



# TROUBLE TRACER CHART VALVE TRAIN

## Stem breakage through collet groove



**Symptom:** Excessive mechanical noise, bent stem and possible head detachment.  
**Cause:** Poor assembly allowing uneven loading. Poor handling, dropping etc. Bouncing the valve after fitting by hitting the tip with a hammer. Valve bounce from excessive seating velocity.  
**Remedy:** May not be possible due to extreme damage this failure can cause, however: Check seats, guides, springs, pistons and bores for damage and repair where necessary. Do not overspeed the engine.

## Scuffed/sticking valve stem



**Symptom:** Poor performance due to low compression. Mechanical breakage due to sticking valves.  
**Cause:** Marginal lubrication from inadequate valve to stem clearance, causing scuffing or metal transfer. This may ream out the valve guide leading to the second cause, excessive oil from too great a clearance carbonising on the stem to cause sticking.  
**Remedy:** Ensure the valve stem to guide clearance is to specification. Ensure the correct valve stem seals have been used. Replace worn components where necessary.

## Radial cracking of valve head, leading to a triangular segment breaking off



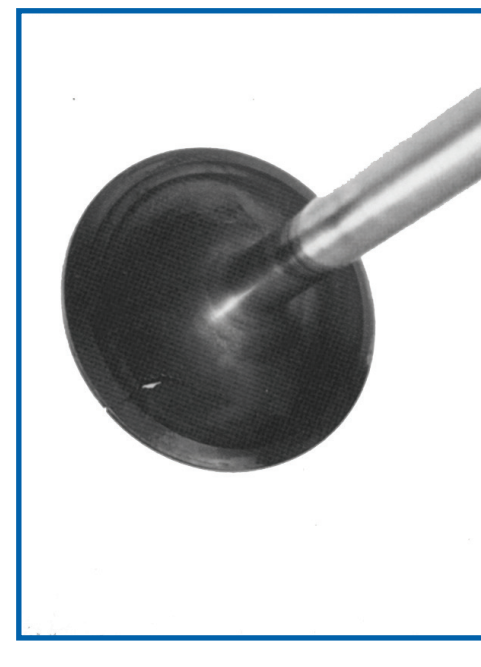
**Symptom:** Sudden mechanical noise. Rough running. Possible seizure.  
**Cause:** Poor temperature distribution across the valve head resulting in high tensile stresses in the rim, often combined with severe deflection due to abnormal combustion pressures and temperatures. Extreme thermal cycles, (continual sudden changing from full power to shut-down). Damage marks on the rim producing stress raisers. Mechanical overload from valve bounce.  
**Remedy:** Check the remaining valves for signs of cracking, replace where necessary. Ensure the correct valves have been used. Check engine settings, valve springs, guides and followers. Do not overspeed the engine.

## "Gutter" burnt through valve rim



**Symptom:** Loss of power. Rough running.  
**Cause:** Valve clearance too small holding the valve off its seat. Sticking stem, poor/uneven seating or misalignment of the valve assembly. Overheating from pre-ignition. Excessive build up of carbon which flakes off the valve face to form a gas leakage path. Hard carbon particlespeen into the seat surface until enough indentations line up to form a gas leakage path.  
**Remedy:** Ensure valve clearance is to specification. Check stem to guide clearance and for any misalignment of the valve assembly. Check engine timing, carburettor settings and injection timing.

## Blow hole through valve head, starting from a radial crack



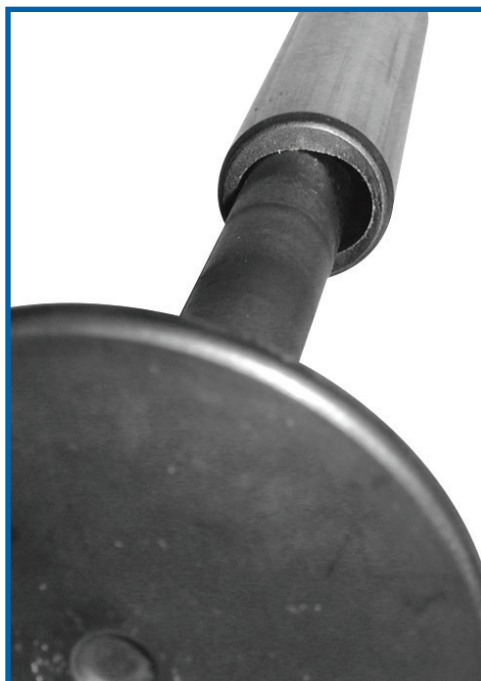
**Symptom:** Rough running. Loss of compression. Poor starting.  
**Cause:** Similar to a segmental breakage, but gas escapes through the crack and burns a hole. Extreme thermal cycles (continual sudden changing from full power to shut down). Damage marks on the rim producing stress raisers. Mechanical overload from valve bounce.  
**Remedy:** Check remaining valves for signs of cracking, replace where necessary. Ensure the correct valves have been used. Check engine settings, valve springs, guides and followers. Do not overspeed engine.

