

Group 10

CYLINDER HEAD, VALVES AND CAMSHAFT**GENERAL INFORMATION**

The intake and exhaust valves are set in the cylinder head. The valve guides are integral with the head. The intake valve seats are ground directly into the cylinder head, whereas exhaust valve seats are ground into replaceable steel inserts. However, replaceable steel inserts for both intake and exhaust valves are available as spare parts. Between each valve stem and rocker arm is a hardened stem cap.

The camshaft is driven at half engine speed by the upper idler gear of the timing gear train. It is supported by four pressure lubricated bores, integral with the cylinder block.

The camshaft has an eccentric lobe to actuate the fuel transfer pump.

DIAGNOSING MALFUNCTIONS**Sticking Valves**

- Carbon deposits on valve stem
- Worn valve guides
- Warped valve stems
- Cocked or broken valve springs
- Worn or distorted valve seats
- Insufficient lubrication

Warped, Worn, or Distorted Valve Guides

- Lack of lubrication
- Cylinder head distortion
- Excessive heat
- Unevenly tightened cylinder head cap screws

Distorted Cylinder Head and Cylinder Head Gasket Leakage

- Improperly tightened cylinder head cap screws
- Faulty gasket installation
- Excessive oil pressure
- Improper cylinder liner height above cylinder block

Worn or Broken Valve Seats

- Misaligned valves
- Distorted cylinder head
- Carbon deposits on seats due to incomplete combustion
- Valve spring tension too weak
- Excessive heat
- Improper valve clearance
- Improper valve timing

Burned, Pitted, Worn, or Broken Valves

- Worn or distorted valve seats
- Worn valve guides
- Insufficient cooling
- Insufficient lubrication
- Cocked or broken valve springs
- Detonation
- Improper engine operation
- Improper valve train timing
- Faulty valve rotators
- Warped or distorted valve stems
- "Stretched" valves due to excessive spring tension
- Distorted cylinder head
- Bent push rods
- Carbon build-up on valve seats
- Rocker arm failure

Camshaft Failures

- Scored camshaft lobes due to inadequate lubrication
- Excessive end play due to thrust plate wear
- Broken or warped camshaft due to improper timing

PRELIMINARY VALVE CHECKS

Checking Valve Clearance

NOTE: Valve clearance can be checked with engine cold or warm.

1. Disconnect battery ground straps.
 2. Remove radiator and fuel tank caps as well as muffler extension. Remove radiator side grille screens and engine hood.
 3. Reinstall radiator and fuel tank caps.
 4. Remove muffler.
 5. *On tractors with air conditioning, loosen compressor attaching screws and lift off compressor.*
- NOTE: The two refrigerant lines may remain attached to the compressor.*
6. Remove rocker arm cover and breather tube.

7. Using engine rotation tool JDE-83 (see Fig. 1) rotate engine flywheel and therefore crankshaft in running direction until No. 1 piston (front) has reached top dead center (TDC) on the compression stroke. **IMPORTANT!** Do not confuse with exhaust stroke.

NOTE: With No. 1 piston at "TDC," intake and exhaust valve springs of No. 1 cylinder are not under tension.

8. Insert timing pin JDE-81-4 in flywheel housing bore (Fig. 1). Timing pin can be inserted further into flywheel bore as soon as "TDC" is exactly reached.

