PLAINTIFF'S EXHIBIT

MAC-83

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CHRIS N. KOLOS

May 29, 1997

David M. Lipman, Esquire
5901 S.W. 74th Street
Suite 304
Miami, Florida 33143

Re: ***Tinker v. Mack Trucks, Inc., et al.***
Ontario County Index No.: 83778

Dear David:

Enclosed please find additional documentation responsive to paragraphs 7 and 11 of Plaintiff's First Request to Produce to Mack. These documents consist of relevant portions of Mack's Highway Vehicle Service Manual concerning the maintenance of brakes and clutches and that part of certain engine work involving gaskets. Also enclosed are service bulletins from the 1970 to 1980 time period.

Thank you for your attention to this matter.

Sincerely,

Chris N. Kolos

CNK:jo
Enclosures

SD-38

DD3 SAFETY ACTUATOR

DESCRIPTION The DD3 Safety Actuator; DD describes the double diaphragm and the suffix 3 denotes the triple action for service, parking and emergency braking. The actuator functions normally as a service brake chamber but in addition has a means of mechanically locking a brake application so it can safely be used for parking. With various system arrangements the actuator may be installed to be automatically or manually applied under emergency braking conditions.

The DD3 Safety Actuator is stud mounted and a selection of actuators are available to fit either vertical or horizontal standard mounting stud centers. Three (3) connecting lines are used for the actuator installations; to the parking, service and locking ports.

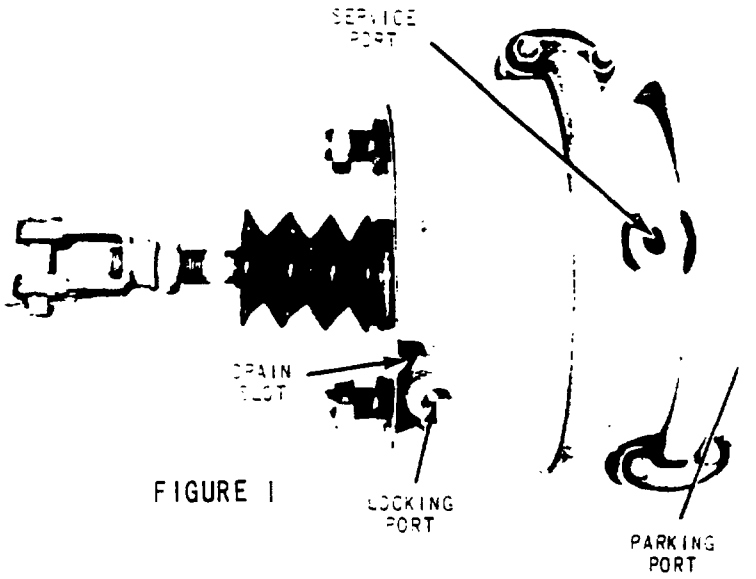

FIGURE 1

In late 1968, design improvements were incorporated into all DD3 Actuators. Changes incorporated are as follows:

1. The non-pressure plate was redesigned to provide better protection against entrance of water into the roller cavity and non-pressure area. Details of this redesign are:
   a. A new design cap incorporating an "O" ring and shaft seal.
   b. A heavier splash plate and gasket.
   c. Studs installed in "blind holes" replace the T-bolts used on the old design non-pressure plate.
   d. An exhaust check valve in the non-pressure plate to purge the non-pressure cavity area each time the actuator is applied.

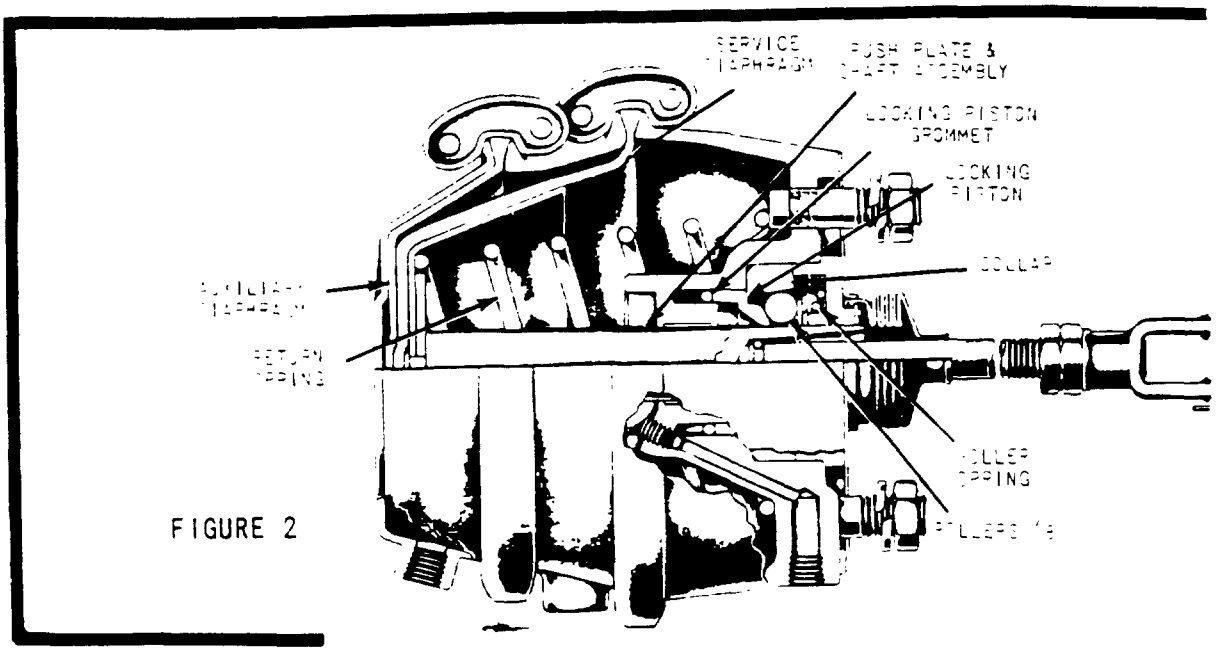

FIGURE 2

RELEASE OF PARKING APPLICATION To release a parking application of the DD3 Actuator, it is necessary to re-apply air pressure to equal a shaft force approximately the same as was used in making the parking application. This is necessary to release the locking rollers so they can be moved away from the shaft when air is re-applied to the locking piston. This can be accomplished by making a heavy service application after the control valve is operated to release the parking application.

To release a parking application, air enters the locking piston and the air on the auxiliary diaphragm is exhausted. A heavy service brake application will be necessary to force the shaft forward sufficiently to allow the locking rollers to dis-engage and unlock the shaft. Upon release of the service application, the return spring will return the shaft to the release position, releasing the parking application.

EMERGENCY OPERATION Through different system arrangements, the DD3 Safety Actuator in conjunction with other automatic or manual air applied valves will operate for emergency situations in the same sequence as described under "Parking".

PREVENTIVE MAINTENANCE General - Depending on experience and type of operation, the drain slot in the actuator non-pressure plate should be checked and cleared of any restricting road grime, mud, ice, snow, etc.

Brakes should be adjusted as is customary with any brake chambers. Push rod travel should be as short as possible without brakes dragging. Excessive travel not only shortens the normal service life of diaphragms but gives slow braking response, wastes air, and could possibly result in decreasing brake torque output.

Push rod to slack adjuster alignment should be checked in both the applied and released positions, the rod should move out and return properly without binding. Also, check the angle formed by the slack adjuster arm and push rod. It should be 90° or greater when the actuator is in the applied or released positions when brakes are adjusted.

EVERY YEAR OR 3600 OPERATING HOURS OR AFTER 100,000 MILES DEPENDING ON TYPE OF OPERATIO

Disassemble DD3 Actuator, clean all parts and lubricate locking mechanism.
Install new diaphragms and other rubber parts/or parts if they are worn or deteriorated.

When diaphragms or return spring or both are replaced, like parts in the corresponding actuator on the same axle should also be replaced.

OPERATING AND LEAKAGE CHECKS

OPERATING With the actuator in the released position, make several service brake applications and note that actuators apply and release properly.

Operate parking control valve and observe that actuators apply. While actuators are in a parking position, drain air supply to auxiliary diaphragm and note that actuators remain applied.

Replenish air supply to auxiliary diaphragm. Operate control valve to release parking application, then make a full service application to complete release of actuators. The magnitude of the service brake application to release the brakes may vary on different vehicles due to compressor governor settings. Normally a service application of approximately 70 psi should release the brakes.

LEAKAGE With system pressure up and DD3 actuators in the released position, check drain slot and around the push rod boot with a soapy solution to detect possible leakage by the locking piston grommet.

Make and hold a service brake application and again check the actuator drain slot or exhaust check valve if so equipped for service diaphragm leakage. Continue to hold the service application and coat around the service and auxiliary diaphragm clamping rings with the soapy solution to detect seal leakage.

Operate the actuator control valve to a parking position and check the exhaust port of a service brake application to detect auxiliary diaphragm leakage. This auxiliary diaphragm leakage detection point could be the exhaust port of the foot brake valve, quick release valve or relay valve depending on system. While still in a parking position, the auxiliary diaphragm clamping ring should be coated with the soap solution to detect seal leakage.

Should leakage be detected at the clamping rings in either of the above tests, the clamping ring nuts should be tightened evenly but only enough to stop leakage.

If the DD3 Safety Actuator does not function as described or leakage is excessive, it is recommended that it be returned to the nearest Bendix-Westinghouse authorized distributor for a factory reconditioned actuator under the repair exchange plan. If this is not possible, the actuator can be repaired with genuine Bendix-Westinghouse parts in which case the following should prove helpful.

CLEANING AND INSPECTION

1. Wash all metal parts in a good cleaning solvent and dry thoroughly. It is generally recommended that all rubber parts be replaced; however, any rubber parts that are to be reused should be wiped dry.
2. Discard felt breather.
3. Inspect all parts for excessive wear or deterioration. Particular attention should be given to the piston and collar bores in the non-pressure plate. The air passage from the lock port to piston bore should be checked for restriction and cleaned; if necessary, remove the inspection plug to thoroughly clean this passage.
4. Rollers should be carefully checked, and all rollers replaced if one or more need replacing.
5. Check springs for cracks, distortion, or corrosion.
6. Replace all parts not considered serviceable during these inspections.

If servicing older design actuators, it may be necessary to replace existing parts with parts of the newer design which obsolete and supersede parts of the older design actuator. For further information, refer to section titled "Description".

ASSEMBLY

NOTE: This procedure covers both the old and new design actuators; for further information, refer to "Description" section.

1. Line up parts as they were marked prior to assembly.
2. If the bearing in the non-pressure plate was removed, it should be reinstalled or replaced if necessary.
3. Lubricate piston and collar bores, shaft, piston "O" ring, piston and roller cavity liberally with "Never Seez" lubricant (BW 404-M).
4. Position piston "O" ring in piston bore, then piston with smooth end down against "O" ring.
5. Place collar in its bore (chamfer side down).
6. Coat rollers thoroughly and liberally with "Never Seez" lubricant (BW 404-M) and place eight (8) rollers in groove formed by top of piston and collar ramp.
7. Pack roller cavity liberally with "Never Seez" lubricant (BW 404-M).
8. Place roller spring seat washer on top of rollers.
9. Position cone-shaped roller spring on washer with smaller end to washer.
10. (New Design Only) Install "O" rings in cap, small "O" ring in inner bore, large "O" ring on outside of cap, making certain "O" rings are properly seated in grooves.
11. (New Design Only) Place seal in bore of cap. Lip of seal should face front of cap. Place retainer spring on seal, position retainer on spring, compress spring, line up tabs on retainer to slots on cap, and lock retainer in cap by turning 1/4 turn counterclockwise.
12. Position cap on roller spring. (*NOTE:* On new design cap, drain hole in cap should be positioned so that it lines up with drain area of non-pressure plate.) Press cap down and hold while installing four (4) machine screws evenly and securely. Install new felt breather.
13. (New Design Only) Turn over non-pressure plate assembly, and install rear seal. Lip of seal faces non-pressure cavity. Install spring retainer, making certain it is retained in groove of non-pressure plate.
14. Install push plate return spring (larger end down).
15. Position push plate and shaft over return spring and press down so shaft moves through lock. The lock should hold shaft position against return spring. If not, check previous assembly procedure.
16. Install separator on service diaphragm, making certain bead on diaphragm engages and retains separator. (*NOTE:* It is recommended that a new service diaphragm with separator and a new auxiliary diaphragm be used as a set and not mixed with the old style diaphragm (without separator) in any combination. The new style diaphragm with separator can and should be used with both the old and new style actuators.

CAUTION: DO NOT ATTEMPT TO INSTALL SEPARATOR IN COMBINATION WITH THE OLD STYLE SERVICE DIAPHRAGM (WITHOUT RETAINING BEAD).

SERVICE BULLETIN

NOV. 20, 1970 **No.** Q67 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

BRAKE DRUM WEAR LIMITS
(All Models)

PURPOSE To advise field of maximum brake drum wear limits.

INFORMATION Maximum allowable wear limits have been established for all size brake drums to aid inspections and provide protection in field against over-boring of used drums. These limits are based on nominal drum diameter plus an allowable wear factor. A wear factor of 0.090 inch is assigned to drums up to and including 14 inches and 0.120 inch to drums over 14 inches. To determine the actual maximum allowable wear diameter for brake drums up to and including 14 inches, add 0.090 inch (wear factor) to nominal diameter, brake drums over 14 inches add 0.120 inch (wear factor) to nominal brake drum diameter. Present production brake drums have the maximum wear diameter plainly and permanently marked on outside face.

RECOMMENDATION Inform and advise personnel of established allowable brake drum limitations. Replace drums if wear limit is exceeded.

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SERVICE BULLETIN

MAR. 17, 1972 **No.** Q68 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

SPRING LOADED BRAKE CHAMBER SERVICING

IMPORTANT BULLETIN

CAUTION

PURPOSE To caution all field personnel to be most careful when working on spring loaded brake chambers.

INFORMATION More and more spring loaded brake chambers are being used on trucks of all makes. Spring loaded auxiliary brakes are STANDARD equipment on Mack chassis with either cam or wedge type brakes.

Because of this, it is important to remind all Customer, Distributor or Branch service personnel that spring loaded brake chambers contain heavy coil springs which, in many cases, must be retained either in an arbor press, special fixture, safety cage or by compressing the spring with a stud or capscrew arrangement.

Inform mechanics not to just disassemble brake chambers. Units of various styles differ in construction. If in doubt, place units under controlled compression, such as in an arbor press or special fixture.

Literature is available on spring loaded brakes as used on Mack trucks. Distribution of various items has been made in the past, however, any of the following literature can be obtained through Mack Service outlets. Requests from these locations will be forwarded to the Technical Service Department at Allentown, Pa. for handling.

CAUTION

It is extremely important to use a retaining method on all spring brake chambers. The spring is under heavy compression and, if improperly handled, can expand rapidly with great force and cause injury.

As a guide, the following methods of retention are used by the spring brake manufacturers:

ANCHORLOK

Remove release stud assembly from carrying pocket built into chamber body. Remove dust cap and insert stud into pressure plate. Turn one quarter turn to capture pressure plate. Tighten nut on stud until spring is fully caged.

(Continued Over)

SERVICE BULLETIN

MAY 5, 1972 **No.** Q69 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

ROCKWELL-STANDARD COMPANY
(Technic Aid (Brakes) Bulletins)

PURPOSE To advise the field of current service information affecting Rockwell-Standard brake components supplied to Mack Trucks, Inc.

INFORMATION Service information covering Rockwell-Standard brakes will be issued periodically and will be mailed individually without an accompanying bulletin or other publication. Rockwell-Standard brake bulletins received are to be filed in Brakes section of your bulletin binder, immediately following this bulletin. File by Aid number sequence, not date of receipt, to facilitate location of desired information.

RECOMMENDATION File attached Rockwell-Standard Technic Aid #54 as described herein. Advise all personnel dealing with Rockwell-Standard brake components of this information.

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SERVICE BULLETIN

AUG. 29, 1972 **No.** Q70 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

TRAILER HAND BRAKE CONTROL VALVE
(All Chassis So-equipped)

PURPOSE To caution field subject control valve is not to be used as a parking brake control.

INFORMATION Reports received indicate attempts have been made to utilize the trailer hand brake control valve as a unit parking brake control. This control valve is designed to activate the trailer brakes independently of the chassis brakes. The control valve provides a finely graduated means of applying and releasing the brakes and, therefore, does not contain detents or lock positions to hold brakes in "ON" position; however, when control valve is new, there is a possibility the control will remain in the "ON" position due to the friction drag on the new parts. This is a false setting and will disappear as the control valve wears in. To stress the fact this control valve is not to be used as a parking brake control, "NOT FOR PARKING" is embossed on top of control handle.

RECOMMENDATION Advise all concerned of this bulletin on proper operation of trailer hand brake control valve.

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SERVICE BULLETIN

DEC. 22, 1972 **No.** Q71 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

BENDIX-WESTINGHOUSE SERVICE BULLETINS
(All Vehicles with Bendix-Westinghouse Equipment)

PURPOSE To advise field of current service bulletins supplied by Bendix-Westinghouse to Mack Trucks, Inc.

INFORMATION Service bulletins covering Bendix-Westinghouse equipment will be issued periodically and will be mailed individually without an accompanying bulletin or other publication. Bendix-Westinghouse service bulletins received are to be filed in Brakes section of your bulletin binder, immediately following this bulletin. File by service bulletin number sequence, not date of receipt, to facilitate location of a desired bulletin.

Bendix-Westinghouse parts are to be ordered through Mack parts outlet in the usual manner. In lieu of a Mack number, the Bendix-Westinghouse part number with the numeral 745 prefixed (e.g. 745-282633) is to be used when ordering Bendix-Westinghouse parts.

RECOMMENDATION File the attached Bendix-Westinghouse service bulletin 242 following this bulletin. Inform all personnel dealing with Bendix-Westinghouse of this procedure and emphasize importance of using the code prefix when ordering parts.

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SERVICE BULLETIN

JUNE 8, 1973 **No.** Q72 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

BRAKE LINING FASTENERS
(All Models with Rockwell "P" Series Brakes)

PURPOSE To inform field of a brake lining rivet change and the availability of brake lining bolts.

INFORMATION Effective March 1, 1973 all brake lining will be secured with 1/4 inch rivets in place of 3/16 inch rivets used previously. When replacing brake lining, drill the brake shoes to accept the new 1/4 inch rivets.

Where service facilities are not equipped with a rivet machine, a brake shoe lining bolt is available for securing the lining to the brake shoe.

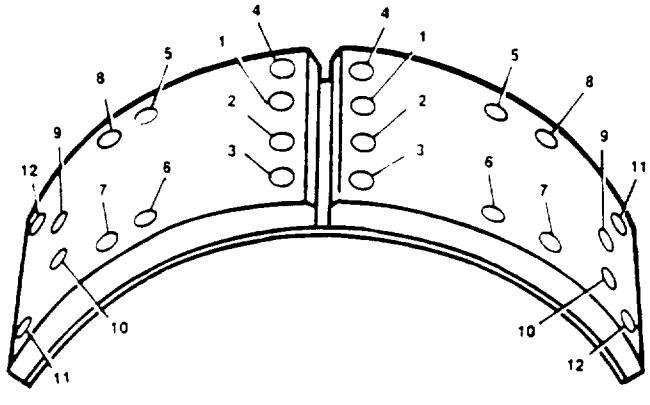
Parts required:

Part No.	Description	Replaces
8235-15X882	Brake Shoe Lining Bolt	- - -
20AX1	Nut, 1/4-28	- - -
36AX1	Lockwasher, 1/4 inch	- - -
	Rivet	341SZ110-P2 or 341SZ113

Installation Instructions

1. Position the lining on the brake shoe so the holes in the lining and shoe are in perfect alignment.
2. Clamp the lining to the shoe with "C" clamps. Locate the clamps as close to the holes as possible.
3. Line drill the lining and brake shoe holes 0.261 inch diameter using a "G" drill or 0.257 inch with an "F" drill.
4. Secure the lining to the brake shoes with the bolts, nuts and lockwashers in the sequence shown in the illustration. Torque the nuts to 84 lb. in. and remove the "C" clamps.

RECOMMENDATION When replacing brake lining, secure the lining to the brake shoes as instructed herein. Parts are available now.



BRAKE LINING BOLT INSTALLATION SEQUENCE

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SERVICE BULLETIN

JULY 5, 1973 **No.** Q73 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

BRAKE CHAMBER
(Anchorlok)

PURPOSE To advise of improved diaphragm and boot available for service replacement.

INFORMATION Short service life of diaphragm and boot used in brake chambers 19QE430-P1, P2, P3 and P4 may occur under some conditions, such as construction service or use of hand control valve in conjunction with service brakes. To insure longer life of these components, an improved diaphragm and boot have been made available. They will be supplied in kit form under part number 6152-11M26934.

When replacing diaphragm, it is recommended that chamber be removed from vehicle and cleaned thoroughly. Install both diaphragm and boot contained in kit.

WARNING

When working with spring brake arrangements DO NOT remove spring brake clamp (at end of assembly away from actuating clevis) from assembly without compressing heavy spring with special release tool contained in carrying pocket built into chamber body.

RECOMMENDATION Use new kit listed in bulletin for all future service requirements. Do not use previous service diaphragm 64SM28A in Anchorlok brake chambers. Present stock of 64SM28A can be used in other vendor chambers. This is a product improvement.

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SERVICE BULLETIN

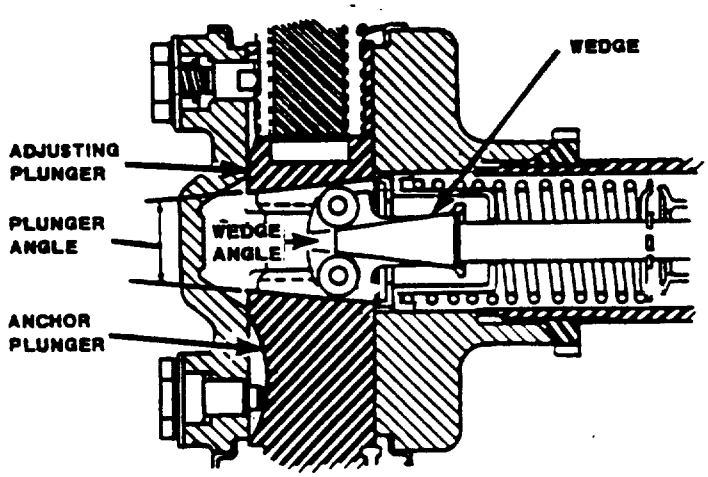
JULY 5, 1973 **No.** Q74 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

BRAKE ACTUATING WEDGE
(All with Rockwell-Standard 15x7" Wedge Brakes)

PURPOSE To point out that two different wedge angles have been used on these brake assemblies and to caution against intermixing wedges with different angles on an individual chassis.

INFORMATION At various times, wedges with an angle of either 12 or 14 degrees have been used in production on these brake assemblies. Intermixing wedges with different angles, as might occur during brake repairs, will result in unbalanced braking action. Because of this possibility, wedges should be inspected when brakes are serviced and any having wrong angle, replaced. Also, check plunger angle which must be same as wedge. The angle is marked on both parts for easy identification. See illustration for arrangement.



RECOMMENDATION During routine servicing or when investigating brake complaints, check wedge and plunger angle and replace any that are of incorrect angle. Be sure that all brake assemblies on a particular chassis have wedges and plungers with same angle.

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SERVICE BULLETIN

OCT. 25, 1973 **No.** Q75 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

INITIAL BRAKE ADJUSTMENT
WITH AUTOMATIC SLACK ADJUSTERS
(All Models with Eaton Automatic Slack Adjusters)

PURPOSE To inform field of correct method of brake adjustment after a brake overhaul (new lining) on subject models.

INFORMATION Whenever new brake lining has been installed on a chassis with Eaton automatic slack adjusters, the brakes must be adjusted as follows:

1. Remove the 1/4 in. pipe plug on the slack adjuster to expose the worm shaft. See illustration.

2. With a 1/4 in. male hex wrench (Allen), turn the worm shaft clockwise until the brake shoes are tight against the drum.

NOTE

Backing off the slack adjuster requires much more force than taking up the slack adjuster.

3. Back off the worm shaft counterclockwise, approximately 3/4 of a turn until wheel drag is eliminated.

NOTE

The Eaton automatic slack adjuster is lubricated for life; no further lubrication is necessary.

4. Reinstall the 1/4 in. pipe plug in the slack adjuster.

RECOMMENDATION When new brake lining has been installed on subject vehicles, adjust the brakes as described herein.

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(Continued Over)

SERVICE BULLETIN

NOV. 27, 1973 **No.** Q76 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

AUTOMATIC SLACK ADJUSTER OVER ADJUSTMENT
(All Models with Eaton Automatic Slack Adjusters)

PURPOSE To inform the field how to correct over adjustment of automatic slack adjusters.

INFORMATION Under certain conditions, Eaton automatic slack adjusters may over adjust and cause the brakes to drag. If not corrected, this will result in shortened brake lining and drum life.

To correct over adjustment, replace the 1/4 in. link pin securing the connecting drive link to the clevis with an undersize link pin, part no. 2719-1000657.

NOTE

The link pins are specially hardened and ground pins and no substitution must be made.

After the undersize link pin is installed the brake must be adjusted as follows:

1. Remove the 1/4 in. pipe plug on the slack adjuster to expose the worm shaft.
2. With a 1/4 in. male hex wrench (Allen), turn the worm shaft clockwise until the brake shoes are tight against the drum.

NOTE

Backing off on the slack adjuster requires much more force than taking up on the slack adjuster.

3. Back off the worm shaft counterclockwise, approximately 3/4 of a turn, until wheel drag is eliminated.
4. Reinstall the 1/4 in. pipe plug in the slack adjuster.

RECOMMENDATION To correct over adjustment of Eaton automatic slack adjusters, install the undersize link pins and adjust brakes as outlined herein.

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SERVICE BULLETIN

JAN. 15, 1974 **No.** Q78 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

PRESSURE REDUCING VALVE
(All with Hand Control Valve for Rear Service Brakes)

PURPOSE To recommend installation of a pressure reducing valve in the hand control valve circuit if operating conditions require considerable use of the hand control valve.

INFORMATION When the rear wheel brakes are applied by the hand control valve a surge of pressure, equal to full reservoir pressure, is admitted to the brake chambers. This is more pressure than required for parking and creates unnecessary wear on the brake diaphragm. The pressure reducing valve limits pressure at hand control valve to 60 psi, thereby prolonging diaphragm life.

The pressure reducing valve is Bendix-Westinghouse part number 282811. This valve is not stocked by Mack and must be obtained locally. It is installed in the hand control valve supply line. The supply port is at the end opposite the adjusting cap and the delivery port is on side of valve body. The mounting arrangement will have to be determined locally.

