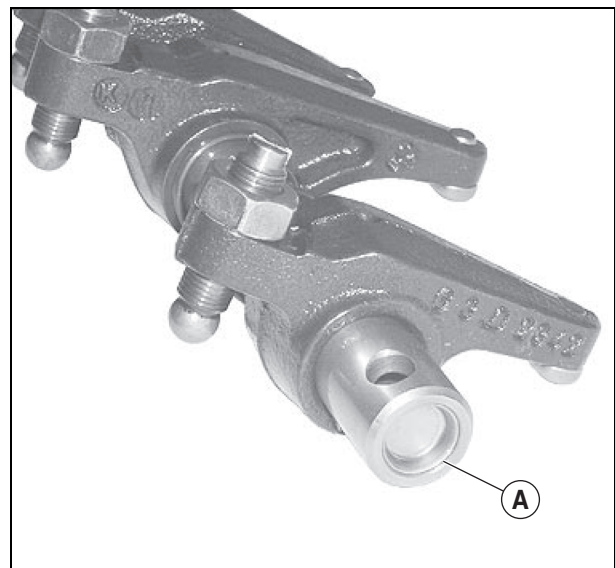
134msm00

Fig. 1

### Inspecting the rocker pin

**Note:** Mark the location of the rockers when removing in order to facilitate refitting.

- Remove the caps (A) only to change them or to clean the rocker axis.
- Disassemble and search for traces of wear or damage. Change all parts which are damaged or non compliant with specifications.

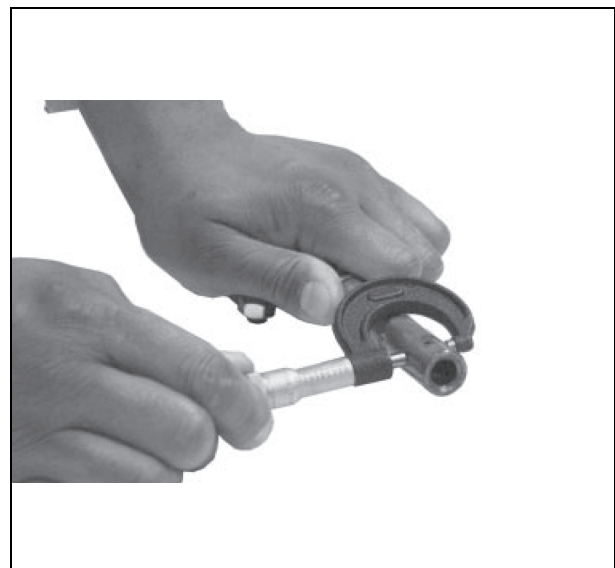


134hsm08

Fig. 2

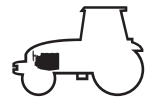
Outer diameter of the axis ..... 19,99 - 20,02 mm

Wear limit ..... 19,94 mm



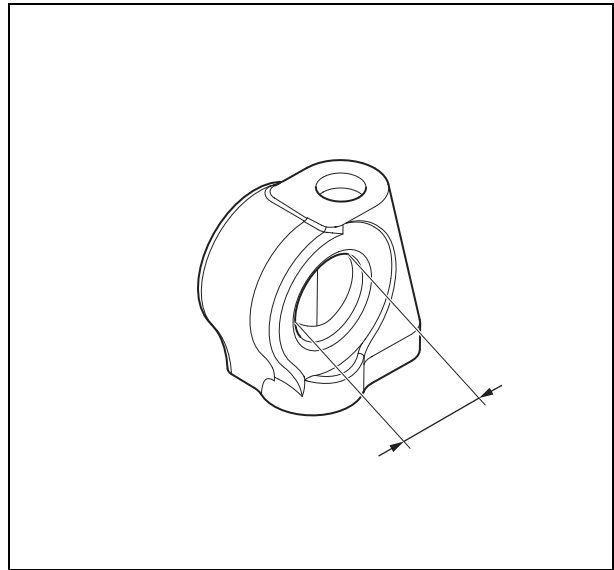
134hsm09

Fig. 3



## Cylinder head and valves

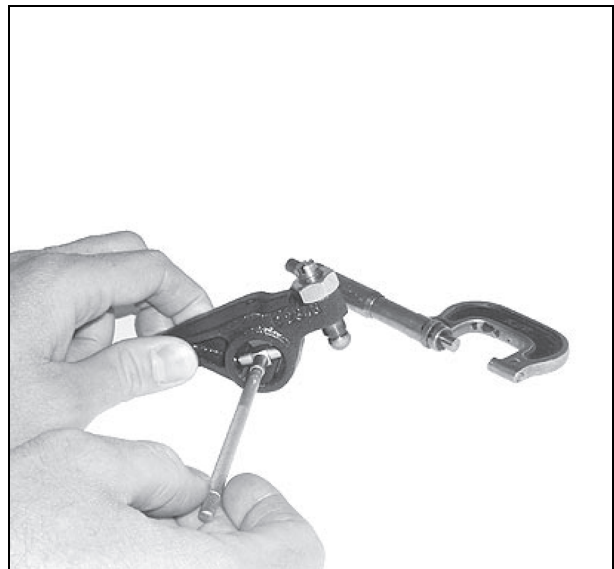
Maximum inner diameter of the shaft rest  
.....20,17 mm



134msm01

Fig. 4

Inner diameter of the rocker.....20,07 - 20,12 mm  
Wear limit.....20,17 mm



134hsm10

Fig. 5

**<https://www.ebooklibonline.com>**

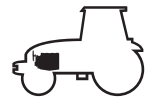
Hello dear friend!

Thank you very much for reading.

Enter the link into your browser.

The full manual is available for immediate download.

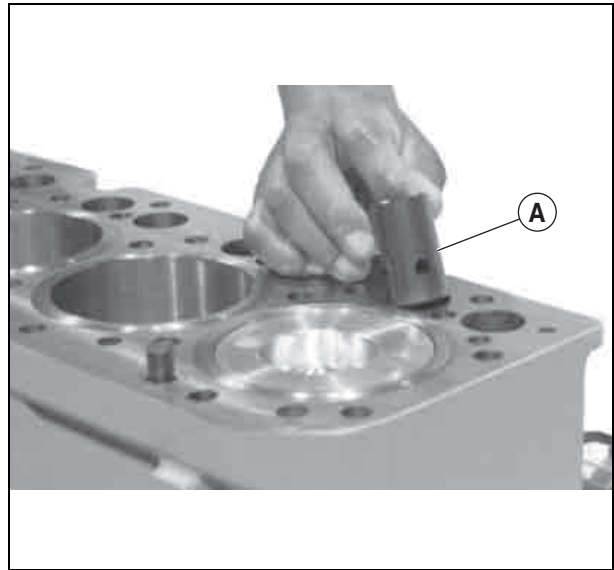
**<https://www.ebooklibonline.com>**



## Cylinder head and valves

### Inspecting the rockers

– Remove and clean the rockers (A). Mark them for refitting.



134hsm11

Fig. 6

– Measure the outer diameter of the rockers. If it is below the value recommended, change it.

Specified value:

Rocker outer diameter .....31,61 - 31,64 mm

– Measure rocker clearance in the bore.

Specified value:

Bore diameter  
(in the block) .....31,70 - 31,75 mm

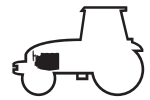
Rocker and borehole clearance.....0,06 - 0,13 mm

– Check the head on the rocker journals. If it is flat or concave, change the rocker and check the camshaft lobes.



134hsm12

Fig. 7



## Cylinder head and valves

### Measuring valve shrinkage

Measurements must be made at a maximum distance of 3 mm from the edge of the valve head.

– Compare the measurements (A) between the 2 inlet and exhaust valves. Check that the gap does not exceed the value specified.