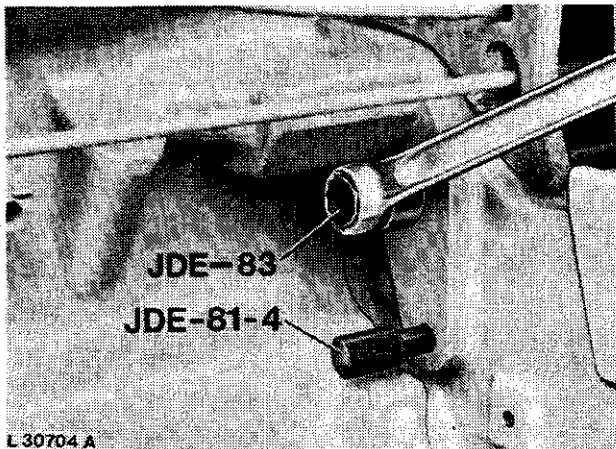
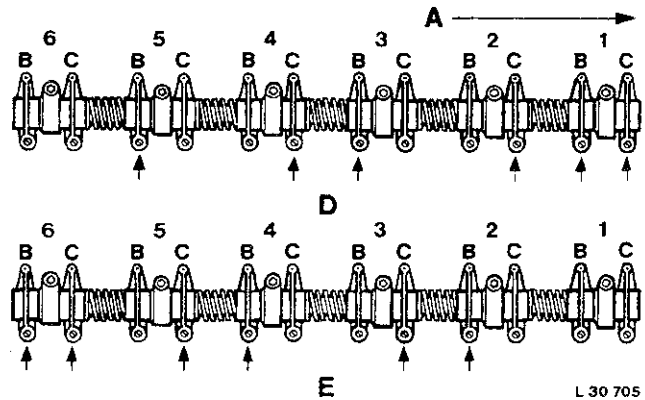


Fig. 1 - Obtaining "TDC"



- A—Front of Engine
- B—Exhaust Valves
- C—Intake Valves
- D—No. 1 Piston at TDC Compression Stroke
- E—No. 6 Piston at TDC Compression Stroke

Fig. 2 - Checking Valve Clearance

Valve Clearance Specifications

Intake Valves	0.35 mm (0.014 in.)
Exhaust Valves	0.45 mm (0.018 in.)

9. Using a feeler gauge, check clearance of the exhaust valves of cylinders No. 1, 3 and 5 and the intake valves of cylinders No. 1, 2 and 4 (Fig. 2).

10. Pull timing pin out of flywheel bore, turn crankshaft one complete revolution (360°) and insert timing pin again into flywheel bore. No. 6 cylinder is now at "TDC."

NOTE: With No. 6 piston at "TDC," intake and exhaust valve springs of No. 6 cylinder are not under tension.

11. Check clearance of exhaust valves of cylinders No. 2, 4 and 6 and intake valves of cylinders No. 3, 5 and 6 to the specifications listed above (see also Fig. 2).

12. When necessary, adjust valve clearances (see page 12).

Checking Valve Lift

Measuring valve lift can give an indication of wear to cam lobes, cam followers, and push rods.

1. Set valve clearance to specifications as previously indicated.
2. Place dial indicator on rotator (Fig. 3). Make sure valve is fully closed and rocker arm moves freely.
3. Manually turn engine in running direction with JDE-83 Engine Rotation Tool.
4. After rocker arm contacts valve stem, observe dial indicator reading as valve is moved to full open position. Repeat valve lift check on each valve.

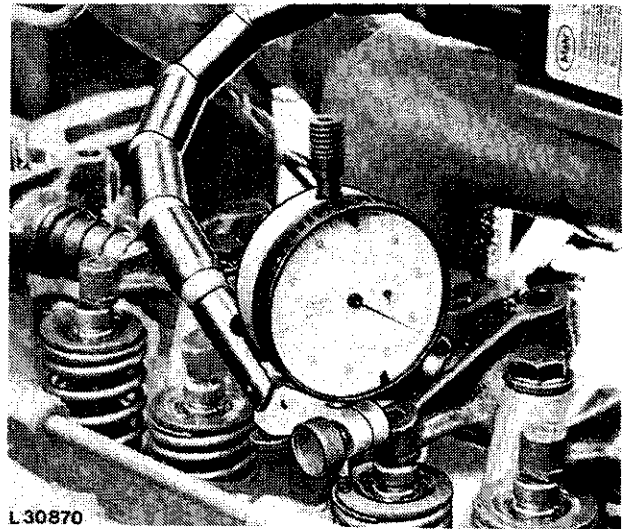


Fig. 3 - Checking Valve Lift

Valve Lift Specifications

Intake Valves	11.7 to 12.5 mm 0.460 to 0.490 in.
Wear tolerance	11.0 mm 0.430 in.
Exhaust Valves	11.6 to 12.2 mm 0.456 to 0.482 in.
Wear tolerance	10.8 mm 0.426 in.