RECOMMENDATION Install the pressure reducing valve if use of hand control valve causes reduced diaphragm life. This is a product improvement to be installed only when unusual operating conditions require it.

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SERVICE BULLETIN

MARCH 19, 1974 **No.** Q79 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN ☑ HAYWARD ☑ OAKVILLE ☑

BRAKE CAMSHAFT
(SW5711C and 5731C with Eaton 16-1/2 x 7 Cam Brake)

PURPOSE To inform service personnel that the camshaft on these brake assemblies does not require periodic lubrication and to advise against installing a grease fitting.

INFORMATION The camshaft on Eaton brake assembly 1QDA4220 is "lubed for life" at time of manufacture and normally does not require additional lubrication. To insure against the entrance of contaminants, the lubrication passage is sealed with a plug. This plug should be left in place while chassis is in operation. Do not replace it with a grease fitting.

If the camshaft is removed or replaced during brake repairs, it must be lubricated at assembly. Remove the plug, install a grease fitting and apply MG-A grease in the normal manner. Remove fitting when lubrication is completed and reinstall plug.

RECOMMENDATION Advise everyone concerned with lubrication that Eaton brake camshafts do not require periodic lubrication and that the plug used to seal the grease passage should not be replaced with a grease fitting.

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SERVICE BULLETIN

MAY 27, 1975 **No.** Q81 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN ☑ HAYWARD ☑ OAKVILLE ☑

BRAKE SHOE SUPPORTS

(SW56, 57, 571, 573, 76, 59, 592 and 68 Series Bogies with Rockwell-Standard Cam Brakes)

PURPOSE To inform service personnel of an improvement that can be added at time of brake overhaul.

INFORMATION Current brake assemblies incorporate brake shoe supports. These items stabilize the shoes and extend life of shoe and spider anchor pin bores, camshaft splines and bushings and slack adjuster splines. The parts required are contained in kit form and installation is shown in sample instruction sheets.

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Parts required:

Bogie	*Brake Shoe Support Kit
SW56C,57C,571C,573C and 76C Series	8235 - MPS2008
SW59C, 592C Series	124QE220
SW68C Series	124QE219

* Each kit services one axle (Two wheels)

Before installing brake shoe supports, check lateral movement of brake shoes at cam head. If it is 3/8 inch or less, add the shoe supports to existing spiders (if not already installed), do not replace spiders.

If shoe movement exceeds 3/8 inch, replace spiders. Replace only spiders that are unusable; it is not necessary to replace in pairs or sets. New service spider assemblies will have provision for shoe supports. Consult with your Mack branch or distributor for part number of latest spiders and related parts.

RECOMMENDATION Install brake shoe supports when rebuilding subject brake assemblies if lateral movement of shoes is within limit specified in bulletin. This is a product improvement to be made at customers option and expense.

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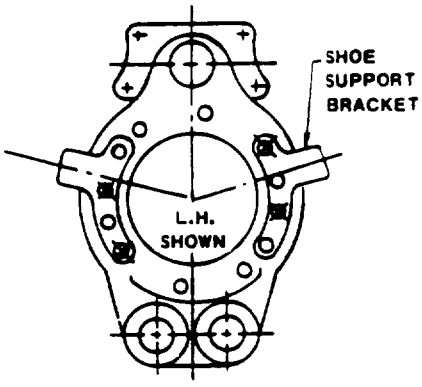
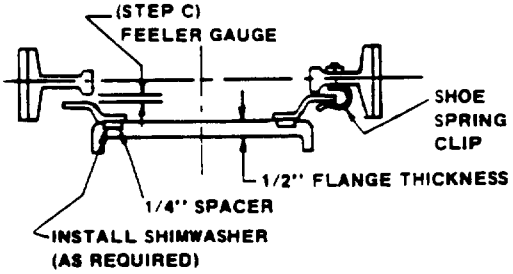
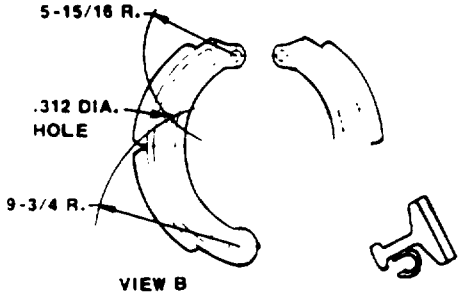
BRAKE SHOE SUPPORT KIT
(1-3/4" and 2-1/2" Spider Offset Cast Shoes)
Mack SW59C, 592C and 68C Bogies

INSTALLATION INSTRUCTIONS:



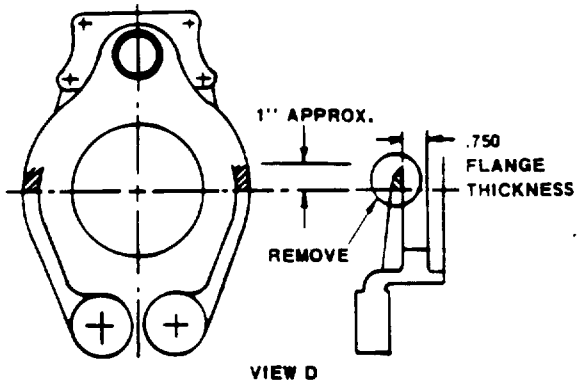


VIEW A



VIEW B

VIEW C



VIEW D

SAMPLE INSTRUCTION SHEET

1. With 1/2 inch thick brake spider flange:

a. Remove four (4) mounting bolts shown.

b. Select and position 1/4 inch spacing washer under hole locations marked "X."

For 1.75 Spider Offset
(4) 3280-M-6123 Shoe Support Pads

For 2.50 Spider Offset
(2) 3280-N-6124 Shoe Support Pads
(2) 3280-P-6126 Shoe Support Pads

c. Use feeler and measure clearance between shoe web and shoe support bracket (See View A).

d. Select proper thin shim washer as measured. Install shim washer under support pad at the mounting bolt to nearest .032.

e. Retorque mounting bolts to 210 - 270 ft. lbs. for .625 diameter bolt, 365 - 470 ft. lbs. for .750 diameter bolt.

f. Drill one .312 diameter hole in shoe web located by scribing a radius off of the anchor pin center of 9-3/4 and a radius off of the roller pin center of 5-15/16. (See View B.)

g. Bolt shoe spring clip to underside of shoe for both forward and reverse shoes with 1/4 inch diameter capscrew, lockwasher and nut provided. (See View C.) Torque capscrew to 14 - 18 ft. lbs.

h. Position shoe support between spring clip and shoe web in proper working position. Clip should provide approximately 65 lbs. lateral support force against the shoe support bracket.

Check for free return at brake shoe against camhead by normal shoe return spring action. Lubricate if necessary.

2. With 3/4 inch thick brake spider flange:

a. Remove cast spider material shown in View D flush with mounting face both sides shown shaded.

b. Follow steps a through h above, but do not use 1/4 spacer washer.

SERVICE BULLETIN

FEBRUARY 6, 1976 **No.** Q82 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN☐ HAYWARD☑ OAKVILLE☐

ANTI-WHEEL LOCK WIRING
(Mack Western RL, RS, WL and WS Models with MVSS121 Brake System)

PURPOSE To advise of a change in the anti-wheel lock warning unit wiring.

RECOMMENDATION Inform all service personnel of the revised wiring and stress importance of determining which system is in use before attempting to diagnose a malfunction.

INFORMATION Starting October 19, 1975, connections at the anti-wheel lock warning unit "W" terminals were changed. Connections for current and non-current chassis are as follows.

Chassis built on and after October 19, 1975

Two-axle vehicles - W1 terminal monitors steering axle
W2 terminal monitors rear axle

Three-axle vehicles - W1 terminal monitors steering axle
W2 terminal monitors bogie forward axle (no change)
W3 terminal monitors bogie rear axle

Chassis built prior to October 19, 1975

Two-axle vehicles - W1 terminal monitors rear axle
W2 terminal monitors steering axle

Three-axle vehicles - W1 terminal monitors bogie rear axle
W2 terminal monitors bogie forward axle
W3 terminal monitors steering axle

When trouble shooting the anti-wheel lock system determine, either by build date or physically tracing the wiring, which system is used. This practice will insure that time is not lost checking the wrong axle related components.

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SERVICE BULLETIN

FEBRUARY 9, 1976 **No.** 083 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN ☑ HAYWARD ☑ OAKVILLE ☑

SPRING BRAKE VALVE
(All with MVSS121 Brake Systems)

PURPOSE To recommend that operation of subject valve be checked periodically.

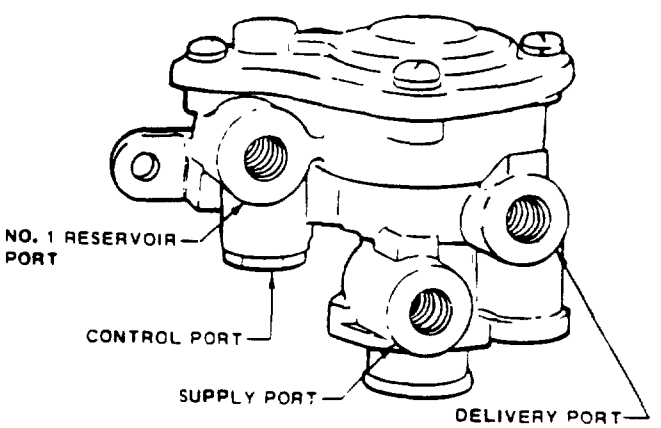
RECOMMENDATION Check performance of the spring brake valve regularly, following the procedure and schedule given in bulletin.

INFORMATION The spring brake (SR-1) valve supplies a specific, limited hold-off pressure to the spring brakes and, in the event air is lost in the primary brake system, it modulates the spring brakes through the treadle valve. In normal operation, internal parts of the valve undergo little or no movement and as a result could corrode and become inoperative over a period of time.

To insure that the SR-1 valve will function in an emergency, it's operation should be checked every 24,000 miles or at 3 months maximum. In addition to verifying correct valve operation, the checking procedure "exercises" the valve and helps to maintain it in good operating condition.

The SR-1 valve (20QE3110R) is located as follows:

F and MB - under cab on right hand frame rail.
R, RD, FM, DM, DMM and U - on crossmember just behind cab.
RL and RS - front of cowl, ahead of air vent
WL and WS - under left hand splash shield, back of head light.



SR-1 SPRING BRAKE VALVE

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SERVICE BULLETIN

FEBRUARY 26, 1976 **No.** Q84 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☑ OAKVILLE☑

AIR RESERVOIR CHECK VALVE
(All Vehicles with MVSS121 Brake System)

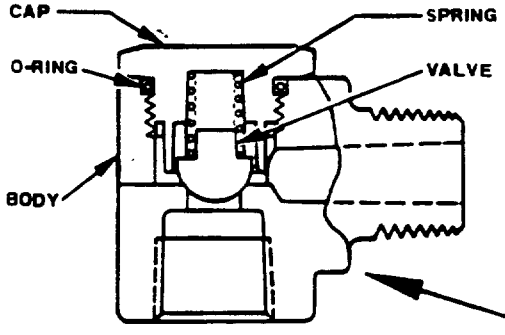
PURPOSE To inform service personnel of a repair kit for subject valve.

RECOMMENDATION Repair a malfunctioning check valve by installing the kit announced in this bulletin.

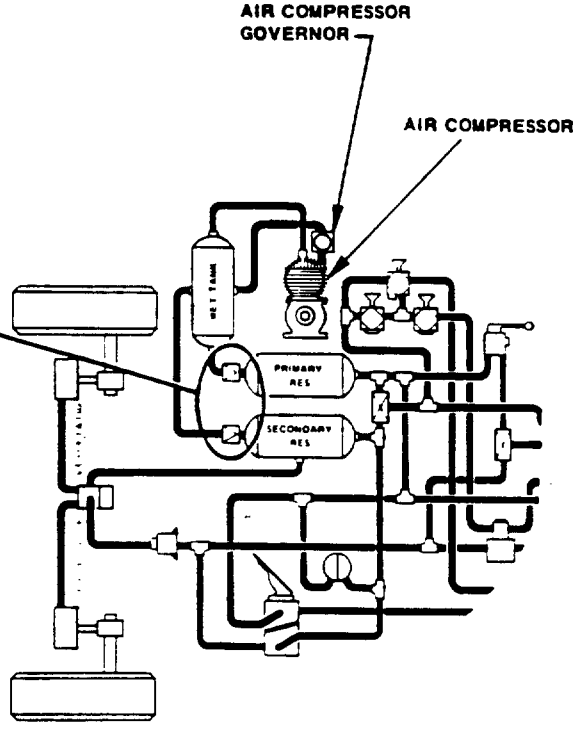
INFORMATION Repair kit 5396-RN10FB has been made available to service inline check valve 20QE1237R. This is the check valve (two required) that is mounted on the primary and secondary reservoirs (see illustration). The repair kit contains improved parts, consisting of a cap, cap O-ring, spring and rubber valve.

The kit parts can be installed without removing valve from system. Be sure all air is drained from affected tank, then remove and discard cap, cap O-ring, spring and valve. Check for and remove broken parts in valve body. Install the new parts as shown in illustration.

Parts available March 15, 1976



CHECK VALVE 20QE 1237R



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SERVICE BULLETIN

APRIL 30. 1976 **No.** Q85 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☐ OAKVILLE☑

RELAY VALVE RELOCATION
(Models R, RD, RM, DM and DMM with SW681 Series Bogies)

PURPOSE To eliminate an interference condition.

RECOMMENDATION Follow instructions contained herein when interference exists between the relay valve and the forward axle carrier.

INFORMATION During extreme articulation an interference condition may exist between the spring brake relay valve and the bogie forward axle carrier housing cover.

To correct interference, the spring brake relay valve must be moved forward on the frame sidemember.

1. Drain air tanks and disconnect all air connections to the spring brake relay valve except the "Balance" line connection.

2. Move relay valve six inches forward on the frame sidemember. Use relay valve as template and drill two 0.406 inch diameter mounting holes. Secure the relay valve in new location.

3. Shorten the "Reservoir Double Check Valve to Relay Valve Supply Line" six inches. Use a new 1/2 inch diameter compression sleeve (ferrule), 52AX50017, and secure the line to the relay valve.

4. Shorten the "Spring Brake Control Valve Delivery to Relay Valve Line" six inches. Use a new 3/8 inch diameter compression sleeve (ferrule), 52AX50016, and secure the line to the relay valve.

5. Remove the "Relay Valve Delivery to Rear Axle Line" and replace with new air line tubing, 101AX126RF50, six inches longer. Do not splice old tubing. Salvage connectors from replaced line and use two new 1/2 inch diameter compression sleeves (ferrules), 52AX50017, and install new line.

6. Test for air leaks and valve operation and return to service.

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SERVICE BULLETIN

OCTOBER 25, 1976 **No.** Q88 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN ☑ HAYWARD ☑ OAKVILLE ☑

RADIO FREQUENCY INTERFERENCE

(All Vehicles Equipped with Anti-Wheel Lock Brake System)

PURPOSE To inform owners and operators of the possibility that field installed electrical equipment may affect operation of the anti-wheel lock system.

RECOMMENDATION Perform the test outlined in this bulletin if additional electrical equipment is installed on subject vehicles.

INFORMATION It is possible for some electrically powered or controlled equipment to cause interference with the operation of other vehicle components. This interference may be conducted or radiated and is dependent on frequency and power level of the added equipment.

If additional electrical equipment is installed in the field, the operator or installer must be certain any signals generated by this equipment will not adversely affect existing components. This precaution is particularly important on vehicles equipped with an anti-wheel lock brake system. To insure that added electrical equipment is compatible with the anti-wheel lock components, the following test should be made.

1. Perform check procedure with vehicle stationary, engine running, and brake air system at normal operating pressure.
2. Depress and hold brake pedal at full application pressure.
3. Operate the added equipment in all its starting, running, and shut-down modes. Listen for air exhausting from the anti-wheel lock controllers and also observe the anti-lock warning light to see if it is illuminated.
4. If air is exhausted from the controllers and/or the anti-lock warning light is illuminated momentarily or constantly, an interference condition exists which must be eliminated before the chassis is released for service.

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SERVICE BULLETIN

NOVEMBER 24, 1976 **No.** Q89 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN ☑ HAYWARD ☑ OAKVILLE ☑

BRAKE IMPROVEMENTS

(All with Stopmaster II 15 x 7 Wedge Brakes)

PURPOSE To advise of improved parts for the self-adjusting mechanism.

RECOMMENDATION Install the new parts listed in bulletin when overhauling the brakes or if existing adjusters bottom out with a useable amount of lining left.

INFORMATION Early production of Stopmaster II brake assemblies had a limited travel adjusting bolt. These brakes reach their maximum adjustment before the lining is worn to the rivet heads. A new adjusting bolt is used in current production brake assemblies that permits additional lining wear. This bolt does not have the retainer ring to serve as a stop, thereby allowing full length of the bolt for adjustment. A new actuator is required with this bolt. See Figure 1 for details of this change.

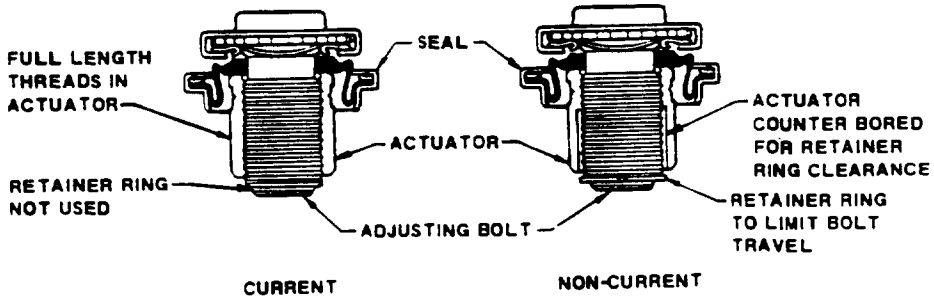

FIGURE 1
ADJUSTING BOLT AND ACTUATOR

Stopmaster II assemblies can be identified by the slotted adjusting pawl guide hole and keyed adjusting pawl as shown in Figure 2. Late production assemblies also have the designation "STOPMASTER II" stamped on dust shield.

SERVICE NOTE

A special, longer adjusting bolt is available for service use to permit full lining wear with refinished drums. This bolt is 0.100 inch longer than the standard bolt and is designed for use with drums having a diameter greater than 15.060 inches but less than 15.120 inches. It is intended for use with regular service thickness linings and can be identified by a large letter "S" on bolt shaft.

(Continued Over)

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SERVICE BULLETIN

DECEMBER 7, 1976 **No.** Q90 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN ☑ HAYWARD ☑ OAKVILLE ☑

ANTI-WHEEL LOCK WARNING UNIT

(All Vehicles with Anti-Wheel Lock Brake Systems)

PURPOSE To advise that the warning unit can be damaged by short circuiting or grounding either the warning unit or anti-lock warning light circuit.

RECOMMENDATION Avoid grounding or short circuiting the warning unit or warning light circuit when trouble shooting this equipment. Always use a voltmeter to determine if voltage exists at any point in the system.

INFORMATION Permanent damage to the warning unit can occur if the terminals are grounded or "shorted" while the unit is powered. Damage can also occur if a test light or screwdriver is used to check for voltage at the warning light by shorting to the side of the bulb socket. "Shorts" or grounds of this nature will cause failure of the warning units internal components (transistors, diodes, etc.) and render it incapable of indicating a failure in the anti-wheel lock system.

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SERVICE BULLETIN

FEBRUARY 11, 1977 **No.** Q91 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN ☑ HAYWARD ☑ OAKVILLE ☑

TROUBLE SHOOTING THE ANTI-WHEEL LOCK SYSTEM

(All Vehicles Equipped with Rockwell International Front Drive Axle)

PURPOSE To provide procedure for trouble shooting the combination anti-wheel lock system used on subject vehicles.

RECOMMENDATION Advise all service personnel of the special trouble shooting procedures contained in this bulletin.

INFORMATION These front driving axles are equipped with the Rockwell International "Skid-Trol" anti-wheel lock system; whereas. the rear axle or bogie has the standard production Eaton or B. F. Goodrich system. It is important that the mechanic determine which system is at fault so that the appropriate trouble shooting procedure can be applied. Trouble shooting instructions for the basic systems are not given here as they have already been issued to the field. In addition to the normal anti-lock components, the Rockwell system incorporates a computer power relay (CPR).

To ascertain that a malfunction exists, turn key switch on and observe the anti-wheel lock warning light. It should glow for approximately three to five seconds and then go out; however, if a malfunction exists. the warning light will stay on. In this case, proceed as follows:

1. Determine if the basic anti-wheel lock system (bogie or rear axle) is Eaton or Goodrich.

2. Using instructions applicable to the basic system, check at warning unit to determine which axle is affected. If both front axle (W1 or P1 terminal) and one or both of the rear axles (W2, P2 and W3, P3) indicate a malfunction, check out the basic system first. Refer to service literature covering system involved.

3. If the basic system checks out satisfactorily, proceed to the front axle system. Refer to trouble shooting charts A, B and C and Figures 1 through 5.

(Continued Over)

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CHART C — Road Test

1. Self test failure indicator light. If it will not self test, correct before proceeding.
2. Drive vehicle at 40 mph for a minimum of 15 seconds, maintain above 20 mph for a minimum of 100 seconds.
3. Observe failure indicator light
   - If light off — system OK proceed to 4
   - If light on, rework of wheel end assembly is required in the following areas:
     - Sensor to rotor gap adjustment
     - Rotor runout is excessive
     - One sensor not plugged in
4. Make a "panic" brake stop from 20 mph. Cycling of front and rear wheels or a "light on" condition indicates that a system test and rework is required.

   NOTE: Panic stops should not be made with a "light on" condition since the skid-trol is not functioning on one or more axles.

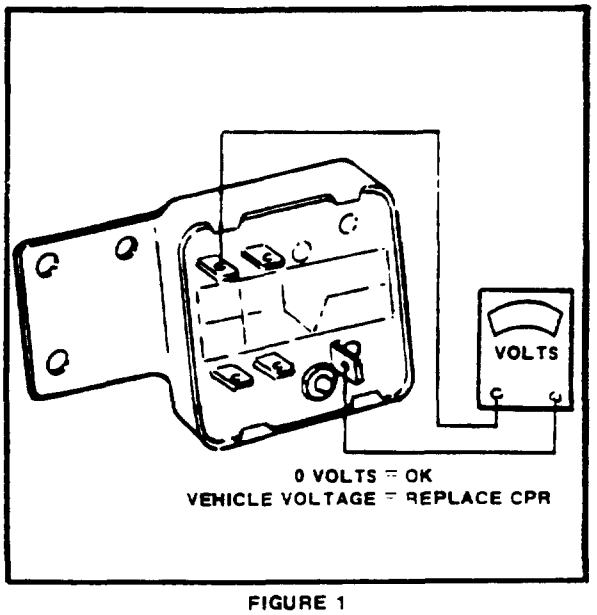
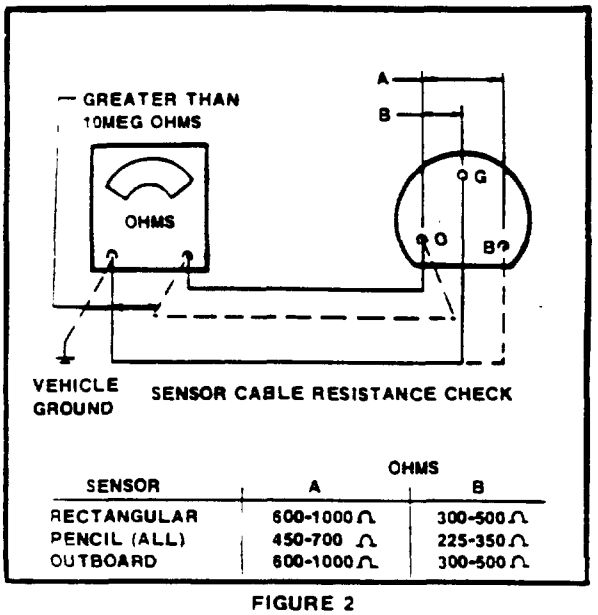


FIGURE 1
CHECKING COMPUTER POWER RELAY



SENSOR	OHMS A	OHMS B
RECTANGULAR	600-1000Ω	300-500Ω
PENCIL (ALL)	450-700 Ω	225-350Ω
OUTBOARD	600-1000Ω	300-500Ω

FIGURE 2
CHECKING SENSOR RESISTANCE

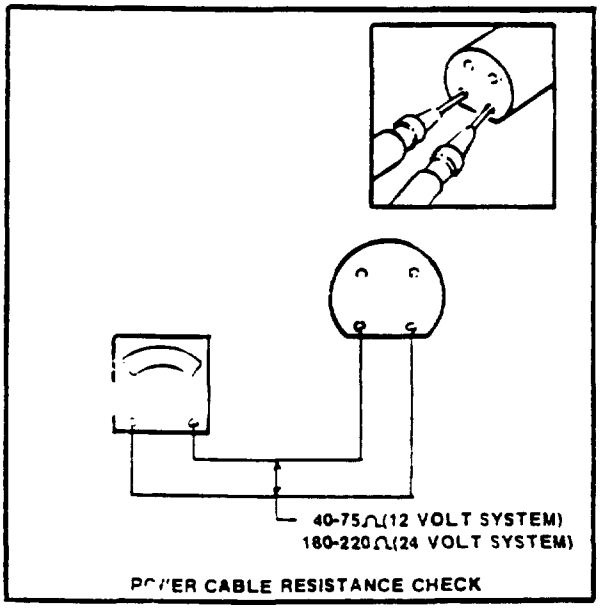


FIGURE 3
CHECKING POWER CABLE RESISTANCE

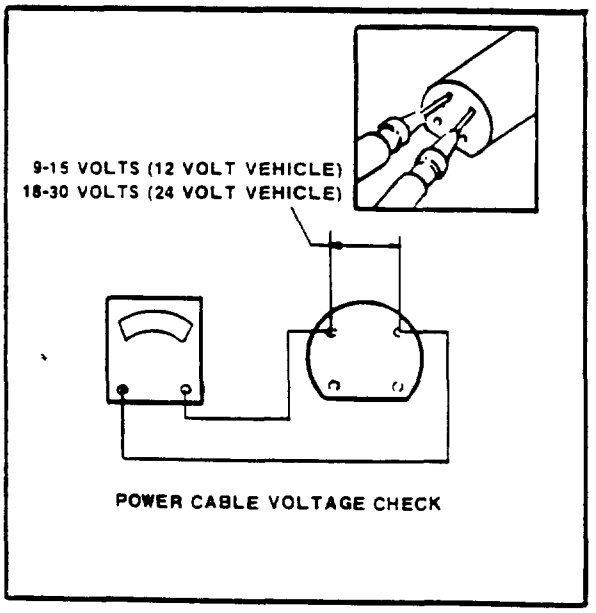


FIGURE 4
CHECKING POWER CABLE VOLTAGE

(Continued Over)

SERVICE BULLETIN

SEPTEMBER 1, 1977 **No.** Q88a **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN ☑ HAYWARD ☑ OAKVILLE ☑

RADIO NOISE SUPPRESSION
(All Models Equipped With Anti-Wheel Lock Brake System)

PURPOSE To instruct owners and operators how to suppress radio noise on subject vehicles.