**Note: If a cylinder has uneven valve wear, check the gap of boreholes on valve bridges.**

Specified value:

- Intake valve

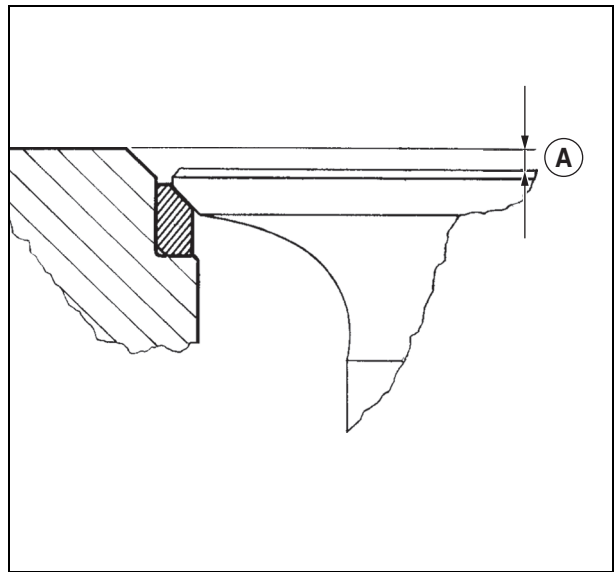
Shrinkage in the cylinder head ..... 0,61 - 1,11 mm

Wear limit ..... 1,63 mm

- Exhaust valve

Shrinkage in the cylinder head ..... 1,22 - 1,72 mm

Wear limit ..... 2,26 mm



131hsm33

Fig. 8

### Cylinder head flatness

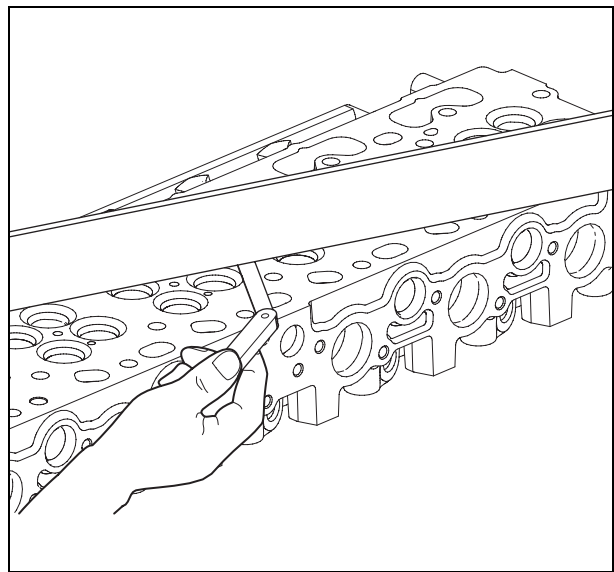
– Check cylinder head flatness using a precision rule and a set of shims. Check along the length, across and in diagonal in several locations.

Specified value:

Maximum acceptable straightness error over the entire length or width ..... 0,08 mm

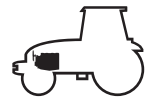
Maximum acceptable straightness error over the entire length of 150 mm ..... 0,03 mm

**Note: If the straightness error exceeds the values specified, rectify or change the cylinder head.**



132hsm05

Fig. 9



## Cylinder head and valves

### Measuring cylinder head thickness

– Measure the cylinder head's thickness between the parting of the cylinder head cover riser and the combustion reaching.

Specified value:

New cylinder head ..... 104,87 - 105,13 mm

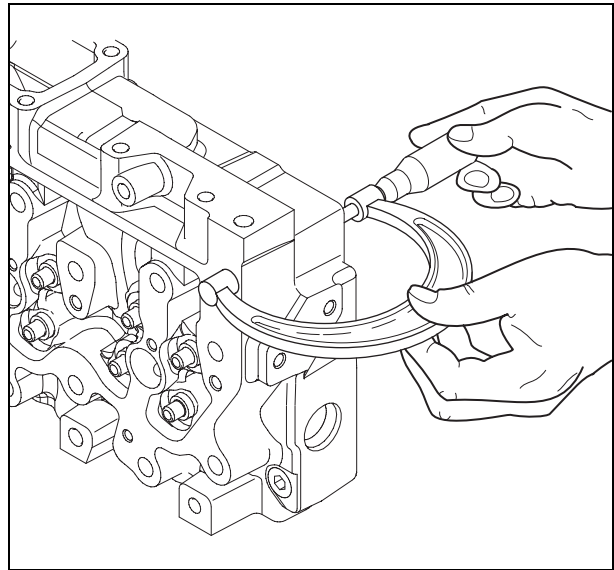
Minimum acceptable cylinder head thickness..... 104,24 mm

Maximum ripple depth ..... 0,012 mm

Maximum material which can be removed when rectifying 0,76 mm

**Note:** *If the cylinder head thickness is below the minimum acceptable, do not rectify. Change the cylinder head.*

**Important:** *Check cylinder head flatness using a precision rule and a set of shims.*



132hsm06

Fig. 10

### Valve guide measurement

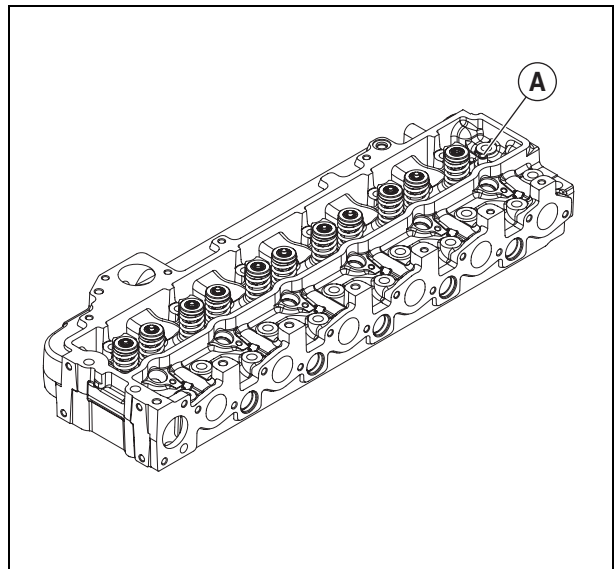
– Measure wear on the valve guides (A).

Specified value:

Diameter of the valve guide borehole..... 7,912 - 7,938 mm

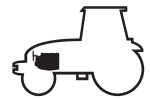
Clearance between rod and guide.....0,05 - 0,1 mm

Wear limit between stem and guide..... 0,15 mm



132msm05

Fig. 11



## Cylinder head and valves

### Measuring the valve seat bore in the cylinder head

If the dimensions of the boreholes do not comply with the values specified, machine the cylinder head according to the values.

Specified value:

• Seat insert valve borehole

– Exhaust

**A.** 42,987 - 43,013 mm.

**B.** Reference 3,82 mm.

**C.** 9,936 - 10,064 mm.

**D.** 38 - 42°.

**E.** Maximum radius 0,5 mm.

– Intake

**A.** 47,104 - 47,130 mm.

**B.** Reference 3,45 mm.

**C.** 9,936 - 10,064 mm.

**D.** 38 - 42°.

**E.** Maximum radius 0,5 mm.

Changing the outer diameter of seat insert valve boreholes.

– Exhaust.....43,038 - 43,064 mm

– Intake.....47,155 - 47,181 mm

### Measuring the valve springs

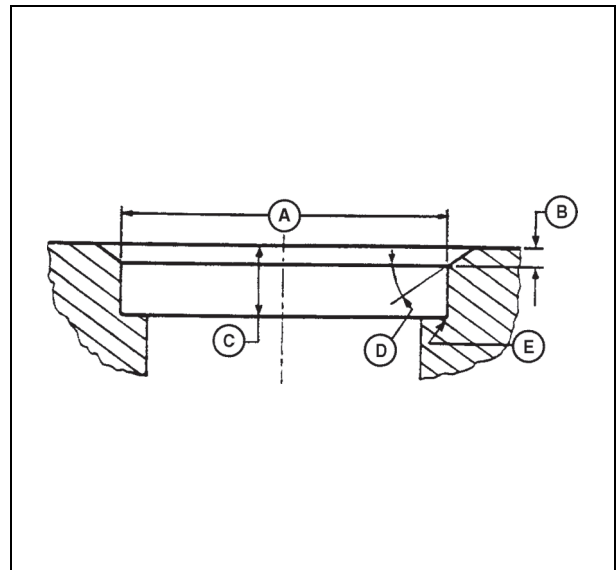
Check spring tension using a spring compression device.

Idle length .....54 mm

Specified value:

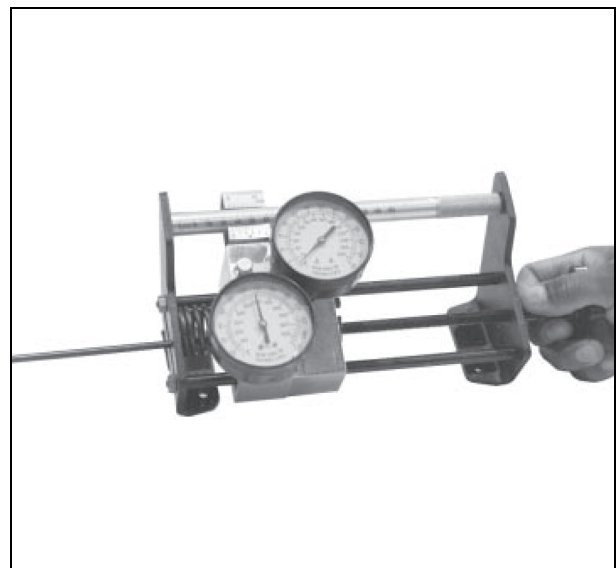
Spring compressed at 240-280 N .....46 mm

Spring compressed at 590-680 N .....34,5 mm



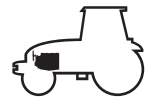
132hsm08

Fig. 12



131hsm34

Fig. 13



## Cylinder head and valves

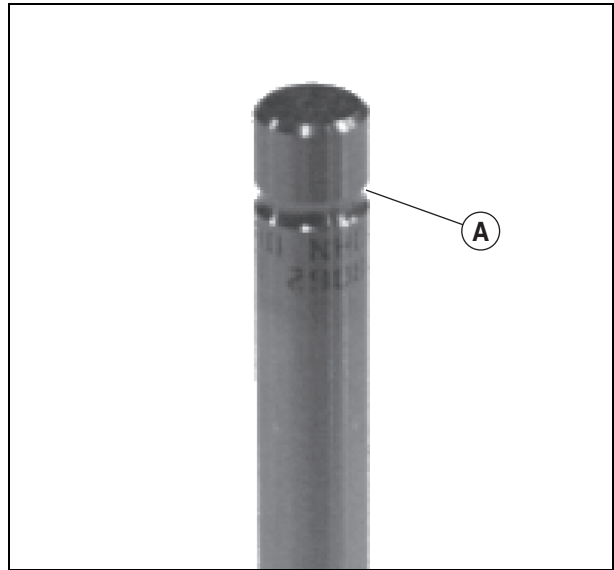
### Measuring the valves

– Inspect the valves, the tip of the rods, and the retainer groove (A).