5. Coat upper side of rocker arm cover gasket evenly with a thin layer of "Scotch Grip 10009" from "3M."
6. Install gasket and cover and tighten cover cap screws to 10 N·m (7 ft-lb) torque.
7. Complete installation of all parts removed, reversing removal procedure.

CYLINDER HEAD AND VALVES

Removal

CYLINDER HEAD

NOTE: It is not necessary to remove the engine in order to work on the cylinder head, valves and associated parts.

When removing, identify parts to facilitate reinstallation.

1. Disconnect battery ground straps.
2. Remove radiator grille screens and engine hood.
3. Drain coolant into a suitable container
4. Remove muffler and exhaust manifold.
5. Disconnect fuel lines at fuel injection nozzles and fuel injection pump and remove lines. Plug open ends with plastic caps.
6. Remove fuel injection nozzles.
7. Disconnect fuel leak-off line.
8. Pull off cable at coolant temperature gauge sending unit.
9. Disconnect upper coolant hose.
10. Remove thermostat housing.
11. Remove fuel filter and disconnect fuel lines.
12. *When equipped:* Disconnect/remove starting fluid aid.
13. Remove air intake support.
14. *On tractors with air conditioning,* loosen compressor attaching screws. Lift off compressor.

NOTE: The two refrigerant lines may remain attached to the compressor.

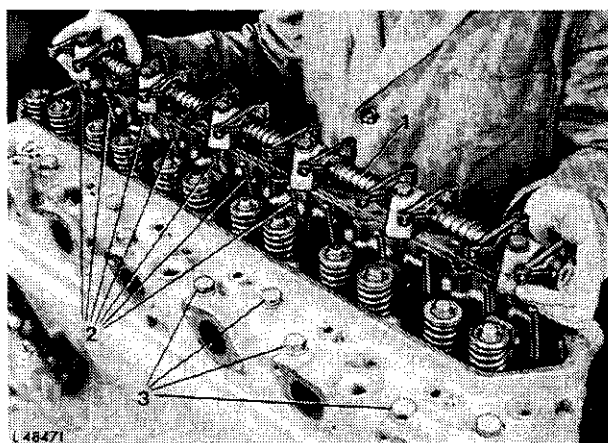
15. Remove rocker arm cover together with engine breather.

16. Remove rocker arm shaft (see below).

17. Remove cylinder head cap screws and lift off cylinder head assy.

NOTE: Do not turn crankshaft after removal of cylinder head, before all liners are secured with screws and washers.

ROCKER ARM SHAFT



- 1—Rocker Arm Shaft
- 2—Push Rods
- 3—Cylinder Head Cap Screws

Fig. 4 - Removal of Rocker Arm Shaft Assembly

1. Remove rocker arm shaft support cap screws and lift out complete rocker arm shaft assembly.

VALVES

NOTE: Before removing valves, mark all valves and valve springs so that they can be reinstalled in their original positions.

1. Using a commercial valve spring compressor, remove valves from cylinder head.

Inspection and Repair

CYLINDER HEAD

Checking for Warpage

1. Thoroughly clean cylinder head externally and internally.
2. Check cylinder head for cracks.
3. Check machined surface of cylinder head for damage.
4. Clean all carbon deposits from cylinder head by scraping or brushing with a wire brush.
5. Remove carbon deposits from bores for fuel injection nozzles. Use special tool JDE-39.

IMPORTANT: Always turn the tool clockwise through the bore even when pulling back, otherwise tool will get dull.

6. Check cooling passages for lime deposits. If necessary, clean using a suitable cooling system cleaner.

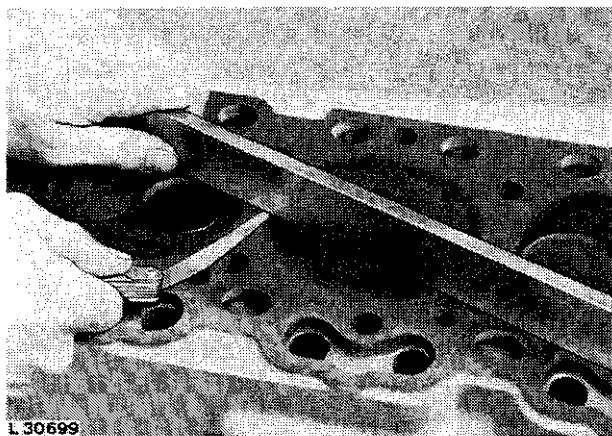


Fig. 5 - Checking Cylinder Head for Warp

7. Using a heavy, accurate straight-edge and feeler gauge (see Fig. 5), check machined surface of cylinder head for warp. Check at several places.

