VOLVO PENTA

AB Volvo Penta
SE-405 08 Göteborg, Sweden

Service Bulletin

Group	Number	Version
25–5	13	02

Marine engines with turbochargers

31-series – D16

Breakdown prevention

Inspection of turbochargers returned because of damage has shown that damage has ocurred as a result of operation in prohibited circumstances.

The following operating instructions must be followed in order to avoid engine damage (especially damage to the turbocharger).

Note: this bulletin can also be used as a guide for assessing warranty claims.

Operation

Lubricating oil

Only lubricating oil which meets the specifications set out in the operater's manual / workshop manual may be used in the engine.

Starting the engine

Allow the engine to idle for the first 10 seconds. Warm through the engine at low rpm and low load until it reaches normal operating temperature before full power is demanded (exception: emergency generators).

⚠ **IMPORTANT!** Never race the engine when it is cold.

Running at high rpm or full load after a cold start can result in damage to the turbocharger bearings.

Stopping the engine

Never stop the engine immediately after running under high load. Allow the engine to run at low idle (in neutral) for at least three minutes after operations are completed. In this way temperatures are evened out and overheating is avoided.

⚠ **IMPORTANT!** The above is especially important when the engine has been run at high rpm and / or under heavy load.

Note: after stopping from full load residual heat can lead to carbonization of oil remaining in the turbo and thereby choke the oil supply by obstructing oil channels.

Turbo breakdown, causes

For the turbocharger to function satisfactorilly it is vital that the engine's lubrication system is kept in good condition and that the right type of oil is used in the engine* (see applicable manual).

Oil supply is crucial for operation and it is therefore important that service instructions are followed meticulously in respect of oil quality, oil-change intervals, and intervals for changing oil and air filters.

* **Note:** if possible replace the engine oil and engine oil filter before the turbocharger is removed so that the engine can be run for a few minutes with the new oil before the turbocharger is repaired or replaced.

The following points should be checked:

- **Oil contamination**
  The turbine shaft has floating bearings. The operating principal involves the shaft journal revolving on the surface tension of a thin film of oil. If the oil film is broken, mechanical contact between the shaft and the bearing will result. Solid contaminants can cause the oil film to break down locally. A combination of small bearing play and high rpm enable incoming contaminants to cause serious damage.

  When this type of wear has gone on long enough, bearing play becomes so great that mechanical contact between the turbine or compressor wheels and their respective housings can occur.

  Mechanical contact between the turbine wheel – turbine housing will result in serious turbine damage and may cause consequential damage to the engine.

- **Oil contamination**
  Oil pressure is very important for establishing and maintaining the bearing oil film. At low oil pressure the oil film breaks down more easily if contaminants enter. Oil flow to the turbo is then further reduced resulting in diminished cooling, at which point carbonization of the oil can result.

  Carbonization can also occur if the engine is stopped immediately after full-throttle operations. The turbine shaft is still rotating at high rpm and is very hot. When the engine is stopped oil pressure is lost and oil flow ceases. The remaing oil can then become so hot that its more volatile elements wholly or partially evaporate leaving carbonized residues behind. At the next start the turbo will suffer from oil starvation. Over time the carbonized residues will block the oil channels and impair oil flow.

- **Oil starvation**
  Oil starvation can also be the result of blocked oil channels or from racing the engine to high rpm immediately after a cold start. The risk of oil starvation increases significantly in cold weather and when the engine has stood unused for a while.

  the engine must therefore be run without load for a few minutes after start and before stopping.

- **Oil contamination**
  The use of lubricating oils of inferior quality often manifests itself in the form of early turbo damage compared to other engine damage. This is because the turbo is relatively more susceptible to sludge and other contaminants in the oil. High turbo temperature must not be allowed to cause the oil to be broken down and sludge products to arise. Therefore oil from well-known manufactures must always be used.

- **Oil contamination**
  In order to withstand very high rpm, the turbo shaft seals are of so-called piston ring type. The disadvantage with this type of seal is that it does not seal completely when the lubricating oil pressure is higher than the charge air pressure in the compressor housing. Such is the case at low rpm when a certain amount of leakage will occur. This is perfectly normal and **should not be seen as a problem**.