Specified value:

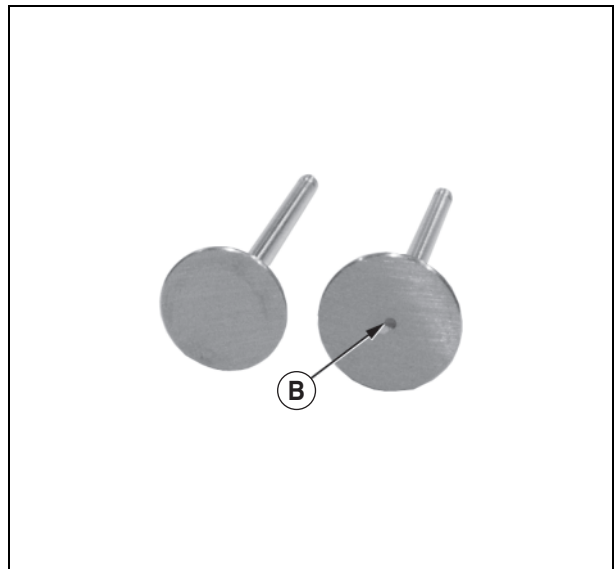
- Valve head diameter
  - Intake .....46,47 - 46,73 mm
  - Exhaust .....42,37 - 42,63 mm

**Note: The intake valves have a larger outer diameter and are recognized thanks to a centering hole (B).**



131hsm35

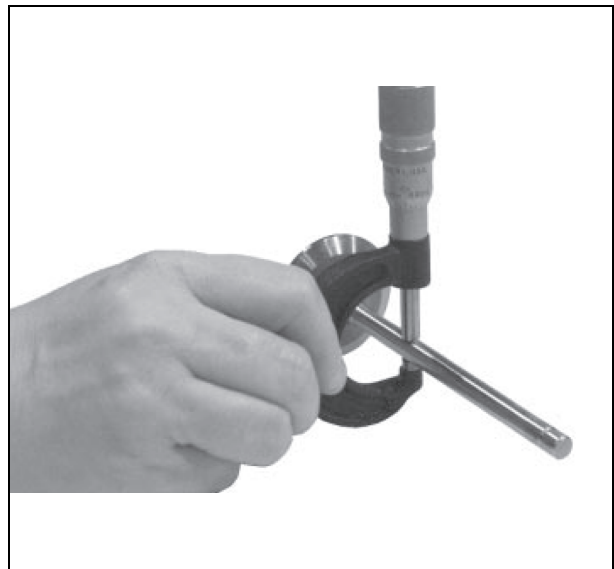
Fig. 14



131hsm14

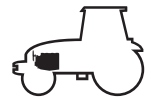
Fig. 15

- Valve stem diameter
  - Intake .....7,864 - 7,884 mm
  - Exhaust .....7,848 - 7,874 mm
- Maximum ovalization
  - Inlet and exhaust .....0,038 mm



131hsm37

Fig. 16



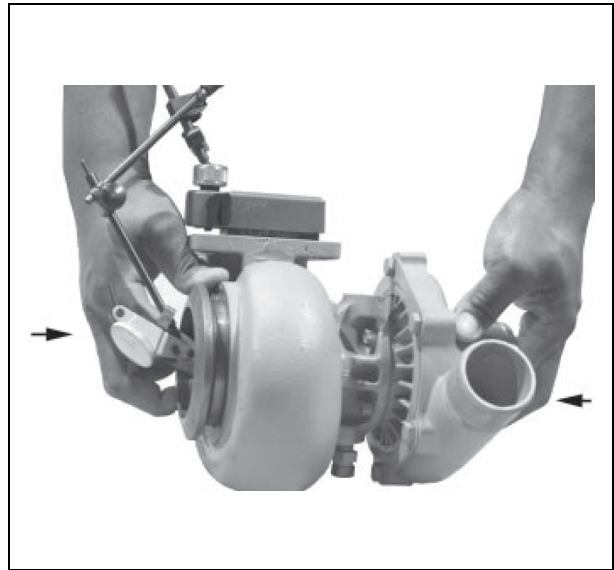
## Cylinder head and valves

### Inspecting the turbocharger

Measuring axial clearance

Maximum axial clearance of the "BorgWarner" turbocharger ..... 0,14 mm

If axial clearance does not comply, change the turbocharger.



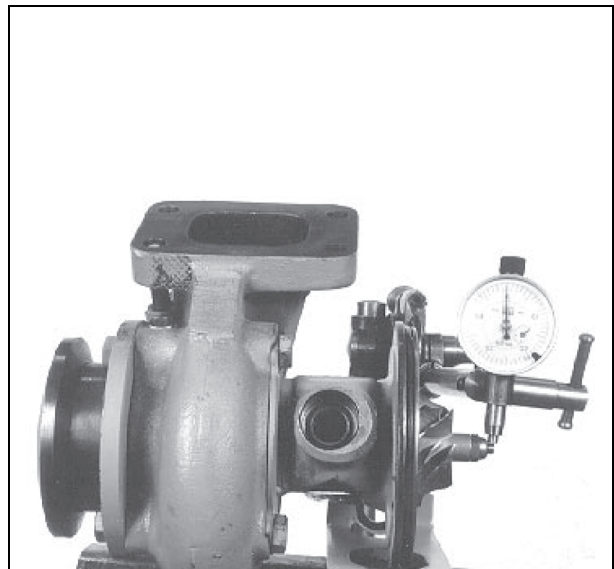
142hsm02

Fig. 17

Measuring radial clearance

Maximum radial clearance of the "BorgWarner" turbocharger ..... 0,51 mm

If radial clearance is not compliant, change the turbocharger.

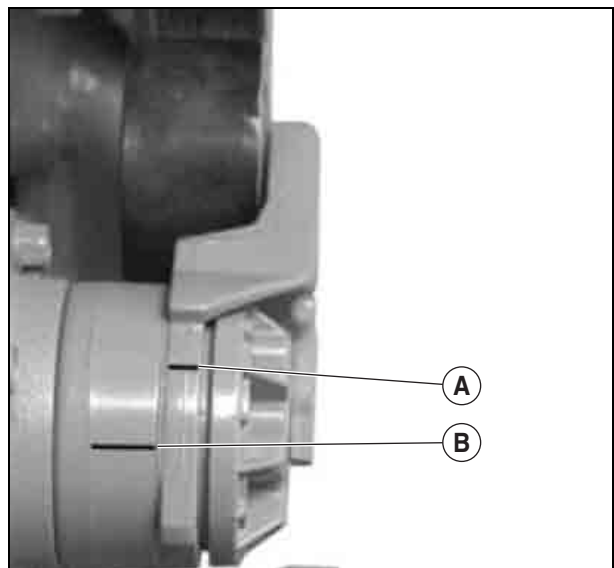


142hsm03

Fig. 18

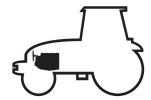
### Checking the belt tensioner spring

- Loosen and remove the tensioner belt.
- Loosen the tensioner and plot a mark (A).
- Measure 21 mm from (A) and make a mark (B).
- Using a torque wrench, align the 2 marks.
- The spring's tension must be 1,8 to 2,2 daN.m.
- Change the tensioner if required.