8. Maximum permissible warp is 0.025 mm (0.001 in.) for each 127 mm (5 in.) length of cylinder head.

9. Machined surface of cylinder head must be refaced if warp is more than specified maximum.

NOTE: Maximum permissible amount to be machined from cylinder head is 0.76 mm (0.03 in.).

Checking Valve Guides

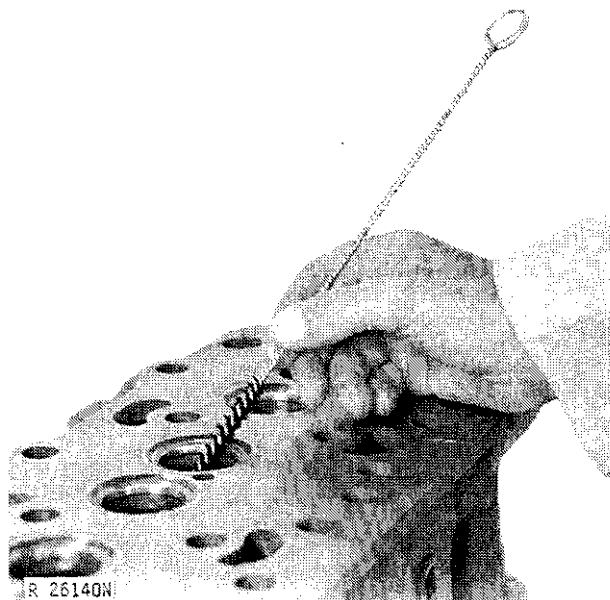
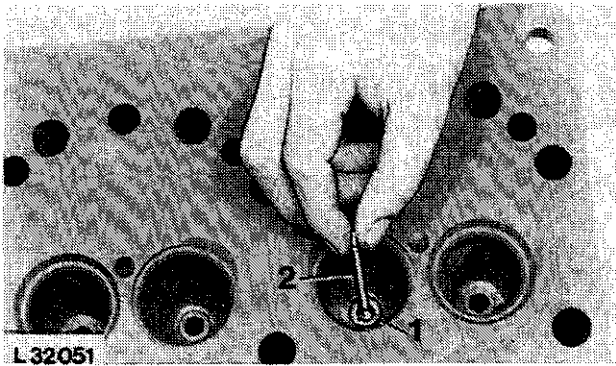


Fig. 6 - Cleaning Valve Guides

1. Use a valve guide cleaning brush D-17011 BR to clean valve guides before inspection or repair.

NOTE: A few drops of light oil or kerosene will help to fully clean the guide.



1—Valve Guide
2—Telescope Gauge

Fig. 7 - Checking Valve Guide

2. Measure valve guides for wear as shown in Fig. 7.

I.D. of guide bore in a new head 9.51 to 9.53 mm
0.374 to 0.375 in.

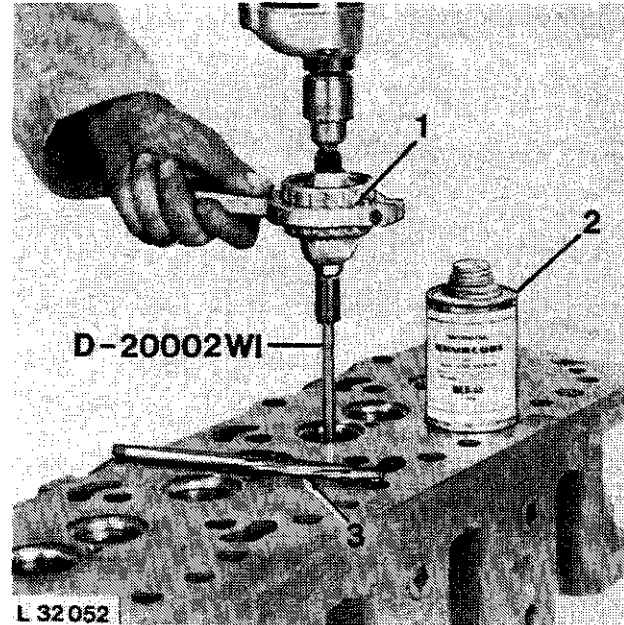
New guide-to-valve system
clearance 0.05 to 0.10 mm
0.002 to 0.004 in.