  It is seldom seen in engines which are used for normal operations, but in engines which often run at low rpm the turbo can leak oil which in small quantities collects in the charge air cooler.

Charge air pressure too low

- Blocked air filter. Replace the filter (clean the filter on TAMD63, TAMD102 / 103).
- Dirty compressor (soot and oil deposits cause too low charge air pressure).

  Clean the compressor housing according to the instruction on page 5.

Suspected turbocharger damage

In order to avoid unnecessary replacement or warranty claims for a suspected damaged turbocharger, the following action must be taken:

– Remove the turbocharger from the engine.
– Check the compressor wheel for signs of damage.
– Check the turbine wheel for signs of damage.
– Check that the rotor spins easily.
– Listen for slight scraping sounds when the rotor spins.
– Check the axial and radial play (see instructions on pages 7 – 8).

Action to be taken in connection with turbocharger inspections

NOTE! Always establish the reason why the turbocharger must be replaced / repaired. Remedy any causes of the defect before the new turbo is fitted.

In order to avoid damage to the turbocharger recurring, the following points must be observed in connection with the replacement.

Check

– Check that the lubricating oil in the engine meets current standards.
– Check that service has been carried out at the prescribed service intervals.

Clean

– Lubricating oil pipes to and from the turbocharger.
– Crankcase ventilation.
– If there is any suspicion of a larger oil leak having occurred after a turbo breakdown, or of foreign objects (such as debris from a shattered compressor wheel) having been forced into the charge air cooler, the following action must be taken:

  ⚠ **WARNING!** If oil is present in the charge air system and as a result can reach the combustion chambers, there is a risk of a ’runaway’ engine, which can have very serious consequences.

– Check the charge air duct between the the turbocharger and the charge air cooler. If any traces of oil are found the charge air cooler must be thoroughly cleaned internally. Wipe clean and blow-dry with compressed air after treatment with a cleaning agent.
– If compressor wheel fracture has occurred the charge air cooler must be pressure tested to check that it has not been damaged by debris from the compressor wheel.
– The air duct between the air filter and the turbocharger.
– Exhaust manifold between the cylinder head /cylinder heads and the turbocharger.

Replace*

– Air filter
– Lubricating oil
– Oil filter(s) / by-pass filter
– Crankcase breather filter(s) (where fitted)
– All of the turbocharger seals / sealing rings must be replaced

*** Note:** if it cannot be established that replacement has already taken place.

Fitting the turbocharger

- Ensure that all turbocharger orifices are taped over until the turbocharger is to be fitted.
- Check that the compressor housing and the turbine housing are positioned correctly against the bearing housing.
- Ensure that the turbocharger is fitted unstressed.
- Fill the turbocharger oil inlet with clean engine oil before the supply pipe is connected, to ensure optimal lubrication of the bearing housing before the first engine start with the new turbocharger. Ensure that oil of the right quality is used.
- Check the lubricating oil supply (lubricating oil pressure, oil supply and oil return pipes respectively). In many cases turbocharger damage is caused by insufficient lubrication.
- Ensure that the lubricating oil pipes to and from the turbocharger are fitted unstressed.
- Apply the prescribed tightening torques.
- Check that the crankcase breather is not blocked.

Pay attention to the following:

Operation

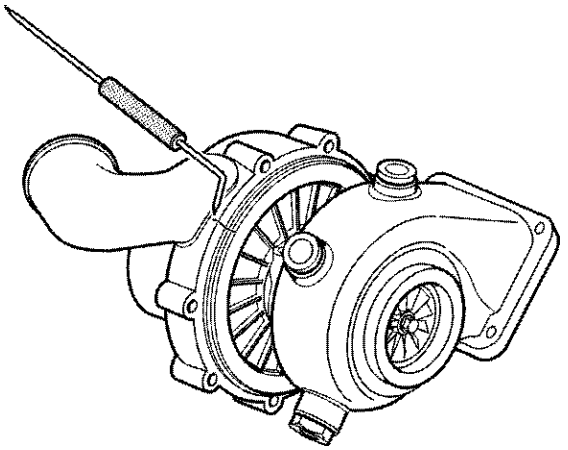
- Start and stop the engine according to the instructions on page 1.
- Follow applicable safety precautions and heed these safety warnings:

  ⚠ Do not touch the turbocharger and beware of hot surfaces. Risk of burns!