251msm04

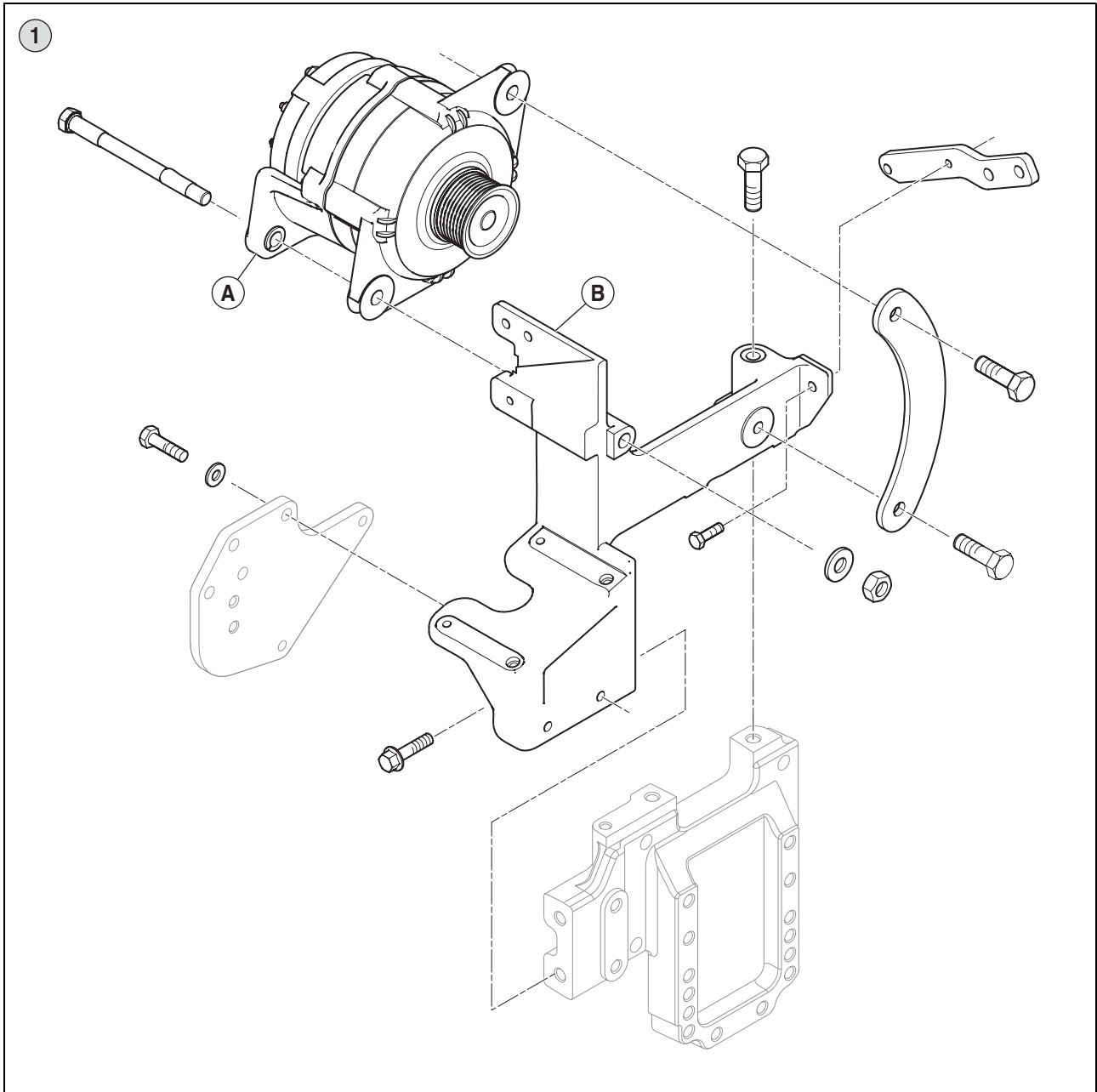
Fig. 19



## Cylinder head and valves

### Removing the alternator and its bracket

- Disconnect the battery.
- Disconnect the alternator connections.
- Remove the alternator (A).
- Untighten the rest screws (B) and remove them.

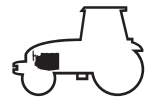


260hsm00

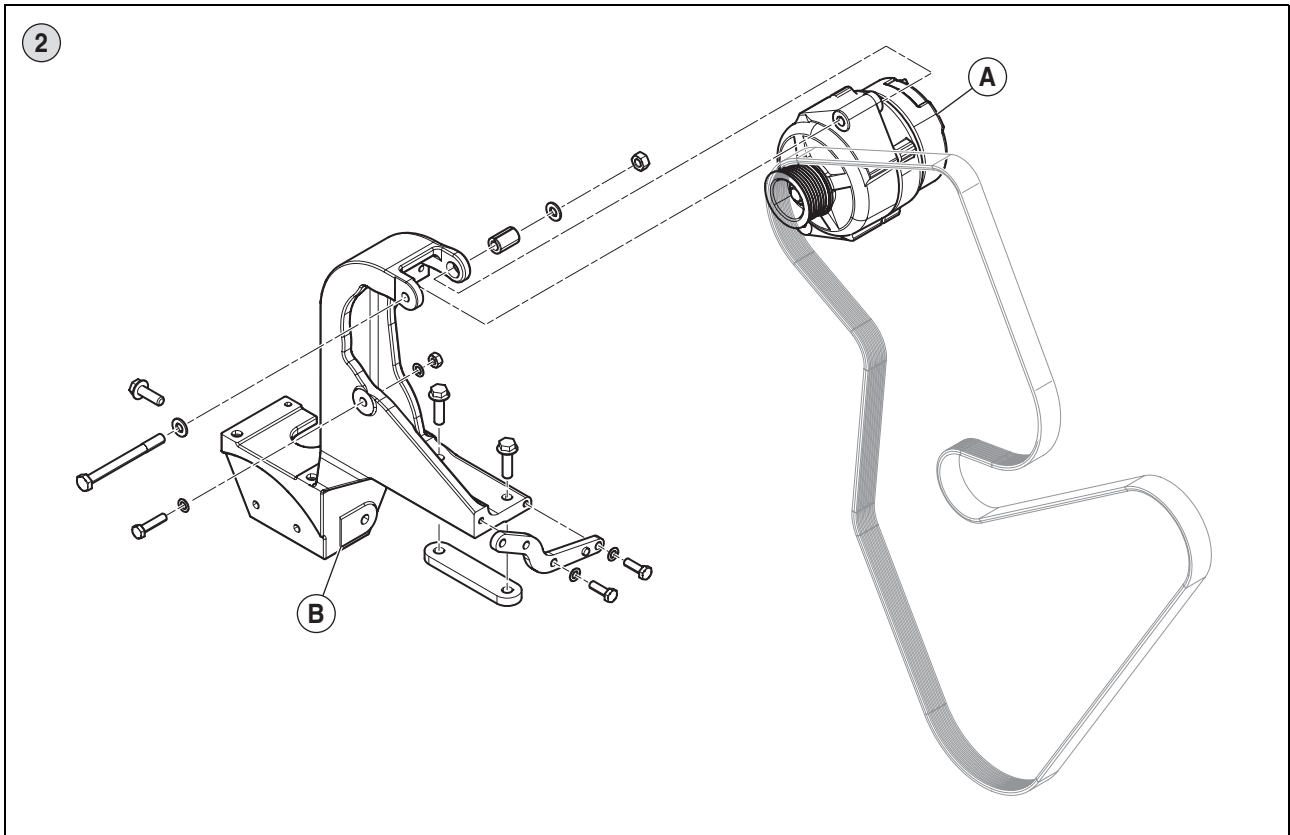
Fig. 20

#### Description

- 1 Pneumatic braking version (175 A alternator).