Max. permissible clearance 0.15 mm
0.006 in.

NOTE: Worn guides can allow a clearance of 0.15 mm (0.006 in.) and still be acceptable. Worn guides may be knurled to return them to specified clearance if valve-to-guide clearance is 0.25 mm (0.010 in.) or less. If clearance exceeds 0.25 mm (0.010 in.) install oversize valves.

3. Use No. D-20002WI Knurling Set to knurl valve guides (Fig. 8).

NOTE: Use tool set exactly as directed by the manufacturer.



1—Speed Reducer
2—Lubricant
3—Reamer

Fig. 8 - Knurling Valve Guides

Cleaning Valve Seats

1. Use an electric hand drill with wire cleaning brush (Fig. 9) and remove all carbon.
2. Check valve seats for cracks, pits, or excessive wear.
3. If necessary, recondition valve seat by grinding.

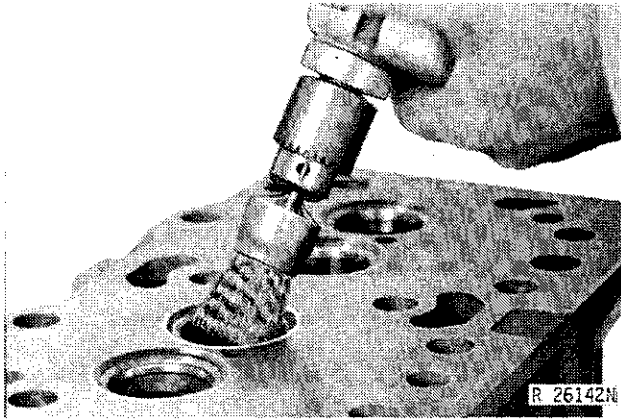


Fig. 9 - Cleaning Valve Seats

Grinding Valve Seats

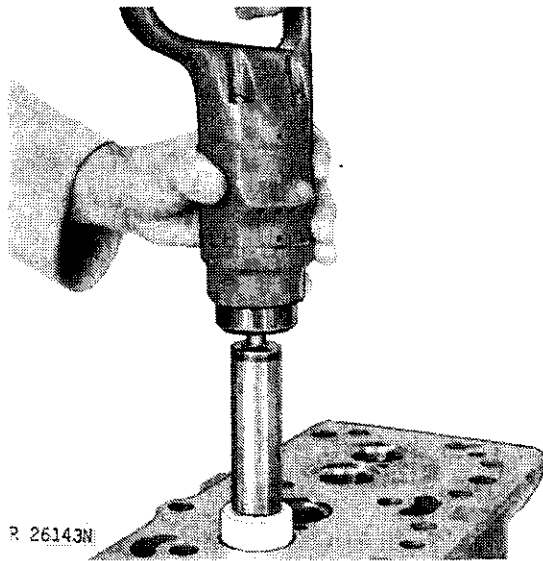


Fig. 10 - Grinding Valve Seats

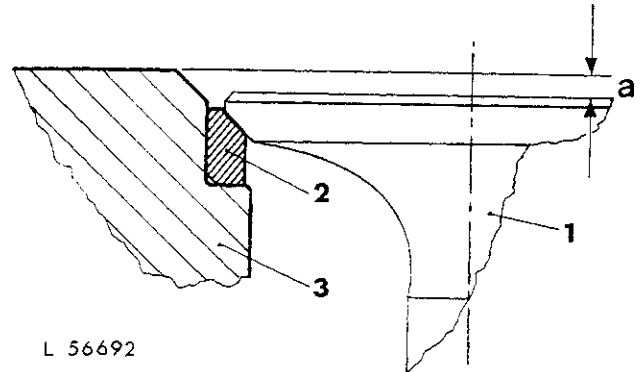
NOTE: Keep your working area clean.

