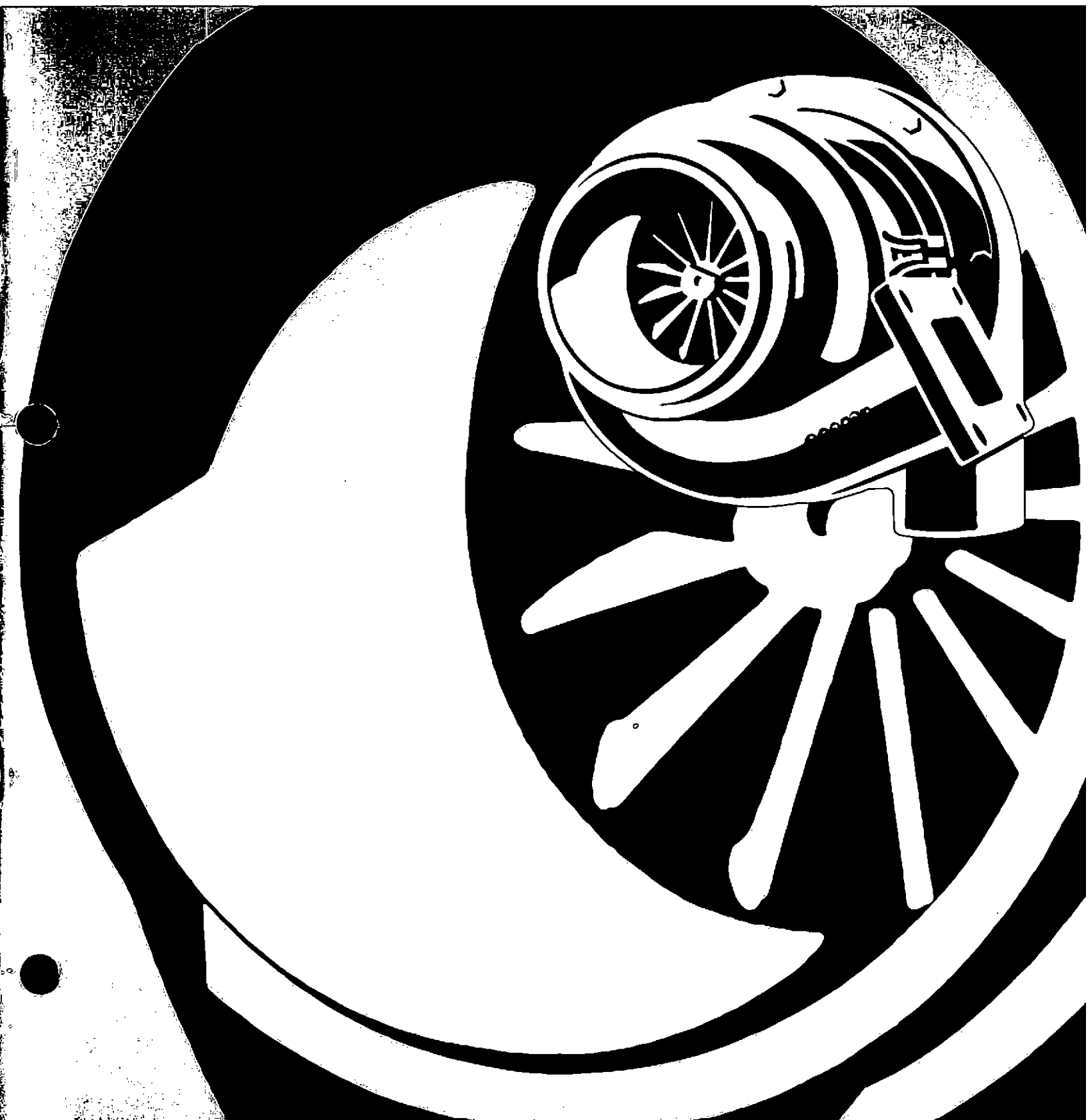




**T-35, T-46, T-50,  
VT-50, ST-50 and T-18A  
Turbochargers  
Component Shop Manual**



**Component  
Shop Manual**

**Cummins  
Turbochargers:  
T-35, T-46, T-50,  
ST-50, VT-50  
T-18A Rebuild Manual**

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## Foreword

This manual contains complete instructions for rebuilding the T-35, T-46, T-50, VT-50, ST-50 and the T-18A Turbochargers. Included in this manual are operation and maintenance, troubleshooting, disassembly, cleaning, inspection, wear limits, repair and assembly instructions.

Specification Tables are located at the end of each section. Worn Limits are found in the specification tables. They indicate the part can be used again if it does not exceed the worn limits. Damage can be in other areas not covered by the worn limits. Further use of any part is the responsibility of the person making the inspection.

The Table of Contents is located in the front of this manual. It contains page locations and other specific information that can be found in each section.

Cummins Engine Company, Inc. is continuously improving its products and procedures. Cummins Distributors and Dealers are kept aware of these improvements through monthly updates from Service/Parts Topics and Service Information Bulletins. The last page in this manual is an order form that contains a list of other service literature.

This manual contains the latest information available at the time of printing. It includes Service Topic Information through October, 1979. This manual supersedes Bulletin No. 3379091-03.

Feedback from the user is an important part of the updating procedure. Please address your comments and requests to:

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## Intake Air System

The turbocharger is a mechanical unit which is driven by exhaust gas. The turbocharger forces more air into the engine cylinder than the engine cylinder receives when operating as a naturally aspirated engine. The additional air and the increased fuel charge helps the engine develop more horsepower and operate more efficiently.

### T-35, T-46, T-50, VT-50, ST-50 and T-18 Turbochargers

#### Turbocharger Description

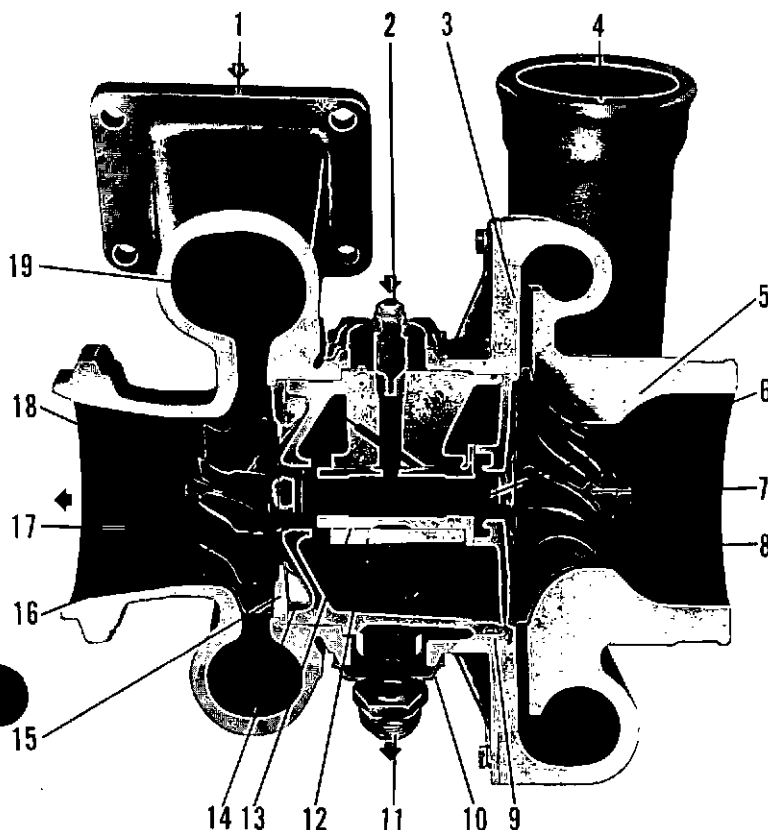
The turbocharger adds a very small percentage to the over-all weight of the engine. The results of using a turbocharger is a higher horsepower to weight ratio.

The turbocharger consists of a turbine wheel and a compressor wheel. They are in separate housings, but they are mounted on and rotate with a common shaft. The turbine side mounts to the exhaust manifold outlet flange. The compressor side mounts with the intake manifold. The lubrication and cooling

for the turbocharger is obtained from the engine oil which circulates through the bearing housing.

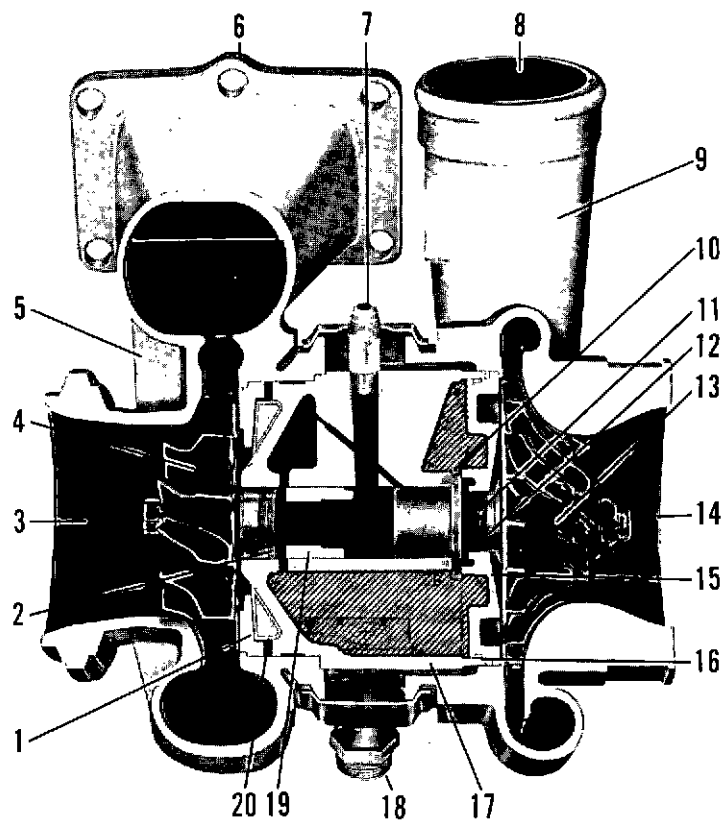
The power to drive the turbine wheel, which in turn drives the compressor wheel, is obtained from the energy of the exhaust gases. The speed of the turbine wheel increases as the speed of the engine increases. This gives the engine enough air to burn the fuel for its load requirements.

The part number, serial number, model number, and other information is on the nameplate attached to the turbocharger.



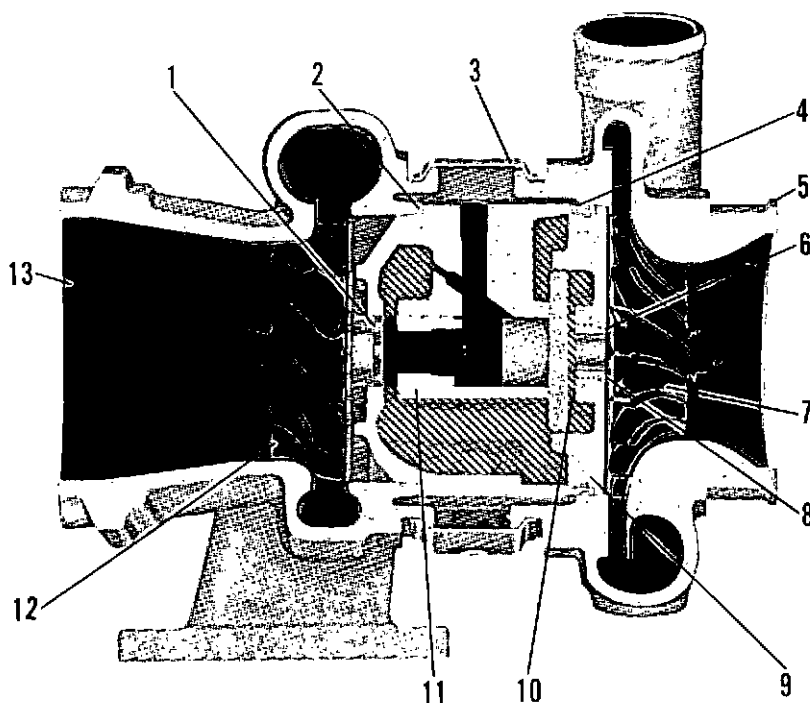
1. Exhaust Inlet
2. Oil Inlet
3. Diffuser Plate
4. Air to Engine
5. Compressor Housing
6. Oil Seal Sleeve
7. Compressor Wheel
8. Air Inlet
9. O-ring Seal
10. V-band Clamp
11. Oil Outlet
12. Bearing Housing
13. Turbocharger Bearing
14. Insulation Material
15. Heat Shield
16. Sealing Ring
17. Exhaust Outlet
18. Turbine Wheel and Shaft
19. Turbine Housing

Fig. 1-1, (AWC1). ST-50 Turbocharger cutaway



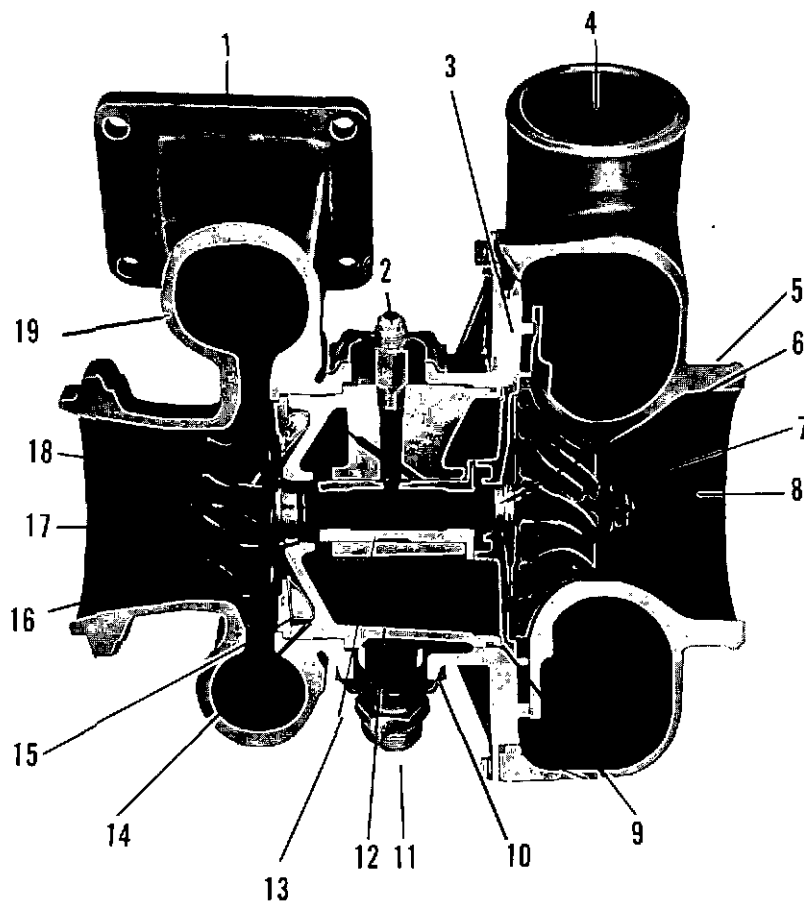
1. Heat Shield
2. Sealing Ring
3. Exhaust Outlet
4. Turbine Wheel and Shaft
5. Turbine Housing
6. Exhaust Inlet
7. Oil Inlet
8. Air to Engine
9. Compressor Housing
10. Bearing Insert
11. Oil Seal Sleeve
12. Sealing Ring
13. Compressor Wheel
14. Air Inlet
15. Oil Seal Plate
16. O-ring Seal
17. Bearing Housing
18. Oil Outlet
19. Turbocharger Bearing
20. Insulation Material

Fig. 1-2, (AWC2). T-50 Turbocharger cutaway



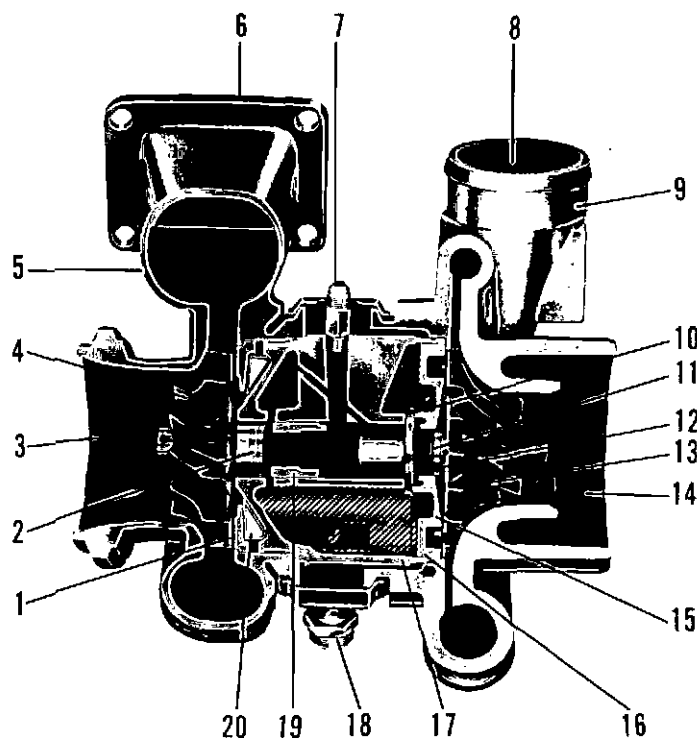
1. Oil Control Ring
2. Bearing Housing
3. V-band Clamp
4. O-ring Seal
5. Compressor Housing
6. Oil Seal Sleeve
7. Compressor Wheel
8. Sealing Ring
9. O-ring Seal
10. Thrust Bearing
11. Turbocharger Bearing
12. Turbine Wheel and Shaft
13. Turbine Housing

Fig. 1-3, (AWC3). T-35 Turbocharger cutaway



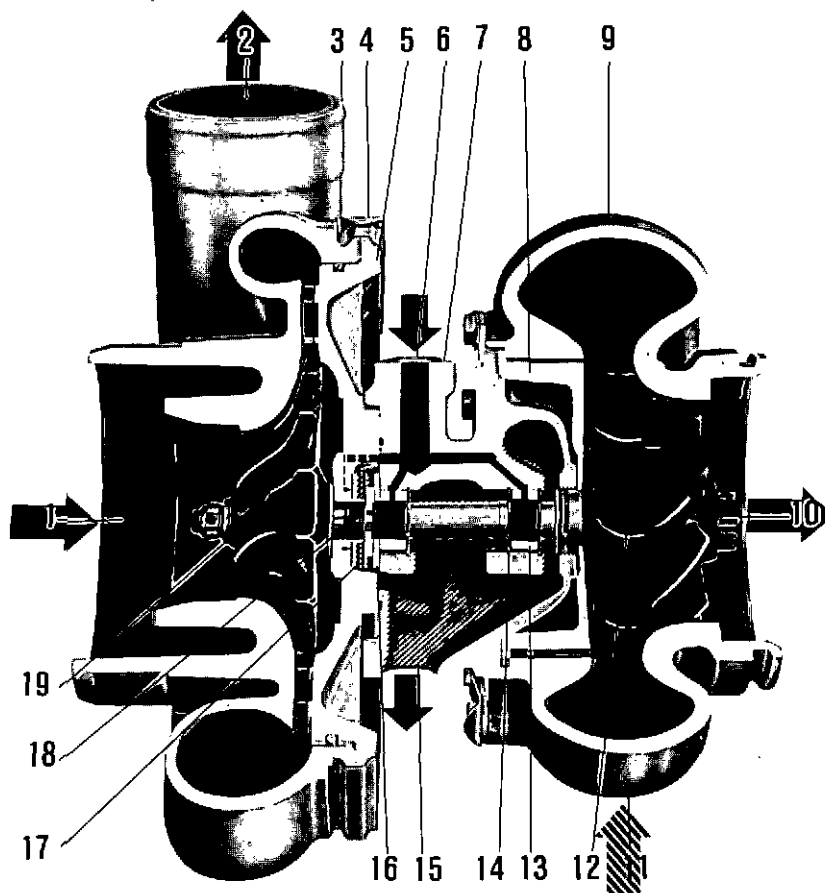
1. Exhaust Inlet
2. Oil Inlet
3. Diffuser Plate
4. Air to Engine
5. Compressor Housing
6. Oil Seal Sleeve
7. Compressor Wheel
8. Air Inlet
9. O-ring Seal
10. V-band Clamp
11. Oil Outlet
12. Bearing Housing
13. Turbocharger Bearing
14. Insulation Material
15. Heat Shield
16. Sealing Ring
17. Exhaust Outlet
18. Turbine Wheel and Shaft
19. Turbine Housing

Fig. 1-4, (AWC4). VT-50 Turbocharger cutaway



1. Heat Shield
2. Sealing Ring
3. Exhaust Outlet
4. Turbine Wheel and Shaft
5. Turbine Housing
6. Exhaust Inlet
7. Oil Inlet
8. Air to Engine
9. Compressor Housing
10. Bearing Insert
11. Sealing Ring
12. Oil Seal Sleeve
13. Compressor Wheel
14. Air Inlet
15. Oil Seal Plate
16. O-ring Seal
17. Bearing Housing
18. Oil Outlet
19. Turbocharger Bearing
20. Insulation Material

Fig. 1-5, (AWC5). T-46 Turbocharger cutaway



1. Air Inlet
2. Air Outlet
3. Compressor Housing
4. V-band Clamp
5. Back Plate
6. Oil Inlet
7. Center Housing
8. Shroud
9. Turbine Housing
10. Exhaust Outlet
11. Exhaust Inlet
12. Turbine Wheel and Shaft
13. Bearings
14. Snap Rings
15. Oil Outlet
16. Thrust Bearing
17. Thrust Collar
18. Oil Seal Assembly
19. Compressor Wheel

Fig. 1-6, (TA1). T-18A Turbocharger cutaway



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## Operation and Maintenance

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The compressor working together with the turbine automatically adjusts the speed and the output of the turbocharger. The turbocharger rotates in only one direction. The direction of the engine rotation has no effect on the turbocharger.

Under continuous load operation, there will not be very much smoke come from a turbocharged engine. Fast acceleration can cause a turbocharged engine to show exhaust smoke for a few seconds. When the turbocharger rpm catches up with the sudden increase in the fuel supply, the smoke will decrease.