  ⚠ To protect against personal injury and to prevent damage from foreign objects being drawn into the compressor, never start the engine without the air filter fitted.
- After starting the engine, check that air ducts, exhaust pipes and oil pipes do not leak.

After operation

⚠ Never touch the turbocharger immediately after opertaion. Risk of burns from hot surfaces!



Compressor housing, cleaning

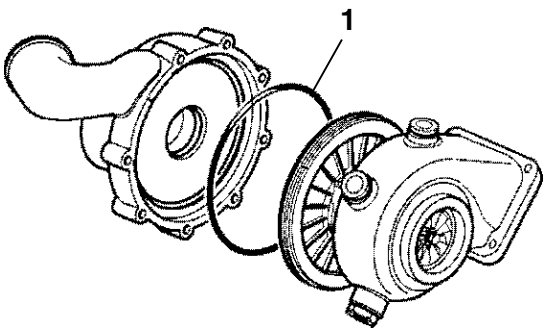
1
Scribe alignment marks between the bearing housing and the compressor housing.

2
Loosen the compressor housing by carefully tapping it free with a plastic mallet.

3
Clean the compressor wheel and compressor housing carefully. Brush the components with a soft brush and denatured alcohol.

NOTE! Steel brushes must never be used for cleaning (risk of scoring).

4
Check that the compressor wheel is free from mechanical damage. The vanes must not be worn, deformed or cracked.



5
Fit a new O-ring (1) on the shield and fit the compressor housing in alignment with the previously scribed markings. Fasten the housing.

Bearing clearance

In order to ensure that a turbocharger is not replaced unnecessarilly (because of presumed excess bearing play), use the table on the following page as a guide.

Bearing plays listed in the table can serve as guidelines whenever turbocharger replacement is necessary.

Permissible bearing play

Engine	Turbocharger	End float	Radial clearance*
31-series, 32-series, 41-series, 42-series, 43-series, 44-series, KAD/KAMD300	KKK K26	0.16 mm (0.0063")	0.42 mm** (0.0165")**
TAMD31S-A	Garrett GT	0.16 mm (0.0063")	0.42 mm** (0.0165")**
D4-180i-B, D4-210A-A, D4-210A-B, D4-210i-A, D4-210i-B, D4-225A-B, D4-225i-B, D4-260A-A, D4-260A-B, D4-260i-A, D4-260i-B, D4-260D-B	KKK K26	0.11 mm (0.0043")	0.42 mm (0.0165")
D6-280A-A, D6-280A-B, D6-280i-A, D6-280i-B, D6-310A-A, D6-310A-B, D6-310D-B, D6-310i-A, D6-310i-B, D6-350A-A, D6-350A-B, D6-370D-B, D6-370i-A, D6-370i-B, D6-435D-A, D6-435i-A	KKK K27	0.11 mm (0.0043")	0.46 mm (0.0181")
TAMD63L-A, TAMD63P-A, TAMD74A-A, TAMD74A-B	KKK K27	0.16 mm (0.0063")	0.45 mm (0.0177")
TAMD74C/L/P-A, TAMD74C/L/P-B, TAMD75P-A, TAMD103A	KKK K31	0.16 mm (0.0063")	0.45 mm (0.0177")
D9A2A MH, D9A2B MH	Borg Warner K29	0.15 mm (0.0059")	0.45 mm (0.0177")
D9A2A MP, D9A2B MP	Borg Warner K31	0.15 mm (0.0059")	0.45 mm (0.0177")
TMD102A, TAMD102A	KKK K28	0.16 mm (0.0063")	0.46 mm (0.0181")
TAMD102D	Holset HX50	0.15 mm (0.0059")	0.58 mm (0.0228")
TMD122A, TAMD122A, TAMD122C, TAMD122D	Holset 4LGK	0.15 mm (0.0059")	0.58 mm (0.0228")
TAMD122P	Schwitzer S4DW	0.20 mm (0.0079")	0.71 mm (0.0280")
D12C-A, D12D-A, D12D-B, D12D-C, D12D-D	Schwitzer S410W, S500W, S500WG	0.18 mm (0.0071")	0.92 mm** (0.0362")**
TAMD162A. TAMD162C, TAMD165C	KKK K356	0.16 mm (0.0063")	0.68 mm (0.0268")
TAMD162B, TAMD163P, TAMD165P	KKK K365	0.16 mm (0.0063")	0.68 mm (0.0268")
TAMD163A, TAMD165A	Schwitzer S4TW	0.20 mm (0.0079")	0.71 mm (0.0280")
D16C-A	Borg Warner S500C	0.12 mm (0.0047")	0.56 mm (0.0220")