RECOMMENDATION When radio noise is encountered, follow instructions in this bulletin.

INFORMATION Operator complaints of undue noise from radio speakers (AM-FM, tape players etc.) have been received. This could be the result of poor grounding of the radio chassis to the vehicle chassis.

A poor ground can aggravate conditons whereby brake controller hum and vehicle borne noise can be carried through the power line to the radio and then through the speaker system.

If after insuring that the grounding is satisfactory, and radio noise is still excessive, proceed as follows:

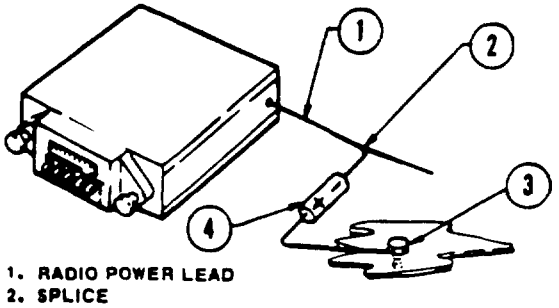
CAUTION

Electrolytic capacitors are polarity sensitive, having both a positive and negative end. Use caution when installing.

Connect a 100 MFD capacitor having a 50 volt WVDC (working voltage, direct current) from the radio power lead to the vehicle chassis as illustrated in Figure 1 for positive ground or Figure 2 for negative ground, depending on the vehicle electrical system.

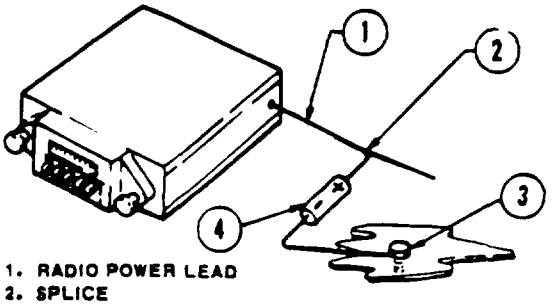
NOTE

The 100 MFD capacitors with a 50 volt WVDC are available from radio/TV repair shops or stores such as Lafayette Electronics, Radio Shack, etc.



1. RADIO POWER LEAD
2. SPLICE
3. VEHICLE CHASSIS
4. 100 MFD CAPACITOR - 50 WVDC

FIGURE 1
POSITIVE GROUND



1. RADIO POWER LEAD
2. SPLICE
3. VEHICLE CHASSIS
4. 100 MFD CAPACITOR - 50 WVDC

FIGURE 2
NEGATIVE GROUND

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SERVICE BULLETIN

DECEMBER 2, 1977 T **No.** Q92 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN ☑ HAYWARD ☑ OAKVILLE ☑

BRAKE SHOE RETURN SPRING
(RAS512C, RAD529C, RAD530C, R170C, L155C Rear Axles and
SW56C, SW57C, SW571C, SW573C, SW76C Bogies with
Rockwell International 16 1/2 x 7 Cam Brakes)

PURPOSE To inform the field of an improved spring.

RECOMMENDATION Install the new spring when replacement is required.

INFORMATION The improved brake shoe return spring is made of high tensile steel for increased service life. Part number is 8235-2258-U-619 and it replaces spring 364SM27. The new spring is painted blue for identification.

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SERVICE BULLETIN

DECEMBER 22, 1977 T **No.** Q93 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☑ OAKVILLE☑

CAM BRAKE ASSEMBLIES

(All Highway Models With SW56C, 57C Series Bogies and FAW5361C, 5371C Series Front Axles)

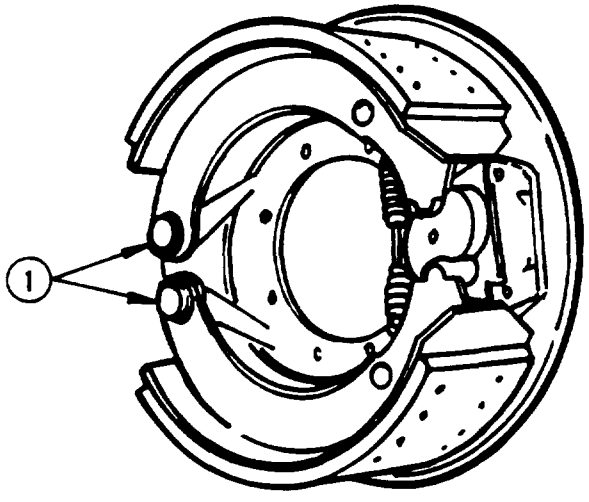
PURPOSE To inform the field of changes in cam brake usage and to describe means of identifying the various brake assemblies involved.

RECOMMENDATION Advise service personnel of these changes in brake application to eliminate possible errors with respect to service procedure and replacement parts.

INFORMATION

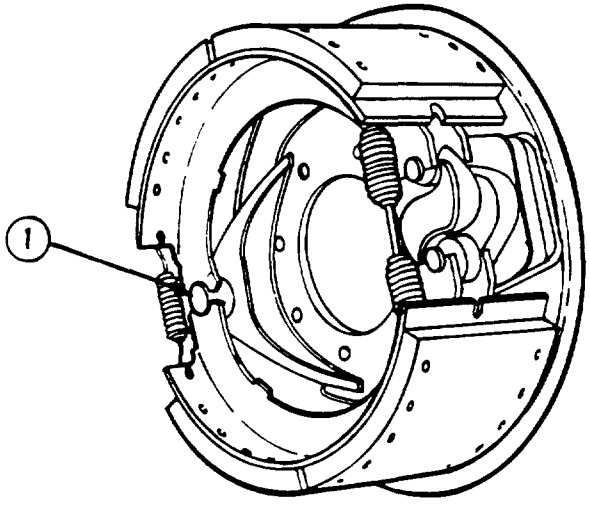
Bogie Brakes - The SW56C (34,000 lb.) and SW57C (38,000 lb.) bogies will be built with either of two cam brake assemblies. The brake used will depend on vehicle model and application, not bogie model. This is in contrast to past practice whereby a particular bogie model would be equipped with one standard brake assembly.

Brake assemblies that will be installed are Rockwell "P" series 16 1/2 x 7 and Eaton 16 1/2 x 7 cam brakes. The Rockwell brake is shown in Figure 1, the Eaton brake in Figure 2. Note from the illustrations that these assemblies can be identified by the number of anchor pins; two are used on the Rockwell brake and one is used on the Eaton brake.



1. ANCHOR PINS (TWO)

FIGURE 1
ROCKWELL BOGIE BRAKE ASSEMBLY



1. ANCHOR PIN (ONE)

FIGURE 2
EATON BOGIE BRAKE ASSEMBLY

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SERVICE BULLETIN

FEBRUARY 22, 1978 **No.** Q94 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☐ OAKVILLE☑

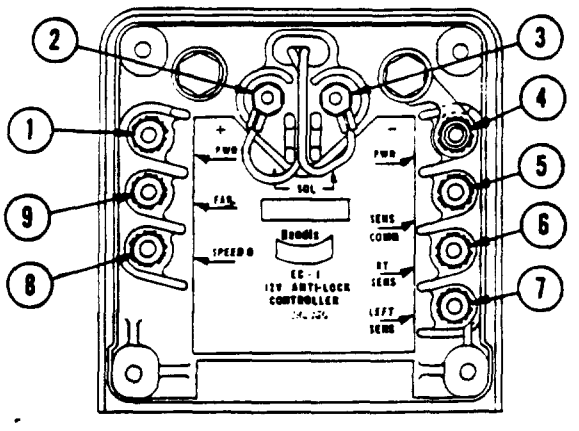
ANTI-WHEEL LOCK SYSTEM
Trouble Shooting Procedure
(Bendix MC-1 and MC-2 Systems)

PURPOSE To provide service personnel with trouble shooting procedures for this new anti-wheel lock system.

RECOMMENDATION Make the information contained in this bulletin available to all who are responsible for brake system service.

INFORMATION The Bendix anti-wheel lock system is similar to others in use on Mack vehicles. It consists of an electronic controller with integral warning unit, that modulates a control valve and a wheel speed sensor system. Two systems are available, MC-1 and MC-2. The MC-1 system utilizes one controller for each axle, whereas the MC-2 system has a single controller to monitor two axles.

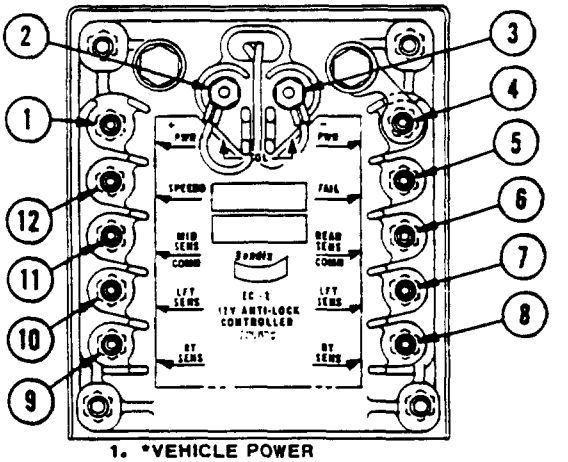
The following trouble shooting guide is offered to facilitate diagnosis and correction of any problems that may develop. See Figure 1 and 2.



1. *VEHICLE POWER
2. SOLENOID
3. SOLENOID
4. *VEHICLE GROUND
5. SENSOR COMMON
6. RIGHT WHEEL SENSOR
7. LEFT WHEEL SENSOR
8. ELECTRONIC SPEEDO (OPT.)
9. INDICATOR LAMP

*REVERSED IN A POSITIVE GROUND SYSTEM

FIGURE 1
EC-1 CONTROLLER TERMINAL CONNECTIONS



1. *VEHICLE POWER
2. SOLENOID
3. SOLENOID
4. *VEHICLE GROUND
5. INDICATOR LAMP
6. LEFT & RIGHT WHEEL SENSOR
7. LEFT WHEEL SENSOR
8. RIGHT WHEEL SENSOR
9. RIGHT WHEEL SENSOR
10. LEFT WHEEL SENSOR
11. LEFT AND RIGHT WHEEL SENSOR
12. ELECTRONIC SPEEDO (OPT.)

*REVERSED IN A POSITIVE GROUND SYSTEM

FIGURE 2
EC-2 CONTROLLER TERMINAL CONNECTIONS

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(Continued)		C. If ohm reading is between 250 and 10,000 ohms, sensor wiring is o.k. If ohm reading is less than 250, sensor or sensor wiring is shorted. If ohm reading is more than 10,000, sensor or sensor wiring is open. Sensor wiring and/or sensor must be replaced. Repeat for each sensor. D. Attach leads of volt/ohmeter to one sensor lead and chassis. Resistance should be 100,000 ohms or greater. If not sensor or sensor wire is shorted to chassis. Repair/replace as necessary. E. If all sensors and wires check o.k., reconnect all wires. Repeat self-check and proceed to probable cause #2.
	2. Faulty lamp relay (Optional on some negative ground vehicles and all positive ground. If there is no relay proceed to the next probable cause #3).	* 1. Check voltage across relay coil. Voltage must be within two (2) volts of battery voltage. If voltage is not satis factory wire from relay to the -PWR terminal of controller or the relay ground is defective. Repair or replace as necessary. If the voltage is satisfactory proceed to probable cause #3.
	3. Fail wire shorted to chassis.	* 1. Remove fail wire from FAIL terminal If the light does not go out, the relay is defective and should be replaced. If the light goes out, the controller is probably defective. Replace wires and repeat self-check. If the light does nc go out, replace the controller.
	4. Defective solenoid (Continued Over)	1. Visually inspect solenoid wires for po sible open or shorts; repair or replac as necessary. If solenoid wires appe to be o.k. proceed to next step. 2. Remove solenoid wires from solenoid terminals, check solenoid with volt/ ohmeter as follows: A. Solenoid resistance should be 3-5 ohms. (If not, replace solenoid). B. Attach one lead of volt/ohmeter to one solenoid wire and one lead of volt/ohmeter to controller case; resistance should be greater than 100,000 ohms. (If not, replace solenoid). If correct, go to proba ble cause #5.

* Test with keyswitch on.

SERVICE BULLETIN

MARCH 15, 1978 **No.** Q87 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS. (Supersedes Bulletin dated JULY 16, 1976)

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☐ OAKVILLE☑

ANTI-WHEEL LOCK PICKUP AND VALVE/CONTROLLER ASSEMBLY
Service Subassemblies and Components
(Eaton, Goodrich and Bendix)

PURPOSE To provide service personnel with part numbers of the component parts used in subject assemblies.

RECOMMENDATION Whenever possible, replace failed components instead of the complete assembly when servicing anti-wheel lock valve/controller assemblies and wheel speed pickups. This practice will lower cost of replacement parts and generally reduce labor time.

INFORMATION Anti-wheel lock controller assemblies consist of three major components or subassemblies which can easily be replaced in the field. They are the valve, controller and solenoid(s). The following parts list shows part number of the valve/controller assemblies currently in use and their components.

Valve/Controller Assembly Component Parts - See Figures 1, 2, 4 and 5.

Vendor		Assembly No.	Controller	Valve	Solenoid Kit
Eaton	Model 21	5MN41R-P1	①2719-630083(Pos. Grd.)	2719-600084	②2719-640023
		5MN41R-P2	①2719-630069(Neg. Grd.)		
	Model 1201	5MN48R	2719-630383(Neg. Grd.)	2719-600084	2719-640023
		5MN401R	2719-630380(Neg. Grd.)	2719-600084	2719-640023
B.F. Goodrich		5MN35R	7MN31R	3355-1700-6	③3355-1670-1
Bendix		5MN49R	745-289670(Neg. Grd.)	745-289614	745-289278
		5MN400R	745-289367(Neg. Grd.)	745-289614	745-289278
		5MN402R	745-289367(Pos. Grd.)	745-289614	745-289278
		5MN403R	745-289670(Pos. Grd.)	745-289614	745-289278

① Includes gasket, harness pigtail and clip
② Includes O-rings
③ Includes O-rings and cover gasket

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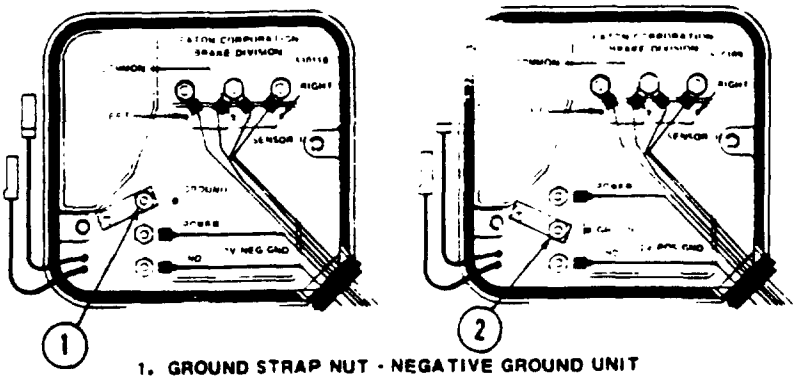
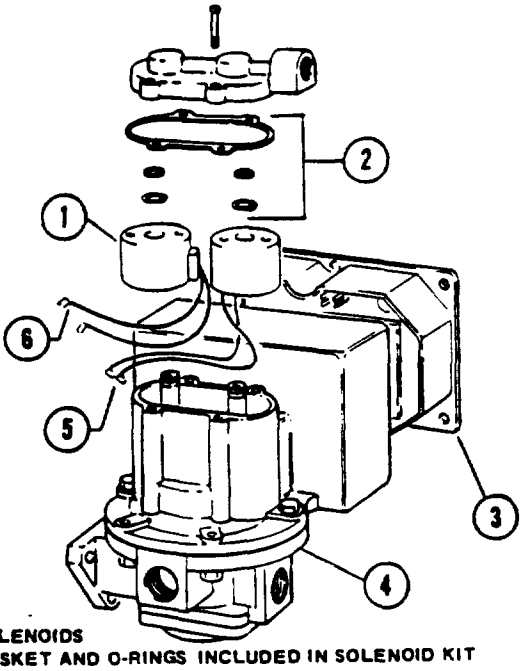


1. GROUND STRAP NUT - NEGATIVE GROUND UNIT
2. GROUND STRAP NUT - POSITIVE GROUND UNIT

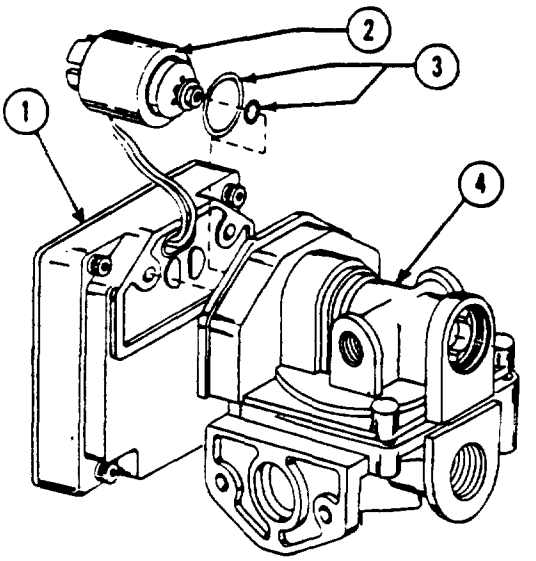
FIGURE 3



1. SOLENOIDS
2. GASKET AND O-RINGS INCLUDED IN SOLENOID KIT
3. CONTROLLER
4. VALVE
5. 1/4 IN. SPADE TERMINALS (SOLENOID NO. 2)
6. 3/16 IN. SPADE TERMINAL (SOLENOID NO. 1)

FIGURE 4

B.F. GOODRICH VALVE/CONTROLLER ASSEMBLY 5MN 35R



1. CONTROLLER
2. SOLENOID
3. O-RINGS
4. VALVE

FIGURE 5

BENDIX VALVE/CONTROLLER ASSEMBLY

Wheel speed pickup assemblies consist of the pickup, pickup gage blocks and mounting bracket. Gage blocks experience some wear during the initial operating period following a clearance adjustment. They must be replaced when the wear indicator grooves are no longer visible. The following parts list shows part numbers for the gage block service kit and the pickup. Bracket part numbers are not shown because they vary depending on the axle used. Consult chassis record for correct bracket part number.

(Continued Over)

SERVICE BULLETIN

MARCH 20, 1978 T **No.** Q95 **under** BRAKES

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FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN ☑ HAYWARD ☑ OAKVILLE ☑

BRAKE IMPROVEMENTS

(All With Air Over Hydraulic Disc Brakes)

PURPOSE To advise of improvements to increase disc brake service life and to provide part numbers for disc brake service kits and replacement parts.

RECOMMENDATION The improvements described in this bulletin will increase service life of disc brakes. Due to a recent change in motor vehicle safety standard 121, older MVSS121 equipped vehicles can incorporate these improvements if the operator desires. These changes are not mandatory however, and are to be made at the operators request and expense.

INFORMATION One of the original stopping requirements for vehicles subject to MVSS121 requirements was 243 feet from 60 mph on dry roads. A revised standard, now in effect, increased the allowable stopping distance to 293 feet under the same conditions. Some Mack vehicles built to comply with the original standard, utilized disc brakes at the front wheels to achieve the high braking force required.

It has been found that short life of these disc brakes can result from failure to keep the rear brakes in adjustment. Disc brakes are self-adjusting and operate at minimum lining to-rotor clearance at all times. As a result, they provide the major portion of the braking force under light braking conditions if the rear wheel brakes are out of adjustment.

If a particular operation entails considerable light braking, disc brake life can be increased by installing a metering valve in the hydraulic system. The metering valve reduces pressure to the disc brakes under low application pressure, causing the rear brakes to assume a larger proportion of the braking effort. At higher application pressure, normal pressure is restored to the disc brakes.

Installation of 17 to 1 ratio intensifier in place of a 23 to 1 ratio unit will increase disc brake life. This modification is permissible on highway vehicles equipped with a bogie rated at 55,000 pounds or less. The intensifier uses brake system air pressure to develop hydraulic pressure for the disc brakes. With a 17 to 1 intensifier, 100 psi of air pressure will generate 1700 psi hydraulic pressure. With a 23 to 1 intensifier, 100 psi air pressure will generate 2300 psi hydraulic pressure.

Longer lining life can also be achieved by installing current service linings. The less stringent stopping requirements now in effect make it possible to use a different lining material which has better wear characteristics than the material originally required.

Correct adjustment of rear axle manual slack adjusters is essential for achieving correct balance between front and rear brakes. If the operator prefers, automatic slack adjusters can be installed on the SW56, 57, 571, 573 and 76 series bogies to aid in maintaining correct adjustment.

(Continued Over)

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2. Installing low ratio intensifier—

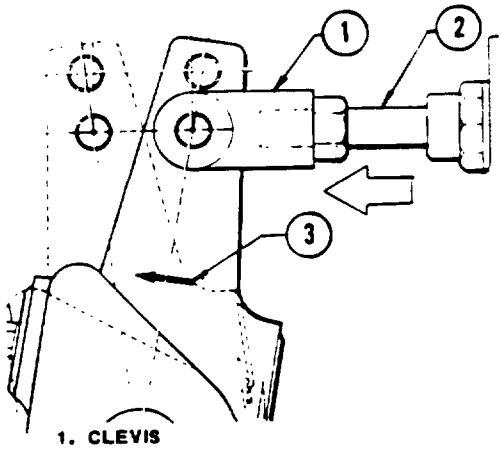
(a) The 17 to 1 intensifier is directly interchangeable with the 23 to 1 intensifier. Parts required:

Qty.	New Part	Description	Replaces
1	8QE429R(17 to 1)	Intensifier	8QE430R(23 to 1)

3. Installing automatic slack adjusters on SW56, 57, 571, 573 and 76 series bogies.

a. Remove existing slack adjusters.

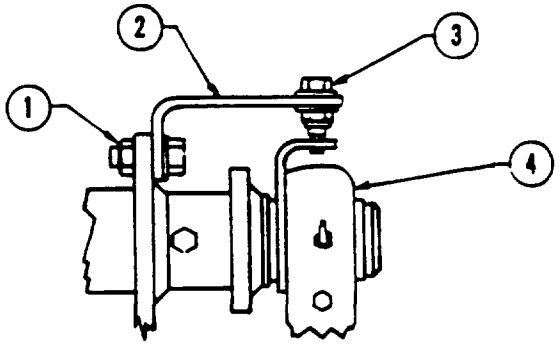
b. Install new slack adjuster on brake camshaft. Be sure arrow on adjuster points in direction unit rotates for a brake application. See Figure 3.



1. CLEVIS
2. PUSH ROD
3. DIRECTION OF BRAKE APPLICATION

FIGURE 3

c. Install slack adjuster retainer bracket on brake assembly using existing spider mounting bolts as shown in Figure 4. Do not tighten the bolts. Align clevis pin hole in slack adjuster with push rod clevis by turning worm adjusting nut as shown in Figure 5 and install clevis pin.



1. EXISTING SPIDER MOUNTING BOLTS
2. BRACKET 72RU 2861-P5, P6
3. SETSCREW 7AX 282Z, WASHER 37AX 473, NUT 21AX 317
4. SLACK ADJUSTER

FIGURE 4

(Continued Over)

3. Servicing the disc brake caliper.

Various components and service kits are available to expedite overhaul of these units. These items are shown in accompanying parts list.

General repair procedures are given in Highway Vehicle Service Manual TS442. Follow these procedures, taking particular care to observe the following points:

a. Minor corrosion and stains in the piston bores can be polished with crocus cloth. Do not use emery cloth or other abrasives.

Also check seal groove for scoring, nicks or corrosion. If any defects are noted, replace caliper.

b. The piston's outer diameter is plated and sized to a very close tolerance and must not be refinished by any means. If the O.D is scored, knicked, corroded or the plating is worn or damaged, the piston must be replaced.

Parts required:

Qty.	Part Number	Description
*	4891-Ø9726602	Kit, Boot and Seal
**	4891-Ø9906101	Kit, Shoe and Lining
***	4891-Ø9829401	Piston
	4891-Ø929501	Lining Holdown Kit

* Services one caliper
** Service two calipers
*** As required

SERVICE BULLETIN

APRIL 13, 1978 T **No.** Q97 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN ☑ HAYWARD ☑ OAKVILLE ☑

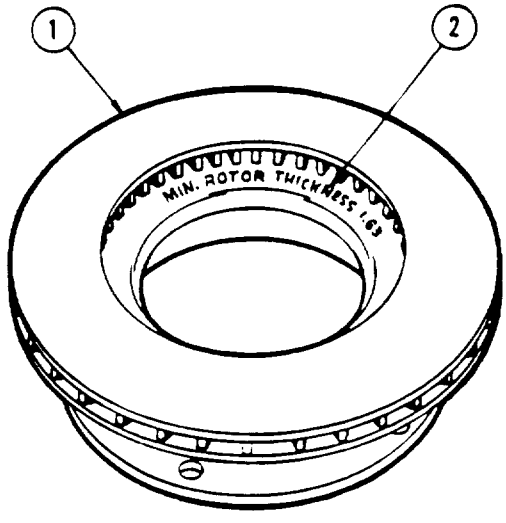
DISC BRAKE ROTOR
Refinishing Braking Surface
(All Highway Models With Disc Brakes)

PURPOSE To inform the field that rotors can be refinished and to advise maximum amount of material that can be removed.

RECOMMENDATION Follow the recommendations in this bulletin when performing subject operation.

INFORMATION As in the case of brake drums, it is permissible to machine the braking surfaces of a disc brake rotor to correct scoring, heat checks etc. When performing this operation, it is very important not to remove an excessive amount of material, otherwise the rotor will be weakened to the point where it is no longer serviceable.

The rotor can be machined to a minimum thickness of 1.63 inches (nominal thickness when new is 1.75 in.). As a guide to the machinist, this dimension is cast into the inner face of rotor hub as shown in Figure 1. Figure 2 is a cross-section through the rotor and brake assembly showing where this demension applies.



1. DISC BRAKE ROTOR
2. "MIN. ROTOR THICKNESS 1.63" CAST INTO ROTOR

FIGURE 1

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SERVICE BULLETIN

AUGUST 18, 1978 **No.** Q95a **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☑ OAKVILLE☑

BRAKE INTENSIFIER
(All With Air Over Hydraulic Disc Front Brakes)

PURPOSE To provide the field with procedure for changing intensifier pressure ratio from 23.5 to 1 to 17 to 1.