### Starting and Checking the Turbocharger

1. Before starting the engine, lubricate the turbocharger by pouring clean lubricating oil through the oil inlet fitting. Turn the rotating assembly by hand to coat the bearings with the oil.
2. Start the engine and run at an idle.
3. Disconnect the oil drain to see if the oil is flowing through the turbocharger. Reconnect the line when finished.
4. Remove the air inlet hose from the compressor end of the turbocharger and observe the rotation of the turbocharger rotor. The rotor must be free of any rotating problems.
5. Stop the engine to see if the rotor stops freely.
6. Restart the engine and check the full speed and the load.
7. Make sure all the connections and the piping are tight. If there are no leaks of any type, the engine is ready for operation.
8. The performance of the turbocharger must be checked at intervals. Data and conditions to be checked are noted in following paragraphs.

### Stopping Engine

It is important to idle an engine 3 to 5 minutes before stopping it. This lets the lubricating oil carry the heat away.

The turbocharger contains bearings and seals that

receive a high degree of heat from the combustion exhaust gases. While the engine is running, the heat is carried away by the oil circulation. If the engine is stopped suddenly, the turbocharger temperature can rise as much as 100°F [38°C].

A high degree of heat in the turbocharger can cause seizure of the bearings, burned O-ring oil seals and distortion of the bearing housing.

### Turbocharger Speed

The speed of the turbocharger changes automatically with the speed and load of the engine. If the turbocharger runs too fast, the engine fuel rate is too high.

### Vibration

If a vibration starts in the turbocharger, stop the engine and find the cause. Vibration can be caused by damage to the compressor wheel, shaft or turbine wheel.

### Inlet Air Restriction

If the inlet air restriction exceeds 25 inches [635 mm] of water, the air flow to cylinders will not be good enough and a loss of power will occur. Too much exhaust smoke and high exhaust temperatures are joined with a loss of power.

1. Check the inlet air restriction by attaching a vacuum gauge or water manometer in the air intake piping. The adapter must be at a right angle to the air flow and one pipe diameter upstream from the turbocharger, Fig. 1-7.
2. Operate the engine until the normal operating temperature is reached.
3. Operate the engine at the rated speed and full-load. Take the reading from the vacuum gauge or manometer.
4. If the air restriction exceeds 25 inches [635 mm] of water:
  - a. Clean or replace the dry type cleaner element.

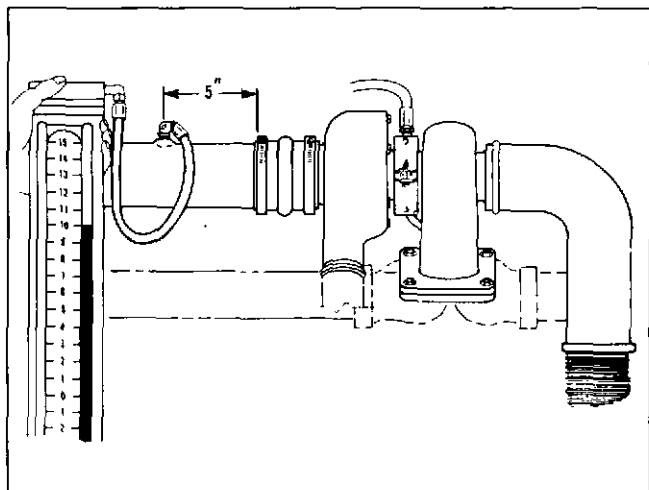


Fig. 1-7, (TM6). Checking the air inlet restriction

- b. Replace damaged air piping, rain shield or housing.
  - c. Remove the extra bends or other source of restriction in the air piping.
5. Air restriction readings can be taken at the air cleaner outlet connection plug. If the reading is taken at air cleaner, the restriction must not exceed 20 inches [508 mm] of water.

**Note:** Do not use this procedure when checking engines that have a correctly mounted restriction gauge in the air cleaner outlet. Reference the applicable engine maintenance manual for further information.

### Exhaust Back Pressure

High exhaust back pressure can be caused by foreign objects or excessive bends in the exhaust piping. The use of piping smaller than the exhaust outlet of the turbocharger can also cause high back pressure. If the exhaust back pressure exceeds 3 inches [76.2 mm] of mercury, you will have poor performance and early engine failure. To check exhaust back pressure:

1. The point of measurement must be as close as possible to the turbocharger outlet flange. The area to be measured must be where there is uniform flow such as a straight section of pipe. Make sure the area to be measured is at least *one pipe diameter from any changes in the flow direction*. If it is impossible to locate a point of measurement in a straight section, you can measure on the side of a bend. Make sure the

flow is uniform and equivalent to the flow in the centerline. Do not measure on the inside or outside radius of a bend. The flow is not uniform at these points. Fig. 1-8.

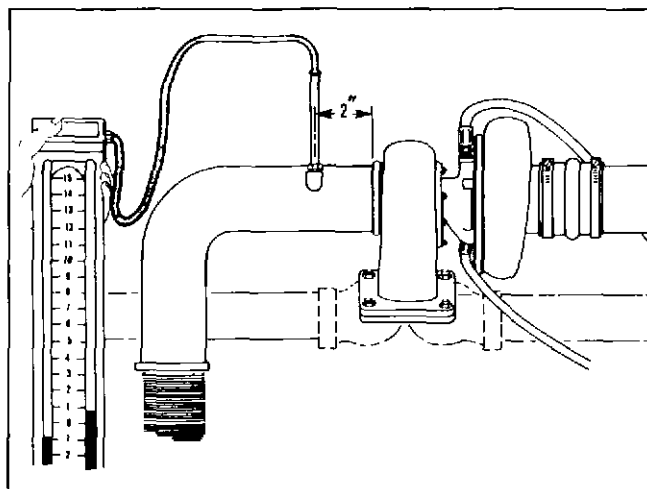


Fig. 1-8, (TM7). Checking the exhaust back pressure

2. At the point selected, weld a 1/8 inch [3.2 mm] pipe coupling to the exhaust tubing. Drill through the tubing with a 1/8 inch drill. Remove all the burrs on the inside of the pipe and mount a 90° fitting to the coupling. Use 3 ft. [0.9 m] of 1/8 inch [3.2 mm] I.D. copper tubing (to resist the heat) *plus* 10 ft. [3 m] of 3/16 inch [4.8 mm] I.D. soft rubber hose to manometer. The manometer can be mercury filled or water filled.

**Note:** It is important that the line to the manometer be the size and length as given. This will minimize the variation in the reading. A change in the length of the line can cause a change in the manometer reading.

### Maintenance

For best turbocharger performance, keep the compressor wheel and the compressor housing clean.

Keep dirt and other deposits from forming on the compressor wheel. These deposits will reduce the compressor efficiency, decrease the balance of the rotor and reduce intake manifold air pressure.

Periodic inspections of these parts will reduce mechanical failure and loss of performance requirements.

Since the rotor is the only moving part, the turbocharger will experience little wear under normal

operating conditions. Due to the rotors high speed of rotation and close running clearance, it must be accurately balanced. Make sure the balance and the running clearance of the rotor are maintained.

Operate the engine at rated horsepower and listen for turbocharger noise. If a shrill noise (above the normal turbine noise) is heard, shutdown immediately. A shrill noise indicates turbocharger bearing failure. Remove the turbocharger for an overhaul. Other noises would result from not enough clearance between the turbine wheel and turbine housing. If these noises are heard, the turbocharger must be removed from the engine, disassembled and inspected.

### Service Periods

1. Clean the turbocharger compressor wheel using the following procedure.
  - a. Remove the air intake to turbocharger connection. Remove the air inlet piping to the turbocharger and the compressor housing to expose the compressor wheel. Use cleaner, or solvent, and a bristle brush to clean the deposits from the compressor wheel and compressor housing.
  - b. Dry the unit and assemble the compressor housing to the bearing housing. Torque the V-band clamp nuts to the torque specifications. See Specifications.
  - c. Connect the air piping and fasten with the clamps.
  - d. Check the compressor wheel for oil sediment build up. Find the cause and correct such items as undersized oil bath air cleaner, air restriction, over filling the oil cup, etc.

**Caution: Never use a cleaner or solution that will damage the aluminum. Never use a wire brush, scraper or abrasives to clean the compressor wheel.**

2. Check the bearing clearance as shown under "Dimensions and Specifications" in this manual.

### Major Cleaning Operation

If the turbocharger has heavy carbon deposits, you must take the turbocharger off the engine for a complete cleaning. Disassemble, clean, inspect, repair or replace and assemble the turbocharger as described in the Rebuild Instructions.

### Total End Clearance

Check the end clearance as listed in the Checking Procedure below. This can be done without removing the turbocharger from the engine. Use a dial indicator to indicate the total end clearance of the rotor shaft. See Pages 2-6, 3-7 and 4-12.

### Checking Procedure

1. Remove the exhaust outlet connection and the intake piping from the turbocharger. This will expose both ends of the rotor assembly.
2. Attach a dial indicator to compressor housing. Push the shaft all the way to the rear. Place the indicator point against the end of the rotor shaft and zero the indicator. Push the shaft from the rear toward the indicator point and check the indicator reading. It cannot exceed the limits listed in the Specifications. See Pages 2-7, 3-8, 4-13 and 5-11.
3. If end clearance is not within these limits, the turbocharger must be removed from the engine and replaced by a new or rebuilt unit.

### Installation

The turbocharger can be mounted in many locations depending on the type of turbine housing and compressor housings. Change the position of the turbine housing and the compressor housing on the bearing housing. This will give you the location of the exhaust inlet and exhaust outlet. Band nuts must be torqued again if they are loose.

In all mounting arrangements of the turbochargers:

1. Check the position of the turbocharger oil drain. This drain must always be down or within 30 degrees of that position when the turbocharger is mounted on the engine, Fig. 1-9.
2. Install the gasket and position the turbocharger on the exhaust manifold flange. Mount the turbocharger to the exhaust manifold flange with the capscrews.
3. Put Teflon tape on the inlet fitting and the drain fitting. Install these fittings in the bearing housing. The torque for these fittings is listed in Specifications.
4. Install the oil drain line from the bottom of the turbocharger to the boss located on the engine block or oil pan. If the inlet or drain hose needs replacing, refer to the parts catalog.

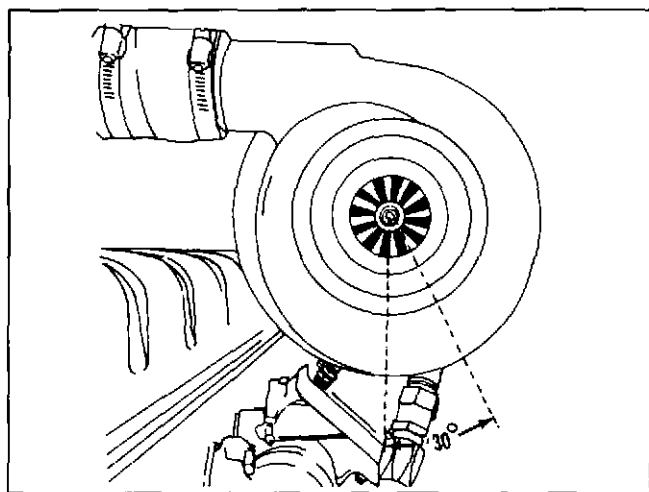


Fig. 1-9, (TM52). Turbocharger mounting

5. Lubricate the turbocharger before using. Add 2 to 3 oz. [60 cc] of clean engine lubricating oil through the inlet opening.
6. Fill the inlet line with clean lubricating oil (same grade as used in engine) and connect to the turbocharger.
7. Install the hose that connects the air outlet of the turbocharger to the engine intake manifold connection.
8. Install the air cleaner and the exhaust piping.
9. Check the crankcase breather condition. Excessive crankcase pressure will cause turbocharger leakage.

### Air and Exhaust Pipe Supports

The air and the exhaust connections to the turbocharger requires support. Make sure these connections are not bent. Too much bending can put stress on the turbocharger housing. There must be a flexible joint between the turbocharger and the support. This will help in movement, misalignment and thermal expansion of the joint.

#### 1. Exhaust Piping

- a. The maximum bending moment of unsupported piping at the outlet plane must not exceed 10 ft-lb [14 N•m].
- b. A maximum of 12 inches [304.8 mm] of flexible connection or two ball joints must be provided within the first 4 feet [1.22 m] of exhaust piping on turbocharged engines. This will permit thermal growth and help avoid

over stressing the turbocharger components.

- c. No more than 4 feet [1.22 m] of exhaust tubing or flexible connection without support can be attached to the turbocharger.

#### 2. Air Piping

- a. The maximum bending moment of the piping at the compressor inlet plane without support can not exceed 5 ft-lb [7 N•m].
- b. A flexible connection must be provided between the turbocharger and the support point of the piping.
- c. No more than 5 feet 9 inches [1.75 m] of air intake tubing without support can be attached to the turbocharger.

**Note:** One foot pound equals one pound of weight at a distance of one foot.



# Rebuild Instructions

## T-35 Turbocharger

### Disassembly

1. Before disassembly of the turbocharger, mark the compressor, turbine and bearing housings to help in alignment during assembly, Ref. Fig. 4-1.
2. Remove the oil drain and the supply fittings.
3. Remove the locknut, flat washers and the bolts securing the V-band clamps to the turbocharger, Fig. 2-1. Lift off the "V"-clamps and discard the locknuts, flat washers and bolts.

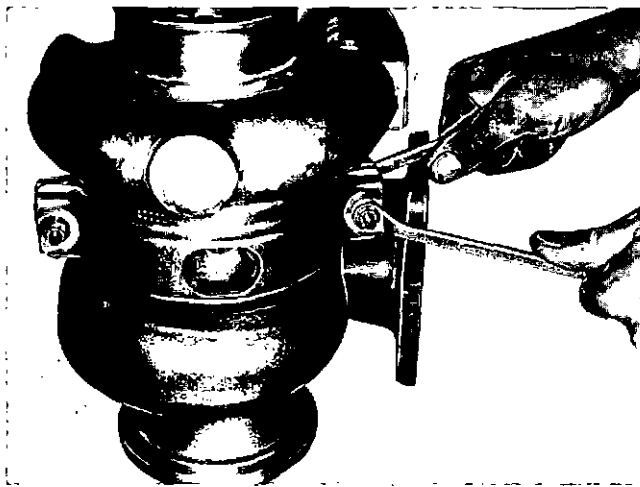


Fig. 2-1, (T-358). Removing the v-band clamps

4. Remove the compressor housing from the bearing housing. Discard the O-ring, Fig. 2-2.
5. Place a special sleeve over the compressor wheel and against the turbine housing, Ref. Fig. 4-4.
6. Place the assembly in a press and press the rotor assembly and bearing housing from the turbine housing, Ref. Fig. 4-5. Place shop towels or rags

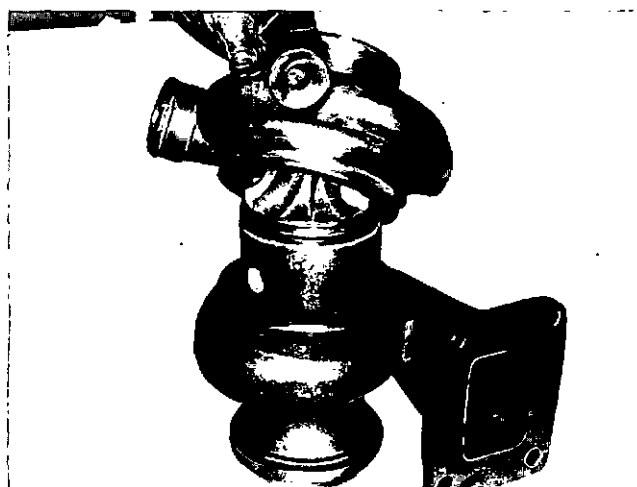


Fig. 2-2, (T359). Removing the compressor housing from the bearing housing

at the bottom of the sleeve to cushion the rotor assembly and bearing housing as it drops out of the turbine housing.

7. Remove the rotor nut from the compressor end of the rotor shaft, Fig. 2-3. Discard the nut.
8. Lift off the compressor wheel. If the wheel does not lift off, insert the rotor assembly into the special sleeve. With the turbine wheel pointing down, press the turbine from the rotor assembly, Fig. 2-4. Place shop towels or rags at the bottom of the sleeve to cushion the turbine wheel and shaft as it drops down.
9. Insert the oil seal plate driver into place at the turbine end of the bearing housing. Strike the driver with a plastic hammer to remove the oil seal plate, Ref. Fig. 4-8.
10. Remove the thrust washer and the turbocharger bearing from the bearing housing, Ref.

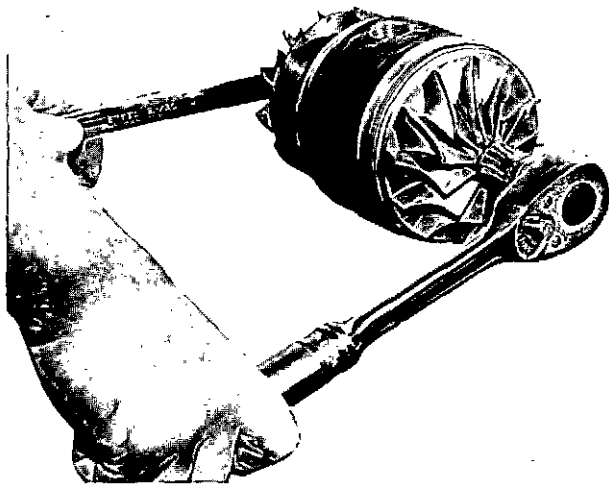


Fig. 2-3, (T3511). Removing the rotor nut from the rotor assembly



Fig. 2-4, (T3512). Pressing the turbine wheel and the shaft from the rotor assembly

Fig. 4-9. Discard the thrust washer if damaged.

11. Remove the oil seal sleeve from the oil seal plate, Ref. Fig. 4-10. Discard the sealing ring.
12. Remove the O-rings from the oil seal plate, Ref. Fig. 4-11. Discard the O-rings.
13. Remove the sealing ring from the groove in the rotor shaft, Ref. Fig. 4-12. Discard the sealing ring.

### Cleaning

Hard carbon deposits will form on the turbocharger parts which are very difficult to remove with ordinary solvents. The cleaner must be capable of removing hard deposits without damaging the metal.

1. Place all parts in a divided wire basket so the part will not be damaged through contact. Do not pile the parts in a basket. Avoid damage to all precision machined surfaces.
2. Do not use a chemical solution or any type solvent that will damage the parts. Use only an approved cleaning solvent. Parts can also be washed in hot water and soap, mineral spirits, or they can be steam cleaned.
3. Use a soft bristle brush to clean the parts. Never use a wire brush or any other type brushes with stiff bristles.
4. To remove the dirt loosened by cleaning, you must flush the oil passages in the bearing housing, from the drain end.
  - a. If time allows, leave the parts in an approved cleaning solvent for 12 to 24 hours,
  - b. After completion of step "a", pump the solvent through the passages again to flush out any loose particles.
5. Drain and steam clean the parts to remove all carbon and grease.
6. Blow off the excess water and dry with moisture free compressed air.
7. Place the parts carefully in a clean basket to avoid damage and dirt.

### Inspection and Repair

When rebuilding a T-35 turbocharger, replace the following parts. Refer to the current parts catalog for the service replacement part numbers.

- a. Turbine End Oil Control Ring (3).
- b. V-band capscrews, flat washers, locknuts.
- c. Bearing Housing O-ring (7).
- d. Oil Seal Plate O-ring (8).
- e. Oil Control Ring (11).

All other parts should be within the specified wear limits. Turn to Page 2-7 for specifications of parts.

1. Turbocharger Bearing (1), Ref. Fig. 4-13.
  - a. Check the bearing length for wear, chips and cracks.
  - b. If the dimensions are worn more than the limits shown in the Specifications, the bearing must be discarded.

2. Compressor Housing (15), Ref. Fig. 4-14.
  - a. A crocus cloth can be used to smooth out small chips and scratches on the compressor housing.
  - b. Discard the compressor housing if cracked or distorted.
3. Turbine Housing (5), Ref. Figs. 4-15 and 4-16.
  - a. Visually inspect the turbine housing for wheel to housing contact.
  - b. Check for cracks in the mounting flange area and the V-band clamp area.
4. Bearing Housing (2), Ref. Fig. 4-17.
  - a. Visually inspect the bearing housing for cracks in the area of the supply and drain fittings.
  - b. Measure inside diameter of the bearing housing bore.
  - c. Measure the length of the bearing housing from the compressor housing stop to the turbine housing stop at four equal locations.
  - d. Discard the bearing housing if the measurements indicate the housing is warped.
5. Oil Seal Plate (9), Ref. Fig. 4-18.
  - a. Inspect the oil seal plate for cracks, rough areas and distortion.
  - b. Discard if damaged.
6. Oil Seal Sleeve (10), Ref. Fig. 4-19.
  - a. Measure the thickness of the sleeve for indication of wear.
  - b. Insert the new oil control ring (11) into the groove as shown. If the clearance exceeds .009, discard the sleeve.
7. Compressor Wheel (12), Ref. Fig. 4-22.
  - a. The compressor wheel cannot be used again if the vanes are cracked, broken or have touched the compressor housing.
  - b. Check for cracks with a dye solution.
  - c. Watch for damage to the vanes in the area marked "A".
  - d. Damage in the area marked "B" is normally caused by wheel to housing contact.
8. Turbine Wheel and Shaft (4), Ref. Fig. 4-23.

- a. Inspect the sealing ring grooves for damage. Small grooves or marks are acceptable, but deep grooves are not. Smooth with a crocus cloth before using again.
- b. Check the turbine thrust shoulder for scratches.
- c. Check for turbine wheel cracks with a dye solution.
- d. Do not use the assembly if there are any cracks in the turbine wheel.

#### 9. Miscellaneous

- a. V-clamps may be cleaned and used again if they are not damaged.