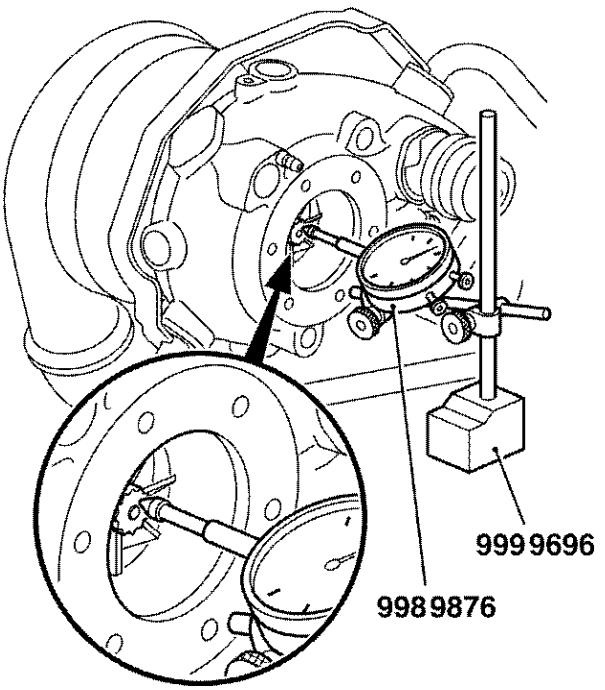
* Applies to the turbine end unless otherwise specified.

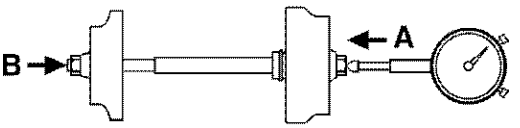
— ** Applies to the compressor end.

Checking the end float

Special tools:

Dial indicator 998 9876
Magnetic stand 999 9696





1. Place the magnetic stand 999 9696 with the indicator dial 998 9876 in a suitable location. Put the measurement tip on the center of the shaft.
2. Press the exhaust turbine **(A)** by hand. Zero the dial gauge.
3. Press the compressor turbine **(B)** in by hand. Read the end float on the dial gauge.

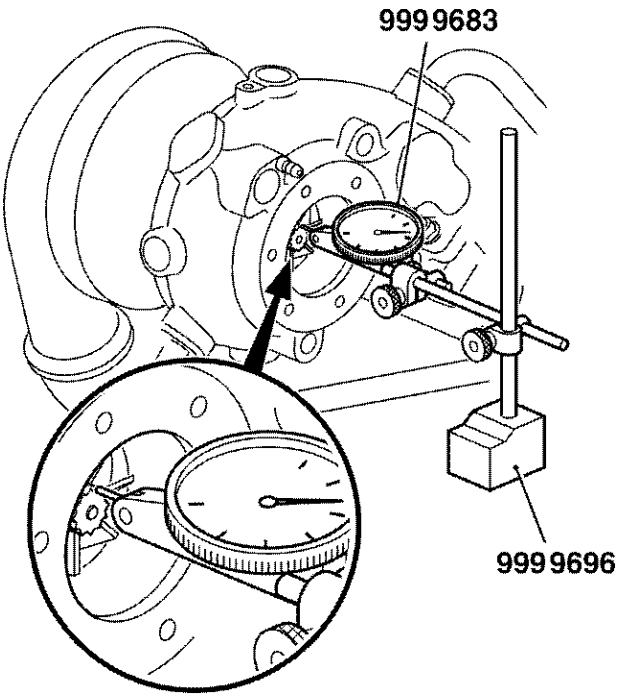
Permissible end float: refer to the table on page 6.

Replace the turbocharger if the wear limits have been exceeded.