## Cylinder head and valves

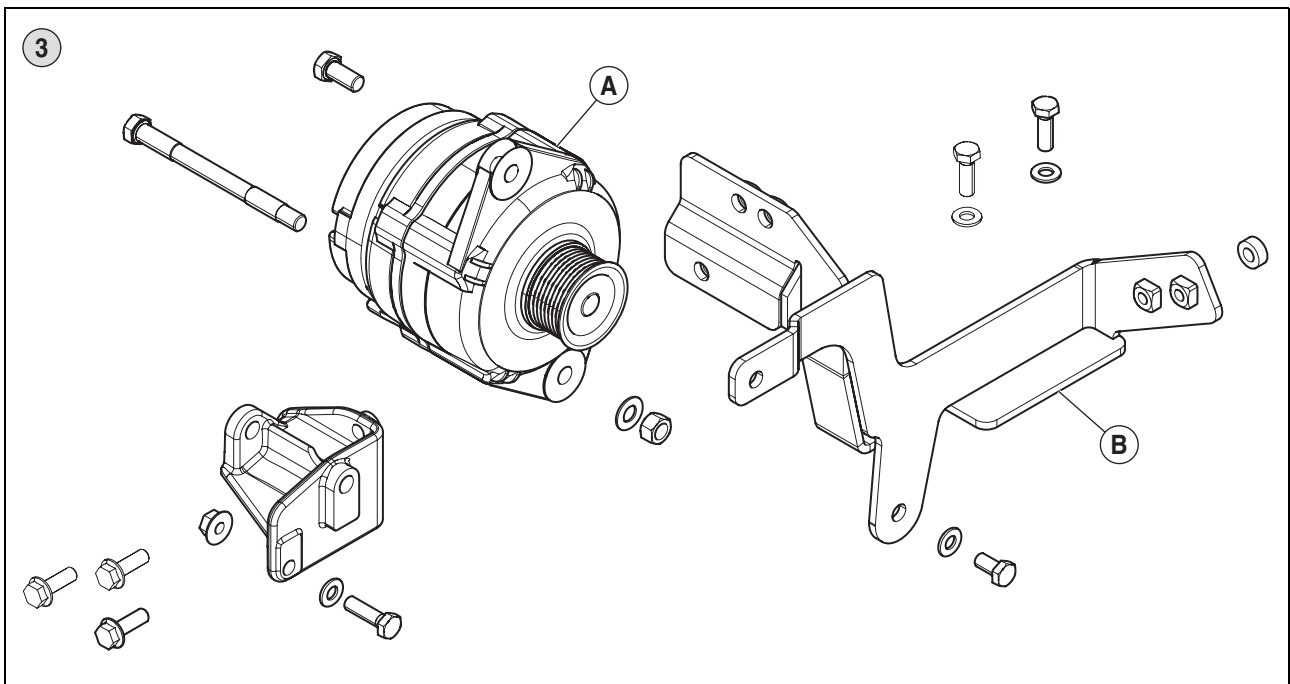


260msm00

Fig. 21

### Description

2 Pneumatic braking version (120 A alternator).

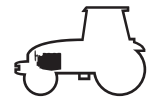


260msm01

Fig. 22

### Description

3 Version without air braking (120 and 175 ampere alternator).



## Cylinder head and valves

### Refitting the alternator and bracket

- Refit the alternator bracket (B).
- Tighten the screws to a torque of 7 daN.m.
- Refit the alternator (A).

**Note:** *If the alternator pulley was removed, tighten the screw at a torque of 5 daN.m.*

### Removing the viscous coupling

- Remove the screws from the radiator nozzle (A).

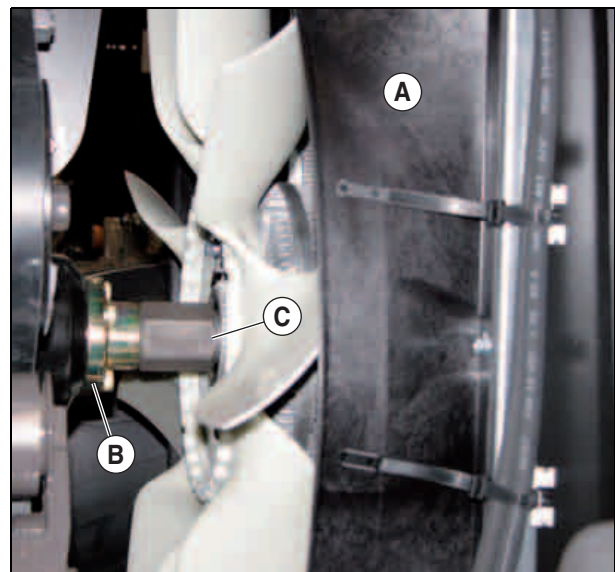
**Note:** *The viscous coupler thread on the hub is a left-hand thread.*

- Using a pin wrench, hold the hub (B) and loosen the viscous coupler (C) and remove it.

### Refitting the viscous coupling

**Note:** *The viscous coupler thread on the hub is a left-hand thread.*

- Refit the viscous coupler (C) on the hub (B).
- Using a pin wrench, tighten the viscous coupler at a torque of 9 daN.m.



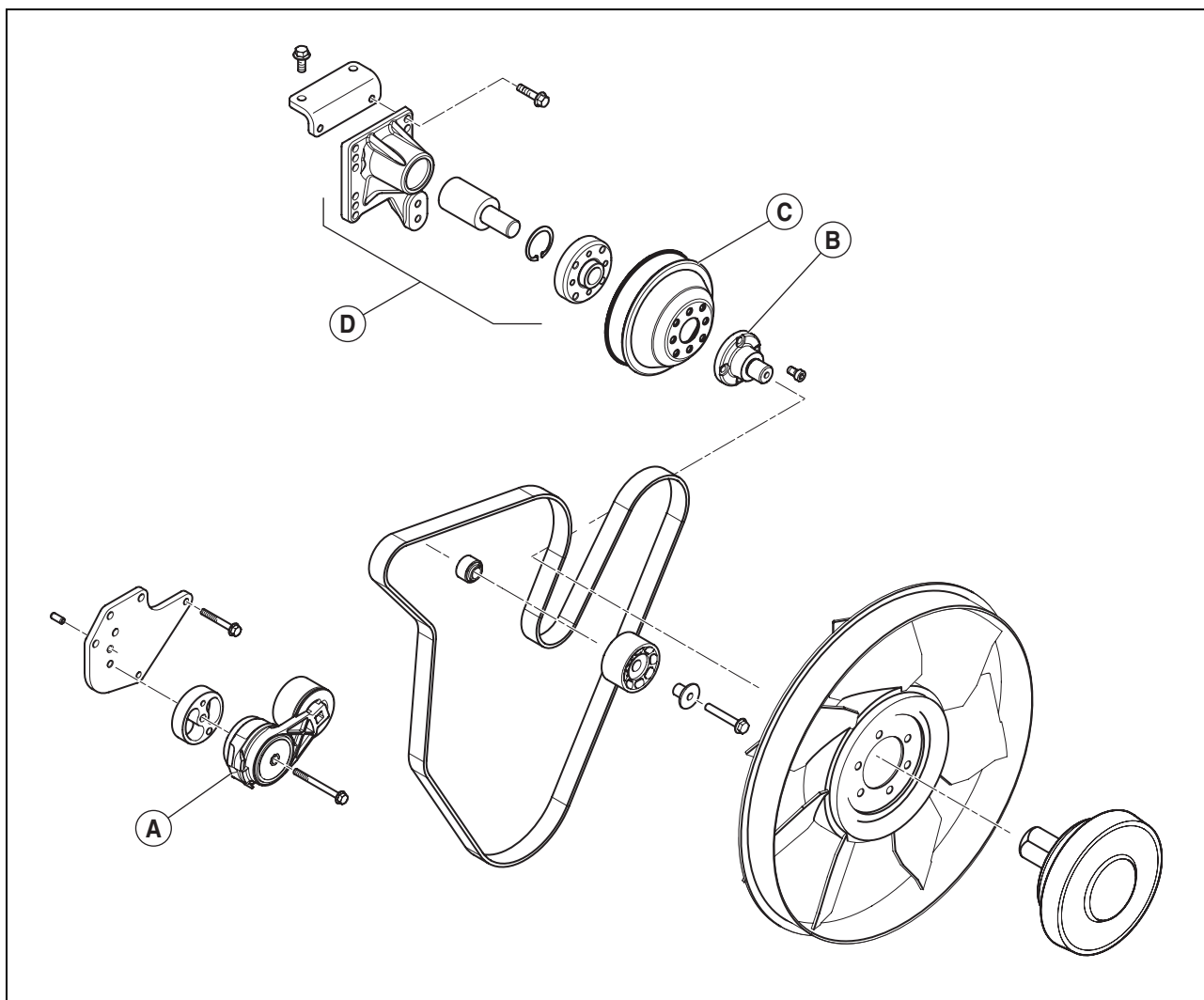
253hsm00

Fig. 23



## Cylinder head and valves

### Removing the fan hub and bracket



251hsm29

Fig. 24

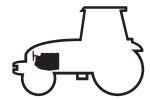
- Loosen the drive belt using the tensioner (A) and remove it.
- Remove the hub of the viscous coupler (B).

- Remove the (C) pulley.
- Remove the pulley hub and its bracket (D).

### Refitting the fan hub and bracket

- Refit the fan bracket and hub (D). Tighten the screws to a torque of 7 daN.m.
- Refit the viscous coupler pulley (C) and hub (B).

- Tighten the screws to a torque of 7 daN.m.
- Position the belt.
- Tighten the belt using the tensioner (A).