## Valve head breaking off stem



**Symptom:** Rough engine with sudden mechanical noise.  
**Cause:** Mechanical overload, such as seating velocity too high from excessive valve clearances. Valve bounce, valve to piston contact caused by overspeeding, weak or broken valve springs or sticking valve stem. Uneven seating due to misalignment or distorted valve.  
**Remedy:** May not be possible due to extreme damage this failure can cause, however: Check valve springs, guides and alignment and repair where necessary. Check seat guides, pistons and bores for damage. Reset the valve clearances.

## Excessive valve stem and guide wear



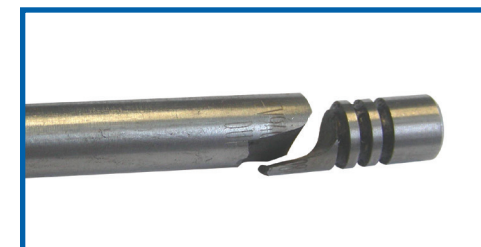
**Symptom:** Valve gear noise, high oil consumption, exhaust smoke on initial start up.  
**Cause:** Too great or too small valve stem to guide clearance. Poor valve stem lubrication or ingress of dirt through the air intake system. It should be noted that the cause of this problem is not always obvious. Unless the cause is readily apparent, additional advice should be sought.  
**Remedy:** Ensure correct valve and guides are fitted. Check alignment, valve stem to guide clearances, valve stem seals and lubrication system.

## Inlet valve overhead carbon build-up



**Symptom:** Poor starting. Loss of power. Blue smoke from exhaust (when throttle closed).  
**Cause:** Excessive clearance between valve stem and guide. Valve stem seal failure or wear. Excessive oil supply due to blocked drainage paths. Incorrect grade of lubricating oil used.  
**Remedy:** Check valve stems, guides and stem seals for wear and replace where necessary. Ensure there is no blockage in the engine drainage or breathing systems.

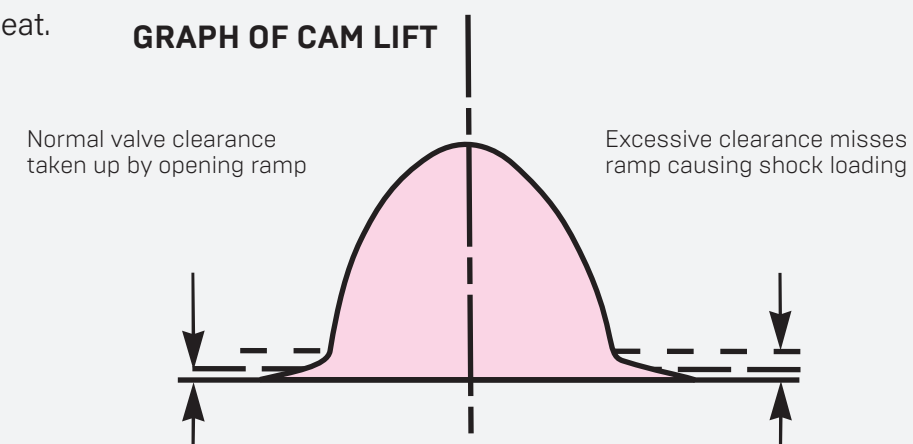
## Valve breakages -fracture at lower cotter groove