Checking the radial clearance

Special tools:

Dial gauge 999 9683
Magnetic stand 999 9696



Turbine end

1. Attach the dial guage 999 9683 to the magnetic stand. Position the measurement tip on the turbine wheel hub, as illustrated.
2. Press the turbine wheel down at the same time as the other end of the shaft (the compressor end) is moved upwards. Zero the dial gauge.
3. Move the turbine wheel upwards, at the same time as the other end of the shaft is pressed down. Read off the radial clearance on the dial gauge. Then rotate the shaft 90° and repeat the measurement.

NOTE! Ensure that the shaft is not rotated during measurement.

Compressor end

The same method applies if measurment is to be carried out on the compressor end. Position the measurement tip
on the round surface on the compressor turbine's locknut.

Permissible radial clearance: Refer to the table on page 6.

Replace the turbocharger if the wear limits have been exceeded.

Checking the wastegate valve function:*

*** Note:** Applies to TAMD63P, TAMD72A/P-A, TAMD73P, TAMD74A-B/C/L/P, TAMD75, D9, D12D-B MP and D12D-D MP.

NOTE! This is only a functional check of the membrane and valve and should not be used for adjustment.

The wastegate valve must **not** be adjusted. If any fault is discovered, the wastegate valve/actuator must be replaced in its entirity. An incorrectly adjusted wastegate valve can cause engine failure. The engine warranty ceases to be valid if the valve has been adjusted.

1. TAMD63–75 and D12: Remove the wastegate valve from the turbo.
2. Check that the valve plate/valve clack are intact.
3. TAMD63–75 and D12: Check that the valve stem has not suffered corrosion.
4. Clean soot and deposits from the valve and valve seat.

Checking the valve opening pressure

5. Pressurize the wastegate valve to the specified value. The valve/link arm should then move: **A mm** (see illustrations and table below).

Engine	Turbocharger Part #	Wastegate valve Part #	Check values: Pressurization	Check values: Valve movement (A)
TAMD63P	866639 3826913 3827451	3828598	2.50 ±0.02 bar (36.26 ±0.29 psi)	2.2 ±0.2 mm (0.0866" ±0.0079")
	3830094	3835670	2.70 ±0.02 bar (39.16 ±0.29 psi)	2.6 ±0.2 mm (0.1024" ±0.0079")
TAMD72, -73	3825414 3826914 3827914 3828244	3828599	2.87 ±0.02 bar (41.63 ±0.29 psi)	3.95 ±0.2 mm (0.1555" ±0.0079")
TAMD74 **TAMD75**	3827195 3837691	3829368	2.45 ±0.02 bar (35.53 ±0.29 psi)	3.2 ±0.2 mm (0.1260" ±0.0079")
D9 MH	3842677	See note**	2.39 ±0.02 bar (34.66 ±0.29 psi)	2.87 ±0.2 mm (0.1130" ±0.0079")
D9 MP	3842676	See note**	2.55 ±0.02 bar (36.98 ±0.29 psi)	1.05 ±0.2 mm (0.0413" ±0.0079")
D12D-B MP, **D12D-D MP**	3886223	See note**	2.05 ±0.02 bar (29.73 ±0.29 psi)	4.0 ±0.2 mm (0.1575" ±0.0079")

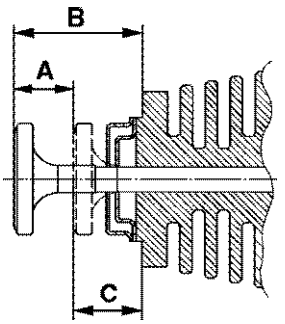
* The part # is displayed on the type plate on the turbocharger bearing housing.
** Not stocked as separate item.

6. Check that the wastegate valve does not leak.

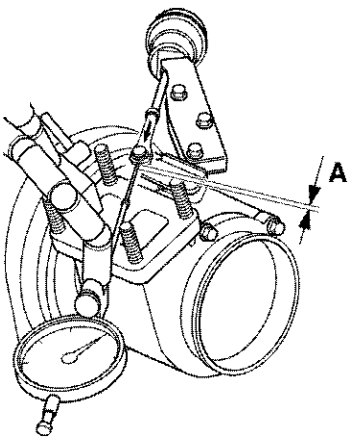
TAMD63, TAMD72, TAMD73, -74, -75 and D12:

A = B – C mm (inch)