RECOMMENDATION Follow procedure outlined herein when changing intensifier ratio. This modification is permissible on highway vehicles with a bogie rated at 55,000 pounds or less.

INFORMATION Improved service life of disc front brakes has been achieved in many cases by changing the intensifier ratio from 23.5 to 1 to 17 to 1. This change lowers the hydraulic system pressure and reduces amount of braking force developed by the disc brakes.

As pointed out in Bulletin Q95 under BRAKES, 23.5 to 1 and 17 to 1 intensifiers are directly interchangeable as assemblies, making it possible to install a complete 17 to 1 intensifier to effect a ratio change.

It is possible to convert a 23.5 to 1 intensifier to the 17 to 1 ratio by installing the smaller Rotochamber used on the low ratio unit. This latter method is less expensive and is recommended if the master cylinder is in good condition.

A switch is mounted on the chamber which actuates a warning light if there is a failure in the hydraulic system. This switch is the same for both intensifier ratios and can be transferred from old to new assembly. Part number of the switch is listed in case existing switch is not useable.

Parts required:

Qty.	Part No.	Description
1	745-286757	Rotochamber, Type 36
* 1	1MR2321	Warning Switch

* Required only if existing switch is not serviceable

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SERVICE BULLETIN

OCTOBER 16, 1978 OH **No.** Q98 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☐ OAKVILLE☑

DISC BRAKE SUPPORT BRACKET
(M35AX and MP404X Off-Highway Models)

PURPOSE To provide field personnel with a method for reinforcing the brake support bracket. This modification applies to the rear wheel brakes on the M35AX and both front and rear wheel brakes of the MP404X.

RECOMMENDATION Install the brake support bracket reinforcements as a product improvement when performing normal brake service.

INFORMATION It has been found desirable to strengthen the brake support bracket on M35AX rear brakes and both front and rear brakes of the MP404X. This is done by welding a reinforcement plate to each side of the support bracket in the caliper mounting area.

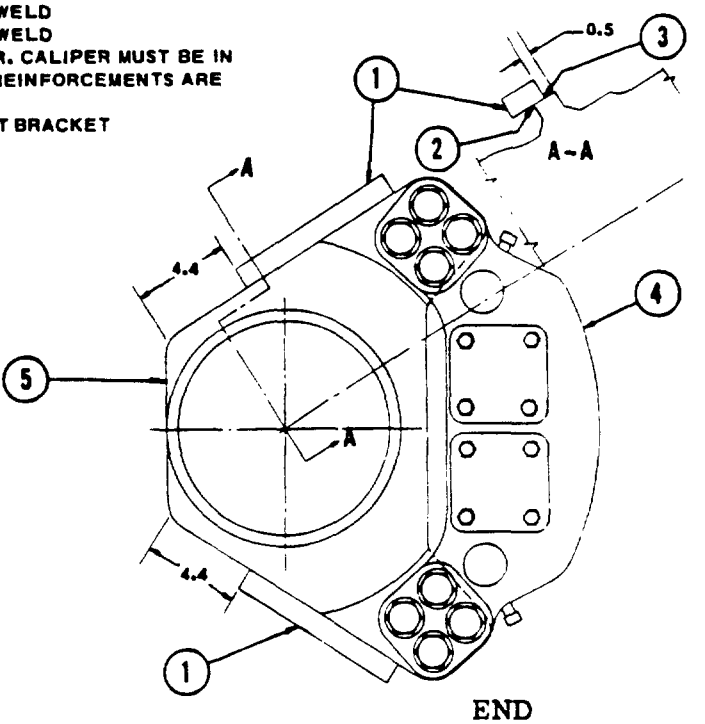
Parts Required:

Qty.	Part Number	Description
*	71RU13075	Reinforcement Plate

* 4 required per axle. Can be made locally from 1 x 1-3/4 x 8 in. carbon steel.

The following illustration shows details for installing the reinforcement plates. Note that the brake caliper must be mounted on the bracket during the welding operation to prevent warpage of brake mounting surfaces.

1. REINFORCEMENT 71RU 13075. (1.0" X 1.75 X 8.0 CARBON STEEL) LOCATE INBOARD FROM OUTER FACE OF SUPPORT BRACKET, USING DIMENSION SHOWN.
2. 3/8 IN. FILLET WELD
3. 1/2 IN. FILLET WELD
4. BRAKE CALIPER. CALIPER MUST BE IN PLACE WHEN REINFORCEMENTS ARE WELDED.
5. BRAKE SUPPORT BRACKET



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SERVICE BULLETIN

DECEMBER 8, 1978 T **No.** Q99 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☐ OAKVILLE☑

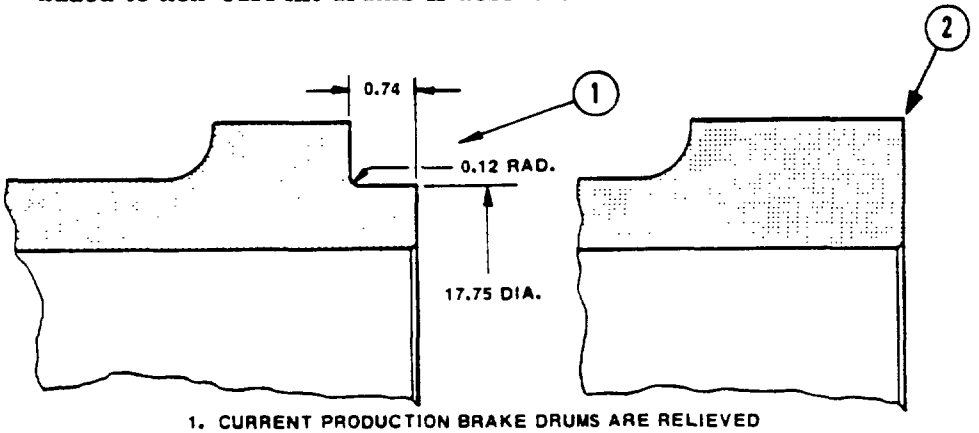
BRAKE DUST SHIELDS
(All With FA(W)616C, 617C Front Axles)

PURPOSE To provide part numbers of dust shields available for the cam brake assemblies used on these axles.

RECOMMENDATION Dust shields should be installed as a product improvement on operations where the brakes are exposed to large quantities of dust, water and other contaminants.

INFORMATION Dust shields were originally offered as optional equipment for the 16 1/2 by 5 cam brake assemblies 1QDA4239 and 1QDA4240 installed on these axles. In some cases it has been found desirable to retrofit shields on vehicles not originally equipped with them, due to adverse operating conditions.

Dust shields can be installed without modification on current production vehicles. To install shields on non-current vehicles it is necessary to modify existing brake drums or replace them with current production drums. Current production drums have a relief on inboard side that provides clearance for the shields. A similar relief can be added to non-current drums if desired. See illustration for dimensions.



1. CURRENT PRODUCTION BRAKE DRUMS ARE RELIEVED IN THIS AREA TO PROVIDE CLEARANCE WITH SHIELD.
2. NON-CURRENT PRODUCTION BRAKE DRUMS DO NOT HAVE A RELIEF.

Parts required per axle.

Qty.	New Part	Description	Replaces
2	17QJ3239A-P1	* Brake Drum	17QJ3239-P1
2	17QJ3239A-P2	* Brake Drum	17QJ3239-P2
2	17QJ3240A	* Brake Drum	17QJ3240
2	8235-A3236Z1794	Dust Shield Service Assembly	----------
12	4AX17	Screw, Dust Shield Mntg.	----------
12	36AX3	Lockwasher, Dust Shield Mntg. Screw	----------

* Check chassis record to determine brake drum originally installed on vehicles. Chassis built after mid-1976 will be equipped with current production brake drums.

END

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SERVICE BULLETIN

FEBRUARY 12, 1979 OH **No.** Q100 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☐ OAKVILLE☑

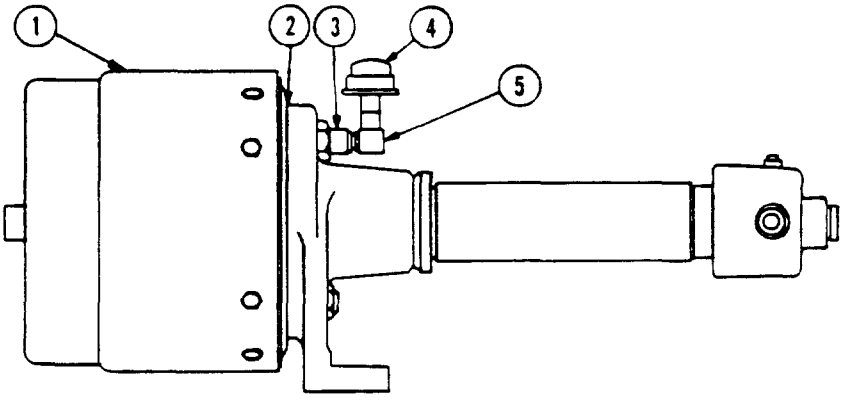
BRAKE ACTUATOR BREATHER
(M35AX, M65BX and MP404X Off-Highway Models With Disc Brakes)

PURPOSE To announce availability of a breather for brake actuators currently in service.

RECOMMENDATION The breather is a product improvement that should be added to actuators not so equipped, to insure best operation.

INFORMATION A breather is now installed as standard equipment on the actuator air chamber to prevent the possibility of contaminants entering and fouling the master cylinder. Parts required to add a breather to actuators in service are available in kit form under part number 3355-304-231. The kit contains a special mounting stud, elbow fitting and the breather.

Procedure - See Illustration



1. AIR CHAMBER
2. APPLY SEALER
3. SPECIAL STUD
4. BREATHER
5. ELBOW

1. Disconnect air line from air chamber.
2. Remove the two mounting stud nuts and separate air chamber from master cylinder. Remove chamber from chassis.
3. Without disassembling the chamber, remove one of the existing studs and replace it with the special stud contained in service kit.
4. Apply a non-hardening sealer to the area of chamber that seats against master cylinder, then reinstall chamber. Be sure breather stud is opposite mounting lugs. The sealer is necessary to insure correct operation of breather. Torque nuts (dry) 130 to 140 lbs. ft.
5. Install elbow and breather on special stud and reconnect air line.

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SERVICE BULLETIN

FEBRUARY 28, 1979 T **No.** Q101 **under** BRAKES

FOR BRANCHES. DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☐ OAKVILLE☑

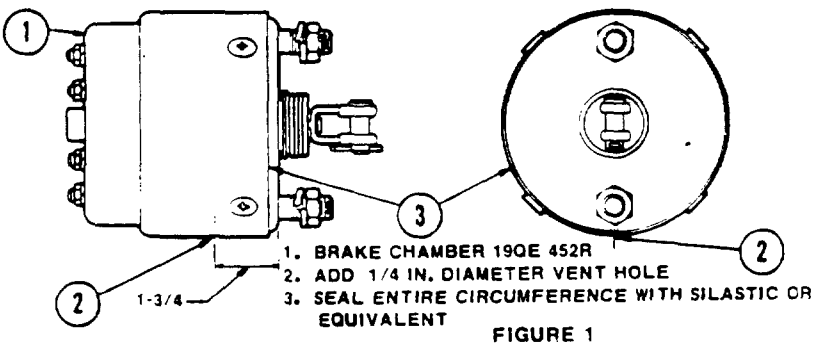
BRAKE CHAMBER MODIFICATION
(All Models With FA(W) 616C or 617C Front Axle)

PURPOSE To inform the field of a procedure for preventing entry of moisture and dust into the brake chamber on vehicles engaged in off-highway operations.

RECOMMENDATION Modify brake chambers as outlined herein if operating conditions require improved sealing.

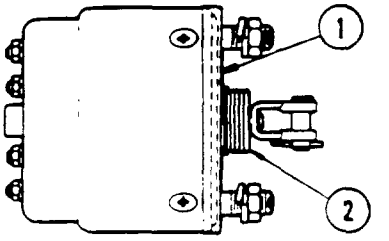
INFORMATION Brake chambers in these axles are mounted with the push rod pointing upward at approximately 60 degrees from the vertical. In this position it is possible for moisture and dust to enter the non-pressure side of chamber through the breather openings.

Chamber venting is accomplished by a controlled gap between end cover and chamber body. To prevent entry of water and dust, the entire circumference of the chamber to cover joint must be sealed with Silastic sealer, or equivalent, and a new vent hole added. The new vent is located on underside of chamber, in line with mounting studs as shown in Figure 1. Use a magnetic drill to keep metal particles out of chamber.



1. BRAKE CHAMBER 19QE 452R
2. ADD 1/4 IN. DIAMETER VENT HOLE
3. SEAL ENTIRE CIRCUMFERENCE WITH SILASTIC OR EQUIVALENT

FIGURE 1
BRAKE CHAMBER MODIFICATION



1. DUST COVER
2. BOOT

FIGURE 2
DUST COVER AND BOOT

NOTE

Future production of these brake chambers(part no. 19QE452R) will incorporate a new boot and dust cover to exclude moisture and dirt. When these parts are available they can be used on existing chambers, if desired, eliminating need for the preceding modification. See Figure 2.

Part numbers are:

Part Number	Description
20QD273	Dust Cover
745-231609	Boot

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SERVICE BULLETIN

MARCH 16, 1979 OH **No.** Q102 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☐ OAKVILLE☑

BRAKE CALIPER INSTALLATION
(M35AX, M65BX and MP404X Off-Highway Models With Disc Brakes)

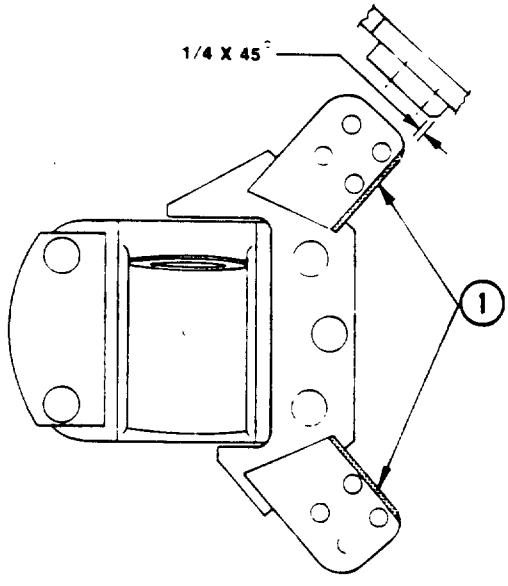
PURPOSE To inform the field of a modification required to permit installation of latest caliper assembly or torque plate.

RECOMMENDATION Be sure all service personnel are familiar with the procedure described her

INFORMATION An improved torque plate is used in current production caliper assemblies. This torque plate is similar to the replaced torque plate and utilizes the same internal components, however a change in the mounting lug configuration causes an interference with the existing caliper mounting bracket.

To insure proper assembly of this torque plate, or a new caliper assembly, it is necessary to grind a chamfer on inboard edge of the bracket mounting lugs as shown in Figures 1 and 2. Chamfer brackets on both front and rear axles.

Longer bolts, as shown in parts list, are required to mount the new torque plate/ caliper assembly due to use of thicker mounting lugs. Reuse hardened flat washer 35AX1438 under the bolt heads. Torque the bolts 1000 lb. ft. (dry).



1. CHAMFER INBOARD EDGE AT SHADED AREAS

FIGURE 1
CALIPER MOUNTING BRACKET - FRONT AXLE

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CIRCULATION

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Night Foreman	
Night Foreman	
Inspector Leadman	
Inspector Leadman	
Inspector Leadman	
Unit Overhaul Room	
Shop Office	

Service Operations, Allentown, Pa. U.S.A.

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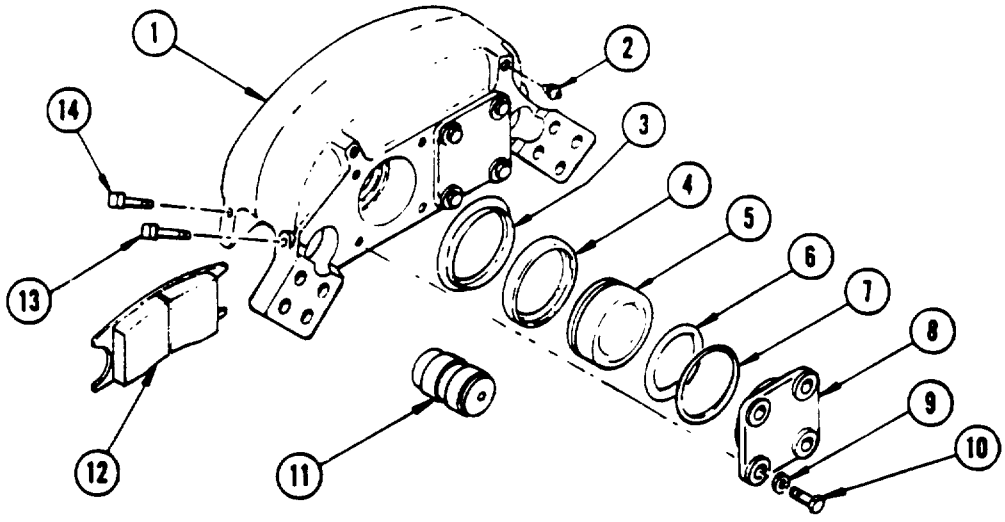

1. TORQUE PLATE
2. BLEEDER VALVE
3. BOOT
4. PACKING ASSEMBLY
5. PISTON
6. PACKING
7. PACKING RETAINER
8. CAP
9. FLAT WASHER
10. BOLT
11. PIN
12. CARRIER AND LINING ASS'Y
13. SETSCREW
14. SETSCREW

FIGURE 3
CALIPER ASSEMBLY

END

SERVICE BULLETIN

JUNE 8. 1979 **No.** Q87 **under** BRAKES

FOR BRANCHES. DISTRIBUTORS AND CUSTOMERS. (Supersedes Bulletin dated MARCH 15, 1978)

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☑ OAKVILLE☑

ANTI-WHEEL LOCK PICKUP AND VALVE/CONTROLLER ASSEMBLY
Service Subassemblies and Components
(Eaton, Goodrich and Bendix)

PURPOSE To provide service personnel with part numbers of the component parts used in subject assemblies.

RECOMMENDATION Whenever possible, replace failed components instead of the complete assembly when servicing anti-wheel lock valve/controller assemblies and wheel speed pickups. This practice will lower cost of replacement parts and generally reduce labor time.

INFORMATION Anti-wheel lock controller assemblies consist of three major components or subassemblies which can easily be replaced in the field. They are the valve, controller and solenoid(s). The following parts list shows part number of the valve/controller assemblies currently in use and their components.

Valve/Controller Assembly Component Parts - See Figures 1, 2, 4 and 5.

Vendor		Assembly No.	Controller	Valve	Solenoid Kit
Eaton	Model 21	5MN41R-P1	①2719-630083(Pos. Grd.)	2719-600084	②2719-640023
		5MN41R-P2	①2719-630069(Neg. Grd.)		
	Model 1201	5MN48R	2719-630383(Neg. Grd.)	2719-600084	2719-640023
		5MN401R	2719-630380(Neg. Grd.)	2719-600084	2719-640023
B.F. Goodrich		5MN35R	7MN31R	3355-1700-6	③3355-1670-1
Bendix		5MN49R	745-289670(Neg. Grd.)	745-289614	745-289278
		5MN400R	745-289359(Neg. Grd.)	745-289614	745-289278
		5MN402R	745-289359(Pos. Grd.)	745-289614	745-289278
		5MN403R	745-289670(Pos. Grd.)	745-289614	745-289278

① Includes gasket, harness pigtail and clip
② Includes O-rings
③ Includes O-rings and cover gasket

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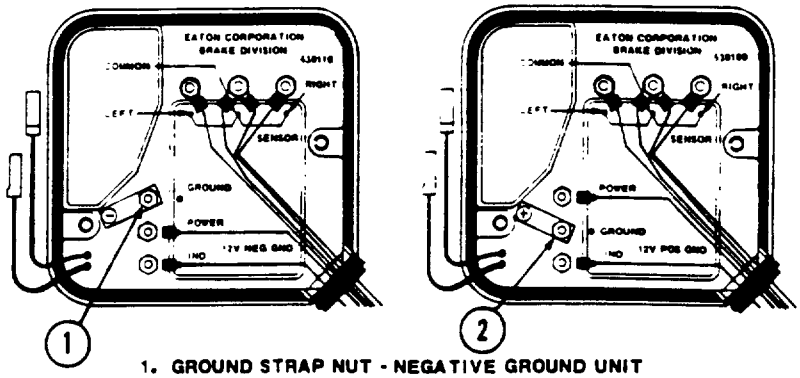
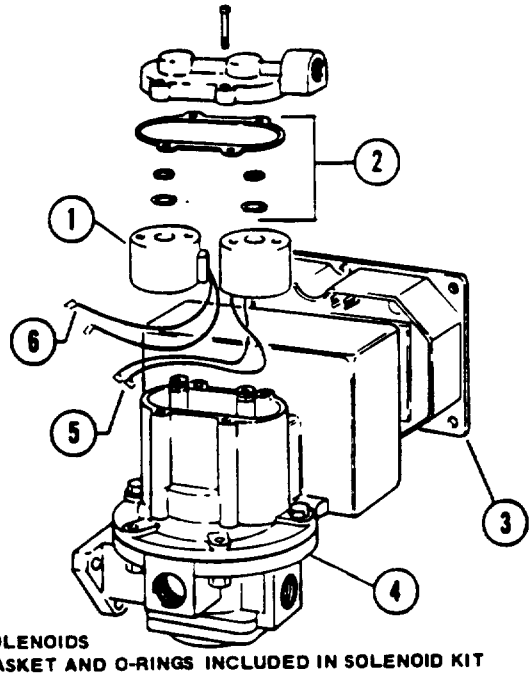


1. GROUND STRAP NUT - NEGATIVE GROUND UNIT
2. GROUND STRAP NUT - POSITIVE GROUND UNIT

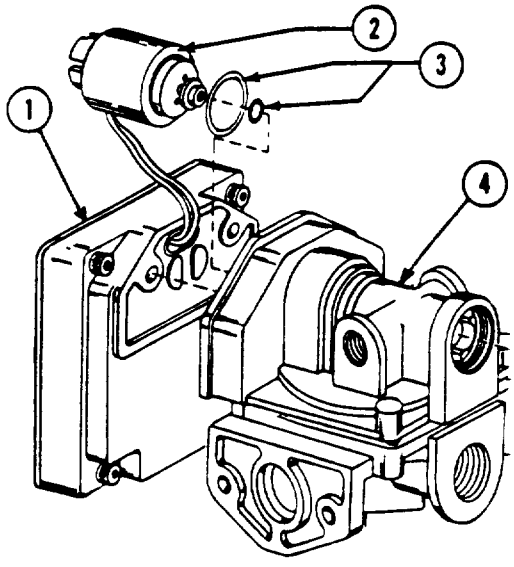
FIGURE 3



1. SOLENOIDS
2. GASKET AND O-RINGS INCLUDED IN SOLENOID KIT
3. CONTROLLER
4. VALVE
5. 1/4 IN. SPADE TERMINALS (SOLENOID NO. 2)
6. 3/16 IN. SPADE TERMINAL (SOLENOID NO. 1)

FIGURE 4

B.F. GOODRICH VALVE/CONTROLLER ASSEMBLY 5MN 35R



1. CONTROLLER
2. SOLENOID
3. O-RINGS
4. VALVE

FIGURE 5

BENDIX VALVE/CONTROLLER ASSEMBLY

Wheel speed pickup assemblies consist of the pickup, pickup gage blocks and mounting bracket. Gage blocks experience some wear during the initial operating period following a clearance adjustment. They must be replaced when the wear indicator grooves are no longer visible. The following parts list shows part numbers for the gage block service kit and the pickup. Bracket part numbers are not shown because they vary depending on the axle used. Consult chassis record for correct bracket part number.

SERVICE BULLETIN

JUNE 20, 1979 **No.** Q103 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☑ OAKVILLE☑

DISCONNECTING ANTI-WHEEL LOCK SYSTEM
(All Vehicles So Equipped)

PURPOSE To inform the field regarding legality of disconnecting or by-passing anti-wheel lock function on vehicles in service.

RECOMMENDATION If the anti-wheel lock system is in good operating condition it is recommended that it be left in operation unless otherwise instructed (e. g. by a mandatory safety campaign). If an anti-wheel lock system is disconnected, be sure to follow the instructions given here

INFORMATION In October, 1978 a Federal Court rendered a decision that invalidated the necessity for anti-wheel lock equipment. This decision means that a manufacturer, distributor, repair shop or owner may legally remove or make inoperative the anti-wheel lock equipment on any vehicle so equipped, regardless of date of manufacture.

Anti-wheel lock function is no longer required to meet the brake standards which the Federal Court modified. This decision does not mean that anti-wheel lock systems cannot be installed or used.

Mack Trucks, Inc. does not recommend that anti-wheel lock systems be disabled unless a condition exists that may increase stopping distances. However, some owners may want to disconnect their system. As a convenience to these owners we are providing the following instructions.

NOTE

We suggest that the disconnected wires be left intact and protected from damage so the system can be reconnected if desired.

A. Disconnecting the Anti-Wheel Lock Electrical System

NOTE

To insure complete deactivation of the anti-lock electrical system, it must be disconnected at two locations as described in following Steps 1 and 2. The procedure is the same for front and rear axle or bogie systems.

1. Disconnect the system power lead(s) at the cab circuit breaker. Location of the circuit breaker and wire identification is shown in the accompanying chart. After disconnecting, tape end of wire(s) so it cannot make electrical contact.

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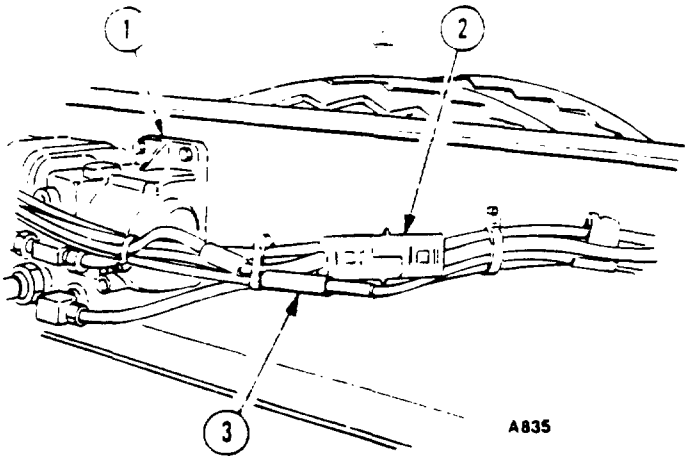


1. ANTI-WHEEL LOCK CONTROLLER
2. POWER/WARNING LEAD CONNECTOR
3. CONTINUITY CABLE (IF USED)

NOTE

The anti-wheel lock warning light will remain lit whenever the key switch is in the run position. This feature is an additional warning to the driver that the anti-lock system is inoperable.