### Assembly

**Caution:** All parts and the work area must be free of grease, oil and dirt to keep abrasives out of the turbocharger during assembly.

1. Position the sealing ring in the groove on the turbine end of the rotor shaft, Fig. 2-5.

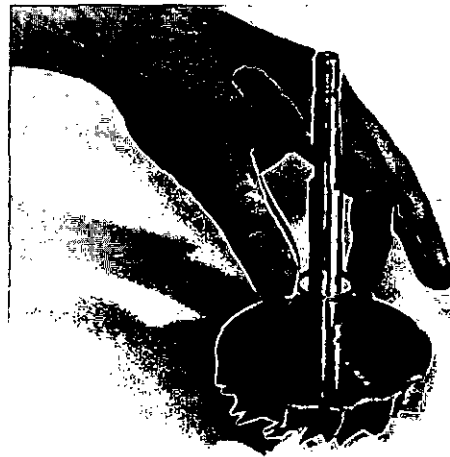


Fig. 2-5. (T3513). Installing the sealing ring onto the turbine wheel shaft

**Note:** When starting the sealing ring in the chamfer of the bore, care must be taken to properly compress the ring during installation.

2. Insert the turbine wheel and shaft into the bearing housing, Fig. 2-6.
3. Lubricate the rotor shaft and the turbocharger bearing with a clean lubricating oil. Insert the turbocharger bearing over the shaft and into the bearing housing bore, Fig. 2-7.



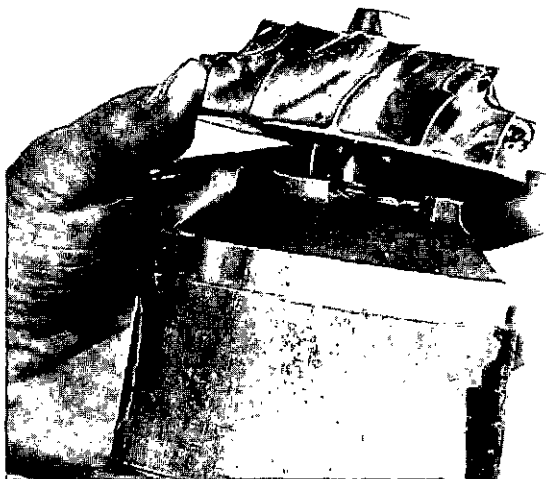


Fig. 2-6, (T3514). Installing the turbine wheel & shaft into the bearing housing

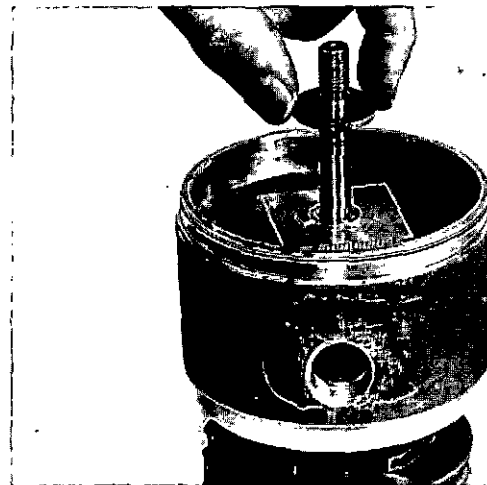


Fig. 2-8, (T3516). Installing the thrust washer

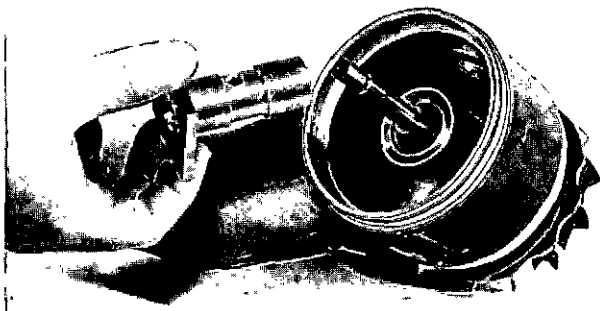


Fig. 2-7, (T3515). Installing the turbocharger bearing

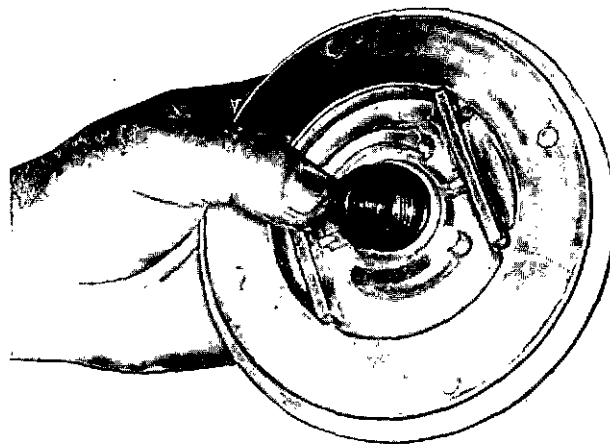


Fig. 2-9, (T3517). Installing the oil seal assembly into the oil seal plate

4. Use a piece of tubing or mandrel and hold the thrust washer on the edge of the shaft. Check the turbocharger bearing end clearance on the shaft. See the Specifications for the clearance.
5. Position the new thrust washer over the turbine shaft. Align the mark on the thrust washer with the balance mark on the end of the rotor shaft, Fig. 2-8. The balance mark on the washer must face outward. If there is no mark on the washer, either side may face outward.
6. Lubricate the bore of the oil seal plate with a clean lubricating oil. Start the ring end of the sleeve into the pilot chamfer of the oil seal plate bore. Use light pressure to compress the ring and push the sleeve into the bore. Make sure the edge of the sleeve is even with the impeller

side of the oil seal plate, Fig. 2-9.

**Note:** Install the seal assembly from the inside of the oil seal plate. The piston ring must be to the outside of the plate.

7. Lubricate and install the new black O-ring in the groove of the oil seal plate, Fig. 2-10. Coat the bearing housing bore with a lubricant. Place the oil seal plate over the shaft and align so the retainer of the oil seal plate covers both sides of the turbocharger bearing flange, Fig. 2-11. Push the oil seal plate in the bearing housing until the plate seats on the shoulder.

**Caution:** Check the alignment mark of the thrust washer with the mark on the end of the rotor shaft before installing the sleeve.

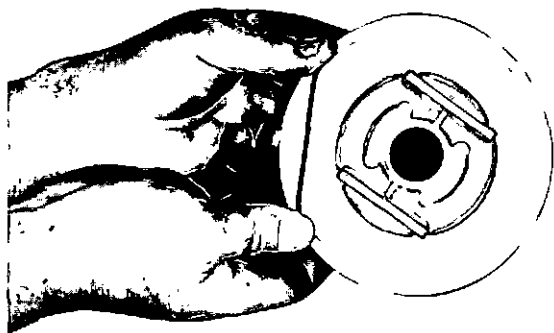


Fig. 2-10, (T3518). Installing O-ring onto the oil seal plate

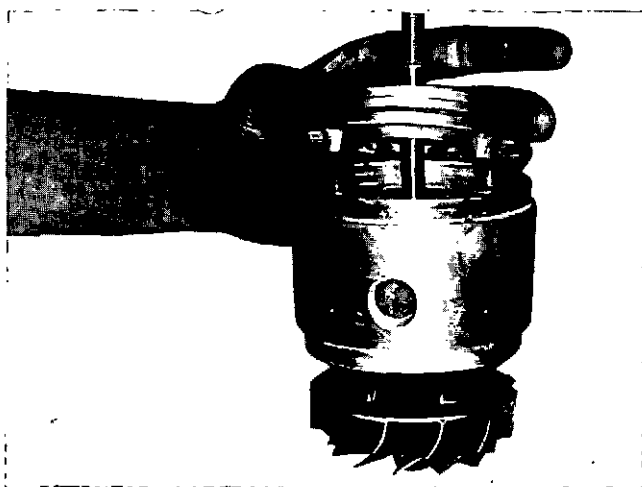


Fig. 2-11, (T3519). Installing the oil seal plate onto the bearing housing

8. Support the rotor and carefully move the assembly to a press.
9. Lubricate the rotor shaft O.D. with a high pressure grease and position the compressor wheel on the shaft. Align the balance mark of the compressor wheel with the balance mark on the end of the shaft. Press the compressor wheel on the shaft until the wheel seats against the sleeve, Ref. Fig. 4-35.
10. Install the new locknut on the rotor shaft. Tighten with a torque wrench to 120 to 130 in.-lb. [13.6 to 14.7 N·m] maximum torque, Fig. 2-12.

**Caution: Do not over torque the nut. This will deform the shaft and cause distortion of the thrust washer and possible oil leakage.**

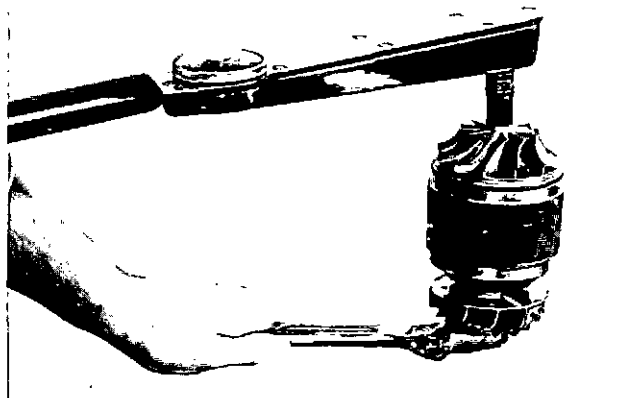


Fig. 2-12, (T3520). Torquing the rotor nut

11. To prevent seizure, lubricate the turbine housing bore with a heat resistant compound.
12. Insert the rotor assembly with the turbine end down, into turbine housing. Align the marks made prior to disassembly. If all components have been cleaned properly, assembly should enter housing by hand and not require being pressed in, Ref. Fig. 4-37.
13. Install the new red O-ring in the groove of the bearing housing. Lubricate the O-ring lightly with engine lubricating oil to prevent cutting the O-ring when the compressor housing is installed.
14. Install the compressor housing. Align the alignment marks, Ref. Fig. 4-38.
15. Position the V-bands around the housings, centering the openings of the V-bands over the oil supply and drain ports. Secure with new bolts, flat washers and lock nuts. Torque the nuts to values listed in Specifications, Fig. 2-13. Check the clearance between the turbine housing and the V-band clamp. There must be a minimum of 0.035 inch [0.89 mm].

**Caution: Do not exceed the recommended torque. This causes clamp distortion and clamp loosening. Do not torque the clamp again during operation.**

16. Check the radial clearance at the turbine end of the compressor end of the turbocharger as follows:

a. Push the shaft toward the side of the bore.

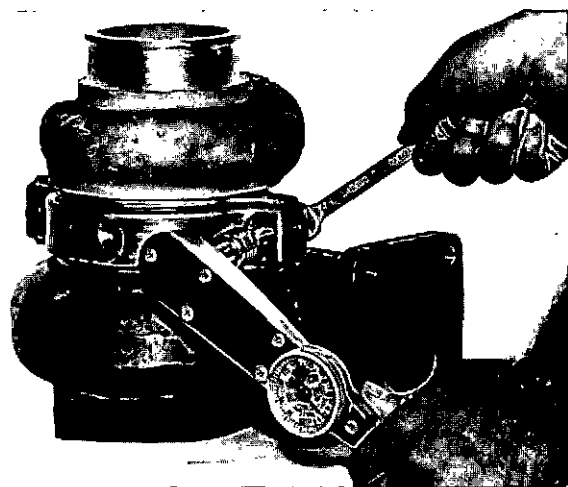


Fig. 2-13, (T3521). Torquing the V-band clamp

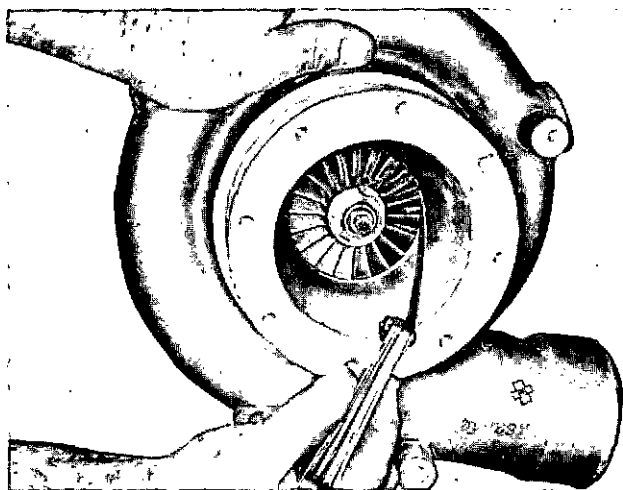


Fig. 2-14, (T3522). Checking the compressor wheel radial clearance

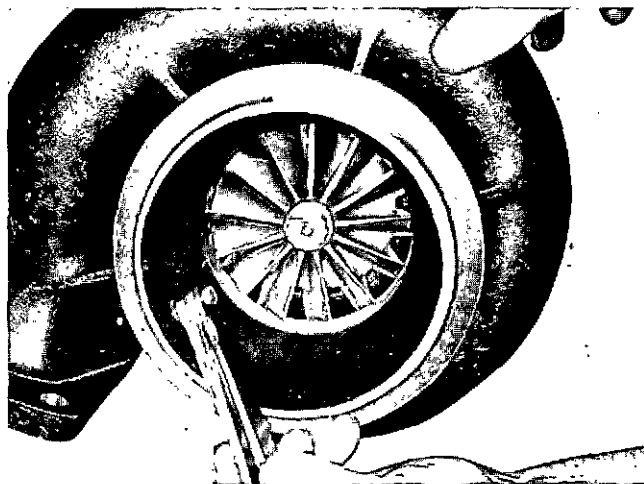


Fig. 2-15, (T3523). Checking the turbine wheel radial clearance

- b. Using a feeler gauge, check the minimum distance between the tip of the wheel vanes and the bore. On the T-35 turbocharger clearance must be 0.0011 to 0.0409 inch [0.028 to 1.039 mm] on the compressor end, Fig. 2-14, and 0.0023 to 0.0397 inch [0.058 to 1.008 mm] on the turbine end, Fig. 2-15.

17. Use a dial indicator to check the total end clearance, Fig. 2-16. The end clearance must be within 0.004 to 0.015 inch [0.10 to 0.38 mm].

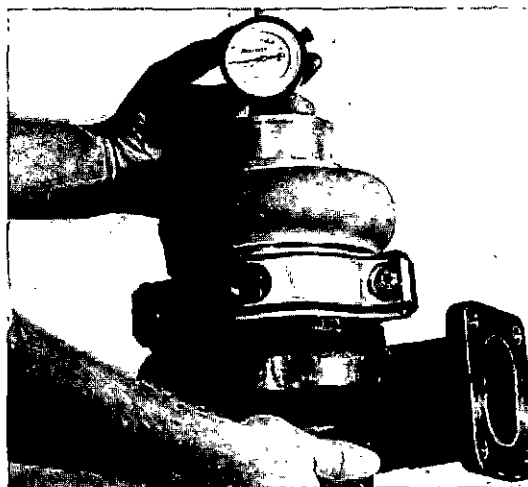


Fig. 2-16, (T3524). Checking the total shaft end clearance

## VT-50 and ST-50 Turbocharger

### Disassembly

1. Before disassembly of the turbocharger, mark the compressor housing, bearing housing and V-band clamps to help in alignment during assembly, Ref. Fig. 4-1.
2. Remove the fittings from the lubricating oil inlet and outlet ports.
3. Remove the locknut from the compressor end of the rotor shaft, Fig. 3-1. Discard the locknut.

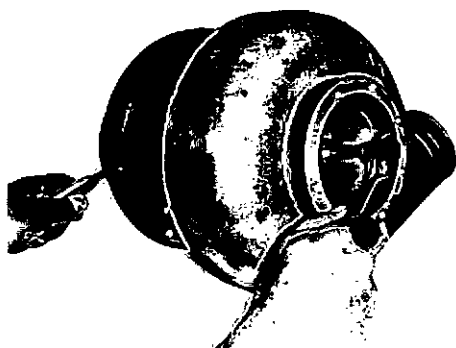


Fig. 3-1, (VTST26). Removing rotor nut from rotor shaft

4. Remove the locknuts, washers and the bolts which hold the V-band clamps to the turbocharger, Fig. 3-2. Lift off the V-band clamps and discard the locknuts, washers and bolts.
5. Using an ST-647 Puller, secure the clamp to the collector housing with the end of the puller bolt on the rotor shaft. Pull the collector housing, oil seal diffuser plate and the compressor wheel from the bearing housing, Fig. 3-3.
6. Remove the capscrews and lockwashers that hold the collector housing to the diffuser plate, Fig. 3-4.
7. Remove the diffuser plate from the collector housing. Discard the sealing ring if used. Lift out the compressor wheel.

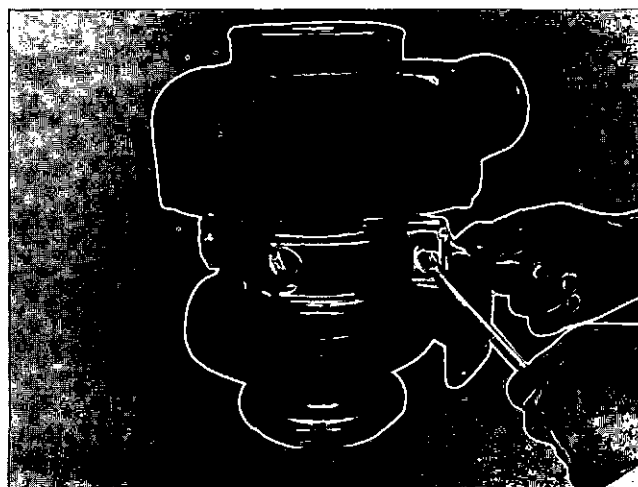


Fig. 3-2, (VTST27). Removing the V-band clamps

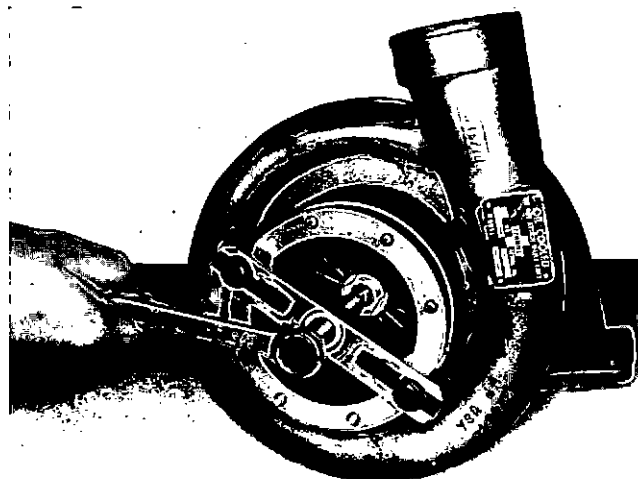


Fig. 3-3, (VTST28). Removing the compressor wheel, housing and diffuser plate

8. Remove the turbocharger bearing insert and the turbocharger bearing from the rotor shaft, Fig. 3-5. Remove the O-ring from the bearing housing. Discard the O-ring and turbocharger bearing insert.
9. Position a turbocharger sleeve over the bearing housing and against the turbine housing, Fig. 3-6.

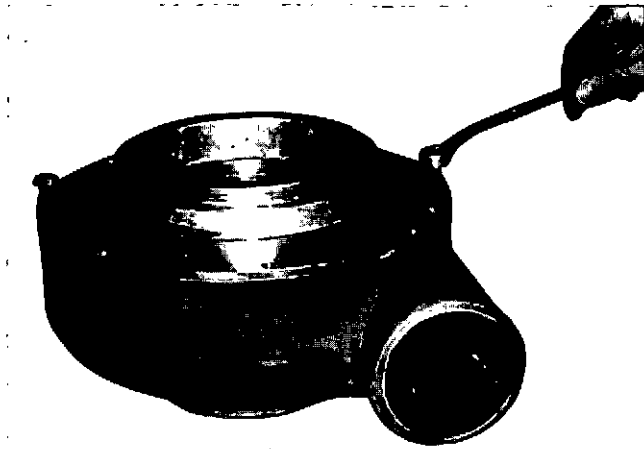


Fig. 3-4, (VTST29). Removing the diffuser plate from the compressor housing

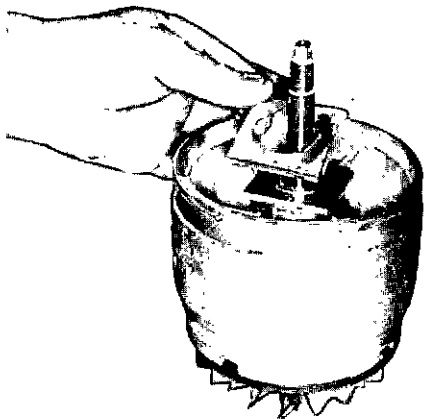


Fig. 3-5, (VTST30). Removing the turbocharger bearing insert

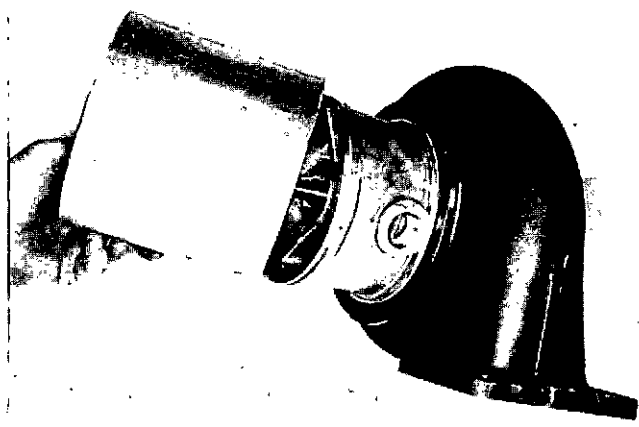


Fig. 3-6, (VTST31). Installing the turbocharger sleeve

10. Place the assembly in a press and press the rotor assembly and bearing housing from the turbine housing, Fig. 3-7. Place shop towels or rags at the bottom of the sleeve to cushion the rotor assembly and bearing housing as it drops out of the turbine housing.