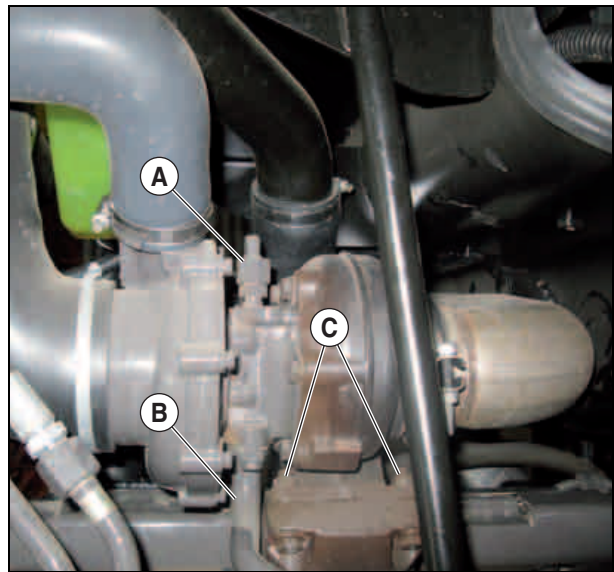
## Cylinder head and valves

### Removing the turbocharger

**Important:** Let the exhaust circuit cool down before removing the turbocharger.

**Note:** Carefully clean the outside of the turbocharger and the surrounding area.

- Remove the air intake and exhaust ducts.
- Disconnect the oil inlet pipe (A).
- Disconnect the oil return duct (B).
- Unscrew the 4 screws (C) of the exhaust manifold and remove the turbocharger.



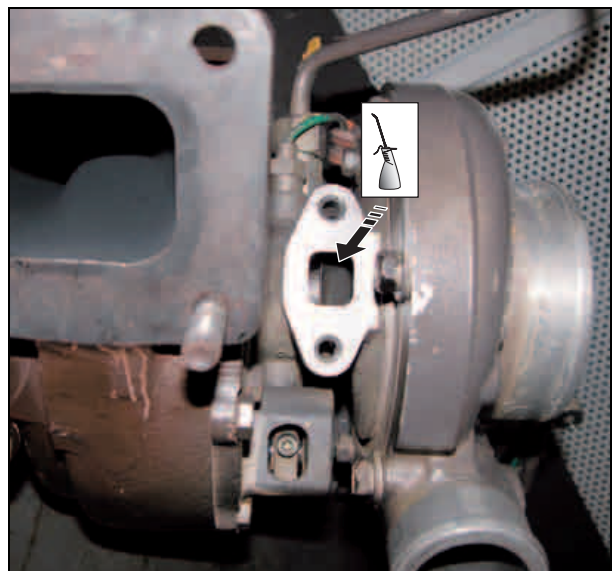
142msm00

Fig. 25

### Refitting the turbocharger

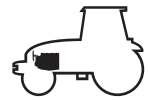
**Important:** Fill the oil return hole with clean motor oil and turn the turbocharger by hand.

- Position the turbocharger onto the exhaust manifold with a new gasket.
- Tighten the screws (C) to a torque of 7 daN.m.
- Connect the oil and air ducts.



142hsm05

Fig. 26



## Cylinder head and valves

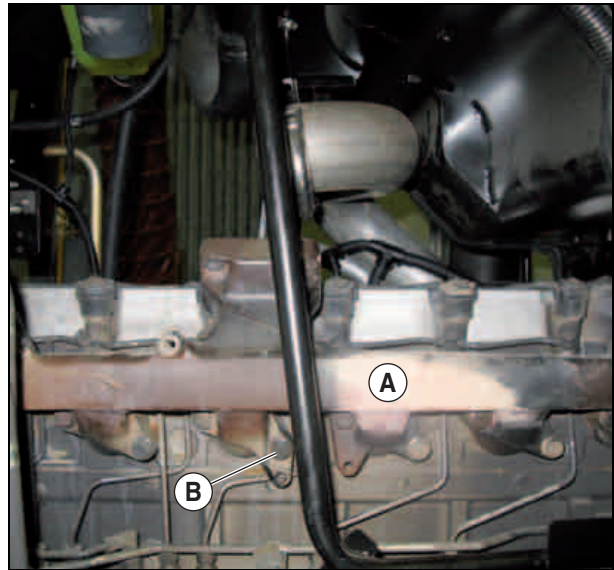
### Removing the exhaust manifold

**Note:** *Draining the A/C circuit is not necessary. Move only the A/C compressor.*

- Remove the pipes, hoses interfering with removing the exhaust manifold.
- Remove the turbocharger (the turbocharger can be removed with the exhaust manifold).
- Remove the exhaust manifold (A).

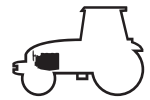
### Refitting the exhaust manifold

- Using centering studs, refit the exhaust manifold and the gaskets.
- Tighten the screws (B) of the cylinders 3 and 4 initially at a torque of 7 daN.m.



142msm01

Fig. 27



## Cylinder head and valves

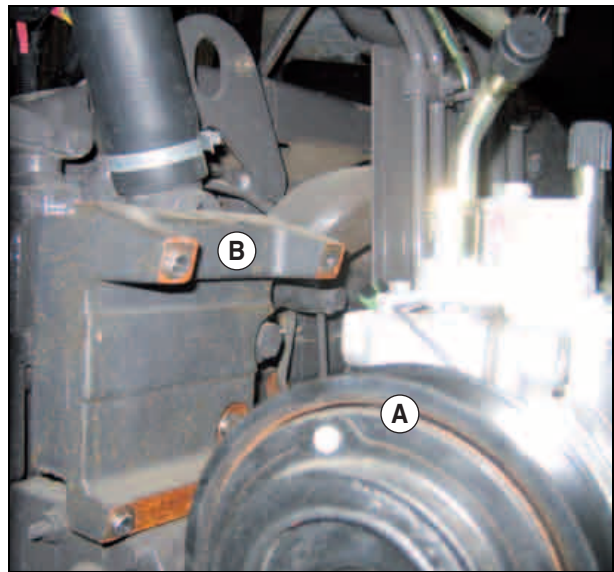
### Removing the thermostat cover

**Note:** *Draining the A/C circuit is not necessary. Move only the A/C compressor (A).*

- Drain the coolant system.
- Remove the A/C bracket (B) if option.
- Disconnect the temperature sensor.
- Disconnect the hose.
- Remove the screws (C).
- Mark the position of the thermostats and remove them.

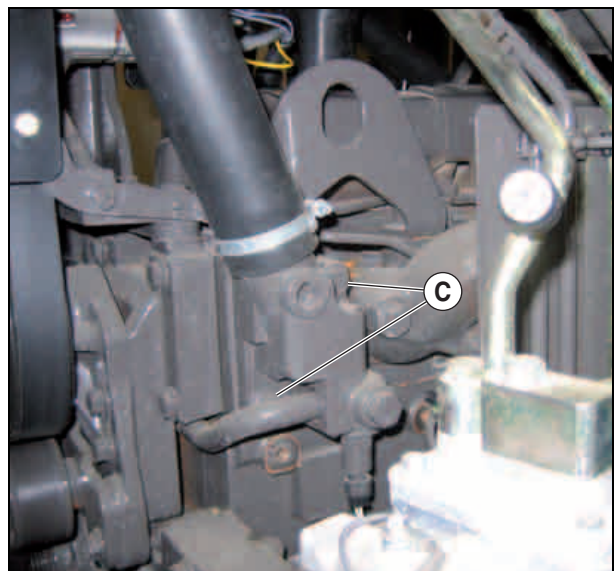
### Refitting the thermostat cover

- Change the gasket and the thermostat.
- Fit the cover.
- Tighten the screws (C) to a torque of 4,7 daN.m.
- Fill the cooling fluid circuit.



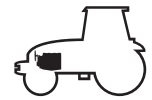
254msm00

Fig. 28



254msm01

Fig. 29

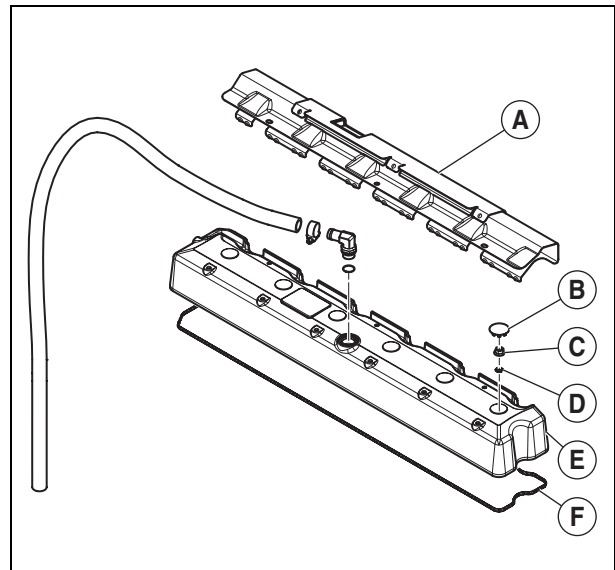


## Cylinder head and valves

### Removing the cylinder head cover

**Note :** *Removing the injector bundle is not necessary. Remove only the connector bracket.*

- Remove any items interfering with removing the rocker cover (alternator according to options, intake hose, etc.).
- Unscrew the thermal shield of the injectors (A).
- Remove the caps (B), nuts (C), and O-rings (D).
- Remove the rocker cover (E).