IMPORTANT WARNING

BE SURE THE NOTICE LABEL 4MR1452 (REPRODUCED BELOW) IS AFFIXED TO THE INSTRUMENT PANEL IN FULL VIEW OF THE VEHICLE DRIVER.

NOTICE

The Wheel Anti-Lock System on this Vehicle has been made Inoperative by Disconnecting the Power Supply. The Brakes are Fully Driver Controlled.

4 MR 1452

B. Front (Steering) Axle Brakes

If the anti-wheel lock capability is removed from front wheel brakes, it is essential that the brakes do not have excessive braking ability, otherwise they may lock up and cause loss of steering control. This condition can exist on FA536 and 537 series front axles built between March 1, 1975 and June 1, 1976 and FA616D, 617D and 618D disc brake equipped front axles. These axles must be checked and if not equipped as follows, they must be modified. Consult your Mack service center.

Cam Brakes

- Type 20 brake chambers
- 5 1/2 in. slack adjusters
- Medium friction (EE) brake lining

Disc Brakes

- 17:1 Intensifier (Type 36 Rotochamber - Refer to Service Bulletin Q95a under BRAKES) or as an alternative.
- Install drum brakes - Consult your Mack service center.

Rockwell Front Driving Axle

No change required

END

SERVICE BULLETIN

JUNE 11, 1970 **No.** Q63 **under** BRAKES

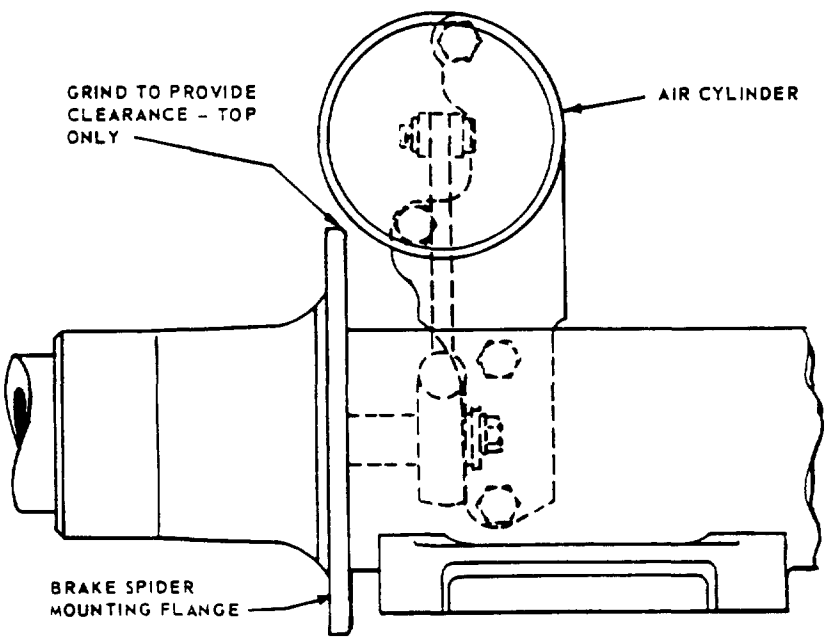
FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

BRAKE SPIDER MOUNTING FLANGE
(DM600 and DM800 Chassis with
SWD68 Bogie and 11.00 x 22 Tires)

PURPOSE To inform field of possible modification to spider mounting flange when replacing axle housing.

INFORMATION The original SWD68 bogie series design featured a flat on top of brake spider mounting flange parallel with the horizontal center line of cast housing. This was necessary to avoid a potential interference between flange and air cylinder when bogies are fitted with 11.00 x 22 tires and 7.00 inch long slack adjusters. To standardize components and introduce a product improvement 7.75 inch long slack adjusters have replaced the 7.00 inch long slack adjusters on current production units. This change increased the clearance gap sufficiently to discontinue the operation required for the flats. However, when installing new type axle housing without flats on the brake spider mounting flange to replace one with flats and 7.00 inch slack adjusters, be sure to hand grind sufficient clearance between brake spider mounting flange and air cylinder. See illustration.

RECOMMENDATION The modification to brake spider mounting flange is required only to eliminate possible interference that may develop when replacing housing.



BRAKE SPIDER MOUNTING FLANGE MODIFICATION

PRINTED IN U.S.A.

R. T. HEINEY 57
MACK TRUCKS, INC.
601 SOUTH 10TH STREET
ALLENTOWN, PENNSYLVANIA 18103

SERVICE BULLETIN

JULY 17, 1970 **No.** Q65 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

INSTRUCTIONS AND SERVICE DATA
(All Mack Chassis Equipped with
Bendix-Westinghouse DD-3 Brake Actuators)

PURPOSE To inform field of instructions and service data applicable to DD-3 brake actuators.

INFORMATION Bendix-Westinghouse Instruction and Service Data Bulletin SD-38 provides detailed information on maintaining, servicing and replacing DD-3 actuators. In addition to established general preventive maintenance procedures it is recommended that yearly or after 50,000 miles, depending on type of operation, the DD-3 actuators be completely disassembled to inspect condition of internal parts and replace diaphragms and other rubber parts/or parts if worn or deteriorated.

RECOMMENDATION File the attached Bendix-Westinghouse Instruction and Service Data SD-38, following this bulletin. Inform all affected personnel of its content.

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SERVICE BULLETIN

AUGUST 15, 1980 T **No.** Q104 **under** BRAKES

FOR BRANCHES, DISTRIBUTORS AND CUSTOMERS.

CHASSIS AFFECTED ALLENTOWN☑ HAYWARD☑ OAKVILLE☑

BRAKE LINING SERVICE KITS
(All With 16-1/2 x 7 Cam Type Rear Axle Brakes)

PURPOSE To inform the field of new service linings made of non-asbestos material.

RECOMMENDATION Install non-asbestos lining kits if improved lining and drum life and/or quieter operation is desired.

INFORMATION The non-asbestos linings provide longer drum and lining life along with reduced noise levels. They are directly interchangeable with standard and combination service kits on axles rated at 20,000 pounds (40,000 per bogie) or less. They can also be used on axles rated up to and including 23,000 pounds (44,000 per bogie) if type 30 brake chambers and six inch slack adjusters are installed.

Lining kits currently available are:

Standard Service Kits	Combination Service Kits	Non-Asbestos Service Kits	Application
202SMH204	202SMH204-P2	202SMM204N	Rockwell Pand Q
not available	202SMH210	202SMM210N	Rockwell P-44,000 lb. bogie
202SMH220	202SMH220	202SMM220N	Eaton

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CLUTCH REMOVAL

NOTE

Always mark clutch cover and flywheel with a center-punch before removing clutch to facilitate reinstalling clutch in same position.

1. Use three spring retention tools (17-T-1123 for CL-28, 40 and 50 series, 17-T-1766 for CL-47 series) or retaining cups as shown in Figure 4 -1, when removing a clutch assembly from the flywheel.

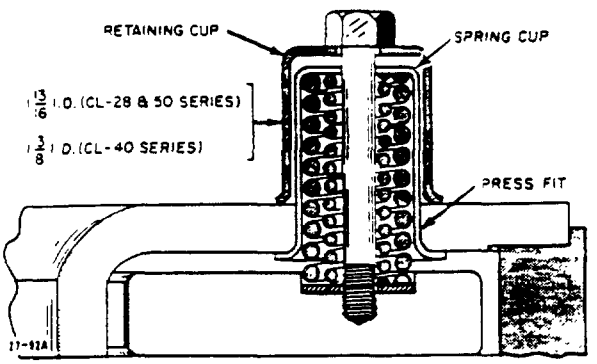


Figure 4-1. Retaining Cups

To use spring retention tools, bottom screws in tapped holes in pressure plate. Set tool nuts up snugly against tool bracket. Tighten tool nuts evenly to relieve spring tension on pressure plate. Not used on CL-58 Series.

2. Remove two clutch-to-flywheel capscrews with lockwashers at the ten o'clock and two o'clock positions of the flywheel and install two long headless guide studs to support the clutch assembly during removal of the remaining attaching capscrews.

3. After removal of all capscrew fasteners, carefully remove heavy clutch and disc assembly from flywheel counterbore and place on bench. Be careful not to drop driven disc assembly which is now free. Also remove the temporary guide studs from flywheel.

CLUTCH INSTALLATION

1. Using spring retention tools, bottom screws in tapped holes in pressure plate. Set tool nuts up snugly against tool bracket. Not used on CL-58 Series.

NOTE

Three retaining cups and screws are used to hold a new clutch assembly together until it is installed on the flywheel. Spring cups are pressed into the clutch cover hence the retaining cups are necessary to prevent spring cups loosening and slipping out of the cover during handling. Retaining cups and screws must be removed after the clutch is assembled to the flywheel. A tag is attached to new clutches (CL-28, 40 and 50 Series) calling attention to this fact and cups and screws are painted red for ready identification.

2. Engage splined end of clutch disc aligning mandrel or a spare main driving pinion with hub splines of driven disc from rear of long hub side. Then position driven disc assembly in flywheel so that spigot end of shaft engages inner race of clutch pilot bearing mounted in flywheel. This arrangement positions the disc assembly in proper alignment until clutch is completely assembled and secured in flywheel.

3. Install two long guide studs in the ten and two o'clock positions in flywheel rim. Mount clutch assembly on guide studs and push unit into flywheel bore until clutch cover flange enters counterbored pilot provided. Be careful not to disturb disc aligning mandrel.

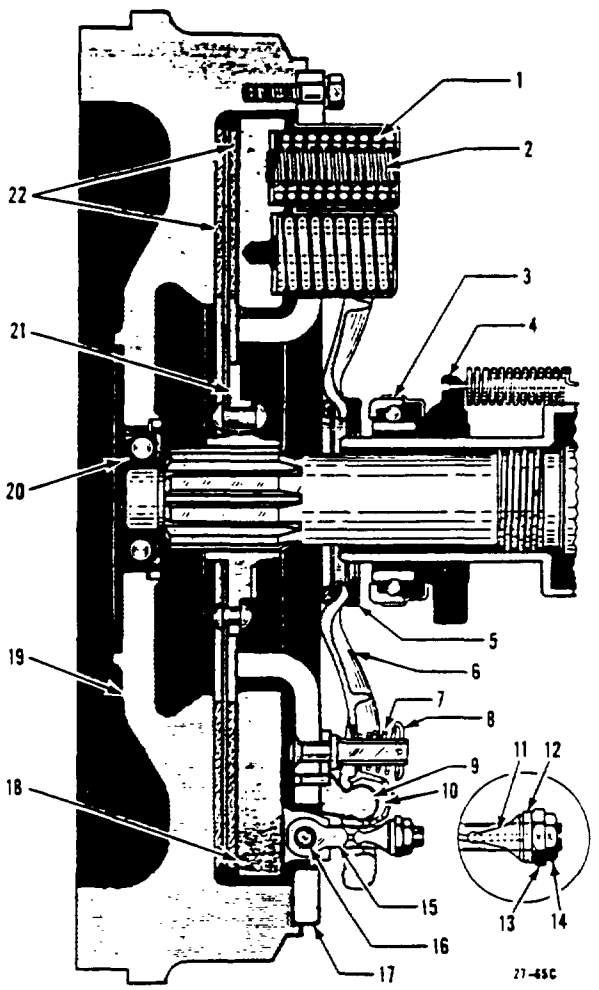
4. Lubricate and install cover-to-flywheel capscrews with their lockwashers. Tighten capscrews a few turns at a time so that cover will not be misaligned and forced into flywheel pilot by the tightening of the capscrews. Remove the two guide studs and replace with capscrews and their lock washers. Remove aligning mandrel.

CL-28 and 40 SERIES

Description

CL-28, -40 Series assemblies are single plate, dry disc pusher type clutches. They consist of a pressure plate, a cover, and a driven disc which is splined to the transmission main driving pinion shaft. When

engaged, the driven disc is clamped between the pressure plate and the flywheel by the pressure of coil springs which are mounted in cups on the cover. Drive is transmitted to the pressure plate by pressure plate lugs which fit in the cover openings. Six release levers have ball pivots and are linked to the pressure plate by eyebolts. The inner ends of the levers are held by the notched release thrust washer. See Figure 4-2.



1. Clutch Spring (outer)
2. Clutch Spring (inner, where used)
3. Release Bearing
4. Release Collar
5. Thrust Washer
6. Release Lever
7. Lever Spring
8. Spring Washer
9. Lever Pivot
10. Lever Bushing
11. Eyebolt Fulcrum
12. Washer
13. Fulcrum Adjustment Nut
14. Lock Nut
15. Eyebolt
16. Eyebolt Pin
17. Cover Plate
18. Pressure Plate
19. Flywheel
20. Pilot Bearing
21. Driven Disc Assembly
22. Driven Disc Facings

Figure 4-2. Sectional View of CL-28. 40 Series Clutch

Disassembly

NOTE

Before disassembly of the various parts, it is good practice to mark these parts with a center-punch, so that at reassembly, they can be reassembled in their original positions. This is necessary in order not to disturb the dynamic balance of the clutch.

1. Before removing the three spring retention tools, compress clutch release lever springs, remove washer pins, then remove washers and release lever springs. Pry off snap ring from thrust washer. Remove eyebolt nuts, fulcrums, and clutch release levers.

CAUTION

If retaining cups are used instead of tool (17-T-1123), clamp the cover in a press before removing the cups. This is necessary because the screw used does not have sufficient thread length to completely release the spring load before coming out of the pressure plate.

2. While holding spring retention tool screws, back off tool nuts alternately making one turn at a time. When spring is entirely relieved, back out the three tool screws.

3. Remove clutch cover and springs. If heat-insulating washers are removed from pressure plate spring pockets, retain them for reassembly. The eyebolts need not be removed unless inspection reveals distortion or loose fit on pins.

Inspection and Repair

Remove all traces of dirt and oil with a suitable safe solvent. Inspect parts carefully for cracks, distortion or excessive wear.

1. If cover is cracked or distorted, replace. Tack-weld loose spring cups (on covers having this construction) replace worn or loose ball-fulcrums. Replace loose or bent pin rivets.

2. Replace springs if cracked or defective. Check all springs on a spring tester. Replace all that do not meet specifications.

3. Replace thrust washer if worn, bent or defective.

4. Replace worn release levers, springs and ball seats. Check levers with a straightedge and 11/16 inch ball (17-T-1126), see Figure 4-3, and if bent so that dimension (1) is more than 11/32 inch when measured at a point where distance (2) is 2-1/2 inch, replace the lever.

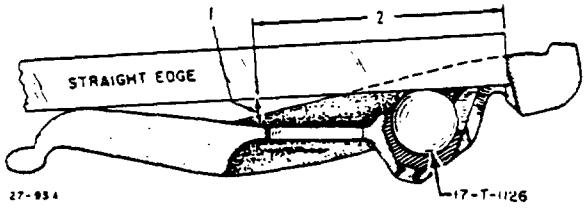


Figure 4-3. Checking Release Lever for Bend

5. If pressure plate is scored, heat checked, or warped more than 0.020 inch, it must be replaced or refaced. Remove only enough metal to obtain a smooth flat surface. Finish with a light cut and polish with emery cloth. When thickness (1) becomes less than the worn limit given in specifications, the plate must be replaced. Measure at outer spring pocket, see Figure 4-4. Measuring at inner pocket is not accurate, if pressure plate is dished. If cleft lugs are worn, cracked or distorted, replace the plate. Replace eyebolts if they are distorted, have worn threads or keyways.

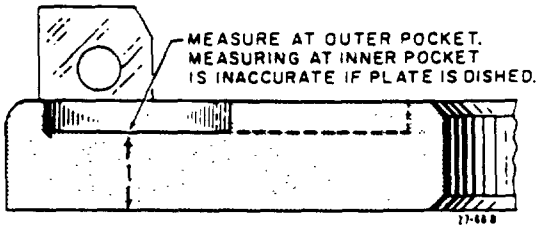


Figure 4-4. Pressure Plate Thickness Dimension

6. If flywheel is warped or heat checked and surface is refinished, maintain the 1.594 inch dimension between disc surface and bolting face for proper release lever adjustment. See Figure 4-5. No more than .070 inch maximum may be removed by grinding.

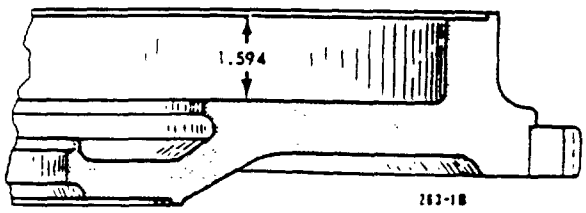


Figure 4-5. Flywheel Rubbing Surface-to-Clutch Cover Bolting Surface Dimension

7. Inspect driven disc assembly for cracks, loose rivets, worn splines, warped or dished condition. If cracked, or hub splines are worn excessively, replace disc assembly. If facings are worn down nearly even with countersunk facing-retaining rivet heads and provided assembly is in otherwise good condition, it may be rebuilt.

8. Pilot bearing should be removed, cleaned and checked each time clutch or engine is removed. Discard bearing if balls or races are chipped or scored. After inspection, hand-pack bearing with recommended clutch pilot bearing grease and install bearing in flywheel. Tap into place with shielded side toward clutch and snap ring seated in counterbore.

NOTE

Old bearings without a snap ring cannot be used in new through-bored flywheels.

After bearing is properly installed, pack the cavity in back of the bearing with recommended clutch pilot grease.

NOTE

To prevent damage to the bearing seal when the transmission is assembled to the engine, the space occupied by the main driving pinion pilot must not be filled with grease. See Figure 4-6.

All current Mack-made engine flywheels have been manufactured by boring the clutch pilot bearing hole straight-through and counterboring a recess to provide proper positioning for the snap ring type pilot bearings now in use.

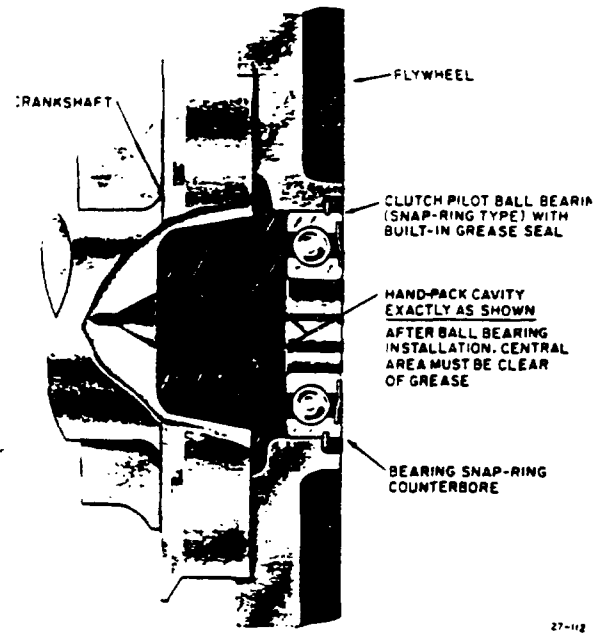


Figure 4-6. Cut-away View of Clutch Pilot Bearing Grease Reservoir Correctly Packed

CAUTION

Do not install a new snap ring bearing in an old flywheel without removing the snap ring and discarding. In old flywheels without the counterbore, the snap ring would position the bearing too far rearward, which would result in early bearing failure and considerable damage to costly components. Use only the recommended snap ring type bearings specified. These bearings will function without premature failure where slight misalignment exists between engine and transmission.

Before assembling the clutch, a positive wear check should be made to insure that it will provide maximum disc wear. This check will uncover any wear conditions that might prevent full release lever travel and allow corrections to be made before the clutch is assembled.

Place the pressure plate assembly and cover (without springs) into position as shown in Figure 4-7, making sure that shims of the correct thickness (.200) are inserted between cover and spacer (17-T-1763). Install each release lever and while pressing firmly on the fulcrum, measure distance (1) inboard end of lever is above cover.

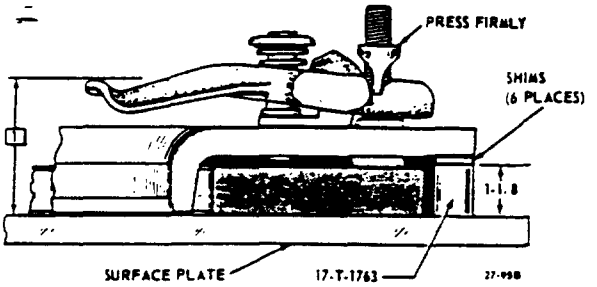


Figure 4-7. Wear Check

Correct height for the CL-28 Series, 3-9/32 inches, for the CL-40 Series, 3 inches.

Reassembly

1. Remove the shims used for the wear check. Lightly lubricate pivot ball bushing, fulcrum groove, eyebolt pin and inboard end of release lever with clutch lever grease.

2. Place the pressure plate on a face plate with the spring pockets of the pressure plate up. Place heat-insulating washers and the springs in the pressure plate spring pockets.

NOTE

If pressure plate was refaced, insert washers into the spring cups of a thickness equal to the metal removed from the pressure plate. Shellac the washers in place to facilitate retention.

3. Place the cover in position, align the springs in the pockets. Bottom the screws of the three spring retention tools into the threaded holes of the pressure plate and bring the tool nuts down snugly against the tool bracket. Tighten the tool nuts alternately, one turn at a time, guiding the pressure plate lugs into the clutch cover holes until the inside face of the cover is 1.125 inch from the face of the pressure plate. Special tool (17-T-1763), is used to facilitate obtaining this dimensions, see Figure 4-8.

4. Place the clutch release levers on the ball fulcrums and eyebolt shanks. Place the lever springs on the spring pins with the small diameter against the release levers.

assembled in their original positions. This is necessary in order not to disturb the dynamic balance of the clutch.

1. Equally space three steel blocks 3/8 inch thick, on bed of arbor or drill press.

2. Place clutch with pressure plate side down, on blocks. (This is done in order to raise clutch to permit disassembly).

3. Place a block of wood, such as a two by four, across cover plate in a position that does not interfere with tips of release levers, as shown in Figure 4-10. Compress clutch assembly slightly, removing lever adjusting screw locknuts.

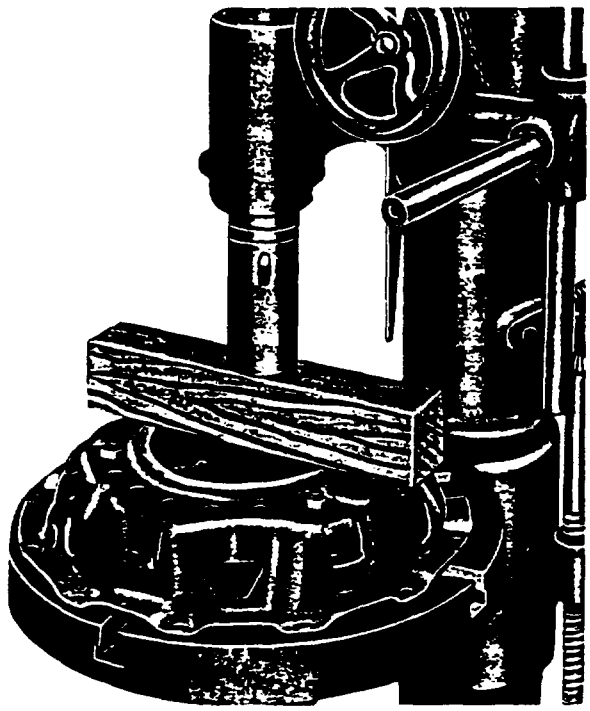


Figure 4-10. Compressing Clutch

4. Turn each lever adjusting screw down (clockwise), a few turns with a screwdriver, releasing spring tension a small amount. Repeat operation until all lever adjusting screws are entirely free of cover plate. Release remaining spring tension, and lift cover plate off pressure springs.

5. Pressure springs may now be removed. After extracting cotter pins and lever pins, remove release levers.

Inspection and Repair

Clean all parts thoroughly with a suitable safe solvent, then inspect carefully for excessive wear, distortion, or cracks as outlined below:

1. Check cover plate for distortion, excessive wear at indentations which register between drive bosses on pressure plate, and for stripped threads in holes accommodating release lever adjusting screws. If the above mentioned conditions are apparent, replacement of cover plate is required.

2. Replace springs if cracked or defective. Check all springs on a spring tester. Replace all that do not meet specifications.

3. Replace release levers that are badly worn on tips (this is an indication of a sticking release bearing), worn threads on lever adjusting screws and nuts, or where binding appears to be present, which retards free back and forth movement.

NOTE

Release levers are serviced as a subassembly only, and consist of lever, adjusting screw, roller, roller block, lever spring and spring retaining pin.

4. If pressure plate shows signs of scoring, excessive wear at lever pin holes, inside of drive bosses, heat checking, or if warped more than .020 inch, plate must be refaced or replaced. (When refacing pressure plate, remove only sufficient metal to obtain a smooth flat surface.)

NOTE

When pressure plate thickness becomes less than 1.141 inch, replacement is necessary.

5. If flywheel is warped or heat checked and surface is refinished, maintain the 1.188 inch dimension between disc surface and bolting face for proper release lever adjustment. No more than .070 inch maximum may be removed by grinding.

6. Inspect driven disc assembly for cracks, loose rivets, worn splines, warped or dished condition. If cracked, or hub splines are worn excessively, replace disc assembly.

If facings are worn down nearly even with countersunk, facing-retaining rivet heads and provided assembly is in otherwise good condition, it may be rebuilt.

7. Pilot bearing should be removed, cleaned and checked each time clutch or engine is removed. Discard bearing if balls or races are chipped or scored. After inspection, hand-pack bearing with clutch pilot bearing grease and install bearing in flywheel. Tap into place with shielded side toward clutch.

After bearing is properly installed, pack the entire cavity in back of the bearing with the same specified clutch pilot grease.

NOTE

To prevent damage to the bearing seal when the transmission is assembled to the engine, the space occupied by the main driving pinion pilot must not be filled with grease. See Figure 4-11.

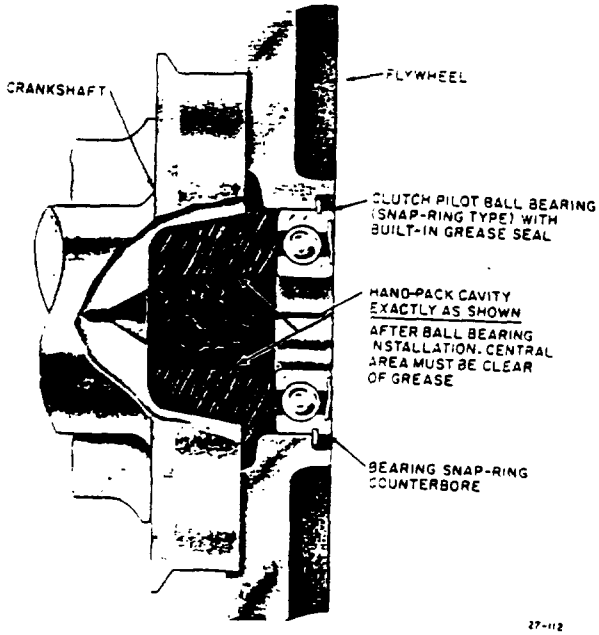


Figure 4-11. Cut-away View of Clutch Pilot Bearing Grease Reservoir Correctly Packed

Use only the recommended pilot bearings specified. These bearings will function without premature failure where slight misalignment exists between engine and transmission.