Fig. 3-7, (VTST32). Pressing the bearing housing assembly from the turbine housing

11. To remove the rotor assembly from the bearing housing, reverse the bearing housing and strike the rotor shaft on the workbench, Fig. 3-8.

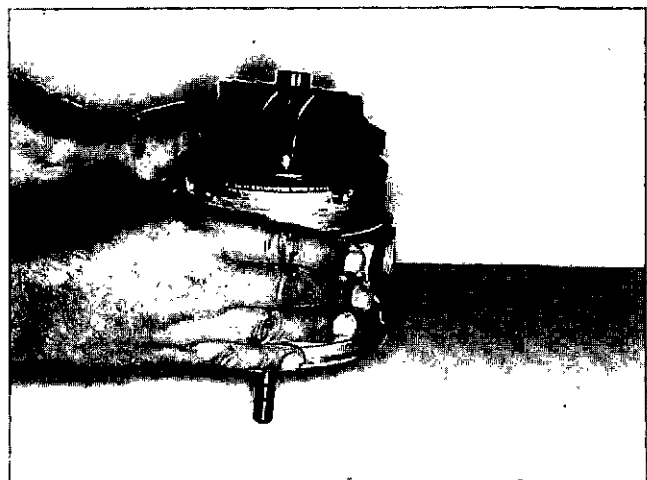


Fig. 3-8, (VTST33). Removing the wheel and shaft from the bearing housing

12. Remove the heat shield and the insulation pad from the bearing housing.
13. Remove the sealing sleeve assembly from the oil seal/diffuser plate.

14. Remove the sealing rings from the grooves in the rotor shaft. Discard the sealing rings.

### Cleaning

Hard carbon deposits will form on the turbocharger parts which are very difficult to remove with ordinary solvents. The cleaner must be capable of removing hard deposits without damaging the metal.

1. Place all parts in a divided wire basket so the part will not be damaged through contact. Do not pile the parts in a basket. Avoid damage to all precision machined surfaces.
2. Do not use a chemical solution or any type solvent that will damage the parts. Use only an approved cleaning solvent. Parts can also be washed in hot water and soap, mineral spirits, or they can be steam cleaned.
3. Use a soft bristle brush to clean the parts. Never use a wire brush or any other type brush with stiff bristles.
4. To remove the dirt loosened by cleaning, you must flush the oil passages in the bearing housing from the drain end.
  - a. If time allows, leave the parts in an approved cleaning solvent for 12 to 24 hours.
  - b. After completion of step "a", pump the solvent through the passages again to flush out any loose particles.
5. Drain and steam clean the parts to remove all carbon and grease.
6. Blow off the excess water and dry with moisture free compressed air.
7. Place the parts carefully in a clean basket to avoid damage and dirt.

### Inspection and Repair

Refer to Page 4-3 for this information.

### Assembly

**Caution:** All parts and the work area must be free of grease, oil and dirt to keep abrasives out of the turbocharger during assembly.

1. Use a piece of tubing or mandrel on the edge of the shaft and check the turbocharger bearing end clearance on the shaft. It should be 0.006 to 0.010 inch [0.15 to 0.25 mm].

2. Position the new metal covered insulation pad on the turbine end of the bearing housing, Fig. 3-9.

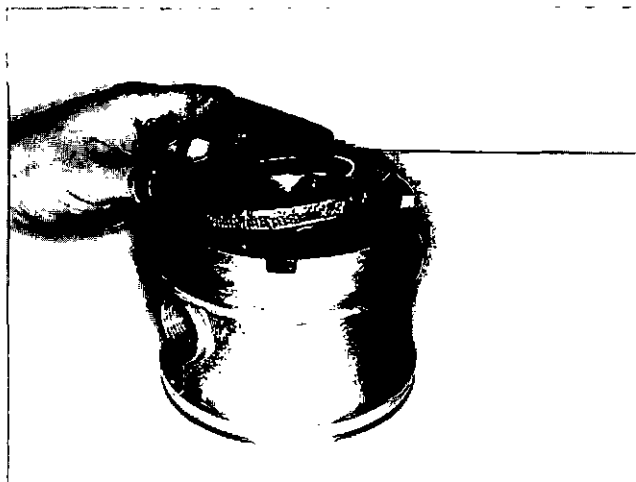


Fig. 3-9, (VTST34). Installing the insulation material

3. Install the heat shield on the bearing housing, Fig. 3-10.

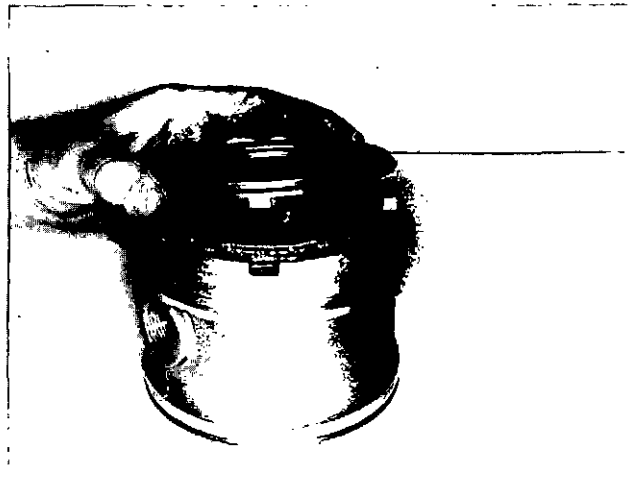


Fig. 3-10, (VTST35). Installing the heat shield

4. Position the sealing rings in the grooves on the turbine end of the rotor shaft, Fig. 3-11.

**Note:** If the wheel and shaft use two sealing rings, be sure the end caps remain 180 degrees apart.

5. Coat the bore of the bearing housing with STP oil or the equivalent. Insert the rotor shaft in the housing, Fig. 3-12.

**Note:** To properly compress the ring during instal-

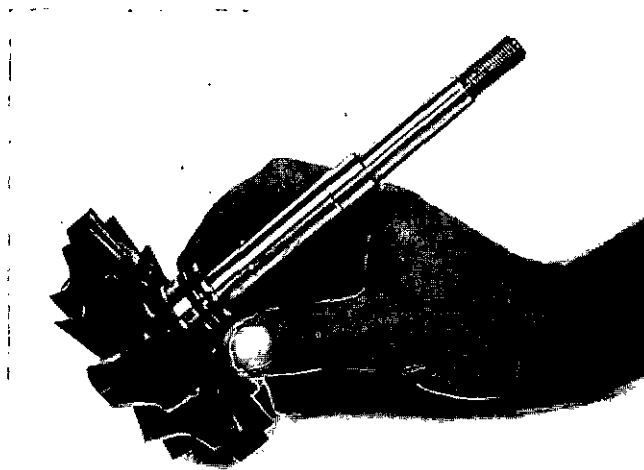


Fig. 3-11, (VTST36). Installing the sealing rings onto the turbine wheel and shaft

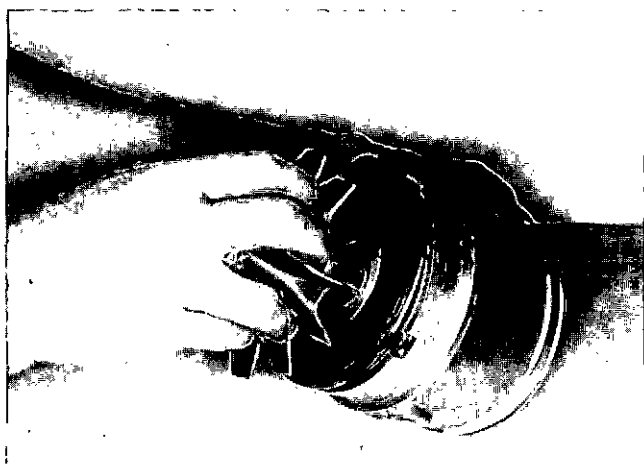


Fig. 3-12, (VTST37). Installing the turbine wheel and shaft into the bearing housing

lation, care must be taken to start the sealing rings in the chamfer of the bore.

6. Lubricate the rotor shaft and the turbocharger bearing with STP oil or the equivalent. Insert the turbocharger bearing over the shaft and into the bearing housing bore, Fig. 3-13.
7. Position the turbocharger bearing insert over the flange of the turbocharger bearing, Fig. 3-14.
8. Lubricate the new O-ring with clean engine oil. Install the new O-ring in the groove of the bearing housing, Fig. 3-15.
9. Lubricate the bore of the oil seal sleeve and the oil seal with STP or the equivalent. Then insert the oil sealing sleeve assembly. Keep the piston

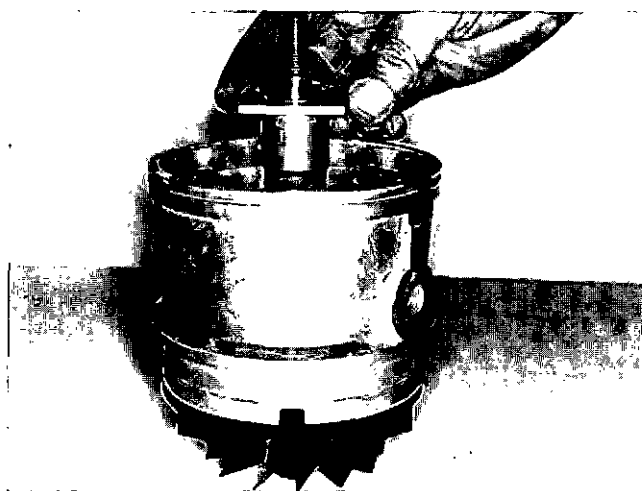


Fig. 3-13, (VTST38). Installing the turbocharger bearing

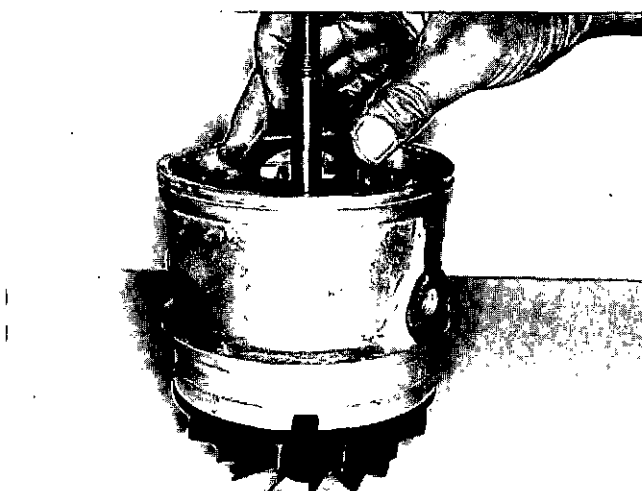


Fig. 3-14, (VTST39). Installing the turbocharger bearing insert

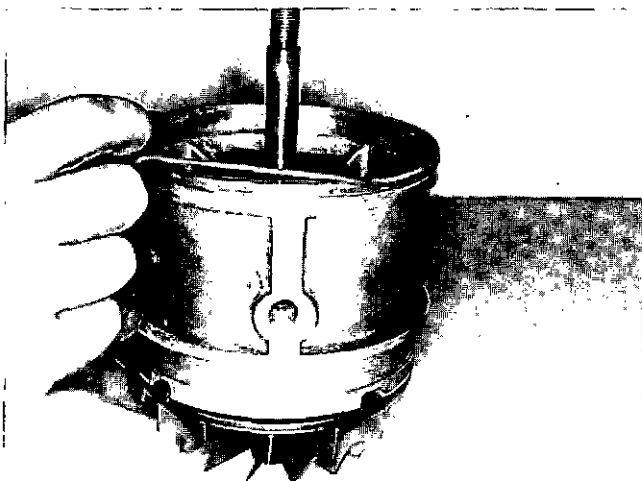


Fig. 3-15, (VTST40). Installing the O-ring onto the bearing housing

ring compressed until the assembly is started in the bore, Fig. 3-16.

**Note:** Install the seal assembly from the inside of the diffuser plate. The piston ring must be to the outside of the plate, and the spiral groove of the sleeve goes to the inside of the diffuser plate.

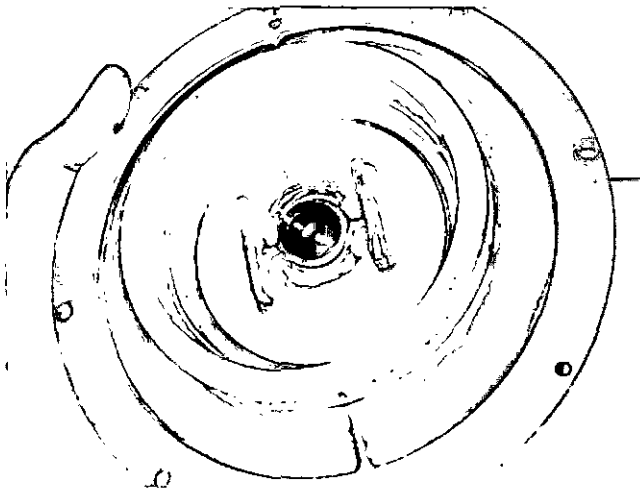


Fig. 3-16, (VTST41). Installing the oil sleeve into the diffuser plate

10. Lubricate the new sealing ring and install on the lip of the diffuser plate, Figs. 3-17 and 3-18. Coat the bearing housing bore with STP oil and place the diffuser plate over the shaft. Align the plate so the retainer of the diffuser plate covers the sides of the turbocharger bearing flange, Fig. 3-19. Push the diffuser plate on the bearing housing until the plate seats on the edge of the diffuser plate.



Fig. 3-17, (VTST42). Installing the O-ring on the ST diffuser plate

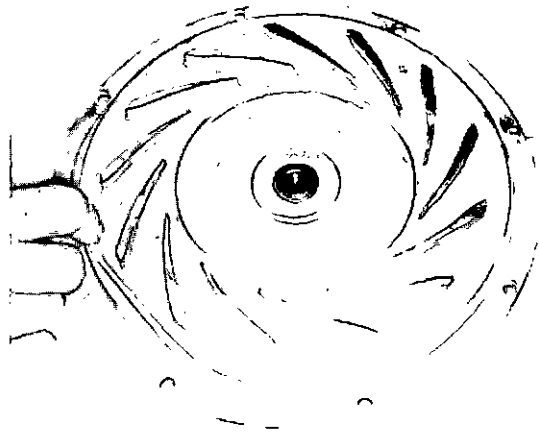


Fig. 3-18, (VTST43). Installing the O-ring on the VT diffuser plate

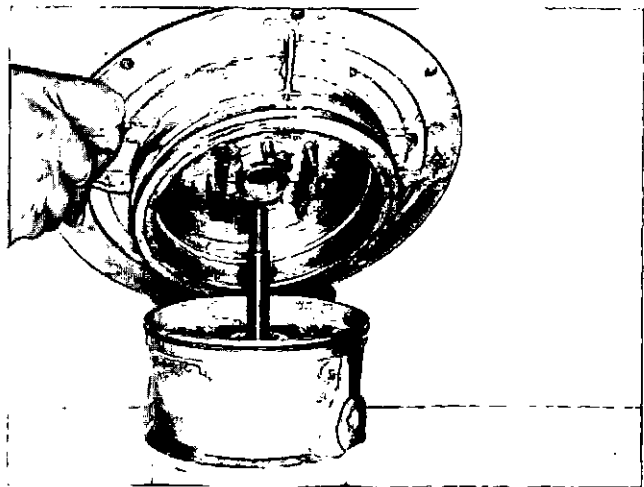


Fig. 3-19, (VTST44). Installing the diffuser plate onto the bearing housing

11. Carefully move the assembly and the rotor support to a press.
12. Lubricate the rotor shaft O.D. with oil and then position the compressor wheel on the shaft. Using a special mandrel, place the compressor wheel on the shaft until the wheel seats against the sleeve edge. A press may be necessary to complete this procedure.
13. Install the new locknut on the rotor shaft. Tighten with a torque wrench to 20 to 24 ft-lb [27 to 33 N·m] maximum torque, Fig. 3-20.

**Caution:** Do not over torque the nut. This will deform the shaft.

14. Using the alignment marks, install the collector



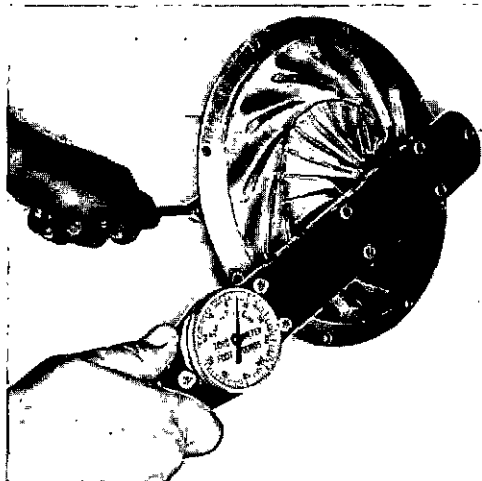


Fig. 3-20, (VTST45). Torquing the rotor nut



Fig. 3-21, (VTST46). Position the compressor housing onto the rotor assembly

housing on the diffuser plate, Fig. 3-21, and fasten with the lockwashers and capscrews. Tighten to 5 to 7 ft-lb [7 to 9 N·m] torque, Fig. 3-22.

15. Lubricate the turbine housing bore with Tread-Guard anti-seize compound or the equivalent. Insert the bearing housing and the rotor assembly in the bore of the turbine housing. Align the marks scribed during disassembly until the assembly seats on the edge.
16. Position the V-band clamps around the housing, centering the openings of the V-band clamps over the oil supply and drain ports. Tighten the V-band clamps with the new bolts, washers and locknuts. Torque the locknuts to values listed in Specifications. Be sure the V-band clamps are

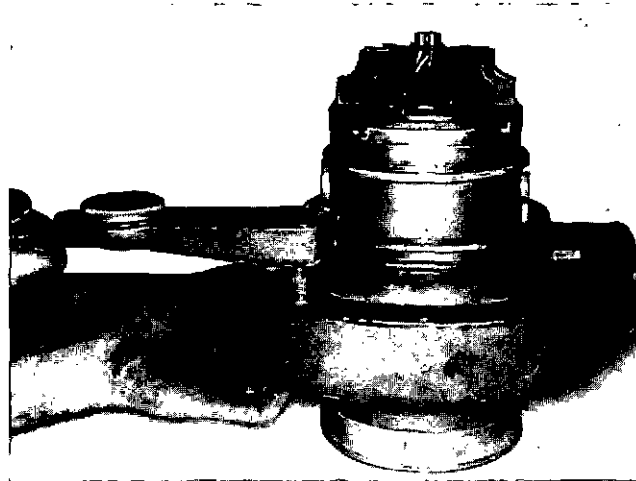


Fig. 3-22, (VTST47). Torquing the diffuser plate and capscrews

seated correctly while torquing the locknuts, Fig. 3-23. Check the clearance between the turbine housing and the V-band clamps. There must be a minimum of 0.035 inch [0.89 mm] clearance.

**Caution:** Do not exceed the recommended torque. This causes clamp distortion and clamp loosening. Do not torque the clamp again during operation.

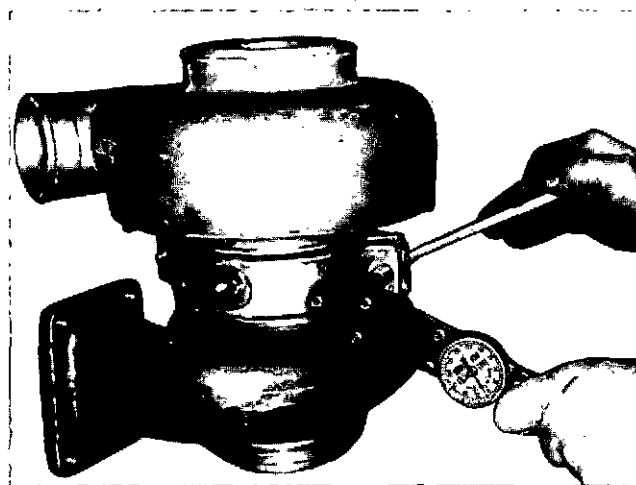


Fig. 3-23, (VTST48). Torque the V-band clamps to 32 to 36 in-lb [3.6 to 4.1 N·m]

17. Check the radial clearance at turbine end and the compressor end of turbocharger as follows:
  - a. Push the shaft toward the side of the bore.
  - b. Using a feeler gauge, check the minimum distance between the tip of the wheel vanes and the bore. The clearance must be 0.006 to

0.028 inch [0.15 to 0.71 mm] on the compressor end and 0.008 to 0.043 inch [0.20 to 1.09 mm] on the turbine end, Fig. 3-24.

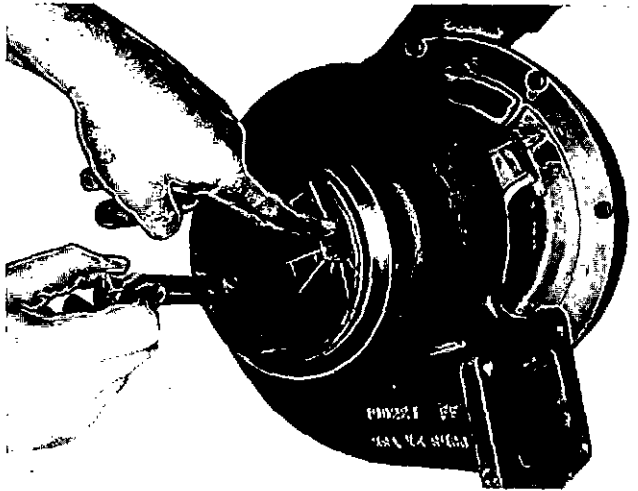


Fig. 3-24, (VTST49). Check the turbine end radial clearance

Torque the fitting to a minimum of 50 ft-lb [68 N•m].

22. Tape all the openings to prevent dirt and abrasives from entering the turbocharger.

18. Use a dial indicator to check the total end clearance, Fig. 3-25. The rotor end clearance must be within 0.006 to 0.018 inch [0.15 to 0.46 mm].