A = Valve movement
B = Not pressurized
C = Pressurized



D9:
A mm (inch)

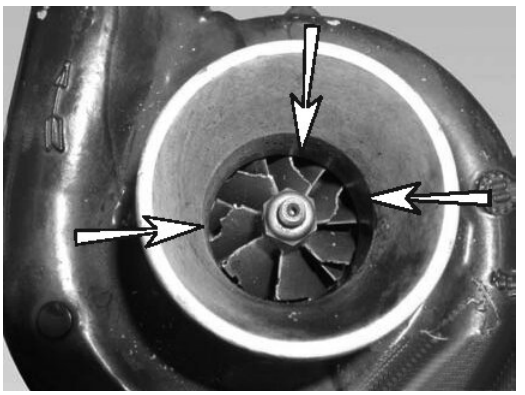


Typical example of damage

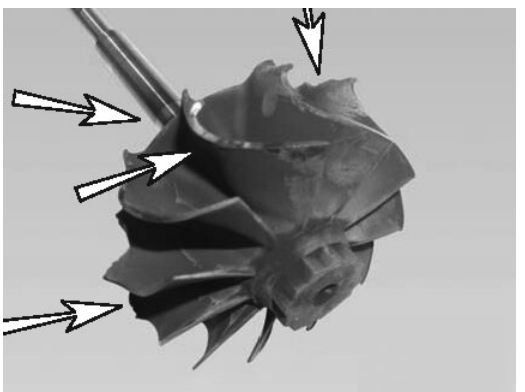
The following illustrations show typical turbocharger damage. The damage indicates that the turbocharger has run in unsuitable operational circumstances (e.g. carbonization caused by the use of poor quality lubricating oil, and bearing damage caused by running with too low a lubricating oil level).

In every case marked (*) the turbocharger is deemed outside of warranty cover.

Shattered compressor blade caused by compressor wheel material fault.

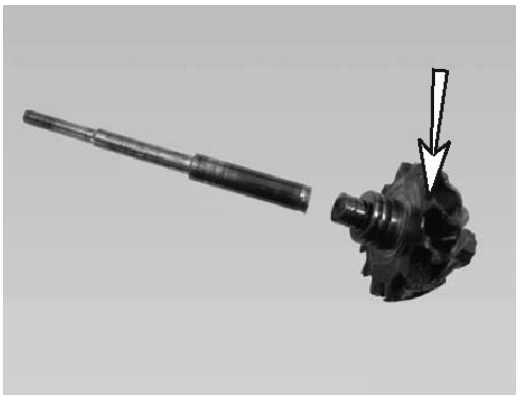


Shattered compressor blade (*) caused by damage from a foreign object, i.e. resulting from poor or no filtration of the induction air or by incorrectly performed overhaul.

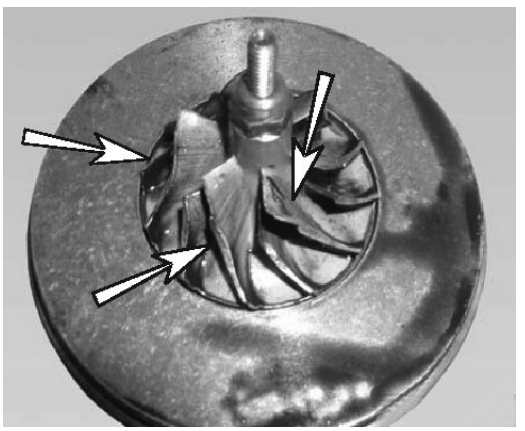


Shattered turbine blade (*) caused by accumulation of metal particles in the lubricating oil.

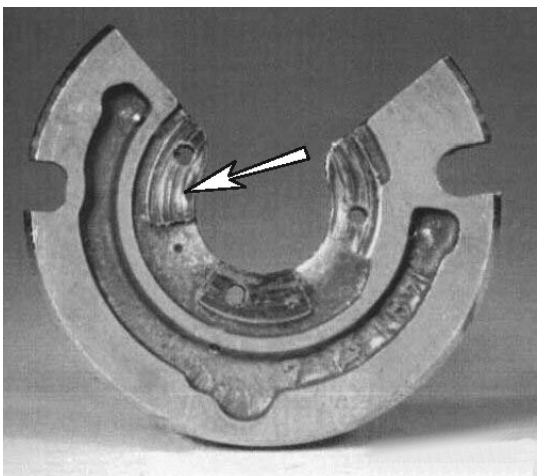
Pitting on the turbine shaft causes damage to the bearing and consequential damage to the turbine wheel.