Reassembly

1. Mount release lever assemblies on pressure plate. Set pressure plate assembly on three equally spaced steel blocks 3/8 inch thick, on bed of arbor or drill press, plate side down.

2. Place pressure springs in position on pressure plate, as shown in Figure 4-12.

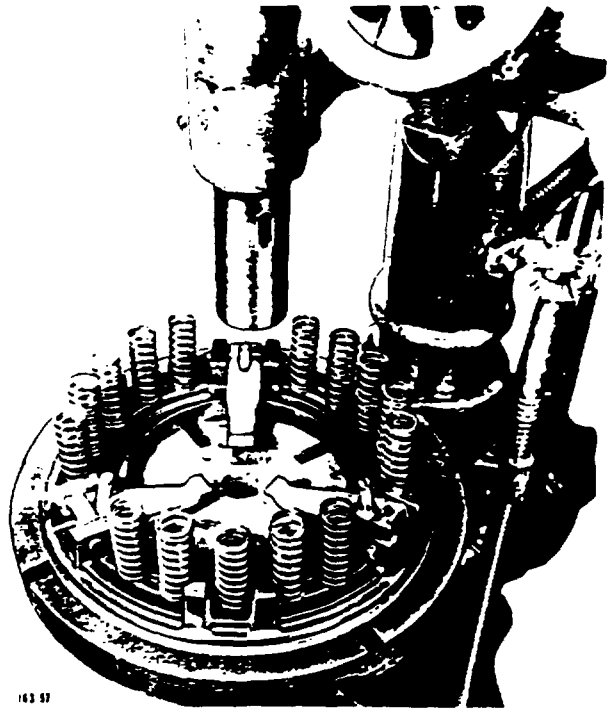


Figure 4-12. Assembling Clutch

3. Lay cover plate over springs, being sure that all springs are seated on bosses of pressure plate, and around indentations on inside of cover.

4. If pressure plate was refaced, it will be necessary at assembly, to add shims under each pressure spring equal to total metal removed.

5. Compress assembly slowly, aligning lever adjusting screws with threaded holes in cover plate. (The indentations inside cover, should enter the spaces between drive bosses on pressure plate freely.) With screwdriver, thread ends of adjusting screws into cover evenly, until screws protrude about 1/2 inch. Hold assembly compressed, while placing locknuts in position, but do not tighten.

6. To facilitate installation on flywheel, place wood blocks approximately 3/8 inch thick, between the tops of release levers and inner rim of cover plate. (Be sure these stay in position as all tension is released).

7. Insert the three spring retention tools (17-T-1766), through cover and bottom in tapped holes in pressure plate (center hole of each five series in cover). With pres-

sure plate face down on smooth surface. insert three clutch cover spacer gages (17-T-1767) (3/4 inch) at three equidistant points around edge of cover. These gages may be held with bolts, but do not allow bolts to extend beyond lower face of gages.

8. Holding bolt head of spring retention tool, draw up nuts evenly until blocks can be removed from between release levers and cover. After removing blocks, release tension by backing off nuts until pressure plate and cover spacers rest evenly on smooth surface. Using lever setting gage (17-T-1768), check distance from release lever tips to smooth surface. Adjust screws until desired setting is obtained. See specifications. Then lock screws in position with locknuts.

CL-50 SERIES

Description

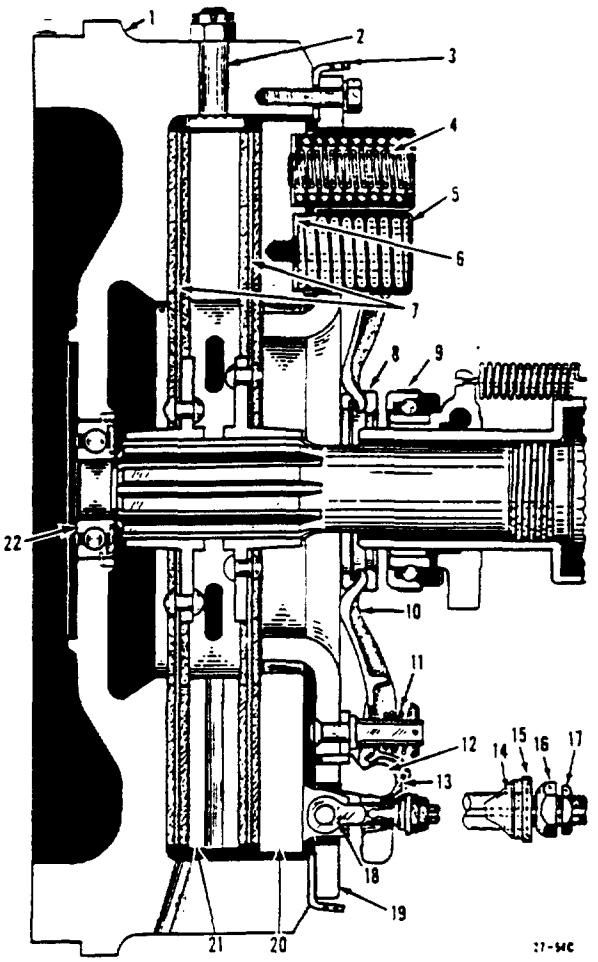
CL-50 Series assemblies are two-plate, dry disc pusher type clutches. In engagement, the two driven discs and the intermediate plate are clamped between the pressure plate and the flywheel by the force of multiple-helical springs backed up by the cover which is bolted to the flywheel. Six lugs in the flywheel, drive the intermediate plate, but permit free longitudinal movement. Pressure plate drive is transmitted by six cleft lugs which fit openings in the cover. The release levers have ball pivots and are linked to the pressure plate by eyebolts. The inner ends of the levers are held by the notched release thrust washer. See Figure 4-13.

Disassembly

NOTE

Before disassembly of the various parts, it is good practice to mark these parts with a centerpunch, so that at reassembly, they can be reassembled in their original positions. This is necessary in order not to disturb the dynamic balance of the clutch.

1. Before removing the three spring retention tools. compress clutch release lever springs, remove washer pins, then remove washers and release lever springs. Pry off snap ring from thrust washer. Remove eyebolt nuts. fulcrums. and clutch release levers.



1. Flywheel
2. Intermediate Plate Drive Pin
3. Adjusting Spacer
4. Clutch Spring
5. Spring Cup
6. Insulating Washer
7. Driven Disc
8. Thrust Washer
9. Release Bearing
10. Release Lever
11. Lever Spring
12. Lever Pivot
13. Lever Bushing
14. Eyebolt Fulcrum
15. Adjusting Nut Washer
16. Eyebolt Adjusting Nut
17. Eyebolt Lock Nut
18. Eyebolt
19. Clutch Cover
20. Pressure Plate
21. Intermediate Plate
22. Pilot Bearing

Figure 4-13. Sectional View of CL-50 Series Clutch

CAUTION

If retaining cups are used instead of tool (17-T-1123), clamp the cover in a press before removing the cups. This is necessary because the screw used does not have sufficient thread length to completely release the spring load before coming out of the pressure plate.

2. While holding spring retention tool screws, back off tool nuts alternately, making one turn at a time. When spring is entirely relieved, back out the three tool screws.

3. Remove clutch cover and springs. If heat-insulating washers are removed from pressure plate spring pockets, retain them for reassembly. The eyebolts need not be removed, unless inspection reveals distortion or loose fit on pins.

Inspection and Repair

Remove all traces of dirt and oil with a suitable safe solvent. Inspect parts carefully for cracks, distortion or excessive wear as follows:

1. If cover is cracked or distorted, replace. Tack-weld loose spring cups (on covers having this construction) replace worn or loose ball-fulcrums. Replace loose or bent release lever spring pins.

2. Replace springs if cracked or defective. Check all springs on a spring tester. Replace all that do not meet specifications.

3. Replace thrust washer if worn, bent or defective.

4. Replace worn release levers, springs and ball seats. Check levers with a straightedge and 11/16 inch ball (17-T-1126) as illustrated, in Figure 4-14 and if bent so that dimension (1) is more 11/32 inch when measured at a point where distance (2) is 2-1/2 inch, replace the lever.

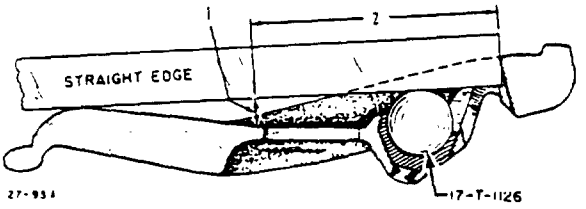


Figure 4-14. Checking Release Lever for Bend

5. If pressure and intermediate plates are scored, heat checked, or warped more than 0.020 inch, they must be replaced or refaced. Remove only enough metal to obtain a smooth flat surface. Finish with a light cut and polish with emery cloth. When thickness (1) becomes less than the worn limit given in specifications, the plate must be replaced. Measure at outer spring pocket as shown in Figure 4-15. Measuring at inner pocket is not accurate if pressure plate is dished. If cleft lugs are worn, cracked or distorted, replace the plate. The intermediate plate features a double set of drive slots for increased service life. At clutch installations after rebuild, it is recommended that the set with less wear be used. Replace eyebolts if they are distorted, have worn threads or keyways.

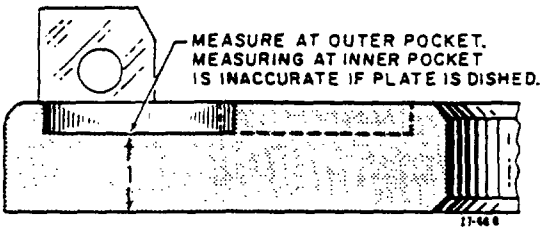


Figure 4-15. Pressure Plate Thickness Dimension

6. If flywheel is warped or heat checked and surface is refinished, maintain the 2.797 inch dimension between disc surface and bolting face for proper release lever adjustment. See Figure 4-16. No more than .070 inch maximum may be removed by grinding.

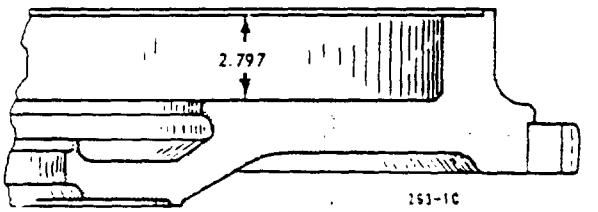


Figure 4-16. Flywheel Rubbing Surface-to-Clutch Cover Bolting Surface Dimension

Intermediate plate drive pins should be inspected for abnormal wear.

When pins have been removed to permit flywheel machining, or require replacement, squareness between flywheel friction and pin drive faces must be maintained at installation. A positioning tool will assist in establishing necessary alignment.

Suitable for this purpose, will be a slotted steel block 4 inches long, 2-1/2 inches wide and 1-1/2 inches thick. One 2-1/2 inches x 4 inches face should be ground for maximum flatness, as it will constitute the major working surface. A 3/16 inch x 45° chamfer along all edges of this face will tend to prevent burrs that would affect accuracy. See Figure 4-17.

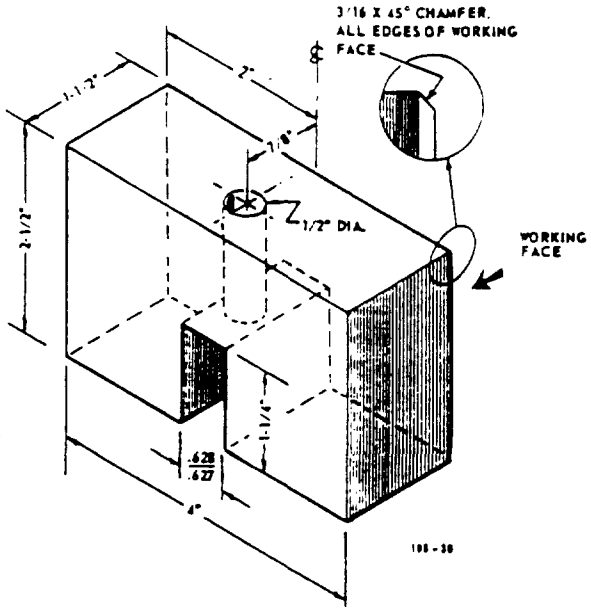


Figure 4-17. Drive Pin Positioning Tool

Midway between ends of the 4 inch length, a .628/.627 inch wide slot 1-1/4 inch deep should be machined through the 1-1/2 inch thickness. The slot must be exactly square with the ground face for it will determine flywheel to drive pin head alignment. A half -inch drift pin clearance hole, drilled from the side opposite, and intersecting with, the slot will complete the tool. Hole centerline should be 7/8 inch from the ground face, so that driving force will be centered over the head. Magnetizing the block will minimize movement during driving and lessen possibility of marring flywheel face.

In use, the threaded portion of the pin is inserted in the flywheel hole. The positioning tool slot is placed over the drive head, with the ground surface held flat against the flywheel friction face. The pin is then driven until fully seated.

7. Inspect driven disc assembly for cracks, loose rivets, worn splines, warped or dished condition. If cracked, or hub splines are worn excessively, replace disc assembly. If facings are worn down nearly even with countersunk facing-retaining rivet heads and assembly is in otherwise good condition, it may be rebuilt.

8. Pilot bearing should be removed, cleaned and checked each time clutch or engine is removed. Discard bearing if balls or races are chipped or scored. After inspection, hand-pack bearing with clutch pilot bearing grease and install bearing in flywheel. Tap into place with shielded side toward clutch and snap ring seated in counterbore. Old bearings without a snap ring cannot be used in new through-bored flywheels.

After bearing is properly installed, pack the entire cavity in back of the bearing with the same specified clutch pilot grease.

NOTE

To prevent damage to the bearing seal when the transmission is assembled to the engine, the space occupied by the main driving pinion pilot must not be filled with grease. See Figure 4-18.

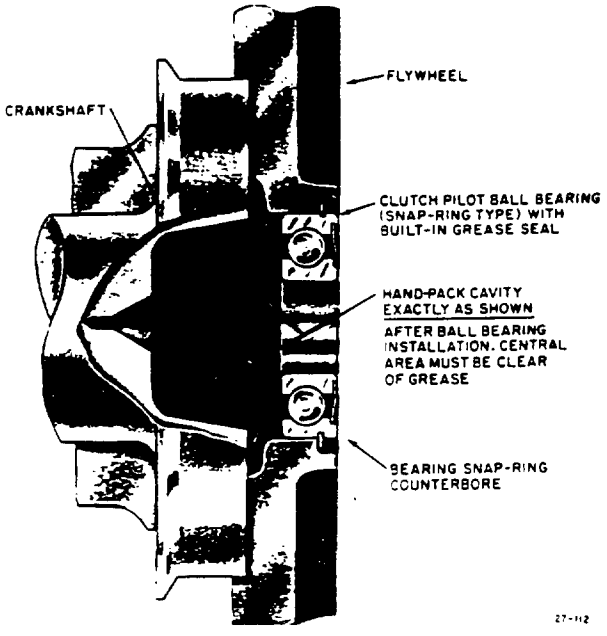


Figure 4-18. Cut-away View of Clutch Pilot Bearing Grease Reservoir Correctly Packed

All current Mack-made engine flywheels have been manufactured by boring the clutch pilot bearing hole straight-through and counterboring a recess to provide proper positioning for the snap ring type pilot bearings now in use.

CAUTION

Do not install a new snap ring bearing in an old flywheel without removing the snap ring and discarding. In old flywheels without the counterbore, the snap ring would position the bearing too far rearward, which would result in

early bearing failure and considerable damage to costly components. Use only the recommended snap ring type bearings specified. These bearings will function without premature failure where slight misalignment exists between engine and transmission.

Before assembling the clutch, a positive wear check should be made to insure that it will provide maximum disc wear. This check will uncover any interference that might prevent full release lever travel and allow corrections to be made before the clutch is assembled.

Place the pressure plate assembly and cover (without springs) into position as shown in Figure 4-19, making sure that shims of the correct thickness (.250) are inserted between cover and spacer (17-T-1763). Install each release lever and while pressing firmly on the fulcrum, measure distance (1) inboard end of lever is raised above cover. Correct height is 3-11/32 inches. Remove any interference that prevents obtaining this dimension.

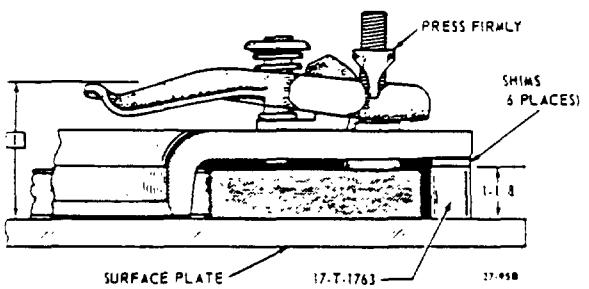


Figure 4-19. Wear Check

Reassembly

1. Remove the shims used for the wear check. Lightly lubricate pivot ball bushing, fulcrum groove, eyebolt pin and inboard end of release lever with clutch lever grease.

2. Place the pressure plate on a surface plate with the spring pockets of the pressure plate up. Place heat-insulating washers and the springs in the pressure plate spring pockets.

NOTE

If pressure plate and intermediate plate were refaced, insert washers into the spring cups of a thickness equal to the metal removed from the pressure plate and intermediate plate. Shellac the washers in place to facilitate retention.

3. Place the cover in position, align the springs in the pockets. Bottom the screws of the three spring retention tools into the threaded holes of the pressure plate and bring the tool nuts down snugly against the tool bracket. Tighten the tool nuts alternately, one turn at a time, guiding the pressure plate lugs into the clutch cover holes until the inside face of the cover is 1.1875 inch from the face of the pressure plate. Special tool (17-T-1763) and a 1/16 inch spacer (17-T-11337), is used to facilitate obtaining this dimension. See Figure 4-20.

NOTE

If the intermediate driving plate is worn or has been machined, the consequent reduction in thickness will produce the same effect as worn clutch discs when the clutch assembly is installed in a vehicle. In an extreme case, one-half the available release collar wear travel may be used up before the vehicle is put back into service.

To compensate for this condition, shims of appropriate thickness must be inserted between cover and spacers (17-T-1763) while the clutch is adjusted. Measure thickness of the intermediate driving plate which will be used with clutch being adjusted and compare with new thickness as shown in specifications. If plate is .010 inch or more below new thickness, secure shims equal in thickness to amount of metal removed and insert them between clutch cover and spacers (17-T-1763) at equally spaced intervals. See Figure 4-20.

4. Place the clutch release levers on the ball fulcrums and eyebolt shanks. Place the lever springs on the spring pins with the small diameter against the release levers. Place the spring washers in position, com-

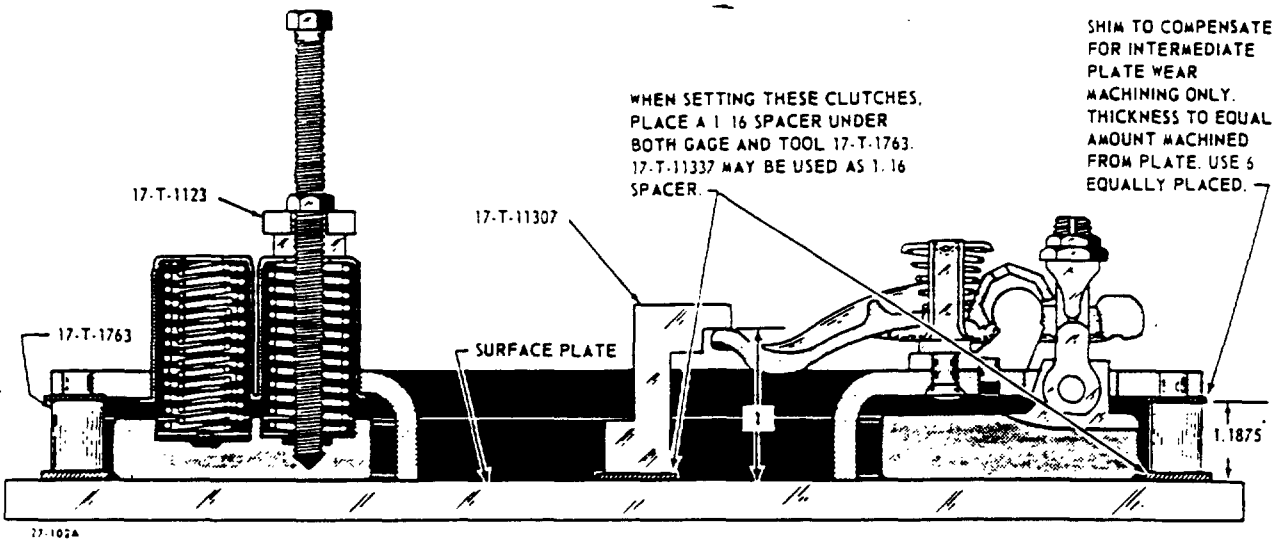


Figure 4-20. Method of Setting Clutch

press, and insert the washer lock pins. Install the fulcrums and adjust the nuts until the distance between the convex surface of each lever to the pressure plate (dimension (1), Figure 4-20) agrees with specifications. Special tools (17-T-11307) and a 1/16 inch spacer (17-T-11337) are used to facilitate obtaining this dimension. See Figure 4-20 showing use of these tools. Torque eyebolt locknut 40 to 45 lbs. ft. Install the thrust washer on the release levers and lock it in place with the snap ring.

CL-58 SERIES

Description

The CL-58 Series clutches are of the conventional single-plate, dry-disc pusher-type. They consist of a cast iron pressure plate, a cast iron cover and a rigid-type driven disc which is splined to the transmission main driving pinion shaft. When engaged, the driven disc is clamped between the pressure plate and flywheel web by the pressure of thirty-six compressed helical main springs reacting on the rigid cast iron cover. The springs are arranged symmetrically in groups of six between each pair of levers. Drive from cover-to-pressure plate is by engagement of six pairs of integral lugs on the pressure plate which are straddled by six pairs of mating lugs integral with the cover. The six forged and hardened steel release levers have anti-friction needle roller bearing mounting to the plate at the drive lugs and pivot in similar anti-friction needle roller bearings supported by yokes bolted to the cover. All six release levers are provided with individual anti-rattle springs. The notched release lever thrust washer ring is held in engagement with the lever tips by wire clamp extensions of three alternate lever anti-rattle springs. See Figure 4-21.

Disassembly

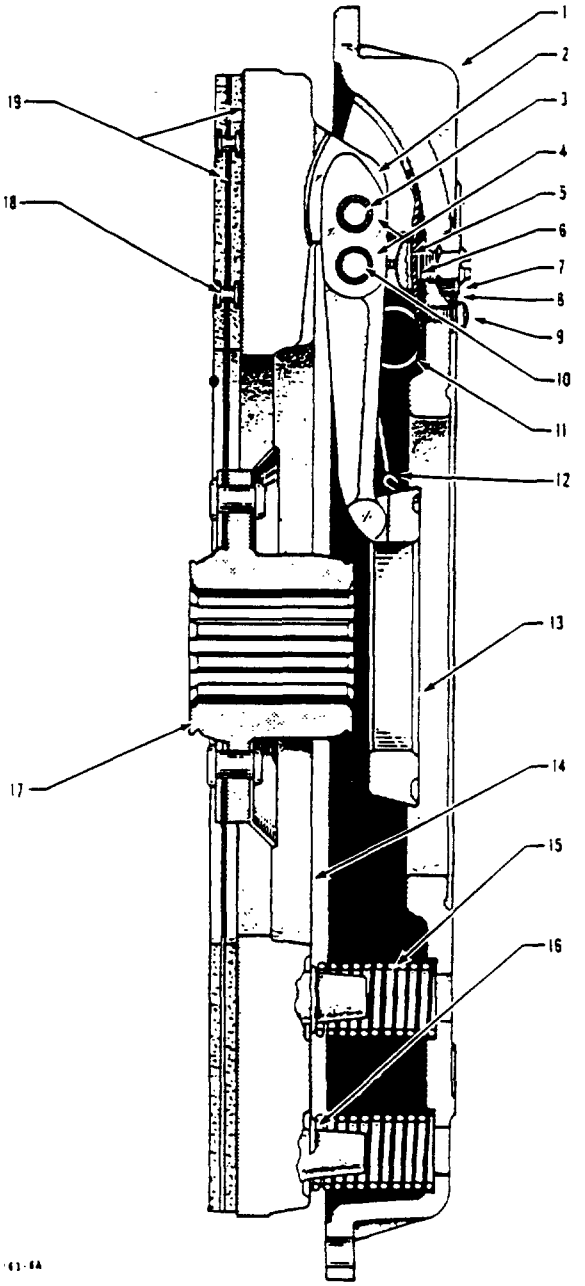
NOTE

Before disassembly of the various parts, it is good practice to mark these parts with a centerpunch, so that at reassembly, they can be reassembled in their original positions. This is necessary in order not to disturb the dynamic balance of the clutch.

1. With a screwdriver, unhook the wire clamps that retain slotted thrust washer ring to the lever tips and remove ring.

2. With pressure plate side down, position clutch assembly on rebuild machine table. With a suitable clamping device, compress the spring-loaded cover assembly. Remove nut lock plate retaining screws, lockwashers, nut lock plates and lever adjusting nuts from cover and put aside for use at reassembly. See Figure 4-22. Clamping pressure on the clutch cover may now be relieved.