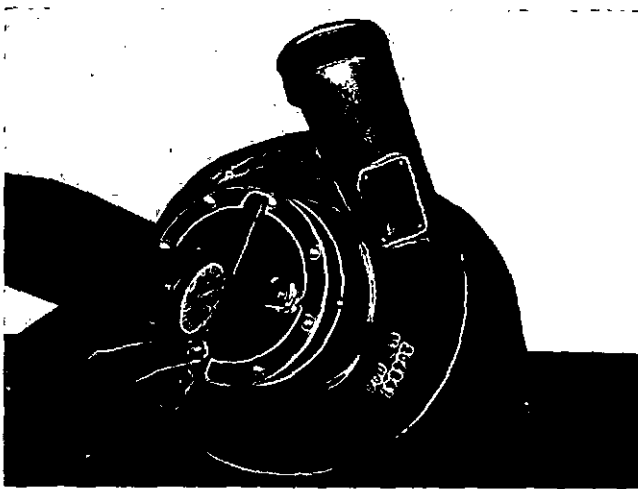


Fig. 3-25, (VTST50). Check the total end clearance

19. Turn the rotor by hand to be sure there are no internal problems with the rotation.
20. Wrap the threads of the steel oil inlet fitting with Teflon tape and install in the bearing housing. Torque the fitting to 20 to 25 ft-lb [27 to 34 N•m].
21. Wrap the threads of the oil drain fitting with Teflon tape and install in the bearing housing.

## T-46 and T-50 Turbocharger

### Disassembly

1. Before disassembly of the turbocharger, mark the compressor, turbine and bearing housings to help in alignment during assembly, Fig. 4-1.

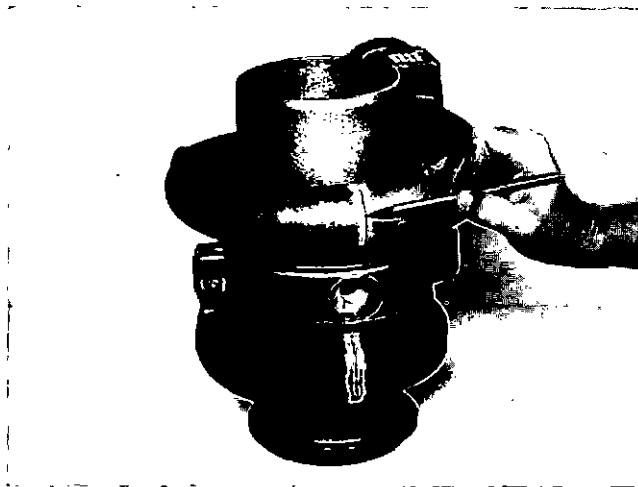


Fig. 4-1, (T465053). Mark the components before disassembly

2. Remove the oil drain and the supply fittings.
3. Remove the locknuts, washers and the bolts which hold the V-band clamps to the turbocharger, Fig. 4-2. Lift off the V-band clamps (15) and discard the locknuts, washers and bolts.

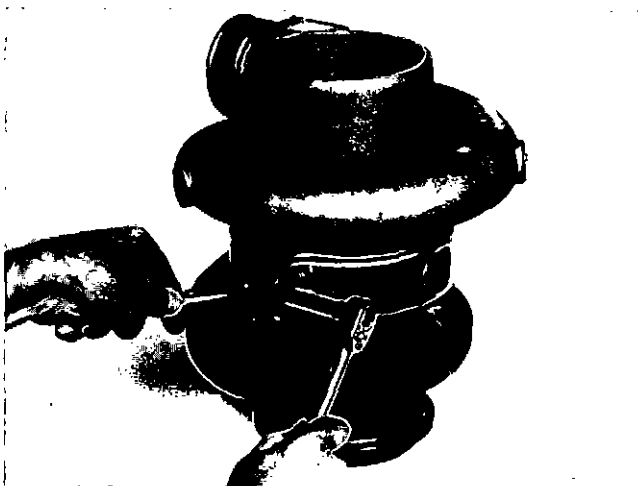


Fig. 4-2, (T465054). Remove the V-band clamps

4. Lift off the compressor housing (16), Fig. 4-3.
5. Put a special sleeve over the compressor wheel (13) and against the turbine housing (10), Fig. 4-4.

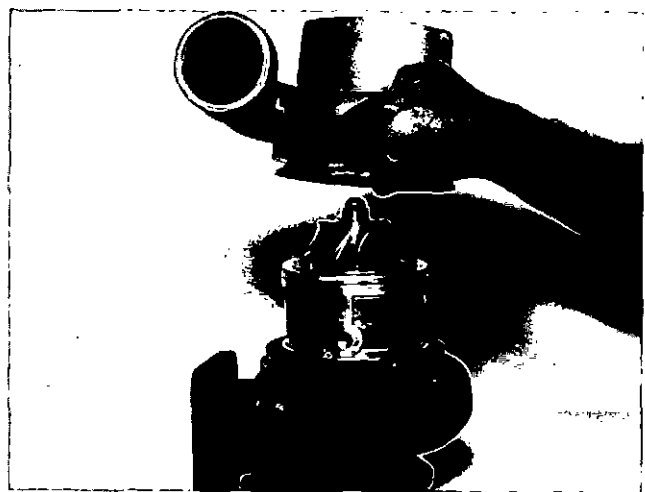


Fig. 4-3, (T465055). Remove the compressor housing

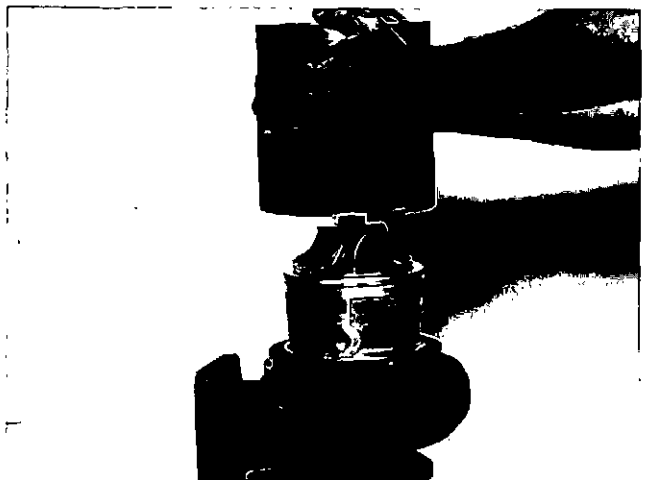


Fig. 4-4, (T465056). Place the turbocharger sleeve into position

6. Put the assembly in a press and press the rotor assembly and bearing housing from the turbine housing, Fig. 4-5. Place shop towels or rags at the bottom of the sleeve to cushion the rotor

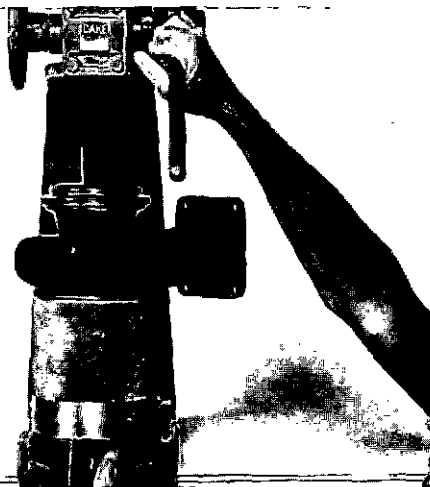


Fig. 4-5, (T465057). Press the rotor assembly from the turbine housing

assembly and bearing housing as it drops out of the turbine housing.

7. Remove the rotor nut (14) from the compressor end of the rotor assembly, Fig. 4-6.

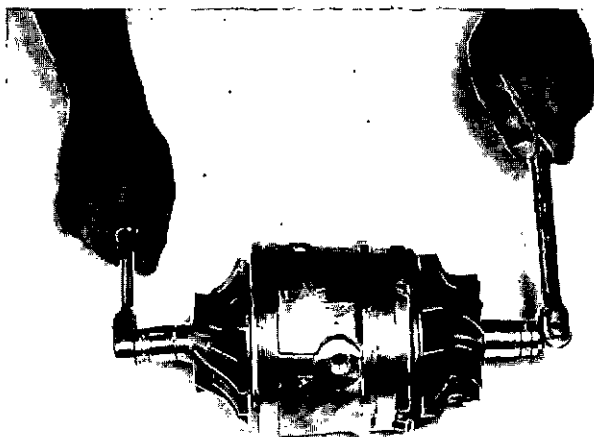


Fig. 4-6, (T465058). Remove the rotor nut from the rotor assembly

8. Lift off the compressor wheel (13). If the wheel does not lift off, put the rotor assembly into the special sleeve. With the turbine wheel (9) pointing down, press the turbine from the rotor assembly, Fig. 4-7. Place shop towels or rags at the bottom of the sleeve to cushion the turbine wheel and shaft as it drops down.
9. Put the oil seal plate driver into position at the turbine end of the bearing housing. Strike the driver with a plastic hammer to remove the oil seal plate (1), Fig. 4-8.



Fig. 4-7, (T465059). Press the turbine wheel and shaft from the rotor

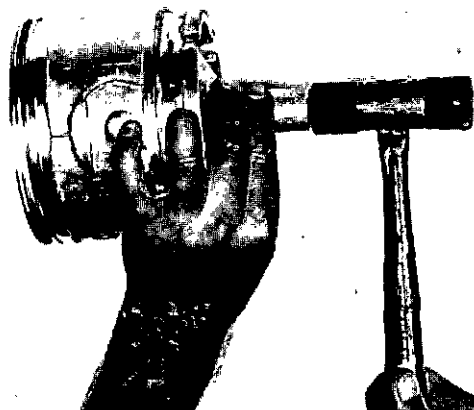


Fig. 4-8, (T465060). Drive the oil seal plate from the bearing housing

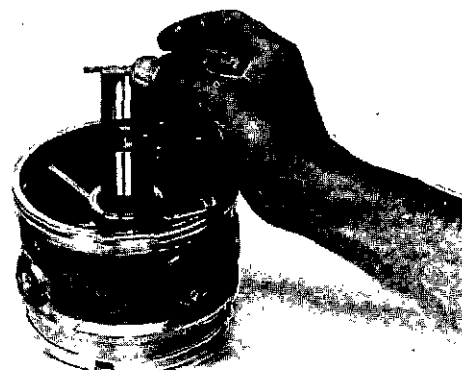


Fig. 4-9, (T465061). Remove the turbocharger bearing from the bearing housing

10. Remove the turbocharger bearing (4) and the bearing insert (3) from the bearing housing (5), Fig. 4-9. Discard the bearing insert.
11. Remove the oil seal sleeve (11) from the oil seal plate (1), Fig. 4-10. Discard the sealing ring.

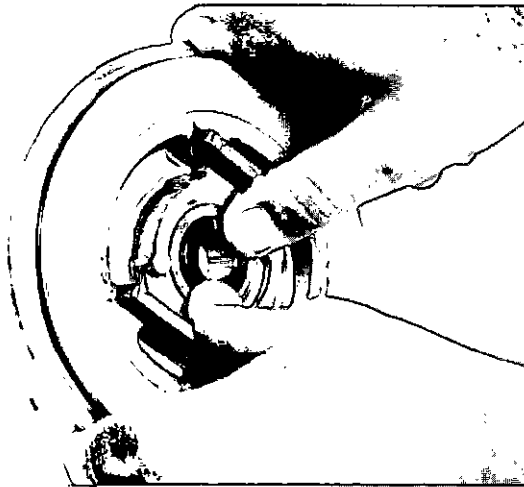


Fig. 4-10, (T465062). Remove the sleeve from the oil seal plate

12. Remove the O-ring (2) from the oil seal plate (1), Fig. 4-11. Discard the O-ring.

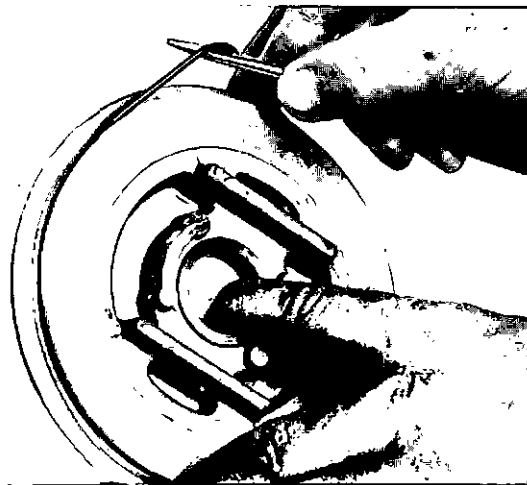


Fig. 4-11, (T465063). Remove the O-ring from the oil seal plate

13. Remove the sealing rings (8) from the turbine wheel and shaft (9), Fig. 4-12. Discard the sealing rings.

### Cleaning

Hard carbon deposits will form on the turbocharger parts which are very difficult to remove with ordinary



Fig. 4-12, (T465064). Remove the sealing ring from the sleeve

solvents. The cleaner must be capable of removing hard deposits without damaging the metal.

1. Place all parts in a divided wire basket so the parts will not be damaged through contact. Do not pile the parts in a basket. Avoid damage to all precision machined surfaces.
2. Do not use a chemical solution or any type solvent that will damage the parts. Use only an approved cleaning solvent. Parts can also be washed in hot water and soap, mineral spirits, or they can be steam cleaned.
3. Use a soft brush to clean the parts. Never use a wire brush.
4. To remove the dirt loosened by cleaning, you must flush the oil passages in the bearing housing, from the drain end.
  - a. If time allows, leave the parts in an approved cleaning solvent for 12 to 24 hours.
  - b. After completion of step "a", pump the solvent through the passages again to flush out any loose particles.
5. Drain and steam clean the parts to remove all carbon and grease.
6. Blow off the excess water and dry with moisture free compressed air.
7. Place the parts carefully in a clean basket to avoid damage and dirt.

### Inspection and Repair

When rebuilding a used turbocharger, it is recom-

mended the following parts be replaced.

- a. The bearing insert (3).
- b. The V-band capscrews, washers, locknuts.
- c. The insulation packing (6).
- d. The sealing rings (8) and (12).
- e. The O-ring (2).

All other parts must be within the worn limits indicated in Specifications.

1. Turbocharger Bearing (4), Fig. 4-13.

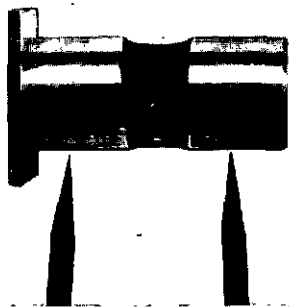


Fig. 4-13, (T465065). Inspect the turbocharger bearing

- a. The minimum length excepted is 3.077.
  - b. The outside diameter at two locations shown is a *minimum* of 1.272.
  - c. The inside diameter of the corresponding area is a *maximum* of 0.7525.
  - d. Discard the bearing if scratches, nicks, or dents are found in the above areas.
2. Compressor Housing (16), Fig. 4-14.
- a. Check for damage in the area indicated by "2a".
  - b. A crocus cloth can be used to smooth out small chips and scratches on the compressor housing.
  - c. Discard the compressor housing if cracked or distorted.
3. Turbine Housing (10), Fig. 4-15 and Fig. 4-16.
- a. Visually inspect the turbine housing for

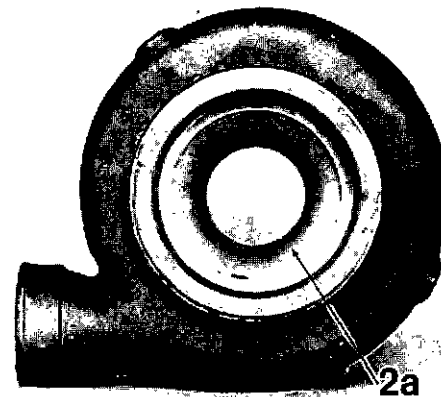


Fig. 4-14, (T465066). Inspect the compressor housing

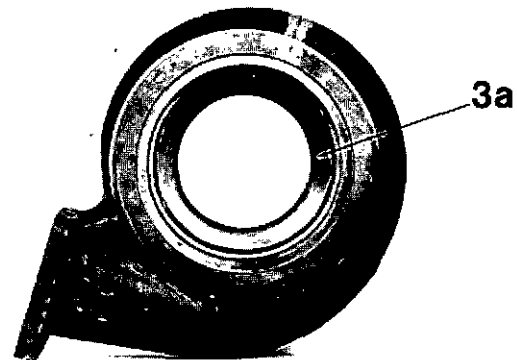


Fig. 4-15, (T465067). Inspect the turbine housing

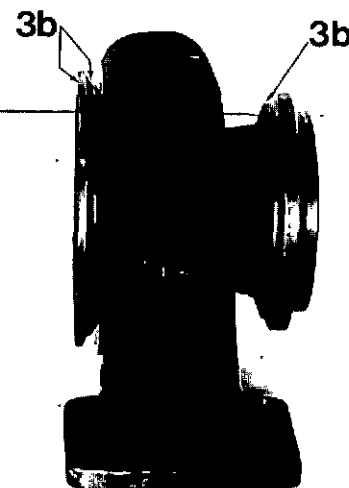


Fig. 4-16, (T465068). Inspect the turbine housing

wheel to housing contact in the area indicated by "3a".

- b. Check for cracks in the mounting flange area and the V-band clamp area as indicated by "3b".
- c. Discard the turbocharger housing if these defects are found.

**Note:** Use straight edge to check flange for distortion.

#### 4. Bearing Housing (5), Fig. 4-17.

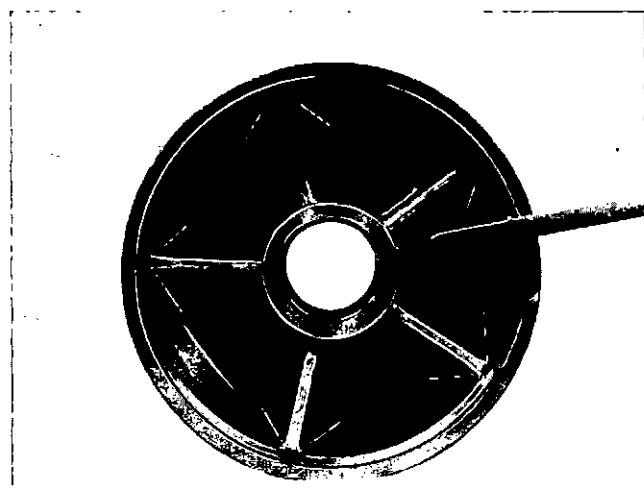


Fig. 4-17, (T465069). Inspect the bearing housing

- a. Visually inspect the bearing housing for cracks in area of the supply and drain fitting.
  - b. Check for notches in dome area of the bearing housing.
  - c. Check for cracks in areas indicated by arrows.
  - d. Measure the inside diameter of the bearing housing bore.
  - e. Measure the length of the bearing housing from the compressor housing stop to the turbine housing stop at four equal locations. Discard the bearing housing if the measurement indicates the housing is distorted. The minimum length is 2.986.
- #### 5. Oil Seal Plate (1), Fig. 4-18.
- a. Inspect the bearing pad area for damage.
  - b. Inspect the oil seal plate for cracks, burrs and distortion.
  - c. Discard if damaged.

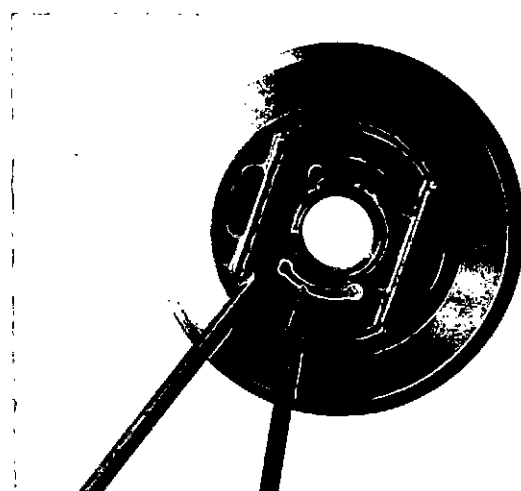


Fig. 4-18, (T465070). Inspect the oil seal plate

#### 6. Oil Seal Sleeve (11), Fig. 4-19.

- a. Measure the thickness of the sleeve for indication of wear.
- b. Insert the new oil control ring (12) into the groove as shown. If the clearance exceeds .009, discard the sleeve.

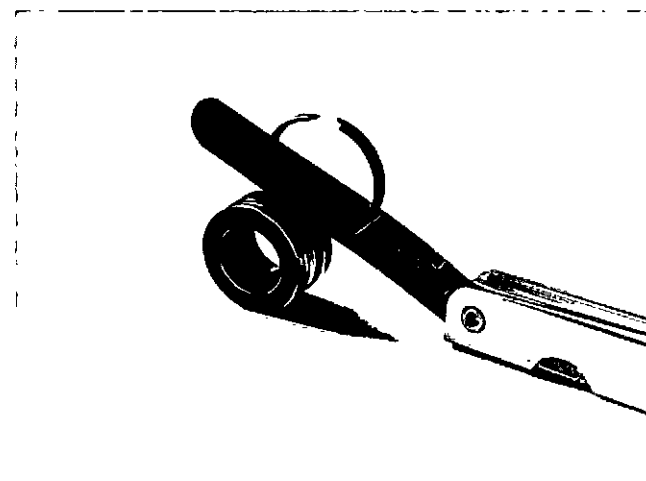


Fig. 4-19, (T465071). Inspect the sleeve

#### 7. Heat Shield (7), Fig. 4-20.

- a. Inspect the heat shield for cracks in the area shown.
- b. Discard if cracked.
- c. Using a straight edge, check the heat shield for distortion, Fig. 4-21.
- d. Discard if distorted.

