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Logistics Operations School  
Marine Corps Combat Service Support Schools  
Training Command  
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FESCR 8202

**STUDENT OUTLINE**

**REPAIR DETROIT TURBO CHARGER**

**LEARNING OBJECTIVES:**

1. Terminal Learning Objective: Given a turbocharger off a Detroit engine, the required common and special tools, precision measuring instruments, repair parts, shop supplies, and TM 9-2320-297-34&P, per information contained in the reference provided, repair the turbocharger assembly.
  
2. Enabling Learning Objectives: Given a turbocharger off a Detroit engine, the required common and special tools, precision measuring instruments, repair parts shop supplies, and TM 9-2320-297-34&P, per information contained in the reference provided:
  - (1) disassemble the turbocharger, (8.2.1a)
  - (2) inspect the disassembled components for serviceability, (8.2.1b)
  - (3) repair or replace the unserviceable components, and (8.2.1c)
  - (4) assemble the turbocharger from serviceable components. (8.2.1d)

**OUTLINE**

**1. CONSTRUCTION, NOMENCLATURE, AND PRINCIPLES OF OPERATION OF THE TURBOCHARGER**

a. Construction. In outward appearances, turbochargers are made in various shapes, but they consist of two general types.

- (1) The first type consists basically of a compressor (main) housing and a turbine housing.

(2) The other type turbocharger consist primarily of three major components; compressor housing, turbine housing, and a bearing housing which separates the compressor and turbine housing.

(a) In both types, the turbine housing encloses the turbine wheel and provides an exhaust inlet and outlet. It is designed to increase the velocity of the exhaust gases.

(b) The compressor housing in both types encloses the compressor wheel and provides an air inlet and outlet. Air entering the compressor housing, is centrifugal compressed by the action of the wheel, and supplied to the engine air induction system.

(3) The three-part type turbo is the type we will be using to train you with. It has a third part called a bearing housing. The bearing housing is used to support the turbine shaft which connects the turbine wheel to the compressor wheel and provides a means of lubricating the shaft. It also acts as a heat barrier between the hot turbine side and the compressor.

#### b. Operation of the Turbocharger

(1) The turbo is essentially an exhaust driven blower, the purpose of which is to increase the engine power by supplying compressed air to the engine combustion chamber. The turbo is not connected to the engine power train; therefore, it is not a horsepower parasite during operation. The unit automatically responds to the engine load demands without any control connections between the turbo and engine.

(2) On a naturally aspirated engine ( one without blower or turbo), air enters at atmospheric pressure, mixes with a specified amount of fuel, and is burned in the combustion chamber, developing power

(3) On a turbocharged engine, the turbo supplies air under pressure to the engine. Thus, a greater amount of air enters the combustion chamber. The fuel system is designed to provide the correct amount of fuel for the increased supply of air. The increased air-fuel mixture enables the engine to develop more power.

(a) The turbo is driven by the engine exhaust which is directed into the turbine housing, where it gains velocity and strikes the turbine wheel. This action spins the turbine wheel and shaft to which the compressor wheel is attached.

(b) The turning of the compressor wheel draws air in through the filter system into the compressor housing. The air is centrifugal compressed and forced into the intake system. This provides a greater volume of air to

the combustion chamber, allowing more fuel to be delivered, resulting in more power output from the engine.

(4) The turbocharger is pressure lubricated by the engine lubrication system by external lines. Oil flows through the bearing housing and around the bearings which support the turbine shaft. The oil returns to the engine by gravity through return lines. The lube oil reduces friction and aids in the cooling of the internal parts of the turbo.

## **2. PROCEDURES FOR PRE-INSPECTION AND REPAIR OF THE TURBOCHARGER**

a. Caution. Never use corrosive cleaning solution for cleaning. This will damage certain parts. Do not use a wire brush, a steel brush, or a steel blade scraper to clean parts.

b. Clean the exterior of the compressor housing, center housing, and the turbine housing.

c. Make a scribe mark across the compressor housing, center housing, turbine housing, and couplings. This is to insure proper positioning during assembly.

d. Caution. When removing compressor and turbine housing, care must be taken to prevent damage to impeller and turbine wheel.

e. Loosen nut in coupling. Remove the compressor housing and coupling.

f. Loosen nut on coupling. Remove turbine housing and coupling.

g. Hold turbine shaft with a 7/8 box end wrench and break torque on impeller locknut

h. Support turbine wheel and shaft assembly with two blocks of wood and press off the impeller wheel. Do not allow the turbine shaft to fall from center housing.

i. Shroud will come off after center housing is removed.

j. Remove turbine wheel and shaft assembly, and shroud from center housing.

k. Slide shroud from turbine wheel and shaft assembly.

l. Remove and discard seal ring from turbine wheel and shaft assembly.

- m. Bend down tabs on four lockplates. Remove four cap screws, lockplates, and backplate from center housing.
- n. Remove thrust collar from spacer.
- o. Remove spacer from backplate. Remove two seal rings from spacer.
- p. Remove thrust bearing from center housing.
- q. Remove bearing and washer.
- r. Remove snapring.
- s. Remove and discard seal ring from center housing.
- t. Remove snapring, washer, and bearing from compressor housing side of center housing.

Remove snapring.