1. Do not grind too long. Only a few seconds are required to recondition the average valve seat. Avoid the natural tendency to grind off too much.

2. Do not use too much pressure. While grinding, support the weight of the driver to avoid excess pressure on the stone.

3. Check the seat width and contact pattern between the seat and valve with blueing.

Measuring Valve Recess



- a—Clearance between valve and surface of cylinder head
- 1—Valve
- 2—Valve seat (replaceable steel insert)
- 3—Cylinder head

Fig. 11 - Valve and Seat Insert

Minimum clearance between an intake valve and surface of cylinder head 0.60 to 1.20 mm
0.024 to 0.047 in.

Minimum clearance between an exhaust valve and surface of cylinder head 1.00 to 1.80 mm
0.039 to 0.071 in.

Reconditioning of valve seats is possible only up to a specified limit. Valve recess should not be more than 3 mm (1.118 in.) below surface of cylinder head (see dimension "a," Fig. 11).

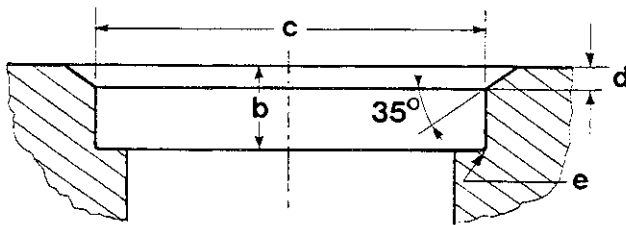
Therefore the replaceable exhaust valve seats (steel inserts) must be replaced as soon as valve recess exceeds 3 mm (0.118 in.) (see "a," Fig. 11). If this dimension is reached by an intake valve, the cylinder head can be rebored and a replacement valve seat insert installed.

Replacing Valve Seats

IMPORTANT: Regrind replacement 30° intake valve seat inserts to an angle of 45° when installed.

NOTE: Installation of exhaust or intake valve inserts should be carried out by a specialized workshop. Replacement exhaust and intake valve seat inserts are available from your John Deere parts depot.

1. Grind used valve to valve seat I.D.
2. Spot weld ground valve to valve seat I.D.
3. Using a hammer, drive out valve seat.



L 56693 A

Exhaust valve:
 b—9.08 to 9.20 mm (0.357 to 0.362 in.)
 c—41.57 to 41.59 mm (1.636 to 1.637 in.)
 d—2.31 to 2.57 mm (0.091 to 0.101 in.)
 e—Radius - 0.5 mm (0.019 in.)

Intake valve:
 b—8.32 to 8.44 mm (0.327 to 0.332 in.)
 c—47.16 to 47.18 mm (1.856 to 1.857 in.)
 d—2.69 to 2.59 mm (0.106 to 0.116 in.)
 e—Radius - 0.5 mm (0.019 in.)

Fig. 12 - Dimensions for Boring Valve Insert Bore in Cylinder Head

NOTE: The surface finish of bore ("c," Fig. 12) should not exceed 0.00158 mm (63 micro-inch).

4. Machine insert bores in cylinder head to dimensions given in Fig. 12.

NOTE: Replacement valve seat inserts have a larger diameter than original (factory installed) inserts.

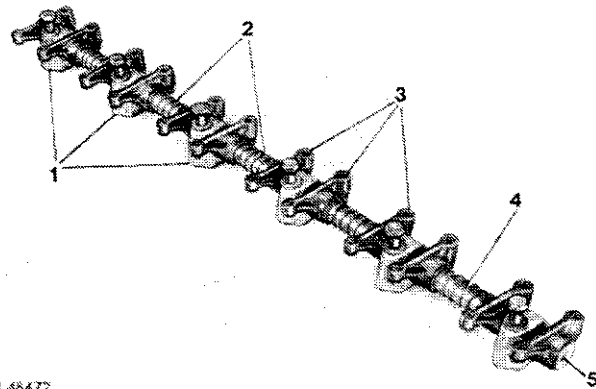
5. Freeze valve seat inserts to -30°C (-22°F). Place inserts into cylinder head bores, maintaining a pressure of 1000 N (220 lb) on each insert for one minute, to ensure that inserts do not "creep" out when warming up.