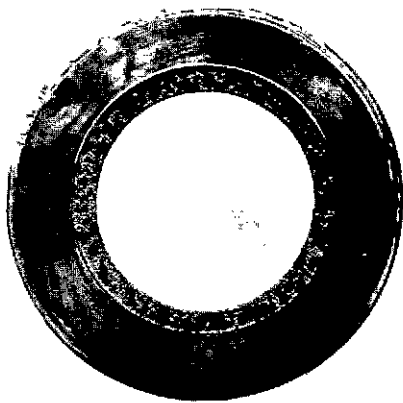


Fig. 4-20, (T465072). Inspect the heat shield



Fig. 4-21, (T465073). Inspect the heat shield

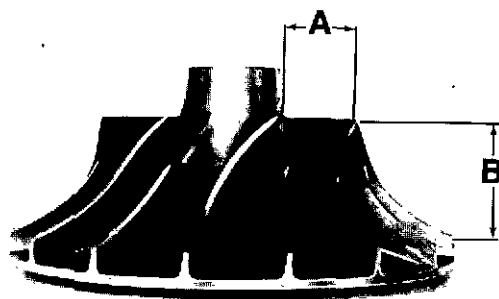


Fig. 4-22, (T465074). Inspect the compressor wheel

8. Compressor Wheel (13), Fig. 4-22.
  - a. The compressor wheel cannot be used again if the vanes are cracked, broken or have touched the compressor housing.
  - b. Check for cracks with a dye solution.
  - c. Check for damage to the vanes in the area marked "A".
  - d. Damage in the area marked "B" is normally caused by wheel to housing contact.
9. Turbine Wheel and Shaft (9).

### Inspection

1. Inspect the sealing ring grooves, Fig. 4-23, for damage. Small grooves or marks are acceptable. Smooth with a crocus cloth before using again.
2. Check the turbine thrust edge (2) for scratches.
3. Check for turbine wheel cracks with a dye solution.
4. Do not use the assembly if there are any cracks in the turbine wheel.
5. The turbine wheel and shaft may be used again if not worn in the bearing mating area (3), beyond the limits given in the specifications section.
6. Check the turbine shaft for damaged threads (4). Discard if damaged.

### Turbine Wheel and Shaft Weld Area

#### Visual Inspection

1. One hole up to 0.080 inch [2.0 mm] in diameter is acceptable.
2. Small chips or scratches near the weld area, are not acceptable.

#### Zyglo Inspection

1. Very small holes with a maximum diameter of 0.015 inch [0.38 mm] that cannot be seen in the visual inspection, are acceptable in the weld area.
2. Cracks are acceptable in the weld area, providing they meet the following standards:
  - a. Surface cracks may be a maximum of 3/8 inch [9.55 mm] in length.
  - b. No more than three cracks per wheel and shaft assembly are acceptable.



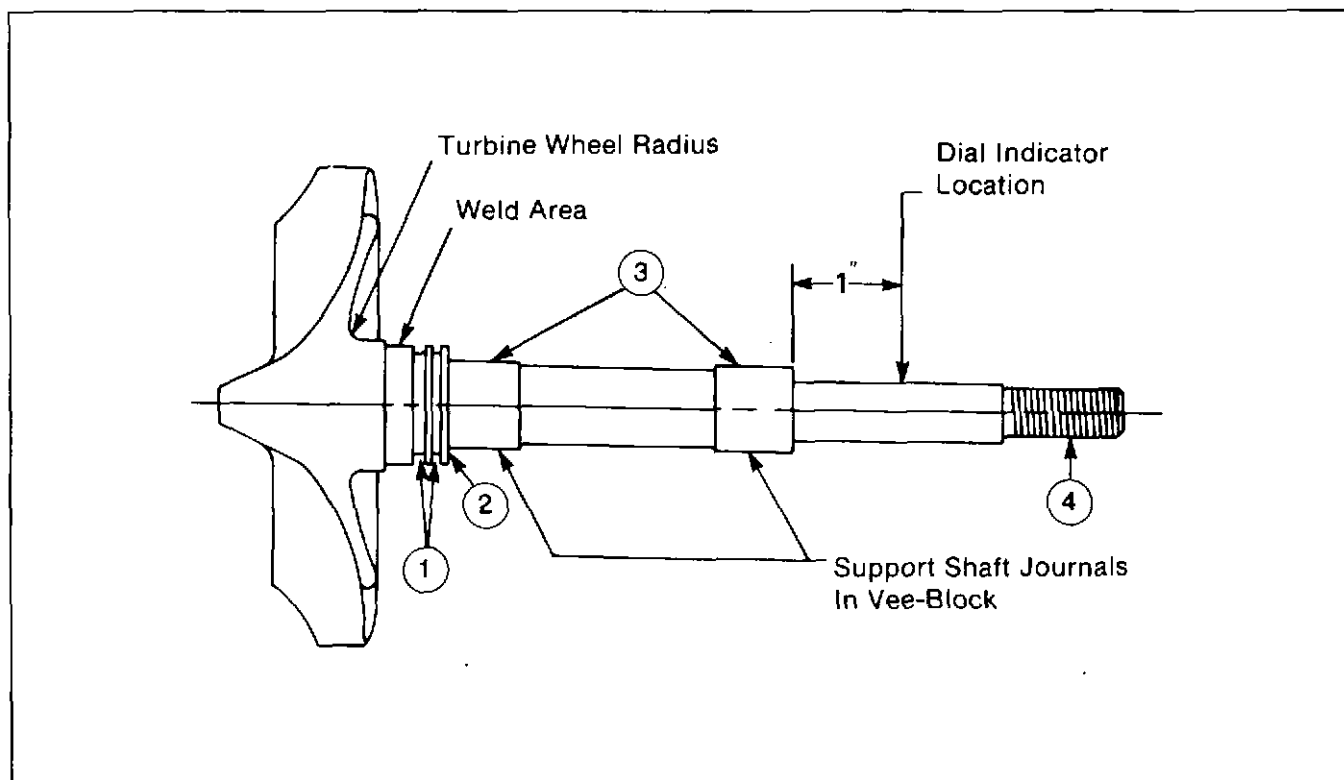


Fig. 4-23. (T465075). Inspect the turbine wheel and shaft

- c. The distance between cracks must be 1/4 inch [6.4 mm] minimum.
3. Small cracks on the circumference of the welded area are acceptable, if no longer than 1/16 inch [7.5 mm].
4. No defects are permitted in the turbine wheel radius above the welded area.
5. Cracks are not acceptable in other areas.

**Note:** While the Zyglo inspection method is referred to above, other methods such as the Spotcheck Type SK-3 Inspection Kit made by Magnaflux Corporation can also be used.

### Turbine Shaft Circumference

**Note:** Check the shaft pilot area for aluminum deposits. They can be removed by polishing with a crocus cloth before the inspection.

1. Support the turbine shaft journals in the Vee-blocks as shown in Fig. 4-23.
2. Position the dial indicator as shown.
3. Hold the shaft securely in the Vee-blocks and rotate the shaft slowly while observing the dial indicator.

4. If the total indicator reading exceeds 0.0005 inch [0.013 mm], the shaft must be replaced.

### Assembly

**Caution:** All parts and the work area must be free of grease, oil and dirt to keep abrasives out of the turbocharger during assembly.

1. Place the bearing housing (5) onto the workbench with the turbine end down. Dip the nose of the turbocharger bearing (4) into a container of 30W oil, approximately 1 inch deep. Install the turbocharger bearing, Fig. 4-24.
2. Fold down the edges of the turbocharger bearing insert (3), Fig. 4-25.
3. Place the turbocharger bearing insert over the square flange of the turbocharger bearing with the locator tabs down over the edges of the flange, Fig. 4-26. Brush STP and 30W oil on the bearing and the turbocharger bearing insert.

**Note:** Be sure oil is applied to the thrust surface of the bearing.

4. Lubricate the oil seal plate sealing ring (12) with



Fig. 4-24, (T465076). Insert the turbocharger bearing into the bearing housing

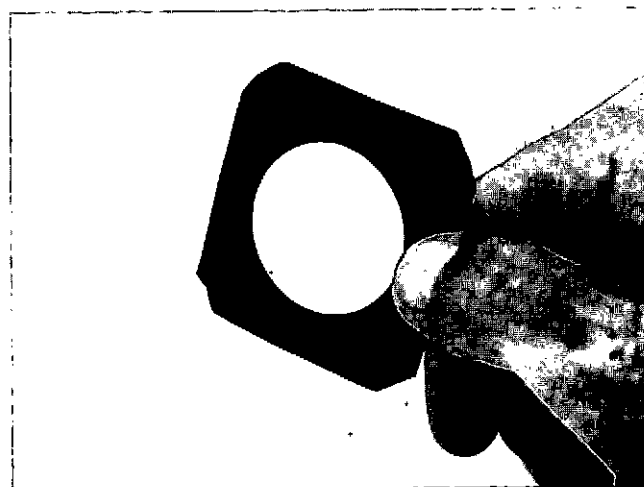


Fig. 4-25, (T465077). Fold down the edges of the turbocharger bearing insert



Fig. 4-26, (T465078). Install the turbocharger bearing insert over the turbocharger

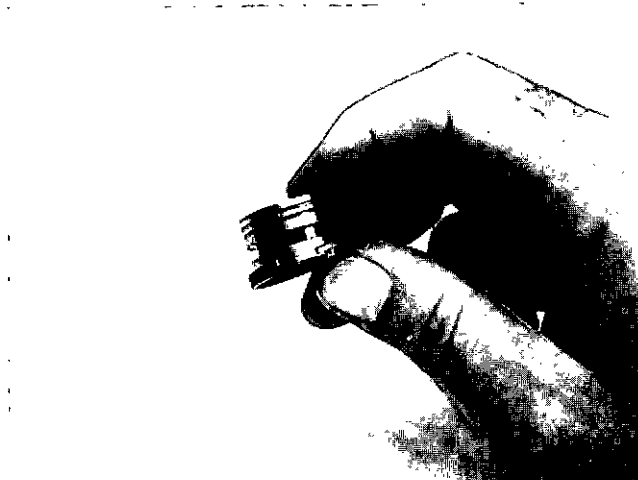


Fig. 4-27, (T465079). Install the ring over the sleeve

30W oil. Place the sealing ring into the groove of the sleeve (11), Fig. 4-27.

**Note:** Do not expand the ring more than is necessary to clear the sleeve O.D.

5. Lubricate the bore of the oil seal plate with 30W oil. Start the ring end of the sleeve into the pilot chamfer of the oil seal plate bore (1). Using finger pressure, compress the ring and push the sleeve into the bore until the edge of the sleeve is flush with the impeller side of the oil seal plate, Fig. 4-28.

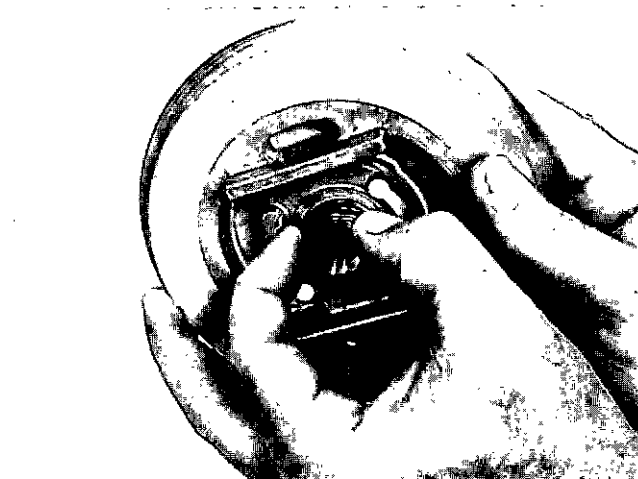


Fig. 4-28, (T465080). Install the sleeve into the oil seal plate

**Note:** The spiral groove of the sleeve goes toward the bearing.

6. Using lubricating oil on the O-ring, install the

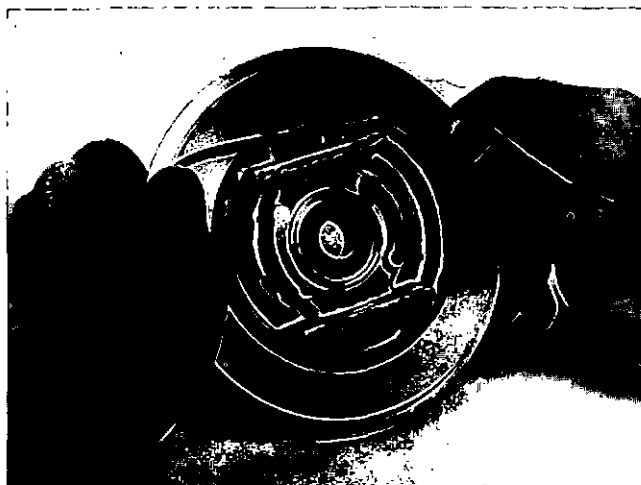


Fig. 4-29, (T465081). Install the O-ring onto the oil seal plate

O-ring (2) into the O-ring groove of the oil seal plate, Fig. 4-29.

7. Install the oil seal plate. Carefully align the turbocharger bearing flange so that the oil seal plate bearing retainer will cover the turbocharger bearing flange as the oil seal plate is lowered into position, Fig. 4-30. Be sure that the turbocharger bearing insert is centered on the turbocharger bearing with its tabs folded down over the bearing flange. Lower the plate assembly onto the shaft until the O-ring is started. Apply light pressure to compress the O-ring and seat the oil seal plate.



Fig. 4-30, (T465082). Install the oil seal plate onto the bearing housing

**Note:** Do not rotate the oil seal plate assembly. When the flange has been contacted, any rotation will displace and damage the turbocharger bearing

insert. If the retainer does not cover the bearing flange, remove the oil plate and inspect the turbocharger bearing insert for damage.

8. Turn the bearing housing assembly over, with turbine end pointing up. Install the insulation batt (6) on the top of the bearing housing. Be sure the flat side of the batt is up, Fig. 4-31.



Fig. 4-31, (T465083). Install the insulation material

9. Put the heat shield on top of the insulation batt. The locating lugs must be in the lug slots in the bearing housing, Fig. 4-32.



Fig. 4-32, (T465084). Install the heat shield onto the bearing housing

**Note:** Compress the insulation batt approximately .050 of an inch. Using a plastic hammer, lightly hit the insulation batt at four equal locations. Do not drive the insulation batt down to where contact is made with the bearing housing.

10. Put the sealing ring (8) over the turbine wheel and shaft (9) and into the ring groove. Oil the rings with a 30W lubricant, Fig. 4-33.

**Note:** Some wheel and shafts require two sealing rings. Rotate the rings so the gaps in the rings are 180 degrees apart.

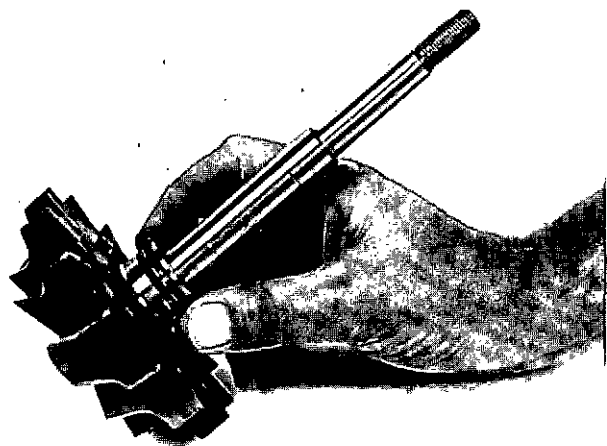


Fig. 4-33, (T465085). Install the sealing rings onto the turbine wheel and shaft

11. Put your hand against the turbine wheel and push the shaft into the bore of the bearing housing, Fig. 4-34. Make sure the oil seal sleeve and heat shield remain in position.



Fig. 4-34, (T465086). Install the turbine wheel and shaft into the bearing housing

**Warning:** Be careful when handling the turbine wheel. The machined edges on the turbine wheel are very sharp.

12. Put the rotor assembly in a press. Put the com-

pressor wheel (13) over the shaft. Put the special sleeve over the shaft and press the wheel onto the shaft, Fig. 4-35.



Fig. 4-35, (T465087). Install the compressor wheel onto the shaft

13. Install the new locknut (14) at the compressor end of the rotor assembly. Put a 3/4" socket on the balance lug located at end of turbine wheel. This will keep the rotor assembly from turning while you torque the locknut to 20-24 ft-lb, Fig. 4-36.

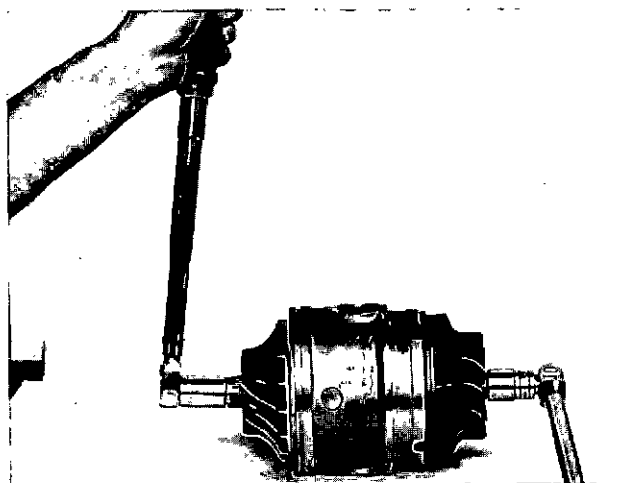


Fig. 4-36, (T465088). Torque the rotor nut on the rotor

**Note:** Before installing the rotor assembly, lubricate the turbine housing bore with Tread-Guard anti-seize compound or the equivalent.

14. Insert the rotor assembly into the turbine housing. Align the alignment marks made before disassembly. If all the components have been cleaned properly, assembly will enter the housing

by hand and not require being pressed in, Fig. 4-37.



Fig. 4-37, (T465089). Install the rotor assembly into the turbine housing

15. Install the compressor housing (16). Align the alignment marks, Fig. 4-38.



Fig. 4-38, (T465090). Install the compressor housing

16. Install the V-band clamps (15) using the new washers, capscrews and locknuts. The torque must be 32-36 in-lbs, Fig. 4-39.

**Caution: Do not exceed the recommended torque. This causes clamp distortion and clamp loosening. Do not torque the clamp again during operation.**

17. Check the clearance between the turbine housing and the V-band clamps. There must be a minimum of 0.035 inch [0.89 mm] clearance, Fig. 4-40.

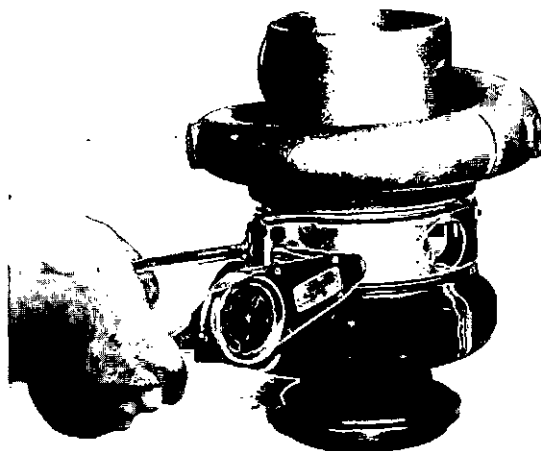


Fig. 4-39, (T465091). Torque the V-band clamps

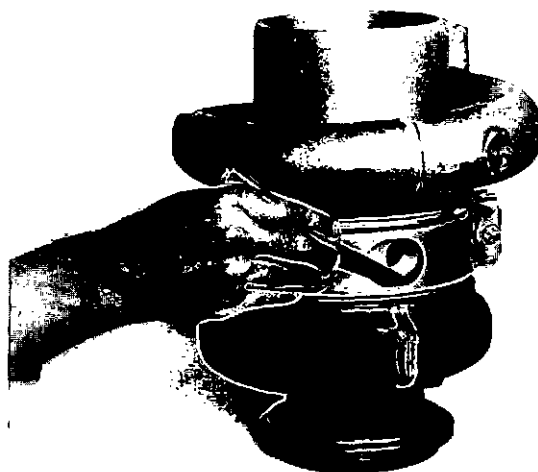


Fig. 4-40, (T465092). Measure the clearance at the V-band clamp

18. Install the oil supply fittings (17). The torque setting must be 20 to 25 ft-lb [27 to 34 N•m]. Install the drain fitting (18). The torque setting must be 50 ft-lb [68 N•m].
19. Check the compressor radial clearance.
  - a. Push the shaft toward the side of the bore.
  - b. Using a feeler gauge, check the minimum distance between the tip of the wheel vanes and the bore. The clearance must be 0.006 to 0.028 inch [0.15 to 0.71 mm], Fig. 4-41.
20. Check the turbine end radial clearance. Use the same procedure as done in 19. Clearance on the turbine end must be 0.008 to 0.043 inch [0.20 to 1.09 mm], Fig. 4-42.
21. Use a dial indicator to check the total end clear-

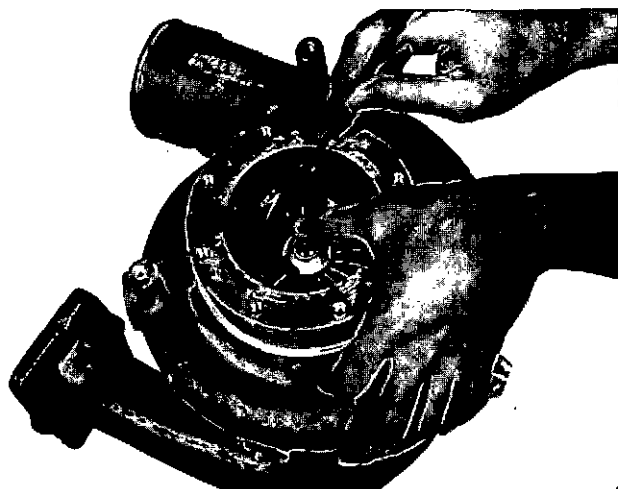


Fig. 4-41, (T465093). Check the compressor radial clearance

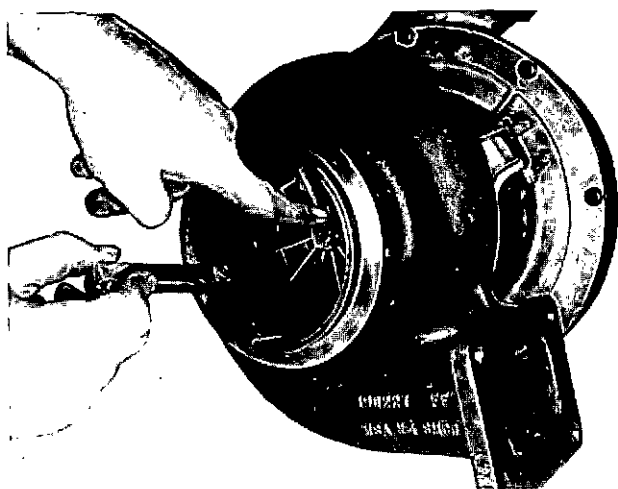


Fig. 4-42, (T465094). Check the turbine end radial clearance

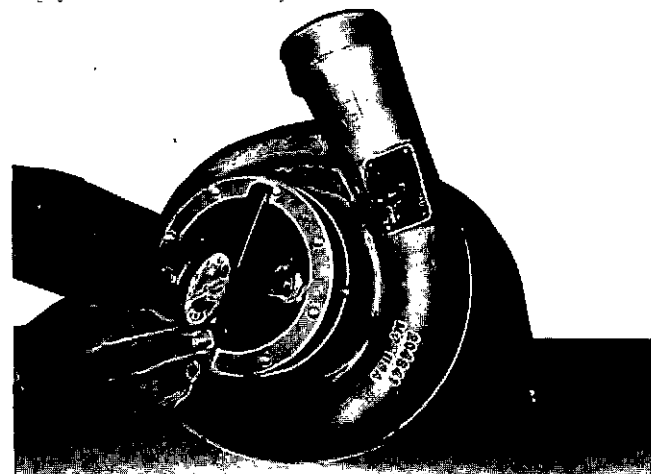


Fig. 4-43, (T465095). Check the total end clearance

ance, Fig. 4-43. The rotor end clearance must be within 0.006 to 0.018 inch [0.15 to 0.46 mm].