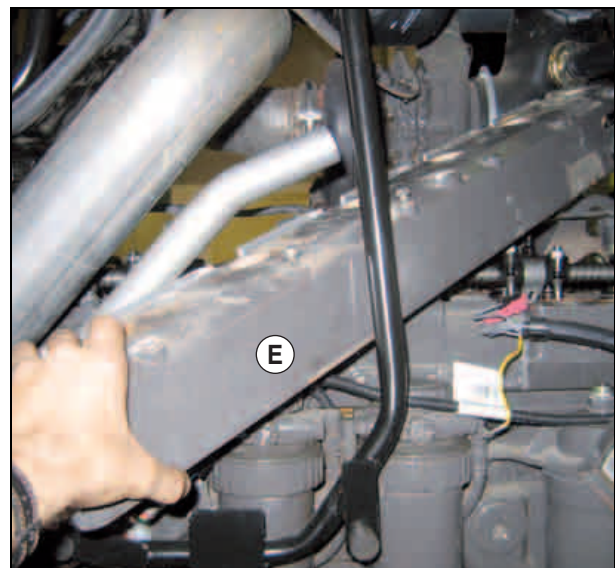
133msm00

Fig. 30

### Refitting the cylinder head cover

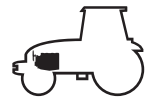
**Important:** *change the sealing gasket (F) whenever removing the cylinder head cover.*

- Fit the rocker cover (E), O-rings (D).
- Tighten nuts (C) to 1,1 daN.m. Fit the caps (B).
- Fit the heat shield (A).
- Tighten the screws to a torque of 1 daN.m.



133msm01

Fig. 31

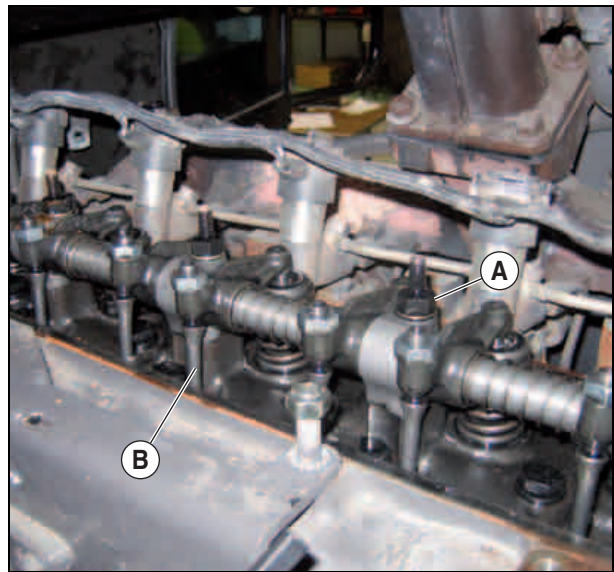


## Cylinder head and valves

### Removing the rocker arm assembly

**Important:** *Untighten the rocker adjustment screws before removing the ramp.*

- Remove the screws (A).
- Remove the rocker arm rods (B).



131msm15

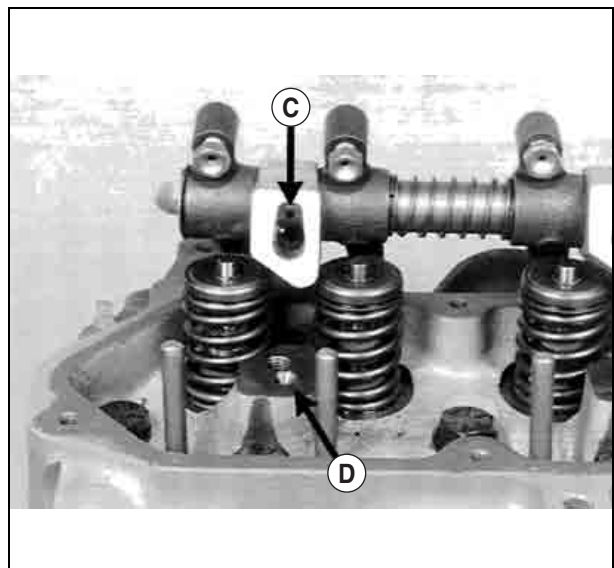
Fig. 32

### Refitting the rocker shaft

- Fit the rocker rods (B).

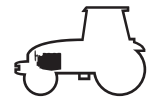
**Important:** *The port (C) in the rocker arm assembly must be aligned with the port (D) in the cylinder head.*

- Lubricate the rocker arm assembly.
- Fit the rocker arm assembly. Tighten the screws to a torque of 6 daN.m.
- Adjust the rocker.



131hsm13

Fig. 33



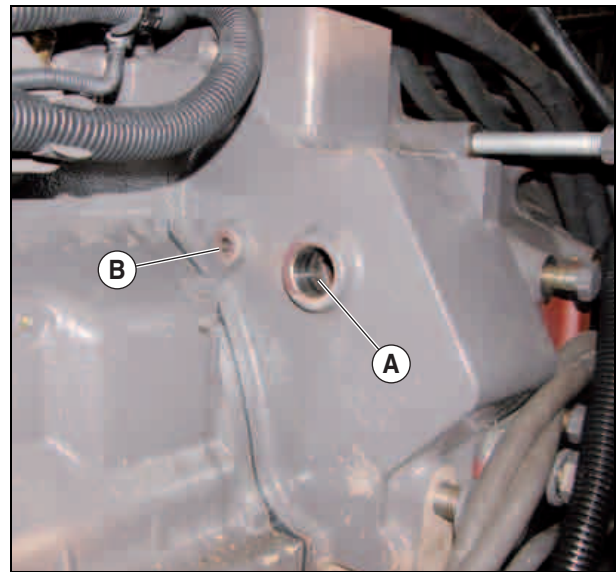
## Cylinder head and valves

### Adjusting the valve rockers

**Note: This check must be performed on a cold engine.**

- Remove the plastic cover covering the rotation hole (A) and the timing hole (B).
- Use tool n°60 05 005 528 to turn the engine in the running direction, until cylinder 1 (timing side) reaches top dead center of its compression stroke.
- Fit the timing gauge n° 60 05 005 576.

**Note: If piston n°1 is at top dead center of its compression stroke, the rockers have play.**



134hsm20

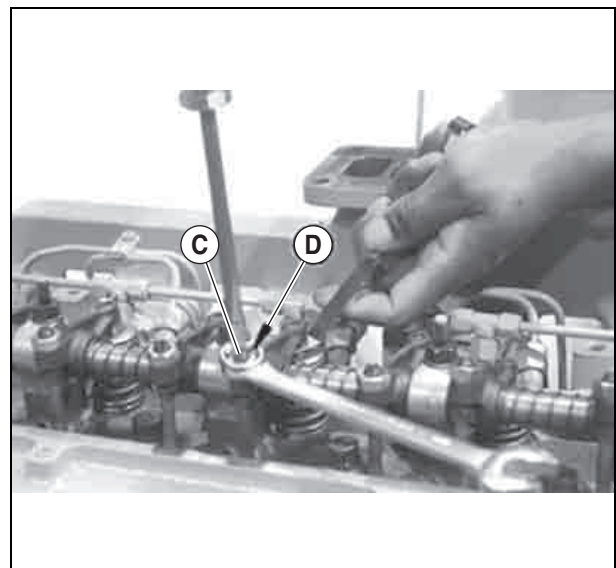
Fig. 34

- Check and adjust the rockers.

Inlet valves: 0,36 mm.

Exhaust valves: 0,46 mm.

- If adjusting the rockers is required, loosen the locknut (D). Turn the adjustment screw (C) until the shim slides with a slight resistance. Hold the adjustment screw (C). Tighten the nut (A) to a torque of 2,7 daN.m.
- Check clearance.



134msm02

Fig. 35



## Cylinder head and valves

### Method of adjustment

- Adjust piston n°1 at top dead center of its compression stroke.
- Adjust the clearance of the exhaust valves No. 1, 3 and 5, and the intake valves No. 1, 2 and 4.
- Turn the crankshaft by 360° and block cylinder n°6 at top dead center 'TDC' of its compression stroke.
- Adjust the clearance of the exhaust valves No. 6, 4 and 2, and the intake valves No. 6, 5 and 3.

**A** Front of engine.

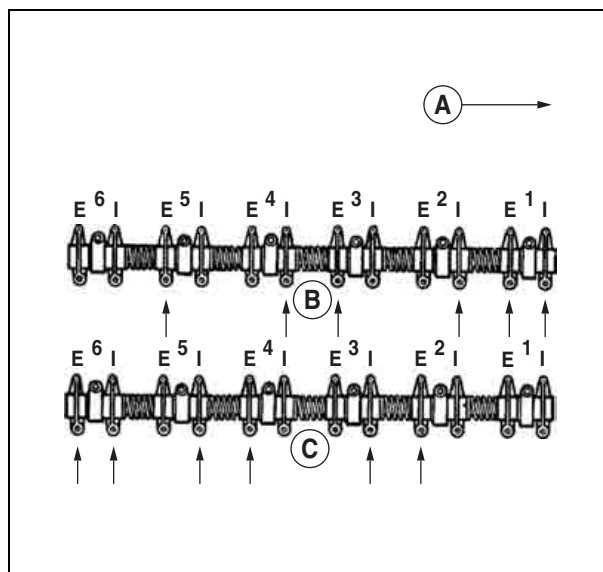
**B** Piston No. 1 at TDC.