6. Regrind valve seats until a valve seat width of 1.5 to 2.0 mm (0.06 to 0.08 in.) has been obtained (intake or exhaust valve).

7. Install valves and check measurement ("a," Fig. 11). If necessary, grind valve seat to dimensions.

ROCKER ARM SHAFT

NOTE: When removing, identify parts of correct reinstallation.



L 48472

- 1—Rocker Arm Support
- 2—Springs
- 3—Rocker Arms
- 4—Rocker Arm Shaft
- 5—Plug

Fig. 13 - Rocker Arm Shaft Assembly

1. Remove rocker arm shaft end plugs (5, Fig. 13) and slide components from shaft.
2. Inspect rocker arm shaft for scratches, scores, or excessive wear at points of rocker arm contact.

NOTE: Wear could indicate weak valve springs, bent push rods, or loose rocker arm shaft clamps.

3. Make sure that all oil bores in the rocker arm shaft, the rocker arms, and the adjusting screws are clear.
4. Thoroughly clean cavities of rocker arm supports, especially cavity of rear support, through which the oil passes to the rocker arm shaft.
5. Check rocker arm adjusting nuts and screws for damage.
6. Check concave wear on ends of rocker arms where they contact valve ends.
7. Examine spacer springs on shaft between rocker arms, and be sure they are strong enough to exert a positive pressure on arms.

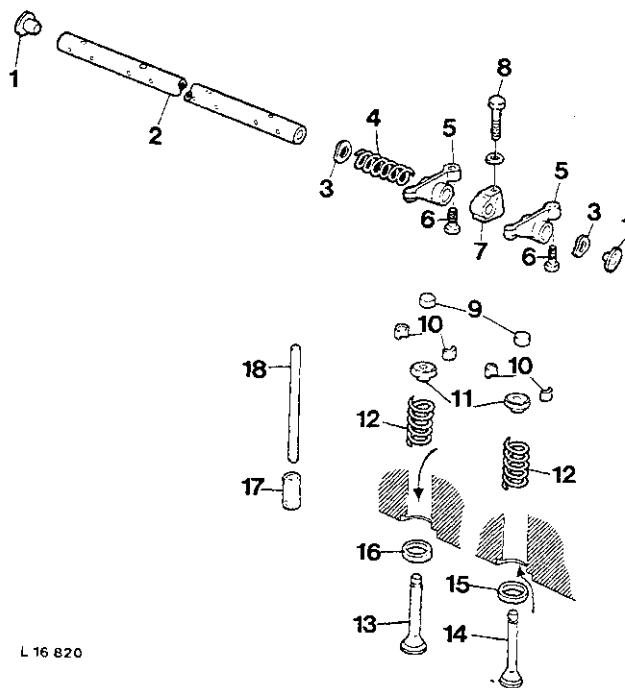
Spring tension at a length of
 46 mm (1.81 in.) 18 to 27 N
 4 to 6 lb

NOTE: If the rocker arm has been damaged by a valve failure, replace it and the push rod when replacing valves.

VALVES

1. Check valve spring caps (11, Fig. 14) for wear or damage.
2. Replace valve stem caps (9) if pitted or worn.

3. Visually check valve face and stem for wear or damage.
4. Perform the following cleaning procedure before measuring or repairing valves.



- | | |
|----------------------|------------------------------|
| 1—Plug | 10—Keepers |
| 2—Rocker Arm Shaft | 11—Valve Spring Cap |
| 3—Special Washer | 12—Valve Spring |
| 4—Spring | 13—Intake Valve |
| 5—Rocker Arm | 14—Exhaust Valve |
| 6—Adjusting Screw | 15—Exhaust Valve Seat Insert |
| 7—Rocker Arm Support | 16—Intake Valve Seat Insert |
| 8—Cap Screw | 17—Cam Follower |
| 9—Valve Stem Cap | 18—Push Rod |

Fig. 14 - Rocker Arm Shaft Assembly and Valves, Exploded View



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