22. Turn the rotor by hand to be sure there are no internal problems with the rotation.
23. Tape all the openings to prevent dirt and abrasives from entering the turbocharger.

## T-18A Turbocharger

### Disassembly

1. Before disassembly of the turbocharger, mark the compressor, turbine and center housings to help in alignment during assembly, Ref. Fig. 4-1.
2. Remove the oil drain and the oil supply fittings.
3. Remove the locknuts, washers and the bolts which hold the V-band clamps to the turbocharger, Fig. 5-1. Lift off the V-band clamps and discard the locknuts, washers and bolts.

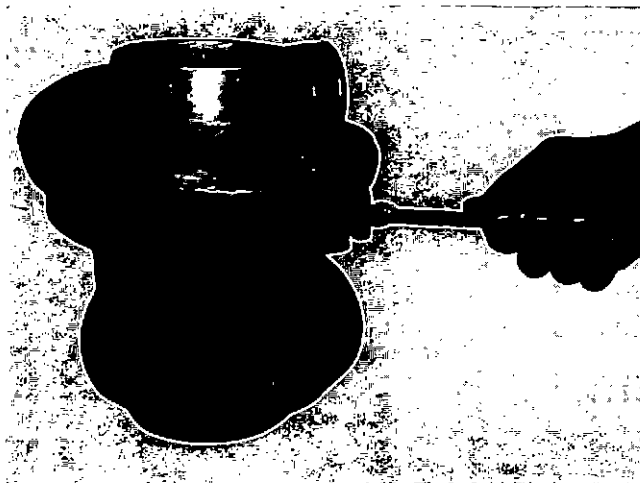


Fig. 5-1, (TA4). Removing the V-clamp

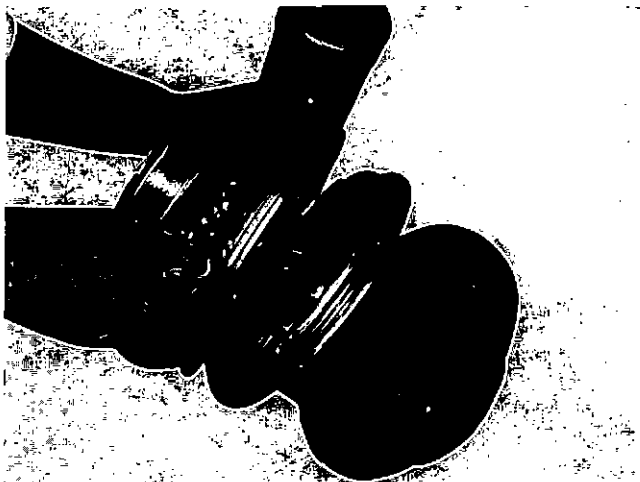


Fig. 5-2, (TA5). Removing the compressor housing

4. Remove the compressor housing, Fig. 5-2. Remove the O-ring (if used) from the backplate, Fig. 5-3. Discard the O-ring.

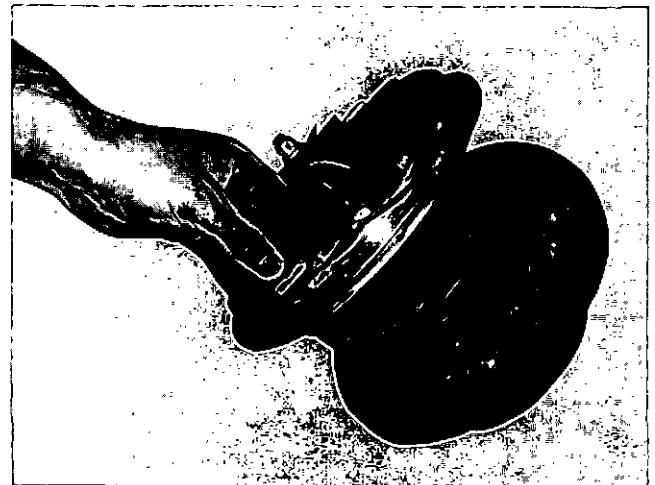


Fig. 5-3, (TA6). Removing the O-ring from the back plate

5. Remove all capscrews holding the turbine housing to the center housing, Fig. 5-4. Remove the lockplates.

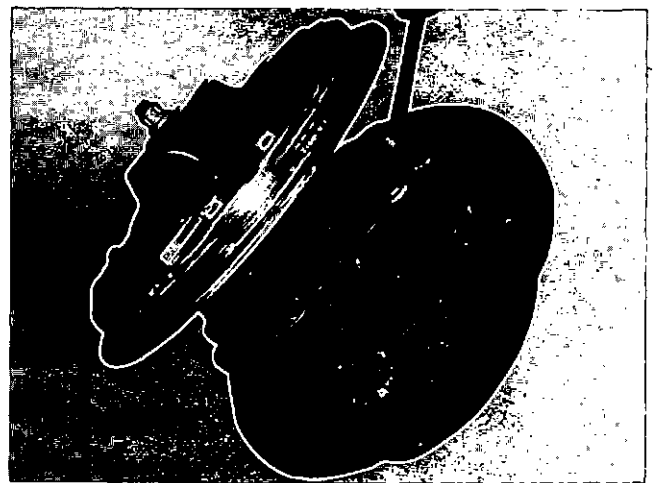


Fig. 5-4, (TA7). Removing the turbine housing capscrews

6. Separate the turbine housing from the center housing. Lift out the center housing assembly, Fig. 5-5.

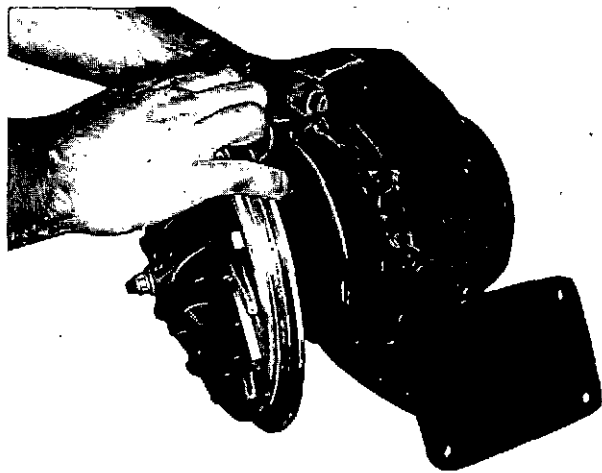


Fig. 5-5, (TA9). Removing the turbine housing

**Caution: Do not damage the compressor turbine wheel when separating the housings.**

7. Place the turbine end of the shaft in a vise. Do not tighten the vise too much. This can cause the shaft to bend. Remove the compressor wheel locknut using a T-handle wrench, Fig. 5-6.



Fig. 5-6, (TA10). Removing the impeller locknut

8. Press the turbine wheel shaft assembly from the compressor wheel. Use an arbor press and support the assembly at the turbine housing mounting face, Fig. 5-7.
9. Remove the turbine wheel and shaft from the center housing, Fig. 5-8. Lift off the shroud.
10. Remove the spacer, Fig. 5-9.
11. Remove the four capscrews holding the back-

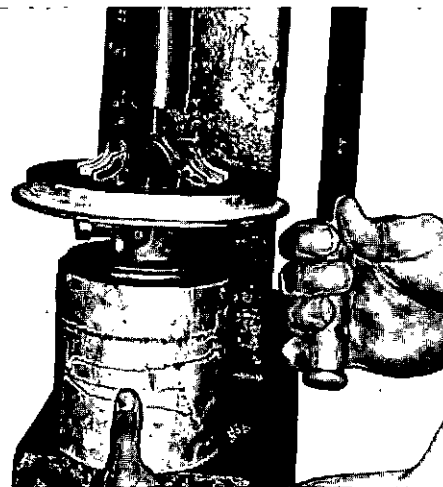


Fig. 5-7, (TA49). Pressing out the turbine wheel and shaft

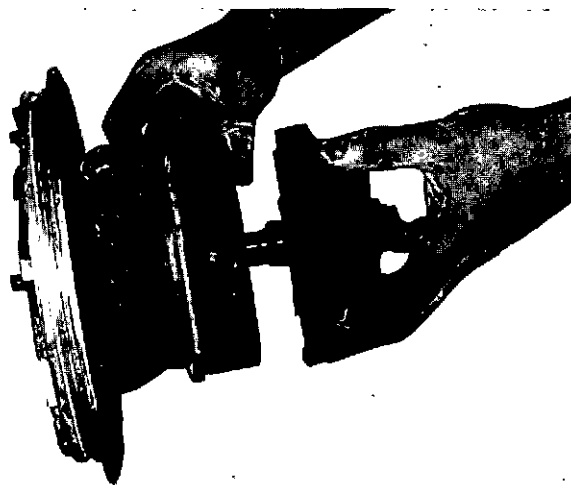


Fig. 5-8, (TA11). Removing the turbine wheel and shaft



Fig. 5-9, (TA12). Removing the thrust spacer



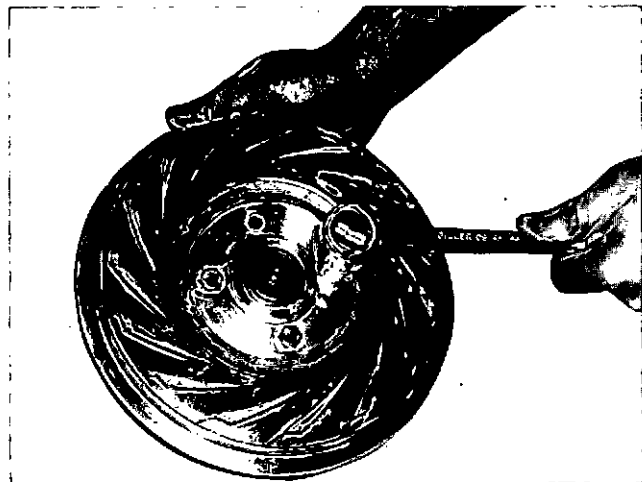


Fig. 5-10, (TA13). Removing the back plate capscrews



Fig. 5-12, (TA15). Removing the thrust washer and collar

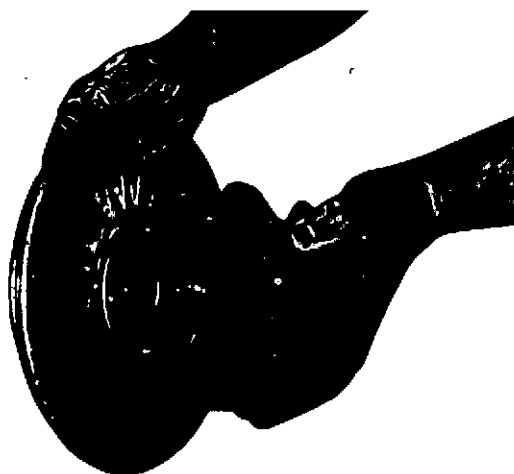


Fig. 5-11, (TA14). Lift off the back plate



Fig. 5-13, (TA16). Removing the O-ring

plate, Fig. 5-10. Lift off the backplate, Fig. 5-11.

12. Remove the thrust collar and the washer from the center of the housing, Fig. 5-12. Remove the seal ring, Fig. 5-13.
13. Remove the bearing, bearing washer, and the snap ring from the compressor end of the center housing, Fig. 5-14.
14. Remove the outer snap ring, bearing, bearing washer, and inner snap ring from the turbine end of the center housing, Fig. 5-15.

### Cleaning

Hard carbon deposits will form on the turbocharger

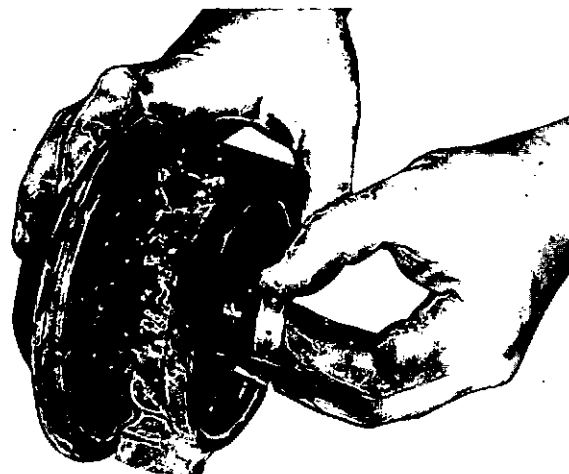


Fig. 5-14, (TA17). Removing the bearing and washer (compressor end)

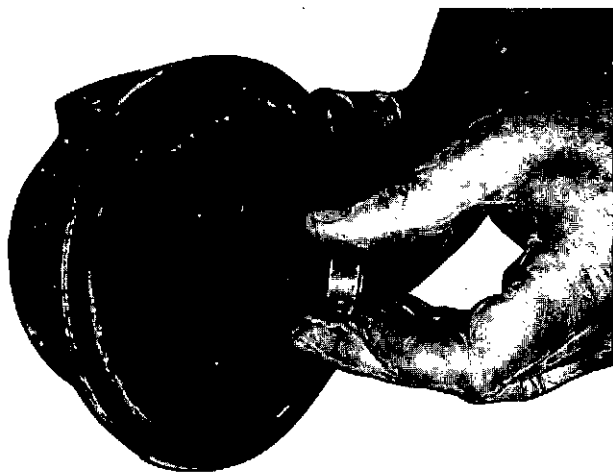


Fig. 5-15, (TA18). Removing the bearing and washer (turbine end)

parts which are very difficult to remove with ordinary solvents. The cleaner must be capable of removing hard deposits without damaging the metal.

1. Place all parts in a divided wire basket so the part will not be damaged through contact. Do not pile the parts in a basket. Avoid damage to all precision machined surfaces.
2. Do not use a chemical solution or any type solvent that will damage the parts. Use only an approved cleaning solvent. Parts can also be washed in hot water and soap, mineral spirits, or they can be steam cleaned.
3. Use a soft bristle brush to clean the parts. Never use a wire brush or any other type brush with stiff bristles.
4. To remove the dirt loosened by cleaning, you must flush the oil passages in the bearing housing, from the drain end.
  - a. If time allows, leave the parts in an approved cleaning solvent for 12 to 24 hours.
  - b. After completion of step "a", pump the solvent through the passages again to flush out any loose particles.
5. Drain and steam clean the parts to remove all carbon and grease.
6. Blow off the excess water and dry with moisture free compressed air.
7. Place the parts carefully in a clean basket to avoid damage and dirt.

## Inspection and Repair

When rebuilding a T-18A Turbocharger, replace the following parts. Refer to current parts catalog for these service replacement part numbers.

- a. O-ring
- b. Seal ring
- c. Bearing
- d. Snap rings
- e. Bearing washers
- f. Lockplates or new capscrews and washers
- g. Backplate assembly
  1. Backplate
  2. Thrust spacer
  3. Piston rings
  4. Thrust collar
  5. Thrust washer

All other parts must be within the specified wear limits. Turn to Page 5-11 for specifications of these parts.

## Compressor Wheel

The compressor wheel must show no signs of rubbing or damage from foreign material. It must be completely free of dirt or other foreign material and the bore must not be burned.

The seals must show no signs of rubbing the running faces.

## Turbine Housing

The turbine housing must show no signs of contact with the rotating parts.

Inspect the turbine housing mounting flange for cracks, distortion and burning. Inspect for any external cracks, Fig. 5-16.

## Center Housing

Inspect the center housing for cracks in the oil passages (inlet and outlet ports), pitting and distortion. Discard if damaged.

Using gauges, take reading of the bearing bores, Fig. 5-17. Discard the housing if worn beyond the replacement limit given in Specifications or if there is any evidence of burned areas.

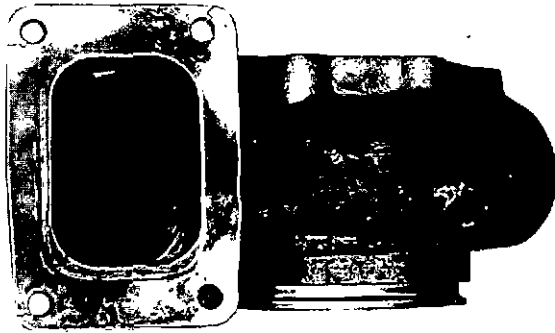


Fig. 5-16, (TA19). Cracks in the turbine housing mounting flange

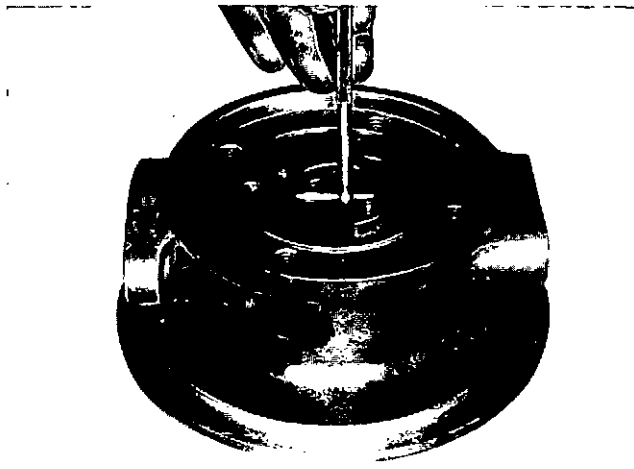


Fig. 5-17, (TA20). Measuring the center housing bore

### Turbine Wheel and Shaft

The turbine wheel must show no signs of rubbing and the vanes must not be torn or worn to a fine edge. The shaft must show no signs of scoring, scratches, or seizure with the bearings.

Check the turbine thrust shoulder for scoring. Check for turbine wheel cracks with a dry penetrant. Discard the turbine wheel if any cracks are found.

Check the shaft bearing journal diameters for wear, Fig. 5-18. The turbine wheel and shaft can be used again if not worn beyond the limits given in Specifications. If the shaft is worn, a new shaft and turbine wheel assembly must be installed.

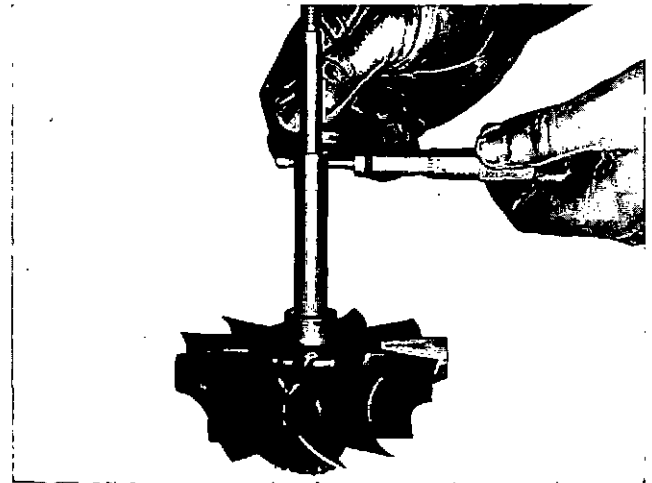


Fig. 5-18, (TA21). Measuring the shaft journals

### Compressor Housing

Do not use the compressor housing if there is a great amount of scoring due to contact with the compressor wheel. The compressor housing contour is very important to the turbochargers performance.

If small scratches or chips are found, they can be smoothed out with a crocus cloth. Discard if cracked or distorted.

### Miscellaneous

The V-band may be cleaned and used again if they are not damaged.

### Assembly

**Caution:** All parts and the work area must be free of grease, oil and dirt to keep the abrasives out of the turbocharger during assembly.

**Note:** Coat all the bearings, bearing washers, thrust washer, thrust collar and the piston seal with a light coat of clean engine lubricating oil.