**C** Piston No. 6 at TDC.

**E** Exhaust valve

**I** Intake valve.

→ Adjusting the valve rockers.



101msm19

Fig. 36

## Cylinder head and valves

### Removing the injector coupling

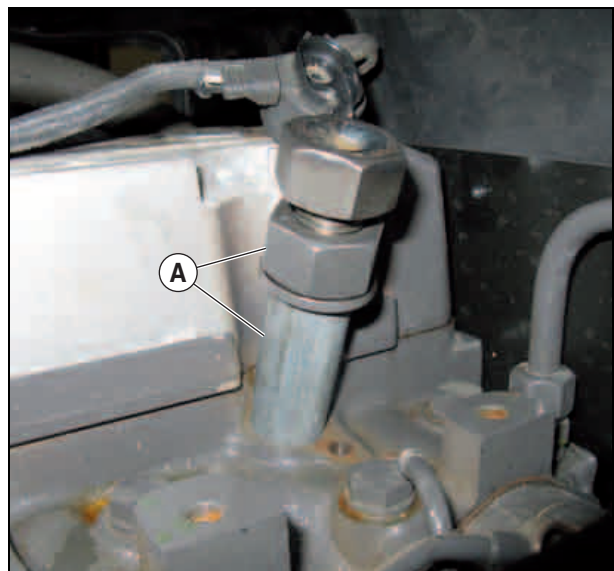
**Note:** Smear the injector coupling to remove with grease.

- Tap the injector coupling over 1 cm using an M22 x 250 tap.
- Install and screw the locally manufactured tool (A) into the injector sleeve.
- Pull the injector coupling (B).



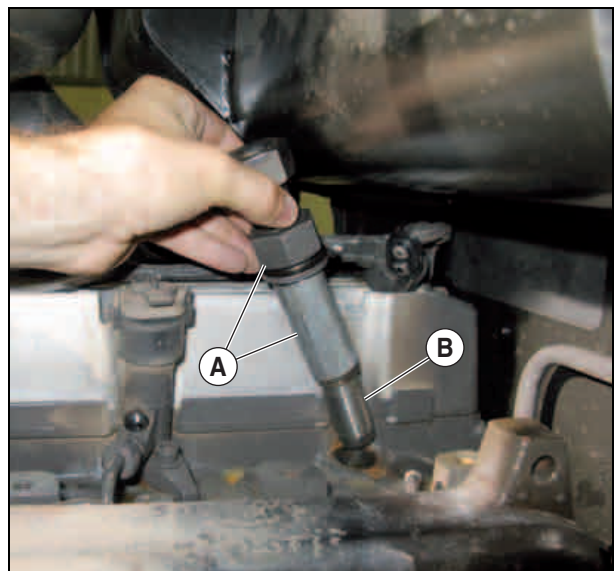
132msm06

Fig. 37



132msm07

Fig. 38



132msm08

Fig. 39



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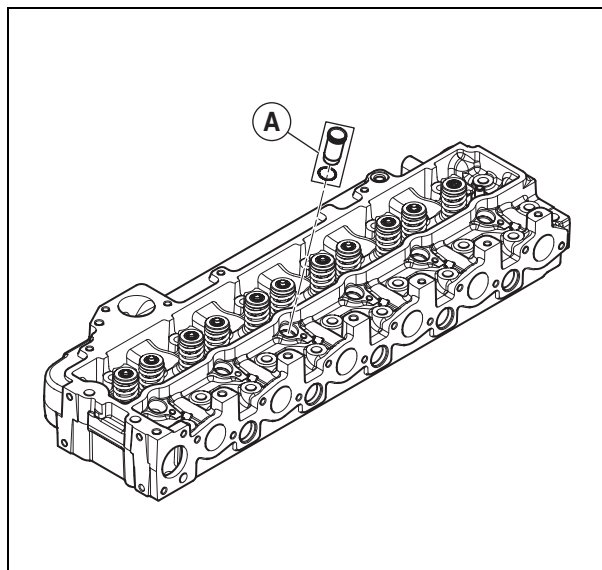


## Cylinder head and valves

### Refitting the injector coupling

**Important:** Check that the piston of the cylinder requiring the replacement of the injector coupling is set to the bottom dead centre.

– Apply Loctite (620) all around the lower edge of the injector coupling (A).



132msm09

Fig. 40

**Important:** Check that all O-rings are properly seated.

– Lubricate the O-ring (B) with liquid soap.

– Using the n°00 11 341 450 tool, slowly enter the injector coupling down to the bottom of the hole.



132msm11

Fig. 41



132msm10

Fig. 42



## Cylinder head and valves

### Removing the cylinder head

- Loosen and remove all cylinder head screws.
- Use lifting means and chains to lift the cylinder head.

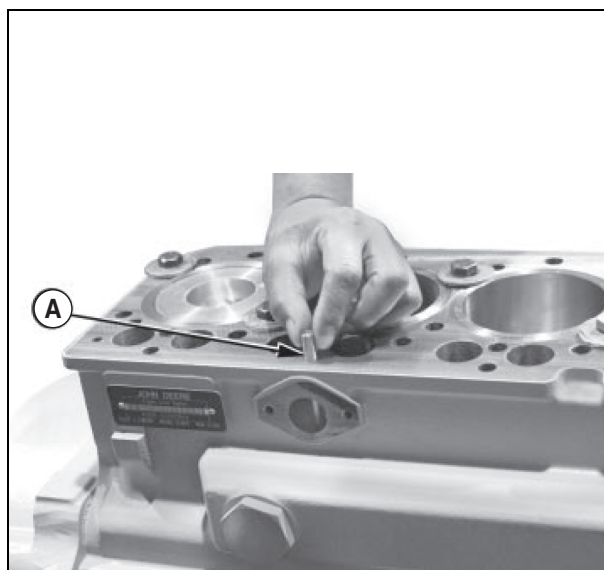


132msm12

Fig. 43

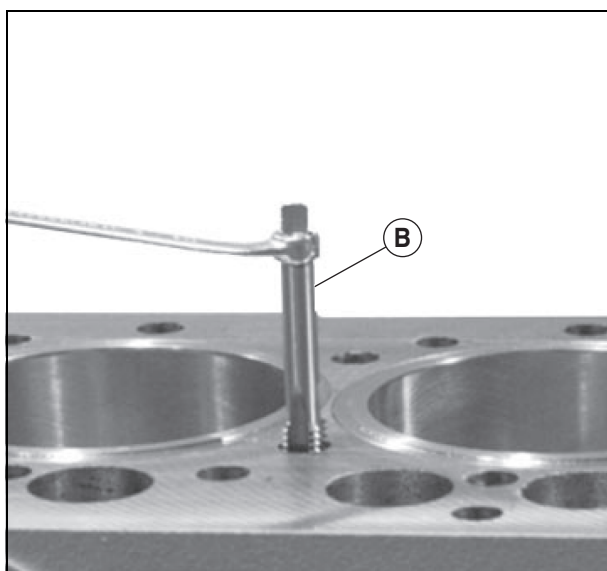
### Preparation

- If the supply pump was removed, check the presence of the rocker (A).
- Clean the threaded holes on the cylinder block using the special tap No.60 05 005 517 (B).
- Clean the surface of the parting surface.
- Lubricate the camshaft rockers (C).



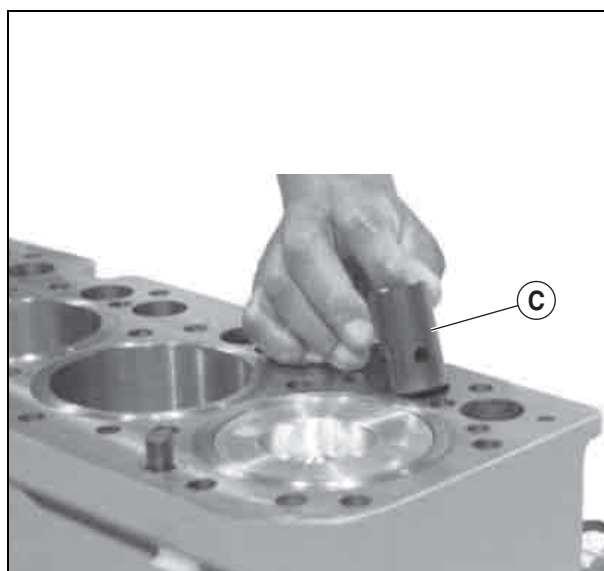
132hsm13

Fig. 44



132hsm14

Fig. 45



132hsm15

Fig. 46

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