3. Remove inverted leaf springs from lever yoke stems, helical main springs, and



1. Clutch Cover
2. Release Cover
3. Release Lever Pin
4. Needle Bearings
5. Release Lever Yoke
6. Yoke Leaf Spring
7. Lever Adjusting Nut
8. Adjusting Nut Lock Plate
9. Lock Plate Lock Screw
10. Yoke Clevis Pin
11. Double Torsion Anti-Rattle Spring
12. Thrust Washer Clamp
13. Lever Thrust Washer Ring
14. Pressure Plate
15. Helical, Main Spring
16. Heat Insulator Ring
17. Driven Disc Assembly
18. Facing Rivet
19. Driven Disc Facings

Figure 4-21. Sectional View of CL-58 Series Clutch

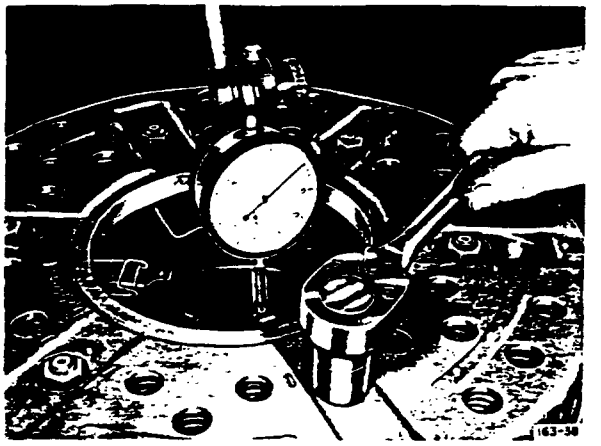


Figure 4-22. Removing Lever Adjusting Nut Lock Plates

main spring insulator washers from pressure plate bosses.

NOTE

Do not remove the six lever anti-rattle springs from the cover unless replacement is necessary.

4. Lay pressure plate on bench and with a soft metal drift, drive hardened lever pins out of pressure plate drive lugs to free release levers. With a pair of pliers, remove cotter pin from each lever yoke clevis pin and then press out each yoke clevis pin by hand.

NOTE

When removing levers from pressure plate drive lugs and lever yoke, be very careful not to lose any of the small uncaged needle rollers.

Inspection and Repair

Remove all traces of dirt and oil with a suitable safe solvent. Inspect parts carefully for cracks, distortion or excessive wear as follows:

1. Replace springs if cracked or defective. Check all springs on a spring tester. Replace all that do not meet specifications.

2. If pressure plate is scored, heat checked, or warped more than .025 inch, it must be replaced or refaced. Remove only enough metal to obtain a smooth flat surface. No more than .070 inch maximum may be removed by grinding.

3. Inspect clutch release lever tips and clevis pin holes for excessive wear. Make sure levers are not bent. Replace where necessary.

4. Inspect release lever yokes for condition of threads. Slight thread damage may be cleaned up with a three-cornered Swiss file. Replace lever yokes if clevis pin holes are elongated.

5. Check clevis pins and lever pins for wear. Replace if wear is excessive. Check lever slotted thrust washer ring for excessive wear. Replace if slots are excessively worn.

6. Check lever needle roller bearings for wear. If flats are such that rollers slide rather than roll, replace rollers.

7. Inspect driven disc assembly for cracks, loose rivets, worn splines, warped or dished condition. If cracked, or hub splines are worn excessively, replace disc assembly.

If facings are worn down nearly even with countersunk facing-retaining rivet heads and provided assembly is in otherwise good condition, it may be rebuilt.

8. If flywheel is warped or heat checked and surface is refinished, maintain dimensions shown in Figure 4-23 between disc surface and bolting face for proper release lever adjustment. No more than .070 inch maximum may be removed by grinding.

Figure 4-23. Flywheel Rubbing Surface-to-Clutch Cover Bolting Surface Dimension

9. Pilot bearing should be removed, cleaned and checked each time clutch or engine is removed. Discard bearing if balls or races are chipped or scored. After inspection, hand-pack bearing with clutch pilot bearing grease specified and install bearing in flywheel. Tap into place with shielded side toward clutch and snap ring seated in counterbore.

After bearing is properly installed, pack the entire cavity in back of the bearing with the same specified clutch pilot grease.

NOTE

To prevent damage to the bearing seal when the transmission is assembled to the engine, the space occupied by the main driving pinion pilot must not be filled with grease. See Figure 4-24.

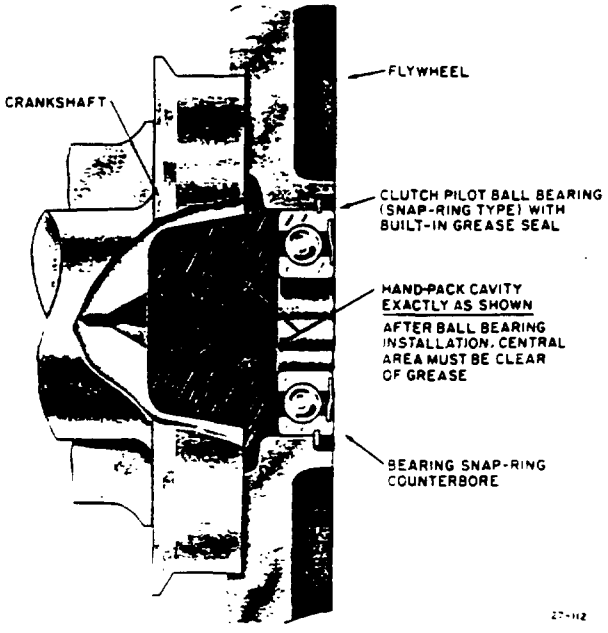


Figure 4-24. Cut-away View of Clutch Pilot Bearing Grease Reservoir Correctly Packed

Use only the recommended snap ring type bearings. These bearings will function without premature failure where slight misalignment exists between engine and transmission.

Reassembly

1. Apply a light coat of clutch lever grease on the loose needle bearings and install rollers in each pin hole of levers. When bearings are installed, apply additional grease to each assembled bearing group.

2. Spread a thin coat of lever grease on the two rubbing flats of each lever and on all yoke rubbing surfaces. Center lever

yoke clevis pin holes over lever inner bearing-lined pin holes and carefully insert clevis pin through the aligned holes. Lock pin in position with cotter pin.

3. Apply a thin even coat of lever grease on all pressure plate drive lug rubbing surfaces. Carefully position lever assembly between drive lugs. Align pin holes in drive lugs with assembled needle rollers and push pin through lugs and bearing opening.

NOTE

Remove all excess grease.

4. Position clutch pressure plate and lever assembly in clutch overhaul machine, arbor press, drill press or whatever clamping arrangement being used. After centering thereon, install heat insulator washers on the spring heat grids, then main springs in their correct specified positions.

NOTE

Except as specified below, install BLACK or COLORLESS main springs on all locating bosses remaining without springs.

CL-58, install an all RED spring on each No. 1 and No. 3 spring boss. CL-581, install an all WHITE spring on each No. 4 and 5 spring boss.

CL-582, install an all WHITE spring on each No. 6 spring locating boss. See Figure 4-25. Install inverted yoke springs on yoke stems.

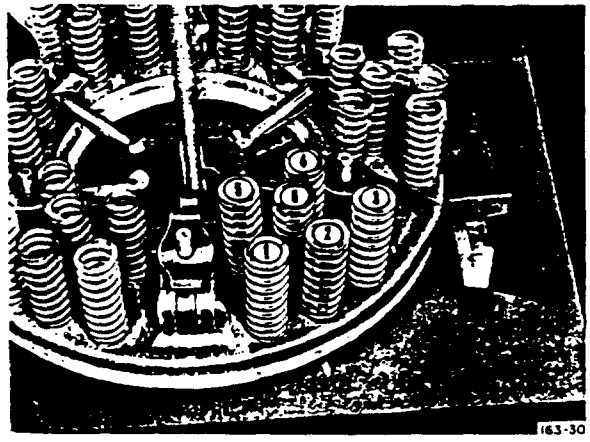


Figure 4-25. Main Spring Arrangement In One of the Six Identical Pressure Plate Segments

NOTE

Make sure leaf springs are inverted on yoke stems and parallel to levers so that their upturned ends will bear against under side of cover when assembled, thus spring-loading each yoke.

5. Position yokes vertically. Position clutch cover over assembly. After centering all main springs in their counterbored seats in cover, set up clamping arrangement and compress springs slowly. Make sure ALL yoke stems are in alignment, then continue to compress springs until all six stems are sticking out of their cover holes.

6. Apply a very thin coat of clutch lever grease to adjusting nut spherical seats in cover. Then install adjusting nuts. Clamping pressure on clutch cover may now be relieved.

7. Lay engine flywheel on bench. Make up four spacers exactly .402 inch thick each and arrange them on flywheel rubbing surface. The spacer thickness of .402 inch corresponds to the mean driven disc assembly thickness under load. See Figure 4-26. Then without disturbing the .402 inch spacer arrangement, position clutch in flywheel counterbore. Install clutch in flywheel counterbore. Install clutch cover-to-flywheel capscrews with their lock washers. Tighten capscrews a turn or two at a time, in rotation, so cover will not be cocked and forced into flywheel pilot by the tightening of the screws.

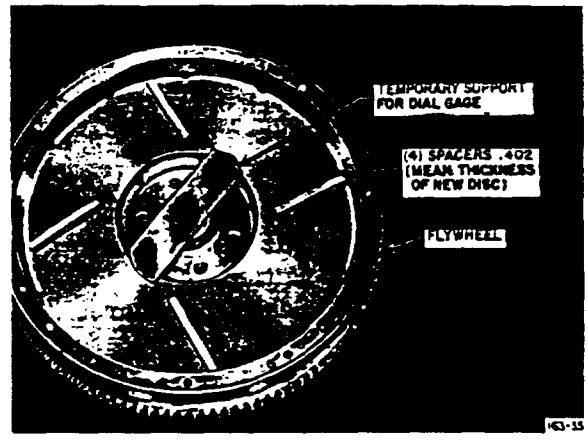
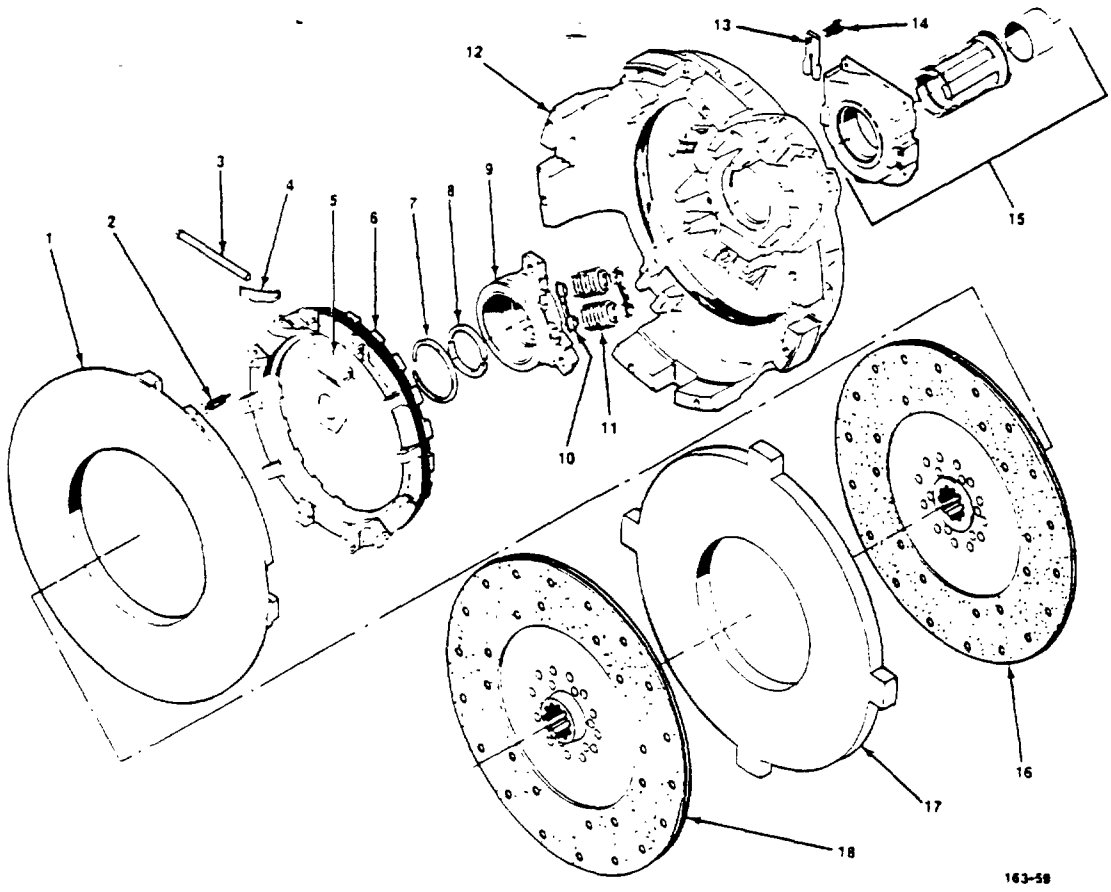


Figure 4-26. Clutch Lever Adjustment Spacer Arrangement in Flywheel



1. Pressure Plate
2. Return Spring
3. Pivot Pin
4. Spring Clip
5. Adjusting Ring
6. Lever
7. Snap Ring
8. Release Sleeve Ring
9. Release Sleeve Retainer
10. Spring Pivot
11. Pressure Spring
12. Flywheel Ring
13. Adjusting Ring Lock
14. Bolt & Lock Washer Assy
15. Release Bearing & Bearing Assy
16. Driven Rear Disc
17. Intermediate Plate
18. Driven Front Disc

Figure 4-33. Exploded View AS-1550 Series Clutch Assembly

Removal and Disassembly

A suitable "sling" or transmission jack should be used to properly support and maintain the engine/transmission alignment when removing or installing a transmission on an engine. DO NOT let the rear end of the transmission drop down and hang unsupported in the splined hubs of the clutch discs to avoid bending or distorting the friction discs. Disconnect the external linkage from the clutch release arm to permit the release yoke to turn up and pull free of the release bearing thrust pads.

1. Prior to actual clutch removal, assemble a clutch disc aligning tool to the driven disc and release bearing assembly.

It is important that two 3/4 inch blocks of wood as shown in Figures 4-34 and 4-35 be inserted between the clutch release bearing housing and clutch flywheel ring as the clutch mounting bolts are loosened around the flywheel. These blocks will relieve the heavy internal spring load, preventing cocking and bending within the clutch and insure easy removal of remaining mounting bolts.

2. When all bolts have been removed, slide clutch assembly back and off using caution to keep aligning tool in place to retain discs and intermediate plate.

3. Carefully remove aligning tool, rear disc, intermediate plate and front disc.

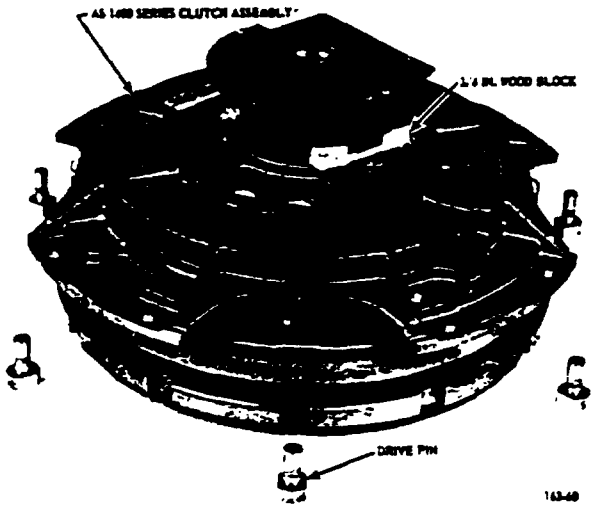


Figure 4-34. Location of Support Block AS-1400 Series

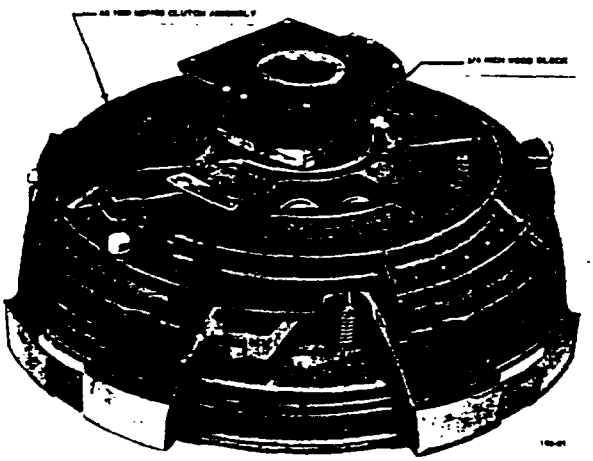


Figure 4-35. Location of Support Block AS-1550 Series

4. Remove bolt and lockwasher assembly and adjusting ring lock. Use screwdriver or similar wedge to remove adjusting ring lock. See Figure 4-36.

5. Set clutch assembly (without driven discs and intermediate plate) upside down on a flat table or workbench. Unhook four return springs from flywheel ring and lift pressure plate off. See Figure 4-37.

NOTE

Mark pressure plate in relation to flywheel ring for reassembly purposes.

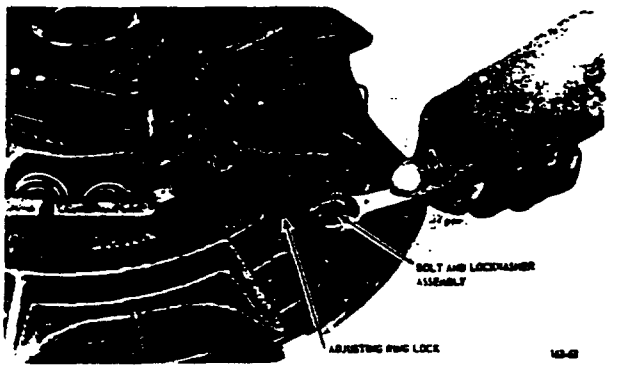


Figure 4-36. Removing Adjusting Ring Lock

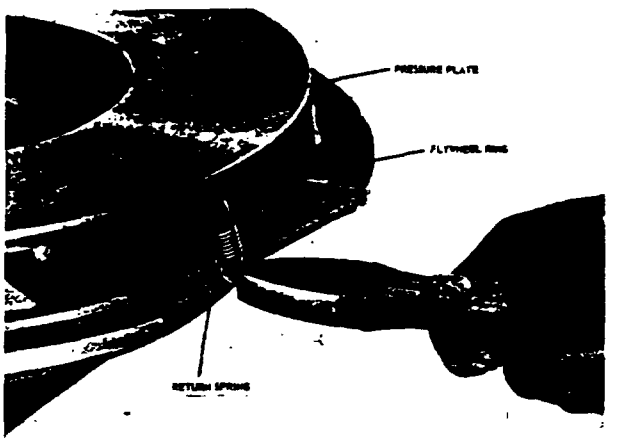


Figure 4-37. Removing Return Spring

6. Turn the adjusting ring and lever assembly counter-clockwise until free of flywheel ring. Then lift and remove assembly. See Figure 4-38.

Figure 4-38. Turning Adjusting Ring

7. Remove snap ring from release sleeve retainer. See Figure 4-39.

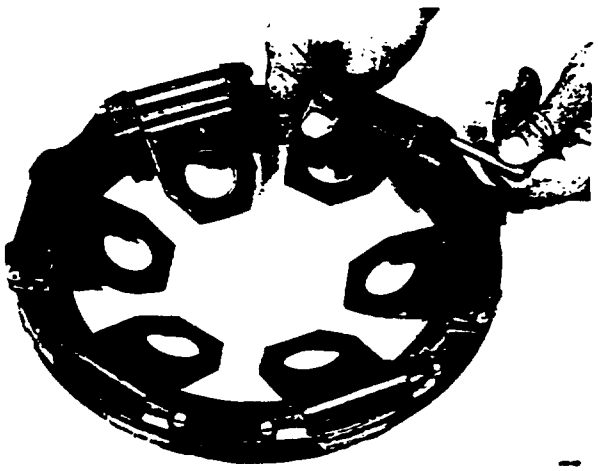
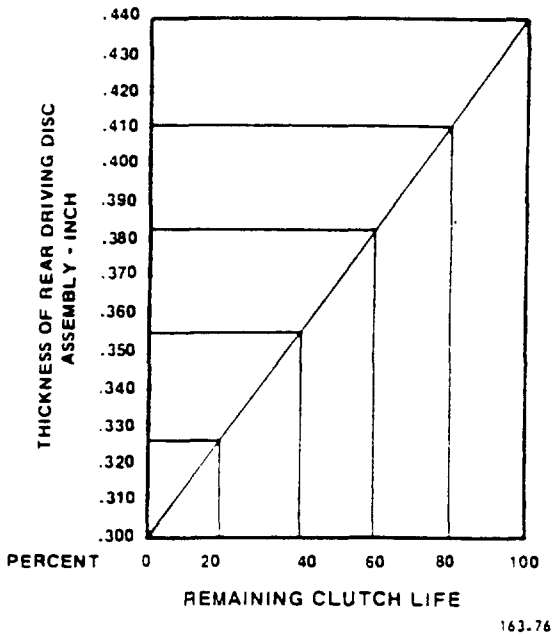


Figure 4-43. Removing Retainer Clip

Remaining Clutch Life Chart - %



Inspection and Repair

Clean all parts thoroughly with a suitable safe solvent.

Many clutches are replaced as a preventative maintenance item at low mileage during repairs of the transmission or engine. Before the Clutch Assembly is replaced, the unit should be inspected for the following items:

1. Heat cracks in the pressure plate.
2. Excessive wear in all drive slots.
3. Broken springs.
4. Dry or damaged release bearing.
5. Broken intermediate plate.
6. Excessive driven disc hub spline wear.
7. Burned facings.
8. Excessive wear on drive pins or intermediate plate slots.

If the preceding list has been inspected and looks to be in good condition, use the chart to determine the approximate remaining clutch life by measuring the thickness of the rear driven disc assembly.

Find thickness of rear disc on column to left then follow curve on right then drop this point down to read % of clutch life remaining.

Driven Discs

Inspect disc assembly for cracks, loose rivets, worn splines, warped or dished condition. Re-straighten if dished or warped - 0.015 inch maximum runout. Replace if hub is cracked, or splines are worn excessively.

Replace facings if they are glazed, scored, worn down to rivet heads, burned, or if grease or oil are on them.

The riveted asbestos facing driven discs, use high-quality facings riveted to the steel disc. They may be furnished with rigid disc or damper type. Used discs can be reworked in the field by drilling out the rivets to remove old facings. Use the correct size drill when removing old rivets to avoid enlarging holes in disc. Use proper facings and a star set anvil to reline used discs.

Ceramic friction material, a combination of metal and ceramic, is relatively new to the clutch facing industry. It is used in producing round or trapezoidal buttons which are riveted to steel discs. These clutch

discs, available with either rigid or damper hubs, offer many advantages for heavy-duty applications. Reworking these discs in the field is not recommended because the ceramic buttons must be assembled and ground to hold thickness as well as squareness with splines.

Super-duty discs have six trapezoidal ceramic buttons and are available with rigid or damper hubs. These S-D discs are thinner than standard discs while the intermediate plate is thicker. This combination of more ceramic buttons and thicker intermediate plate provides longer life and increased torque capacity.

A super-duty kit consisting of two driven discs and an intermediate plate is available for converting a standard Angle-Spring clutch into a super-duty A-S clutch. It is very important that the kit be installed as a unit and its components should never be intermixed with standard components.

Flywheel Ring

Inspect the flywheel ring for cracks. Replace if cracks are visible. Check slots for indentation caused by wear of pressure plate driving lugs. See Specification Chart for slot limits.

Inspect bolt circle face and pilot for nicks and burrs due to removal or handling. Remove burrs with file to insure proper seating and squareness when clutch is mounted to flywheel.

Adjusting Ring

Check pivot pin holes for wear. Clearance may not exceed 0.010 inch between pin and hole. Inspect for cracks; replace if cracks are visible.

Pressure Plate

Inspect fulcrum for wear. If wear exceeds 0.015 inch, remachine. See Specification Chart for maximum rework.

Inspect friction surface of pressure plate for scoring, burning, heat checking or distortion. If friction surface is badly scored, heat checked, warped or dished in excess of 0.010 inch, resurface or replace with new pressure plate. Smooth and flat pressure plate surfaces must be used for satisfactory clutch life.

Check drive lugs for wear per Specification Chart.

Intermediate Plate

Inspect friction surfaces of intermediate plate for heat checks, scoring or distortion. If friction surface is badly scored, heat checked, warped or dished in excess of 0.020 inch, resurface or replace with new intermediate plate. Smooth and flat intermediate plate surfaces must be used for satisfactory clutch life. Inspect driving slots of intermediate plate for wear per Specification Chart.

Release Levers

Inspect levers for excessive wear at points of contact with pressure plate, release sleeve retainer, and pivot pin. If levers are bent or worn, replace with new levers. It is good preventive maintenance to replace levers during clutch rebuild.

Release Sleeve Retainer

Inspect for wear in lever groove and internal splines. Refer to specifications for driving slot clearance between flywheel ring drive slots and release sleeve retainer drive lugs.

Spring Pivots

Inspect for cracks; if visible, replace.

Release Sleeve Sub-Assembly

Check bushing for excessive wear. Check bearing diameter for tight fit. Refer to Specifications Chart and replace if necessary.

Release Bearing and Sleeve Assembly

It is recommended that the release bearing and sleeve assembly be replaced as a unit at the time of clutch rebuild. Assemblies are available as service replacement items.

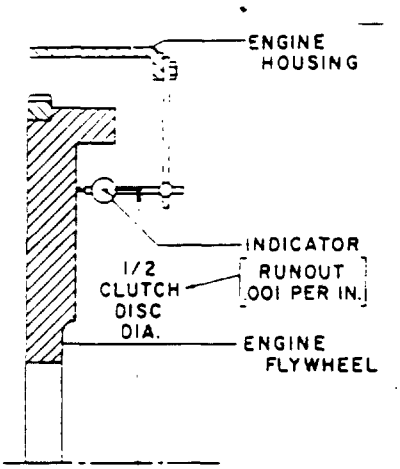


Figure 4-82. Checking Flywheel Face Runout

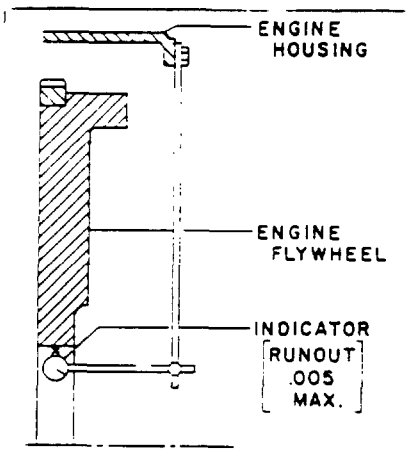


Figure 4-83. Checking Flywheel Bore Runout

2. Check recessed type flywheel for correct depth. See specifications.

3. Replace release bearing and carrier, if worn, and flywheel pilot bearing. Pilot bearing should be a hand press fit in the flywheel recess and on the transmission drive gear. The release yoke or fork should contact the release bearing carrier pads evenly to prevent a bind on the front bearing cap extension.

4. The friction face of the flywheel must be free from heat cracks, score marks and taper. The presence of any of these conditions will have an adverse effect on clutch function and life.

Installing Clutch Assembly

It is a good idea to try the cover assembly on the flywheel without the disc assembly to check fit where cover is piloted at O.D.