1. Install a new snap ring in each end of the center housing, Fig. 5-19 and Fig. 5-20.
2. Install a new bearing washer against the snap ring (turbine end), Fig. 5-21. Install a new bearing and secure with the outer snap ring, Fig. 5-22.
3. Position the shroud on the center housing, Fig. 5-23.
4. Install a new piston ring on the turbine shoulder, Fig. 5-24, and insert the turbine and shaft through

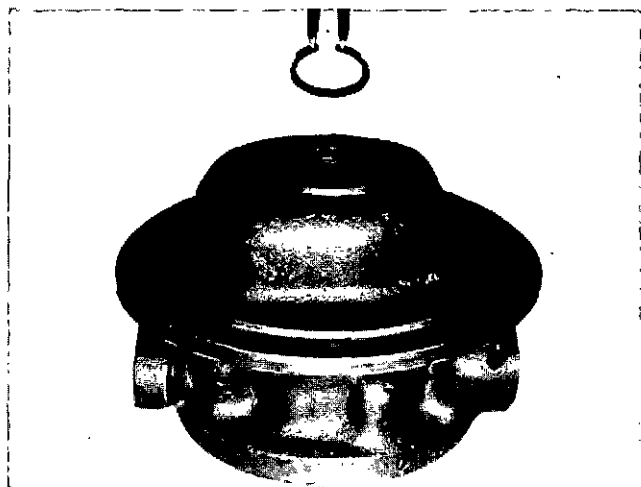


Fig. 5-19, (TA22). Installing the snap ring (turbine end)



Fig. 5-22, (TA25). Installing the bearing (turbine end)

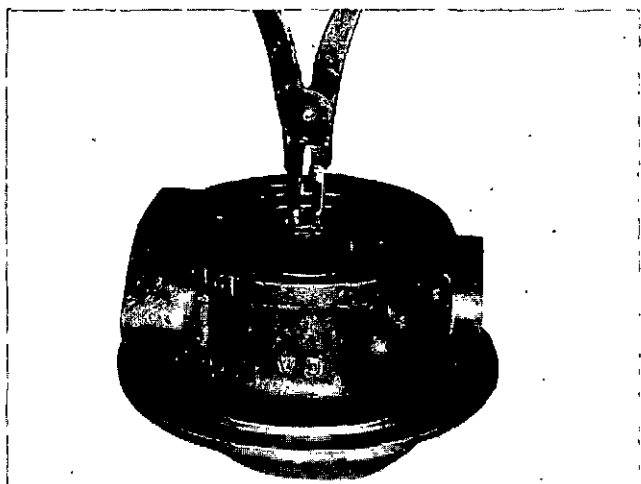


Fig. 5-20, (TA23). Installing the snap ring (compressor end)

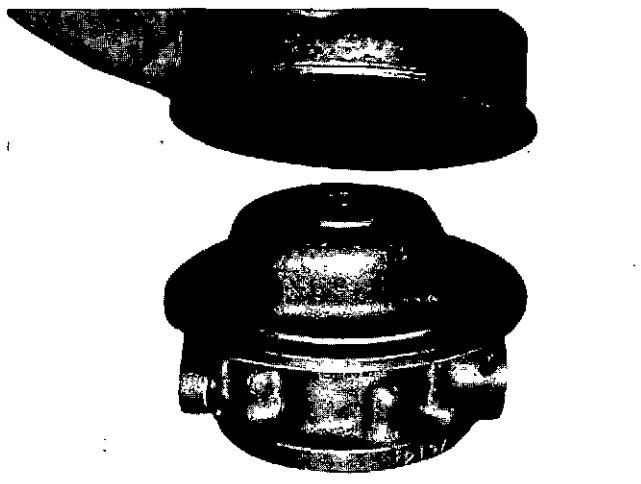


Fig. 5-23, (TA-26). Placing the shroud on the center housing

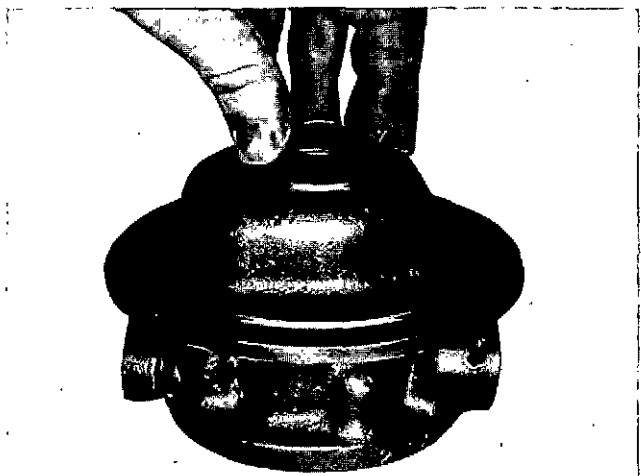


Fig. 5-21, (TA24). Installing the bearing washer (turbine end)

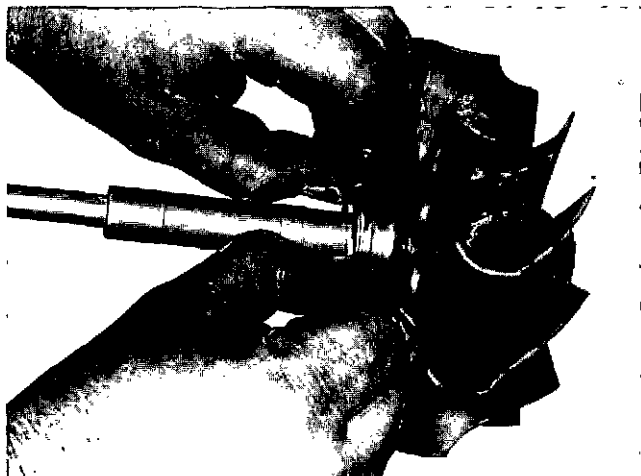


Fig. 5-24, (TA50). Placing the ring on the turbine shaft

the center housing, Fig. 5-25.

**Note:** Older turbochargers may not require the ring.

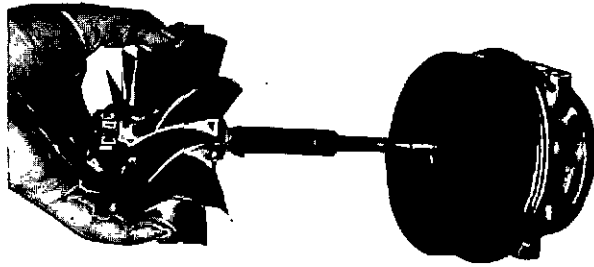


Fig. 5-25, (TA27). Installing the turbine wheel and shaft

5. Install a new bearing washer over the compressor end of the shaft, Fig. 5-26, down to the inboard snap ring. Install a new bearing over the shaft, Fig. 5-27, down to the bearing washer.

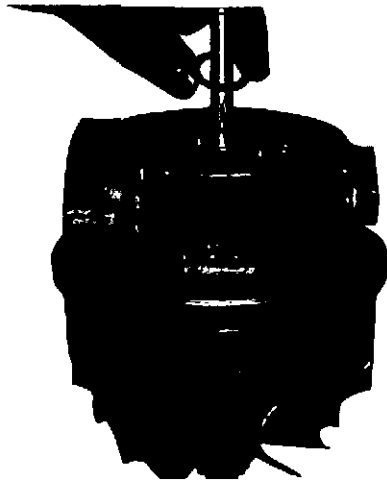


Fig. 5-26, (TA28). Installing the bearing washer (compressor end)

6. Position a new thrust washer (grooves out), Fig. 5-28, on the center housing. Make sure the hole and cut-out engage the pins in the center housing and the thrust washer is seated flat against the surface of the housing.
7. Install a new thrust collar over the shaft and tight against the thrust washer, Fig. 5-29.

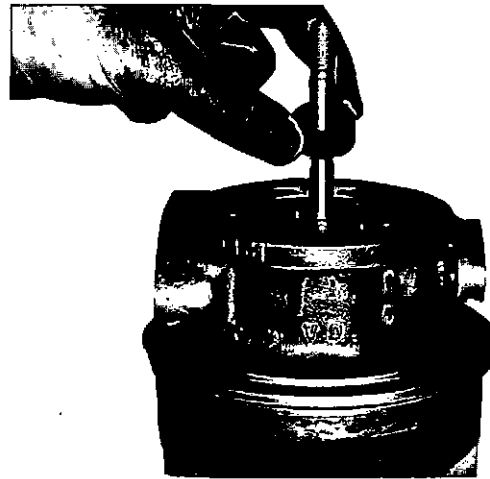


Fig. 5-27, (TA29). Installing the bearing (compressor end)

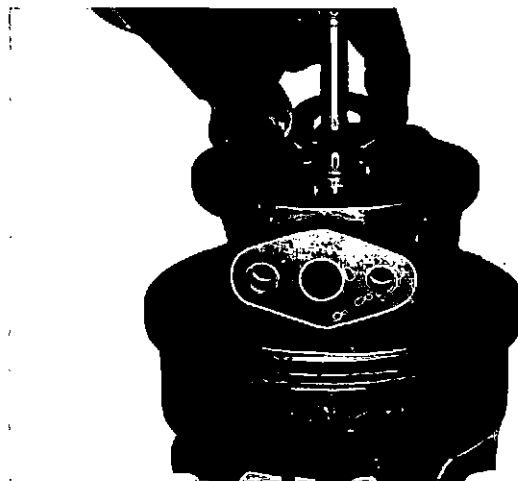


Fig. 5-28, (TA30). Installing the thrust washer

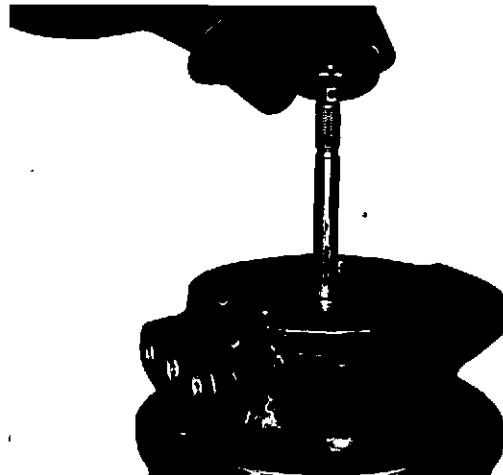


Fig. 5-29, (TA31). Installing the thrust collar

8. Position a new O-ring in the proper groove in the center housing, Fig. 5-30.

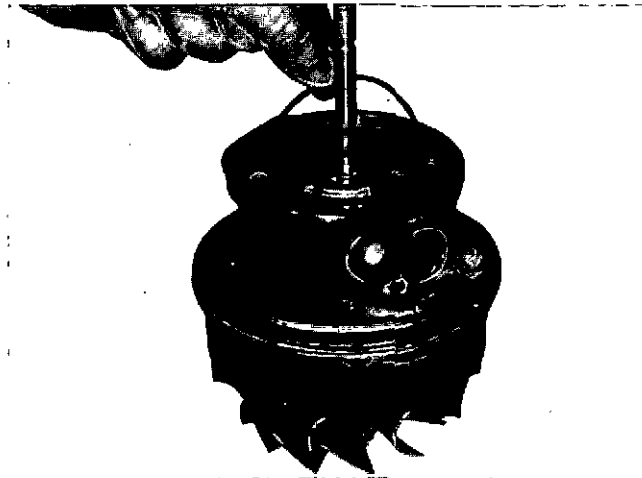


Fig. 5-30, (TA32). Installing the O-ring

9. Align the oil feed holes of the center housing and the new back plate. Position the back plate on the center housing, Fig. 5-31. Install the new lockplates and capscrews. Torque the capscrews to 90/110 in-lb [18.1/20.3 N•m] for cast iron, back plates, Fig. 5-32.

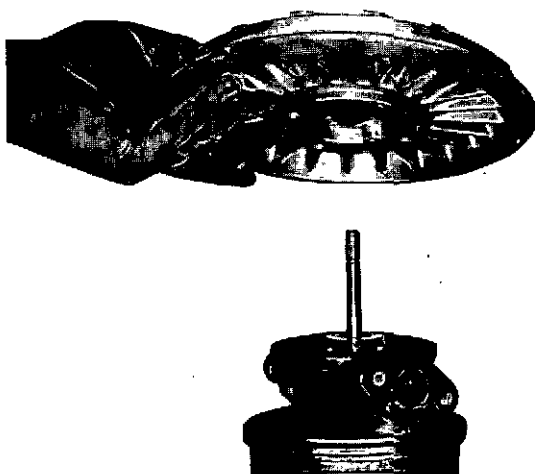


Fig. 5-31, (TA33). Installing the back plate

**Note:** Several models of the T-18A turbocharger now use a vaneless back plate. Replace the back plate with the correct type for your engine.

10. Position a new piston ring in the groove of the new seal spacer. Insert the seal spacer over the turbine shaft and into the bore of the back plate

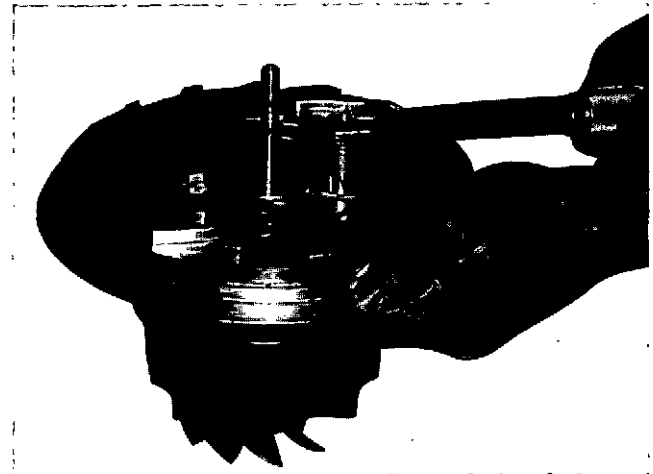


Fig. 5-32, (TA34). Torquing the back plate capscrews

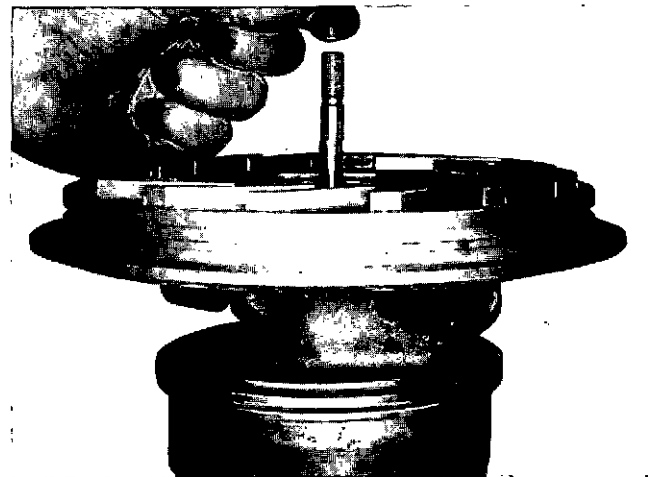


Fig. 5-33, (TA35). Installing the seal spacer

and the thrust collar, Fig. 5-33. Do not force the piston ring seal into place.

11. Place the impeller, at room temperature, on the shaft, Fig. 5-34.
  - a. Oil the threads and the impeller face that will be under the nut.
  - b. Install the nut and tighten to 125 to 150 in-lb [14.13 to 16.95 N•m] of torque. This will seat the impeller against the thrust spacer.
  - c. Loosen the nut and then tighten to 35 to 55 in-lb [3.96 to 6.22 N•m] of torque greater than the drag torque\*.
  - d. Tighten the nut for shaft stretch of 0.009 to 0.010 inch [0.23 to 0.25 mm]. Use a T-handle



Fig. 5-34, (TA36). Installing the impeller on the shaft

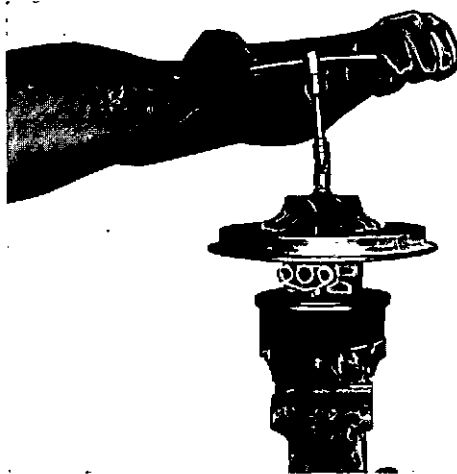


Fig. 5-35, (TA37). Torquing the shaft nut

or a flexible socket to tighten the shaft nut, Fig. 5-35.

\*Drag torque is being defined as the amount of torque required to move the nut on the threaded portion of the shaft before contact with the impeller. Torque values must be in addition to the drag torque.

**Note:** If the equipment is not available to measure the shaft stretch, this alternate method may be used. The procedure is the same up to the point of tightening to achieve the shaft stretch. Instead turn the nut an additional 110 degrees. This procedure is valid for all T-18A turbochargers equipped with either 7/16 inch [11.11 mm] or 3/8 inch [9.52 mm] shafts.

12. Position a new O-ring in the groove of the back plate (if applicable), Fig. 5-36.

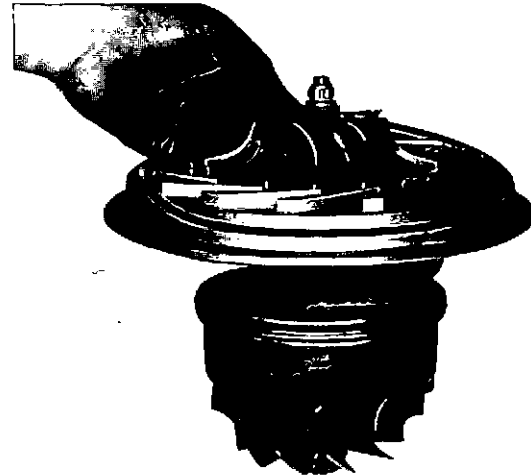


Fig. 5-36, (TA38). Installing the O-ring on the back plate

13. Position the compressor housing to the center housing, Fig. 5-37. Align the marks, install and tighten the V-band coupling to 40/60 in-lb [4.5/6.8 N•m], Fig. 5-38.

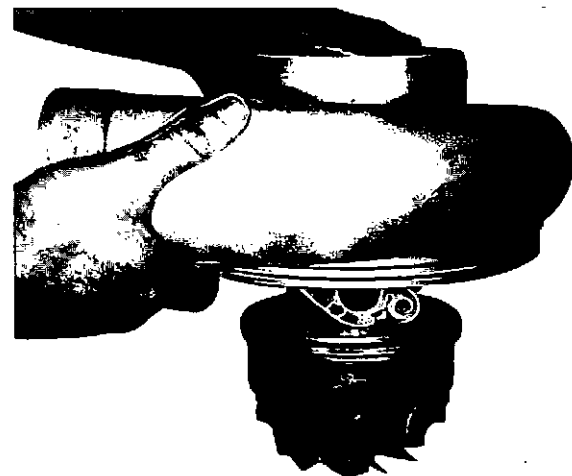


Fig. 5-37, (TA39). Installing the compressor housing

14. Position the turbine housings to the center housing, Fig. 5-39. Align the marks. Install the clamps, lockplates and bolts. Coat the threads of the bolts with an anti-seize compound or the equivalent. Torque to 100/110 in-lb [11.5/12.5 N•m], Fig. 5-40.
15. After assembly, push the rotating assembly as far as possible from the turbine end, turn and check for binding. Repeat the check pushing

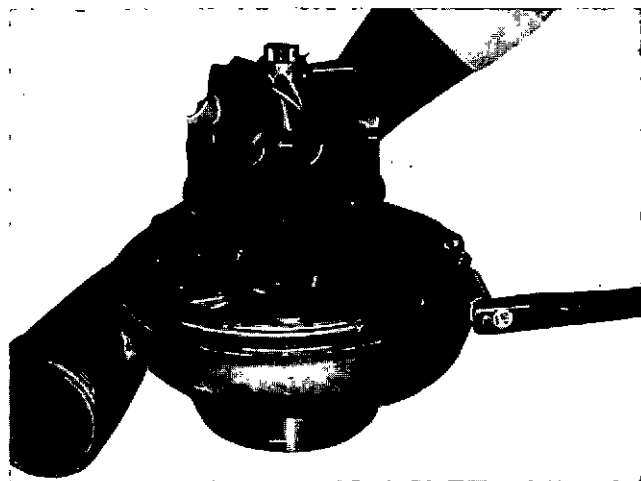


Fig. 5-38, (TA40). Torquing the V-band nut

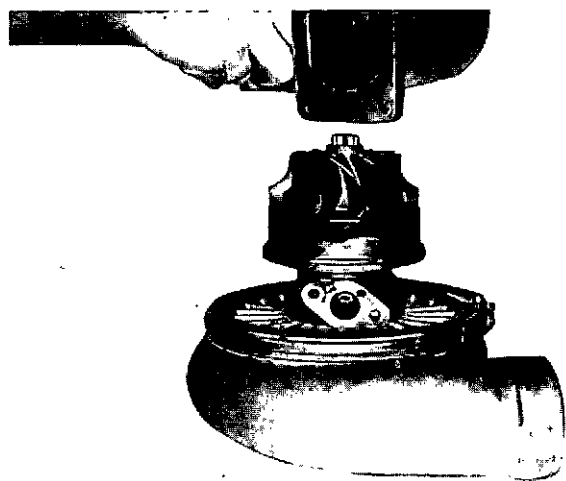


Fig. 5-39, (TA41). Installing the turbine housing

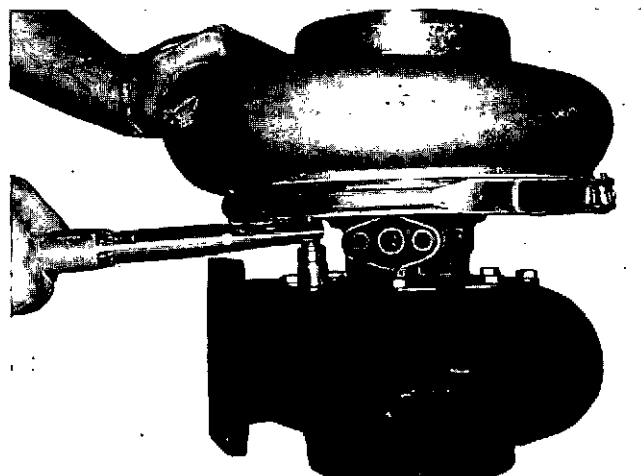


Fig. 5-40, (TA43). Torquing the turbine housing capscrews

from the compressor end of the turbocharger.

16. Use a dial indicator to check the total end clearance, Ref. Fig. 4-43. The total end clearance must be within 0.004/0.009 inch [0.10/0.23 mm].
17. Using the new gaskets, install the oil inlet and outlet connections onto the center housing.
18. If the unit is to be stored, lubricate the internal parts and tape all the openings.



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