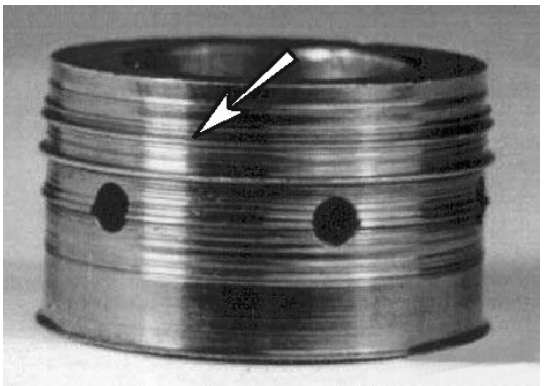
Sheared shaft (*), caused by accumulation of metal particles in the lubricating oil. Pitting on the shaft causes damage to the bearing and consequential damage to the turbine wheel.



Damaged compressor blades (*), caused by accumulation of metal particles in the lubricating oil. Pitting on the shaft causes damage to the bearing and consequential damage to the compressor wheel.

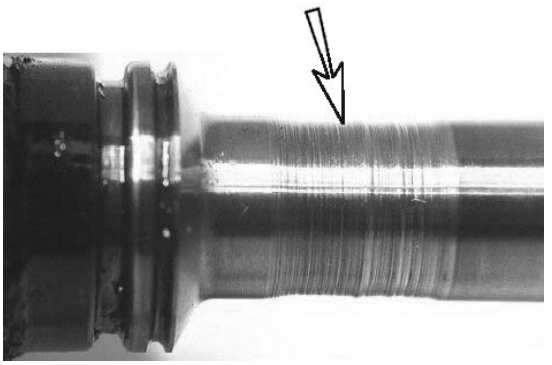


Damaged axial thrust bearing (*), caused by accumulation of metal particles in the lubricating oil. Poor maintenance of the lubricating oil system (see pages 1–2) causes bearing damage.



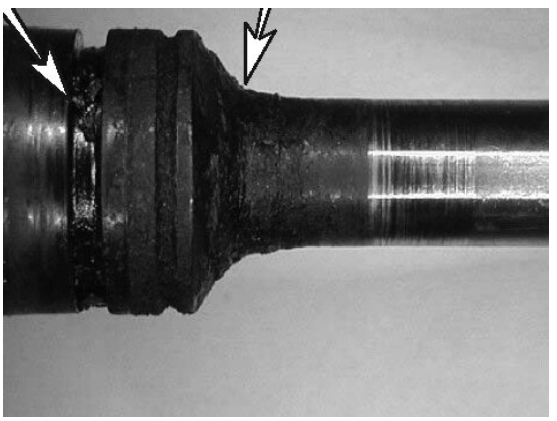
Damaged axial thrust bearing (*), caused by accumulation of contaminants in the lubricating oil.

Neglected maintenance of the lubricating oil system (see pages 1–2) causes bearing damage.

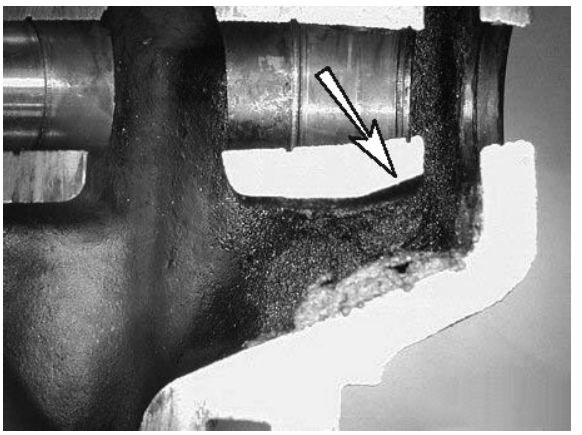


Damaged shaft (*), caused by accumulation of metal particles in the lubricating oil.