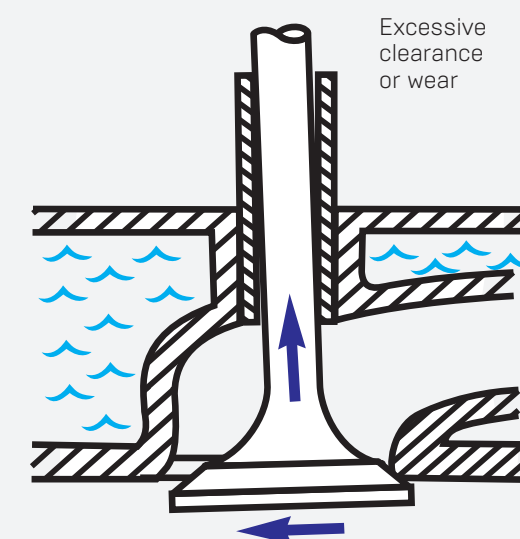
**Symptom:** Valve breakage shortly after cylinder head rebuild, during initial start-up or during test run.  
**Cause:** Over extension / "pump-up" of hydraulic lifters (photo 1). Incorrect seating of the valve spring to the head (photo 2). Engine over-speed or weak springs.  
**Remedy:** Where possible fit new hydraulic lifters with new valves. Ensure the engine block is thoroughly cleaned to remove all traces of debris. Take extreme care to seat all valve springs correctly in the recess of the cylinder head. Renew engine oil and replace oil and air filters.

## VALVE OPERATING CONDITIONS

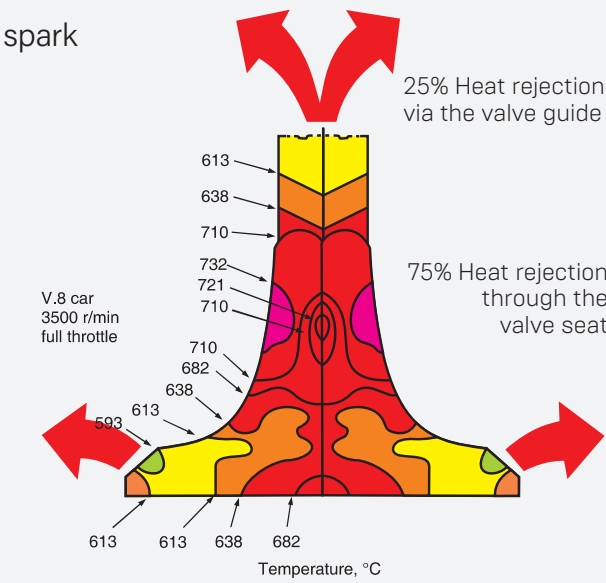
- Initial valve opening and final valve closing occurs very gently. Cam lobe profiles include lifting and lowering ramps to achieve this.
- Ensure the valve clearances are not too great to prevent the valve being hammered open or dropped onto its seat.



- The valve seat must be concentric with the valve guide. Any eccentricity that exists between the valve seat and guide will force the valve sideways.
- Excessive valve guide wear will occur as a result of this which can lead to a fatigue failure of the valve stem.



- Typical exhaust valve temperature distribution in a spark ignition engine. Figures are degrees in centigrade.
- An exhaust valve may operate at up to 800 °C, and 75% of its cooling is by transferring heat to the valve seat.
  - Ensure the valve seat contact is correct and as specified by the engine manufacturer.







# ROCKER ARM PACKAGING UPDATE

With immediate effect, all AE rocker arms will be available in a brand-new style packaging as shown below, example part FOL40, with a self-adhesive part number label which now **includes barcode**:

## NORMAL PACKAGING

- Type: plastic bag



## NEW PACKAGING

- Type: flow bag
- **Includes separate barcode sticker for fluent stock management**



**NEW**

## SEPARATE PRE-PRINTED BARCODE STICKERS

In order to be offer the best of service, all AE parts now come with a separate pre-printed barcode sticker, which offers numerous benefits:

- Barcodes eliminate the possibility of human error
- Inventory control improves
- Barcodes provide better data, e.g. regards inventory & pricing amongst many others





# BUCKET TYPE MECHANICAL TAPPET TEMPORARY PACKAGING CHANGE

Starting from **June 2016**, all AE bucket type mechanical tappets will be temporarily packed in a new style as shown below, example part FOL169, **with a self-adhesive part number label which now includes barcode:**

## NORMAL PACKAGING

- Type: flow pack



## TEMPORARY PACKAGING

- Type: plastic bag
- **Includes separate barcode sticker for fluent stock management**



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# TROUBLE TRACER CHART CAMTRAIN

## Broken camshaft



**Appearance:** Camshaft breakage between or through cam-lobes.

**Causes:** Distorted camshaft housing or cylinder head. Incorrect torque sequence and mishandling can also cause similar breakage.