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### **3. CLEANING**

- a. Never use corrosive cleaning solution for cleaning. This will damage certain parts. Use cleaning solution in an open or well-ventilated area. Avoid breathing fumes to avoid possible toxic effect. Keep away from flames to avoid possibility of fire. Do not use a wire brush or a steel blade scraper to clean parts.
- b. Before cleaning, inspect parts for signs of burning, rubbing, or other damage, which might not be evident after cleaning.
- c. Soak all parts in a non-corrosive cleaning solvent for about 25 minutes. After soaking, use a stiff bristle brush and remove all dirt particles. Using a lint free cloth, dry all parts thoroughly.
- d. Thoroughly clean impeller turbine wheel and shaft assembly. Any deposits left on the blade will affect the balance of the rotating assembly.
- e. Clean all internal cavities and oil passages in center housing. Thoroughly dry all parts with compressed air.

### **4. INSPECTION**

- a. Visually inspect all components for wear marks or damage.

b. Using T-gage and micrometer inspect the backplate for wear or damaged sleeve bore. \_\_\_\_\_

c. Using a micrometer, measure spacer for wear. \_\_\_\_\_

d. Using a T-gage and micrometer, inspect the thrust collar for wear. \_\_\_\_\_

e. Using a T-gage and micrometer, inspect the impeller for signs of rubbing or damage from foreign material. Measure the inside diameter of bore. \_\_\_\_\_

f. Using a T-gage and micrometer, measure the inside diameter-bearing bore. \_\_\_\_\_

g. Using a micrometer, measure the shaft journal diameter. \_\_\_\_\_

h. Using a T-gage and micrometer, measure the bearing. \_\_\_\_\_

i. Inspect all threaded components for damage.

j. Replace all parts failing inspection.

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## **5. ASSEMBLY**

a. Lubricate bearing with clean engine oil.

b. Install snapping in shaft assembly end of center housing.

c. Install bearing, washer, and snapping through compressor side of center housing. The bearing, washer, and snapping will be secured on turbine wheel and shaft assembly side of center housing.

d. Install snapping, washer, and bearing in compressor side of center housing.

e. Install thrust bearing on dowel pins on center housing.

f. Install new seal ring on center housing.

g. Install new turbine seal ring on turbine wheel and shaft assembly.

- h. Install shroud on center housing.
- i. Install turbine wheel and shaft assembly through shroud and center housing.
- j. Place center housing so turbine wheel and shaft assembly faces up.
- k. Install thrust collar on turbine wheel and shaft assembly. Open side of collar faces up.
- l. Install two new seal rings on spacer.
- m. Install spacer in backplate. Compress seal rings so spacer will slide in bore of backplate. Bevel end of spacer faces towards center housing side of backplate.
- n. Install backplate on turbine wheel and shaft assembly.
- o. A line capscrew holes on back plate and center housing. Install four capscrews and lockplates. Torque as required and bend lockplate tabs up against capscrew heads.
- p. Install impeller on turbine wheel and shaft assembly.
  - (1) Using clean engine oil, lubricate the shaft threads and the impeller surface that will be under the locknut.
  - (2) Support turbine wheel and shaft assembly in vise with 7/8 inch wrench during torquing sequence.
  - (3) Install locknut on turbine wheel and shaft assembly. Torque locknut to 125-150 inch-pounds to seat the impeller against spacer.
  - (4) Loosen locknut and inspect lock nut face and impeller surface to be sure they are smooth and clean.
  - (5) Retorque lock nut to 35-55 inch-pounds. Turn locknut an additional 1/4 turn.
- q. Remove turbine wheel and shaft assembly from vise.
- r. Check bearing axial endplay with a dial indicator.
  - (1) Clamp the center housing and backplate in a soft-jawed vise.

(2) Install the dial indicator so that indicator tip is positioned at the end of the turbine wheel and shaft assembly on impeller side.

(3) Move the turbine wheel and shaft assembly in and out by hand. The total movement must be within specification in TM .\_\_\_\_\_

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(4) If readings are not within specifications, repair or replace the rotating assembly.

s. Align disassembly marks on turbine housing with marks on center housing. Failure to properly align coupling can result in an exhaust leak or turbine wheel damage.

t. Install and align coupling on turbine housing and center housing. Alignment marks were made during disassembly. Do not pull a misalign housing into alignment with the coupling together. Parts must be alined and seated first.

u. Tighten coupling in the following sequence:

(1) Lubricate coupling threads with anti-seize compound.

(2) Torque nut on coupling.

(3) Loosen and retorque nut to specifications in TM.

v. Align the disassembly marks on the compressor housing with the marks on the backplate.

w. Install and align the disassembly mark on coupling with compressor housing and backplate.

x. With clean engine oil, lightly lubricate the thread on the coupling and torque the nut.

y. Check the shaft radial movement on rotor assembly.

(1) Place magnetic base with swivel adapter on the flat surface of the turbine housing.

(2) Insert the extension rod into the oil tube opening. The extension rod must be against and perpendicular with the turbine wheel and shaft assembly. Make sure the extension rod does not make contact with the

sides of the center housing, otherwise it will be impossible to obtain an accurate reading.

(3) Grasp each end of the rotating assembly and apply equal pressure at each end, move the rotating shaft first toward and then away from the dial indicator, creating a transverse movement in the shaft. \_\_\_\_\_  
The radial movement must be within specification. If not within specifications, disassemble and repair or replace the rotating assembly.

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**REFERENCE**

TM 9-2320-297-34