Neglected maintenance of the lubricating oil system (see pages 1–2) causes damage to bearings / shaft.

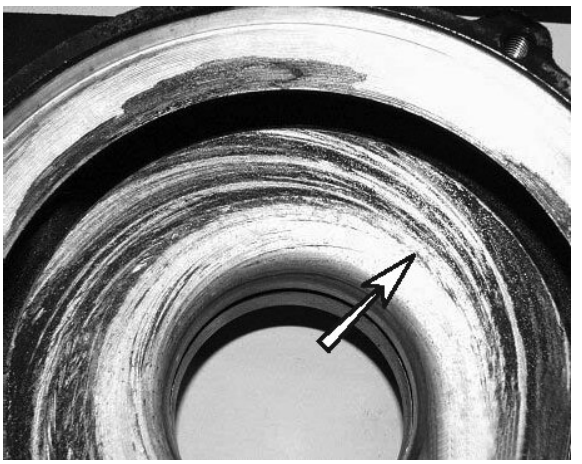


Damaged shaft / axial thrust bearing / piston ring seals (*), caused by hard carbonization of oil. Carbonization of residual oil caused by immediate stopping of engine from full load.



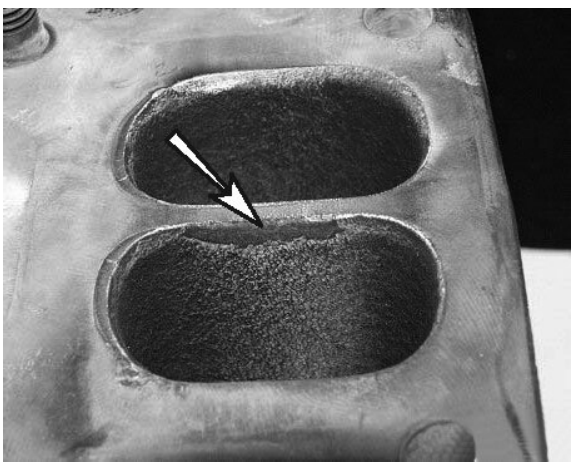
Carbonization of oil in the bearing housing (*), caused by lubricating oil starvation (lack of cooling), caused by immediate stopping of engine from full load.

Restriction / blockage in oil return line with presence of blue smoke.

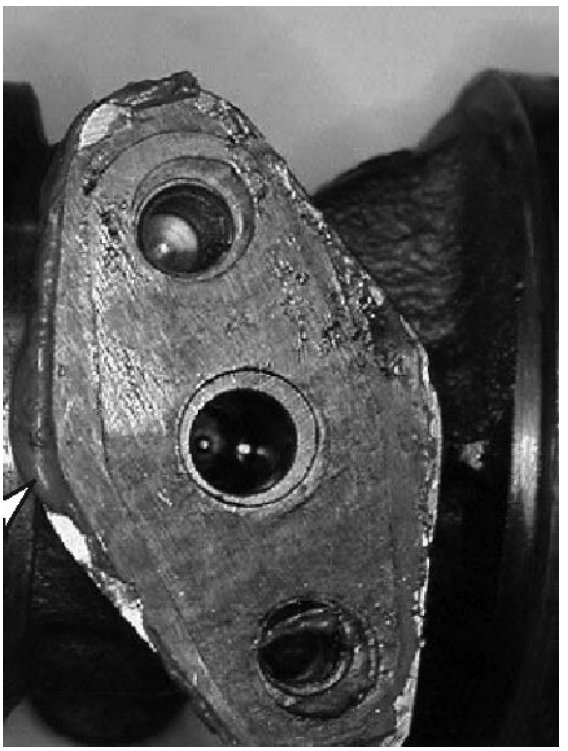


Oil leak (*), caused by running at rpm when the compressor is not yet providing charge pressure or by too high a crankcase pressure (blocked crankcase breather).

Wear in the piston ring area or ruptured piston ring sealing.



Deposits in the turbine housing (*), caused by too high exhaust gas temperature over a long period (injection, damaged air filter, too high induction air temperature).



Damage to turbocharger caused by faulty assembly. (*)

Through the use of liquid sealant at the oil inlet; a quantity of the sealant squeezed into the oil inlet when the delivery pipe was fastened.

Bearing damage and total turbocharger failure after a short period.