**Remedy:** Straighten or replace camshaft carrier/cylinder head, use correct bolt torque sequence and handle with care. Thoroughly flush the lubricating system, replace cam and followers, prime with extreme pressure lubricant and replace oil and oil filter.

## Cam-lobe and follower wear

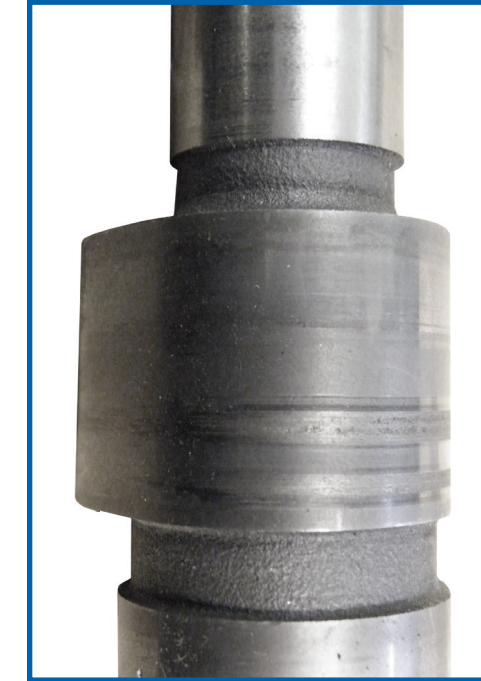


**Appearance:** Premature wear of one or more cam-lobes & followers. Follower contact surface will be concaved with chipped edges.

**Causes:** Incompatible cam-lobe & follower contact surface geometry. Often caused by fitting new camshaft with old followers or vice versa. Can also result from lubricant starvation from blocked or restriction in oil supply.

**Remedy:** Thoroughly flush the lubricating system, replace cam and followers, prime with extreme pressure lubricant and replace oil and oil filter. Do not mix old and new components.

## Base circle contact marking



**Appearance:** Witness marking on base circle of cam-lobes, biased to one side.

**Causes:** Worn hydraulic lifter and/or retainer springs.  
**Remedy:** Replace cam and followers if marks are deep, otherwise set tappets to correct clearance. Thoroughly flush the lubricating system and replace oil and filter.

## Follower breakage



**Causes:** Mechanical overload resulting from:

- 1 Sticking or seized valve, resulting in the follower to break due to cam-lobe pressure.
- 2 Piston contact with the valve due to:
  - a Weak valve spring
  - b Over extended hydraulic lifter
  - c Incorrect assembly of valve tip-cap
  - d Timing belt breakage
  - e Or through over high revving of engine.
- 3 Incorrect valve timing.

**Remedy:** Investigate & rectify the mechanical overload cause. Thoroughly flush the lubricating system, replace all damage components, prime cam and followers, with extreme pressure lubricant and replace oil and oil filter.

## 'Scored' bearings



**Appearance:** Severe scoring of the camshaft bearings.

**Causes:** Starvation or contamination of oil, i.e. foreign particles circulating in oil.

**Remedy:** Thoroughly flush the lubricating system, replace cam and followers, prime with extreme pressure lubricant and replace oil and oil filter.

## Carbonised oil deposits



**Appearance:** Carbonised oil build-up on cam and followers.

**Causes:** Excessive operating temperatures resulting from marginal lubrication conditions due to contaminated lubricating oil or blockages/restrictions in oil feed galleries.

**Remedy:** Thoroughly flush the lubrication system, ensuring that all galleries and hydraulic lifters (where fitted) are free from blockages & debris. Install new camshaft and followers, prime with extreme pressure lubricant and replace oil and oil filter.

## Excessive cam-lobe wear



**Appearance:** Severe cam-lobe wear.

**Causes:** Starvation or contamination of oil, tappet clearance too tight, excessive valve spring pressure.

**Remedy:** Thoroughly flush the lubrication system, install new camshaft and followers. Adjust tappets to the correct clearances, prime with extreme pressure lubricant and replace oil and oil filter.

## Overheated camshaft



**Appearance:** Cam-lobes, bearings & followers have a 'blue' discoloration.

**Causes:** Overheated engine possibly due to cooling failure.

**Remedy:** Investigate and rectify the cause of the overheating. Thoroughly flush the lubricating system, replace cam and followers, prime with extreme pressure lubricant and replace oil and oil filter.

## Physical damage to camshaft & followers

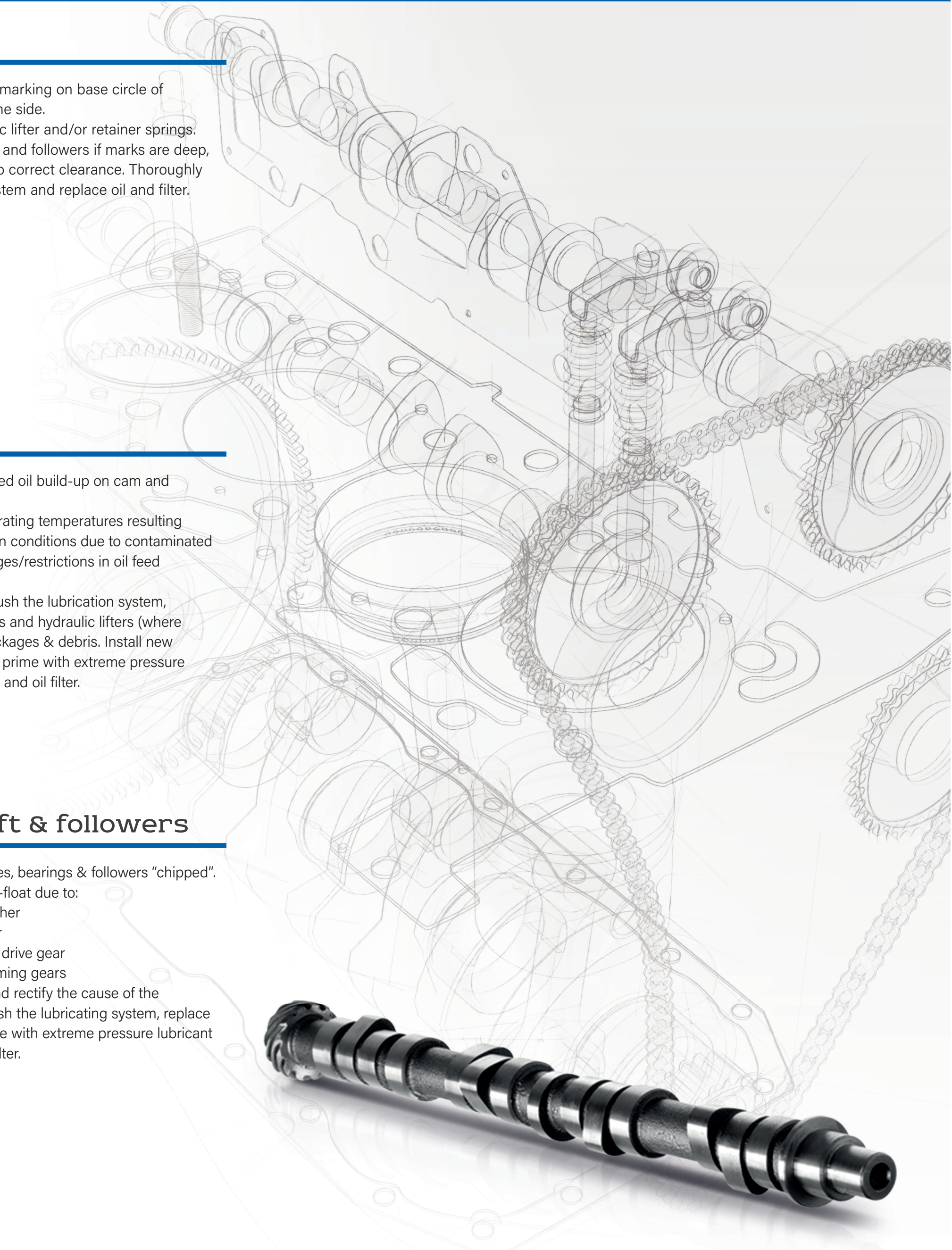


**Appearance:** Cam-lobes, bearings & followers "chipped".

**Causes:** Excessive end-float due to:

- a Worn thrust washer
- b Loose distributor
- c Worn distributor drive gear
- d Or misaligned timing gears

**Remedy:** Investigate and rectify the cause of the damage. Thoroughly flush the lubricating system, replace cam and followers, prime with extreme pressure lubricant and replace oil and oil filter.







# VW 1.9 TDi PD – Fitting Instructions

## Camshafts:

CAM672 - Cast Iron,  
CAM914 - Steel



## Hydraulic Tappets

FOL175 - Fully Phosphated  
FOL202 - Diamond Like Coated Face



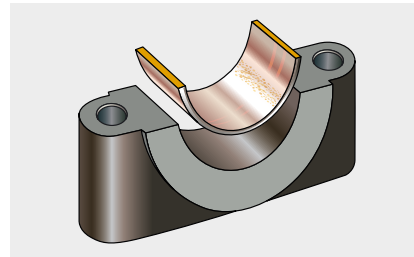
In order to ensure a long service life of AE® replacement camshafts, CAM672 & CAM914, it is vital and essential that the following fitting instructions are followed. Failure to comply with these instructions may result in premature wear or failure of the replacement parts.

## Removal

1. Drain the old engine oil, remove the sump and clean the oil strainer.
2. Refer to the engine manufacturers recommended sequence for the removal of all bolts when removing the old camshaft. Following the recommended sequence will minimize any chance of distortion.
3. Remove the old camshaft and bearing shells.
4. Remove the old hydraulic lifters.
5. Ensure all oil galleries are THOROUGHLY flushed to remove any remaining engine oil or debris.

## Installation of camshaft

1. Ensure the crankshaft sprocket has been secured at Top Dead Centre (TDC), before installing the new camshaft.
2. Wipe clean the bearing shell housing and carefully fit new bearing shells.



3. Prior to fitting new hydraulic lifters slightly depress the plunger to allow a degree of movement when installing the camshaft.
4. Install the camshaft in TDC position with the cam lobes of cylinder 1 pointing upwards.
5. Install bearing caps 2 and 4 and secure with NEW bolts. Tighten bolts sequentially to 8Nm +90°.
6. Install bearing caps 1, 3 and 5 and secure with NEW bolts. Tighten bolts sequentially to 8Nm +90°.





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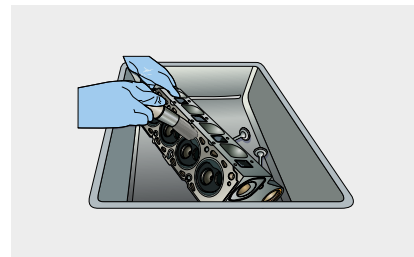


### Installation of rocker arm shaft

1. THOROUGHLY inspect the roller-type rocker arms for any sign of wear and / or damage, particular attention must be paid to the rollers. If necessary the rocker arms MUST be renewed.
2. Install the rocker arm shafts and secure with NEW bolts. Tighten the bolts sequentially in stages to 20Nm +90°.
3. Adjust the unit injectors according to the engine manufacturer's recommendations.



- Clean or if necessary replace the oil cooler.



- Renew air and oil filters.
- Use correct grade of engine oil as recommended by the engine manufacturer.
- It is vital to allow the hydraulic tappets to settle after the camshaft is installed, therefore please wait a minimum of 30 minutes before carefully turning the crankshaft 2 full rotations manually to ensure no valve to piston contact occurs.
- Upon initial start-up allow the engine to idle at no more than 1500rpm until the hydraulic lifters are fully primed.

### Special instructions

- Clean the cylinder head THOROUGHLY
- Thoroughly inspect the unit injector bores for any signs of wear and/or damage. Worn or damaged bores will allow fuel leakage to contaminate the engine oil, leading to rapid wear of the camshaft bearings and lifters



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2/2