Install driven disc, making sure that it is properly positioned and insert an aligning shaft. Normally the long end of the driven disc hub extends toward the transmission, but in a few instances the long end may face toward the engine. Make sure that the driven disc hub does not come within 5/32 inch of the pilot bearing.

Bolt the cover assembly to the flywheel, tightening each capscrew gradually until the cover is drawn up tight. Extreme care must be exercised to make sure flywheel ring or cover is seated in piloting rim on recessed type flywheels.

Some cover assemblies are piloted to the flywheel by capscrews with a ground shank which fits the reamed holes in the cover.

The machined shank extends through the cover into a recessed or counterbored hole in the flywheel. If a flywheel has been reground there is a chance that the counterbores could be too shallow and may require deepening. If the flywheel has been remachined several times to remove heat cracks or scores, the counterbored holes may not be deep enough to allow complete tightening of the capscrews. This will necessitate replacing the flywheel.

Dimension 'A'

Dimension 'A' is the distance from the top of the clutch flywheel ring (cover) to ends of release levers. See Figure 4-84.

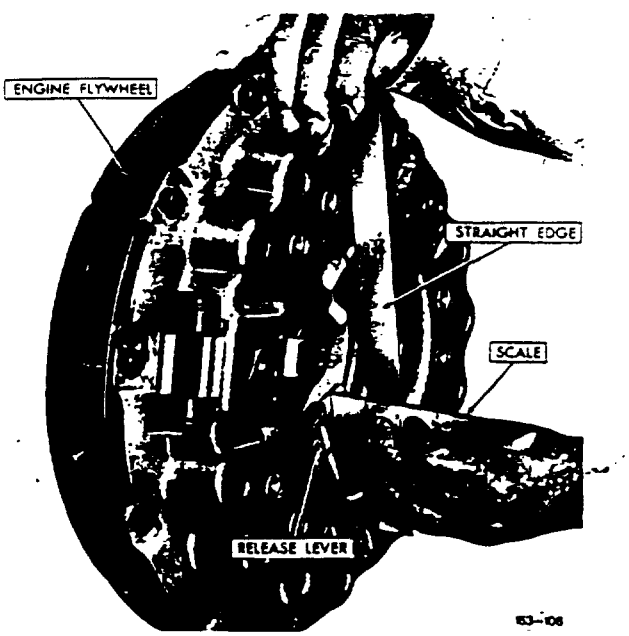


Figure 4-84. Checking 'A' Dimension

Check specification chart for correct 'A' Dimension. Satisfactory operation of the clutch depends greatly upon the accuracy of the lever setting, as this controls the parallel movement of the pressure plate.

3/8 inch capscrews. 7/16 inch capscrews are used for 15-1/2 inch - 2 applications.

The pressure plate is driven by means of driving lugs extending into mating slots of the flywheel ring (cover). The intermediate plate is driven by drivepins located in the engine flywheel.

Depressing the clutch pedal pulls the release bearing toward the transmission. The release bearing being connected to the release levers thus retracts the pressure plate from contact with the driven disc assembly, thereby relieving the pressure on the intermediate plate and the forward driven disc assembly which disengages the clutch.

Releasing the clutch pedal allows the release bearing assembly to move toward the engine permitting the pressure plate to move toward the flywheel gripping the discs, causing engagement.

Clutch Installation

Before installing the clutch on the flywheel, check for free fit of cover assembly to flywheel and flywheel alignment before proceeding with installation. See Figures 4-80, 4-81, 4-82 and 4-83.

Be sure that intermediate drive pins are a press fit in holes in flywheel rim and that the heads are perfectly square to the friction surface. Drive pins must be square to provide proper clearance for the drive slots in the intermediate plate. A machinist's square and feeler gage may be used to check for squareness.

After the pins are installed and properly squared, try the intermediate plate for fit over the pins. With new pins and a new intermediate plate, there should be from 0.006 inch to 0.014 inch clearance. Try the plate in different positions and select the position which provides the greatest freedom of movement. Mark the plate for location to the flywheel. Lock the drive pins in place with the socket head or Allen set screws.

Driven discs are marked, "Pressure Plate Side" and "Flywheel Side", to indicate their proper positions. Install as indicated.

The cover assembly may now be installed on the flywheel but, before tightening capscrews, install an aligning shaft through the two hubs and into pilot bearing.

Cover capscrews may now be tightened progressively around the flywheel using 35 to 40 ft. lbs. of torque.

Remove the three hold down bolts from cover before removing splined aligning shaft or disc assemblies may fall out of position.

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TS442	REV.	9/77	18M

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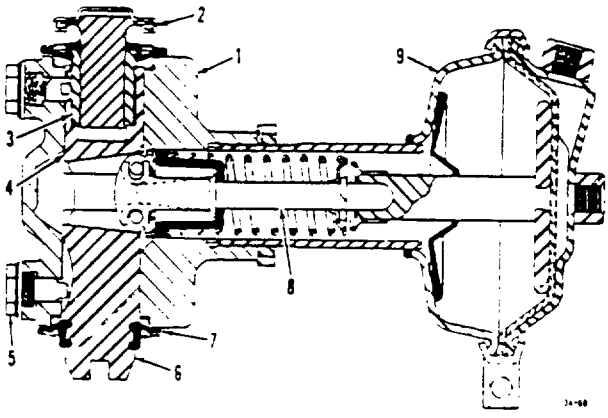
The system for actuating the wedge brake has an air chamber power unit threaded into the wedge bore of the plunger housing. Air applied to the diaphragm pushrod pushes the wedge rod against the plungers. See Figure 8-13.



1. Plunger Housing
2. Adjusting Bolt Assembly
3. Adjusting Sleeve (Actuator)
4. Adjusting Plunger
5. Guide Screw
6. Anchor Plunger (solid)
7. Plunger Seal and Retainer
8. Wedge Assembly
9. Brake Air Chamber Assembly

Figure 8-13. Wedge Actuation - Air Chamber

Disc Brakes

Front axles that incorporate disc brakes are of the sliding caliper, dual piston design. The dual pistons are actuated by hydraulic pressure which is multiplied through the use of an air over hydraulic fluid intensifier. Hydraulic pressure is increased over air pressure by a ratio of 17 to 1 or 23.5 to 1, depending on the model intensifier.

The master cylinder includes both air and hydraulic systems. They should be considered as separate systems, although operating together. Air pressure actuates a diaphragm in the master air chamber which actuates a plunger in the hydraulic master cylinder, creating pressure to the disc brake units. See Figures 8-14 and 8-15.

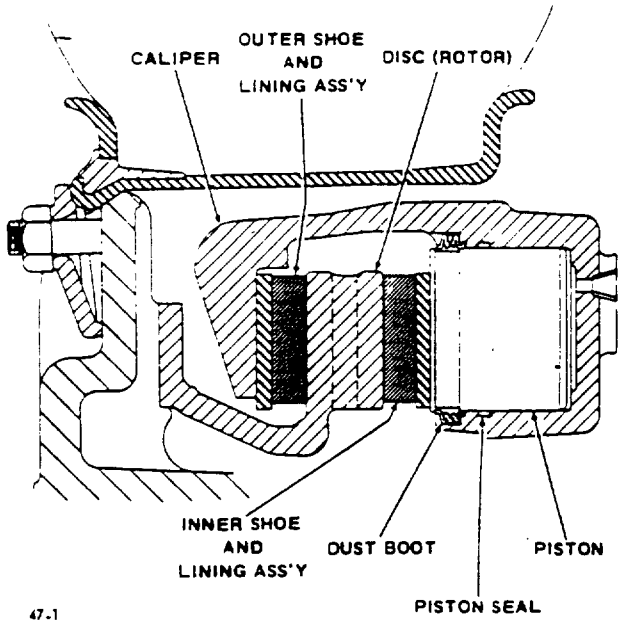


Figure 8-14. Disc Brake Assembly

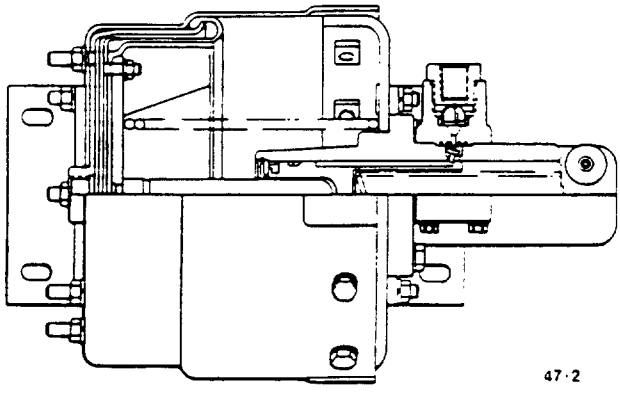


Figure 8-15. Air Hydraulic Intensifier

Adjustment

Cam Brakes

Initial adjustment on cam brakes is done by adjusting the slack adjusters, which can be either the manual or automatic type. Maintaining correct drum to lining clearance requires periodic readjustment of the manual slack adjusters, usually monthly or at approximately 8,000 miles. Under severe braking conditions, adjustments may be needed at more frequent intervals.

Accuracy of the wheel bearing adjustment cannot be overemphasized as it has a direct effect on brake performance. You cannot properly adjust a brake if the wheel bearing has not been correctly adjusted. It is therefore important that a torque wrench be used in the adjusting and that you adhere to the manufacturer's specification.

NOTE

Do not adjust brakes when drums are hot because the brakes will

drag when the drums cool - always adjust brakes when the drums are cool or at room temperature.

The routine of adjusting brakes to a drag and then relieving the drag should be supplemented with a feeler gauge check. This is the only true means of establishing what the actual clearances are at the three vital positions of cam, center and anchor on both shoes. When self-centering of the shoes in the drum is possible we should utilize this feature by applying the brakes a few times and rechecking the clearances. Be certain that the initial adjustment at time of reline affords extra lining to drum clearance because of lining swell. A clearance of .020 between lining and drum should be adhered to on a newly relined vehicle. After the break-in period .010 clearance would be the rule.

Actual brake to drum adjustment procedure is covered under Slack Adjuster section.

Wedge Brakes

Two types of adjustable plungers are in use - manual and automatic. The manually adjusted plunger has an adjusting bolt threaded into the plunger proper. The bolt head is scalloped to facilitate adjustment and carries a detent arrangement which engages the brake shoe web and prevents accidental rotation of the bolt.

Manual Adjustment Type

To adjust manual adjusters.

1. Jack or hoist wheels free of ground.

2. Remove dust cover from adjusting slot - two places on each brake. The adjusting slots are below the forward and above the rear power unit.

If star-wheel adjusting bolts are not found at these positions, the brake had been assembled on the wrong side of the vehicle.

3. Adjusting bolts have right hand threads. With an adjusting spoon, turn the star-wheel until a heavy drum drag is developed. Then back off the bolt to a very light drag on the drum. Repeat for other shoe on the brake. Replace dust covers in adjusting slots. Repeat for other brakes.

NOTE

Recommended adjusting spoons, are Snap-On-Blue-Point S-9523, Wizard 4-H-2530 and Proto 2006.

Automatic Adjustment Type

The automatic type maintains the correct lining-to-drum clearance. This is accomplished by the action of an adjusting bolt and sleeve fitted into a hollowed plunger body working with an adjusting pawl, a spring, and a retainer cap screw. The end of the pawl has saw-tooth teeth which engage similar teeth on the outside of the adjusting sleeve. See Figure 8-16.

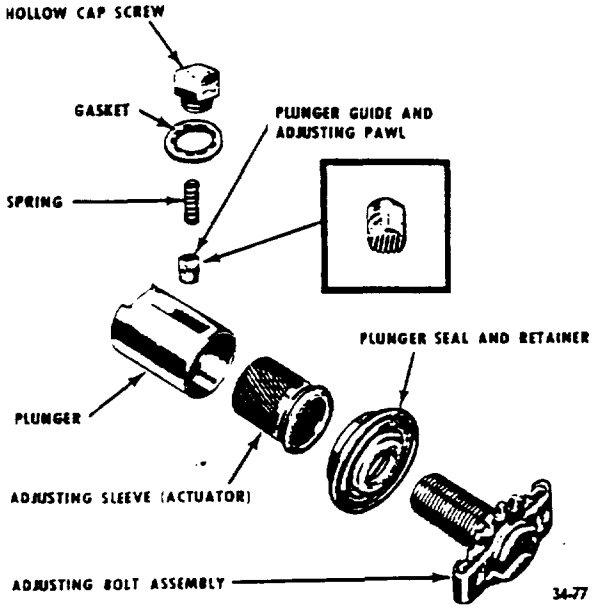


Figure 8-16. Automatic Adjustment Components

When the brake is actuated, the plunger, sleeve, and bolt are forced outward applying the brakes. The sloping teeth on the adjusting sleeve push the pawl back against the spring. At this point, the pawl teeth disengage from the sleeve teeth. If the brake shoes have traveled sixty thousandths of an inch (.060) or less to apply the brakes, all adjusting parts will return to their original position when the brake is released.

As the lining wears and shoe to drum clearance exceeds sixty thousandths of an inch (.060), the pawl climbs over and drops into the next tooth space on the sleeve. When the brake is released, the new tooth position causes the sleeve to rotate, advancing the adjuster bolt.

Current production models of the wedge brake incorporate a limited travel adjusting bolt to prevent over adjustment and possible sleeve damage. This is accomplished by using a snap ring retainer located around the bottom of the adjusting bolt. The snap ring acts as a stop against a shoulder in the adjusting sleeve.

Disc Brakes

No manual adjustment required. Brakes adjust automatically during braking operation. The square-cut piston seal is distorted when pressure is applied to piston. When braking pressure is released, the seal returns to its normal condition and pulls the piston away from the lining. This action, plus some slight rotor lateral runout ("wobble"), considerednormal, provides adequate running clearance.

Disassembly and Assembly

When brakes are relined or disassembled for other repairs, all parts should be inspected for wear and worn parts should be replaced as required.

Cam Brakes - (See Figure 8-10)

Disassembly

1. Remove shoe return spring.

2. Remove lock rings, retainers, and felts from brake shoe anchor pins.

3. Cut lock wire and remove anchor pin lock screws.

4. Remove anchor pins and shoe assemblies.

5. Remove brake shoe roller retaining clip (or screw) and remove roller.

6. Remove slack adjuster lock ring and spacing washers.

7. Remove camshaft, washer, and felt seal (if used).

8. Remove nylon bushings if replacement is necessary. Use suitable tool for both removal and installation of bushing. See Figure 8-17.

NOTE

On brakes where lip type seals are used, these will have to be removed and replaced if nylon bushings are replaced.

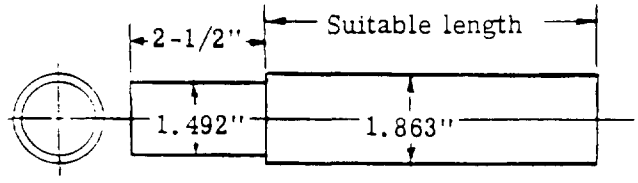


Figure 8-17. Bushing Removal and Installation Tool

Assembly

1. Install new nylon bushings, if required, using suitable tool. (Install new lip type seal if used.)

2. Install brake shoe rollers and retainers. Make certain rollers are of proper size. See instructions relative to brake shoe "Cam Roll-Over."

3. Install camshaft, washer, and felt seals. (if used.)

4. Position brake shoe assembly over spider and tap anchor pin into position with brass punch, "flat" in line with lock screw hole.

5. Install lock screws, tighten securely and thread with lockwire.

6. Position felts, retainers, and lock rings on anchor pins.

7. Install shoe return spring. New springs should be used with each brake reline. Tension loss occurs from normal use and heat build up. New springs will ensure that shoes are returned to fully relaxed position, and not in contact with drum, which would cause premature wear.

8. Assemble slack adjuster on splined end of camshaft; using spacers and washers on each side of adjuster to obtain .030-.060 end play.

Wedge Brakes - (See Figure 8-12)

Disassembly

1. Remove shoe return springs. Use brake spring pliers. (Do Not use screwdriver.)

2. Remove brake shoe assembly.

3. Remove plunger guide screws and gaskets from plunger housing. If brake is automatic adjusting, remove hollow capscrew, gaskets, spring and adjusting pawl. It may be necessary to use a magnet to remove the adjusting pawl.

4. Using a suitable screwdriver, pry the seals loose and remove anchor (solid) plungers, adjusting plungers, adjusting sleeves (actuators) and adjusting bolts.

5. Thoroughly inspect and clean all parts including the housing plunger and seal bores and shoe rest pads. DO NOT solvent clean any rubber parts (plunger seals or gaskets).

Wire brush plunger parts and adjusting bolt threads to remove caked on dirt and corrosion.

Carefully inspect plunger seals and gaskets for tears, cuts or deterioration, and replace if necessary. Also check the angled plunger roller faces for pits, grooves or nicks and replace if necessary.

NOTE

Brakes have one adjusting plunger and one anchor (solid) plunger per plunger housing. The anchor plungers are marked on the shoe slot end, "R" for right hand brakes and "L" for left hand brakes. DO NOT mix at reassembly.

Assembly - Anchor (Solid) Plunger

1. To assemble seals into plungers, apply a film of grease to inside surfaces of seals. See Figure 8-13.

2. Inspect nose for burrs. Mask brake shoe web slot in the plunger nose with masking tape to protect seal.

Carefully push the double lip seal onto the plunger, stretching the outer seal lip over the plunger nose end, until the inner seal lip is completely in the second plunger groove and the outer seal lip is in the first plunger groove. Remove masking tape. (Brakes employing single grooved plungers and single lip seals should be assembled in the same manner except masking tape is not used.)

IMPORTANT: DO NOT ASSEMBLE SEALS INTO PLUNGER HOUSING FIRST. THIS WILL RESULT IN COMPLETE LACK OF SEALING OF INTERNAL PLUNGER HOUSING COMPONENTS.

3. Coat all plunger bores with grease.

4. Make sure anchor plungers marked "L" are installed in left hand brake and anchor plungers marked "R" are installed in the right hand brake.

5. Coat entire anchor plunger with grease, packing cavity behind seal, and insert plunger and seal into housing with plunger keyway slot aligned with guide screw hole. Make certain the plunger goes all the way into the plunger bore and seats on bosses at the bottom.

6. Seat plunger seal in plunger housing with correct seal driver tool. Driver must be centered over seal retainer to prevent damage to seal assembly.

NOTE

If seal driver is not available, a 1-3/4" wrench socket can be used for spider mounted brakes and 1-3/8" wrench socket can be used for backing plate mounted brakes.

7. Assemble gasket and guide screw into plunger housing. Make certain guide screw end enters the plunger key-way slot so plunger can slide freely in housing bore. Tighten guide screws to 15-20 ft. lbs. torque.

CAUTION

Wedge and plunger assemblies are 12° or 14° angles. Also "Right" and "Left" plungers. Any inter-mixing of these parts will cause erratic and uneven braking.

Assembly (Manual Adjusting Plungers)

1. Apply film of grease to inside surfaces of seals.

2. Push the inner seal lip over the threaded hole end of the plunger until the lip completely enters the plunger seal groove.

3. Apply grease to outside of plunger and install plunger and seal into plunger housing in the same manner. Refer to Assembly-Anchor (solid) Plunger steps 5, 6 and 7.

4. Coat adjusting bolt threads with grease and turn bolt into the adjusting plunger by working it through the hole in the outer seal flap, being careful not to pinch the seal on the threads. Turn adjusting bolt in just short of the seal. DO NOT bottom bolt on the seal.

Assembly (Automatic Adjusting Plungers)

Two types of automatic adjusting plungers are being used. The latest designed parts are readily identified since the new plunger seal has only a single sealing lip instead of a double lip. The adjusting bolt of the latest design also has a retaining ring.

leading to the bottom of the container. The air then rises through the alcohol and passes into the line to the compressor, carrying alcohol in the form of vapor with it. The alcohol, thus introduced into the air system acts as an anti-freeze.

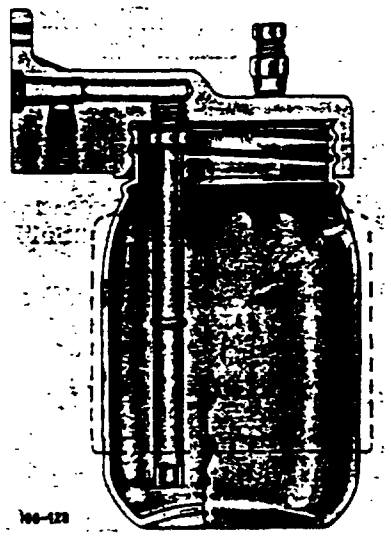


Figure 8-55. Alcohol Evaporator

Preventive Maintenance

Every 1,000 Miles or as Determined by Actual Usage

Check alcohol level and if necessary replenish with 188 proof methanol alcohol. In cold weather, alcohol level should be at least 2/3 full.

NOTE

If alcohol is not being consumed. it indicates the evaporator is inoperative and should be inspected.

Every 1,800 Operating Hours or 50,000 Miles

Remove strainer if present in bottom of evaporator body and clean thoroughly in solvent.

Every Year, 3,600 Operating Hours or 100,000 Miles

Disassembly evaporator unit and clean thoroughly. Inspect all parts for cracks and be sure evaporator tube is not clogged with dirt. Replace all gaskets and rubber parts.

Inspection

When the compressor is compressing air. air bubbles should be passing through the alcohol. If air bubbles are not present when the compressor is compressing air. then the alcohol evaporator is not functioning properly. Check to be sure all connections are tight. Check condition of filler cap gasket and cover gasket.

RELINING & RECONDITIONING

Drum-Type Brakes

After supporting the axle on stands, cage the springs in the spring brake chambers. Remove the tires, wheels, and drums as an assembly, and inspection drums for heat checks, cracks, distortion or other damage.

Close inspection of all worn brake parts may lead to clues for corrective action to improve lining life and future drum damage.

Scored Drum

Only the tops of the ridges will contact brake lining. Since a small percentage of the brake lining is required to do all the work, hard pedal and fade will result. A scored drum must be reconditioned in a lathe. See Figure 8-56.

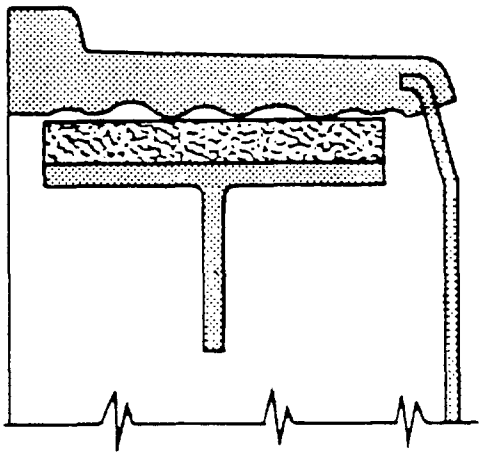


Figure 8-56. Scored Durm

Hard Spots

Hard spots are "islands" of steel in the cast iron surface. They result from a change in metallurgy caused by the heat of braking Hard spots must be ground out or brake performance will be poor and erratic. See Figure 8-57.

Bell-Mouthed Drum

If a drum is bell-mouthed or flared. full lining to drum contact cannot be achieved. Hard pedal, fade and noise can be expected. A bell-mouthed drum must be trued in a lathe in order to procure full lining to drum contact. See Figure 8-58.

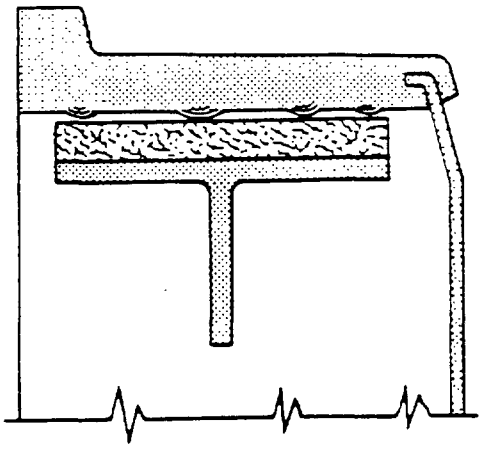


Figure 57. Hard Spots

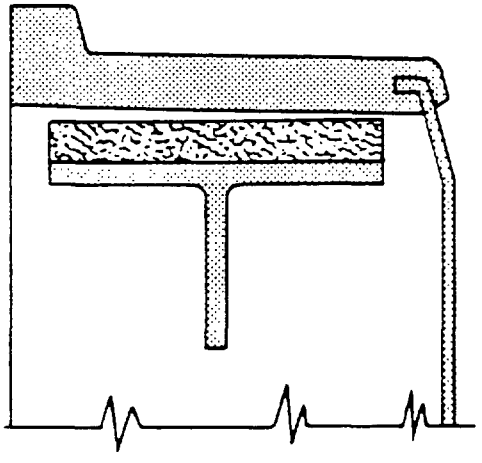


Figure 8-58. Bell Mouthed Drum.

Heat checking and discoloration, if only superficial, can be corrected by resurfacing the drum, otherwise replace drum.

Drums having more than .010" out of round, or any of the conditions described above should be resurfaced. Use only those drums which produce a satisfactory surface finish.

CAUTION

Drum manufacturer and state vehicle inspection laws (where applicable) govern the amount of drum diameter increase allowed when resurfacing. Most drums are stamped by manufacturers as to maximum oversize allowable.

Excessive removal of drum material could result in drum failure or unsatisfactory brake performance and is illegal in some states.

NOTE

When reconditioning brakes, it is important that the brake assemblies on each side of the same axle be serviced in exactly the same manner. This will avoid unequal braking performance. (Drums on the same axle should be resurfaced within .010 of each other.

Cam Roll-Over

Increasing the drum diameter will permit the cam to rotate beyond its maximum lift when the lining becomes worn. To prevent cam "Roll-Over," oversize roller cam followers are available.

Standard (1.250" O.D.)

Standard rollers are used when installing standard linings with standard drums. "X" lining (1/16 oversize) with 1/16 oversize drums, and "XX" lining (1/8 oversize) with 1/8 overside drums.

1/8" Oversize (1.375")

1/8" oversize rollers are to be used with the installation of standard linings with worn or trued drums which are 1/32" oversize. 1/8" oversize rollers should be installed and the liners circle ground a few thousandths less than drum diameter.

1/4" Oversize (1.500")

Where "X" linings have been installed with 1/16" oversize drums and standard rollers, these rollers should be removed and 1/4" oversize installed before the lining becomes worn to a point where the brake cam is no longer effective with the standard rollers.

1/2" Oversize (1.750")

Where "XX" linings and 1/8" oversize drums have been used, the standard rollers should be removed when the linings become approximately 50% worn and 1/2" oversize rollers installed.

Brake Linings

Linings must be the correct material for a specific application, and the same type lining should be used for each wheel on the same axle.

Handle lining carefully to prevent grease, oil, or any other type of contamination to come in contact with lining surface.

MACK

engine

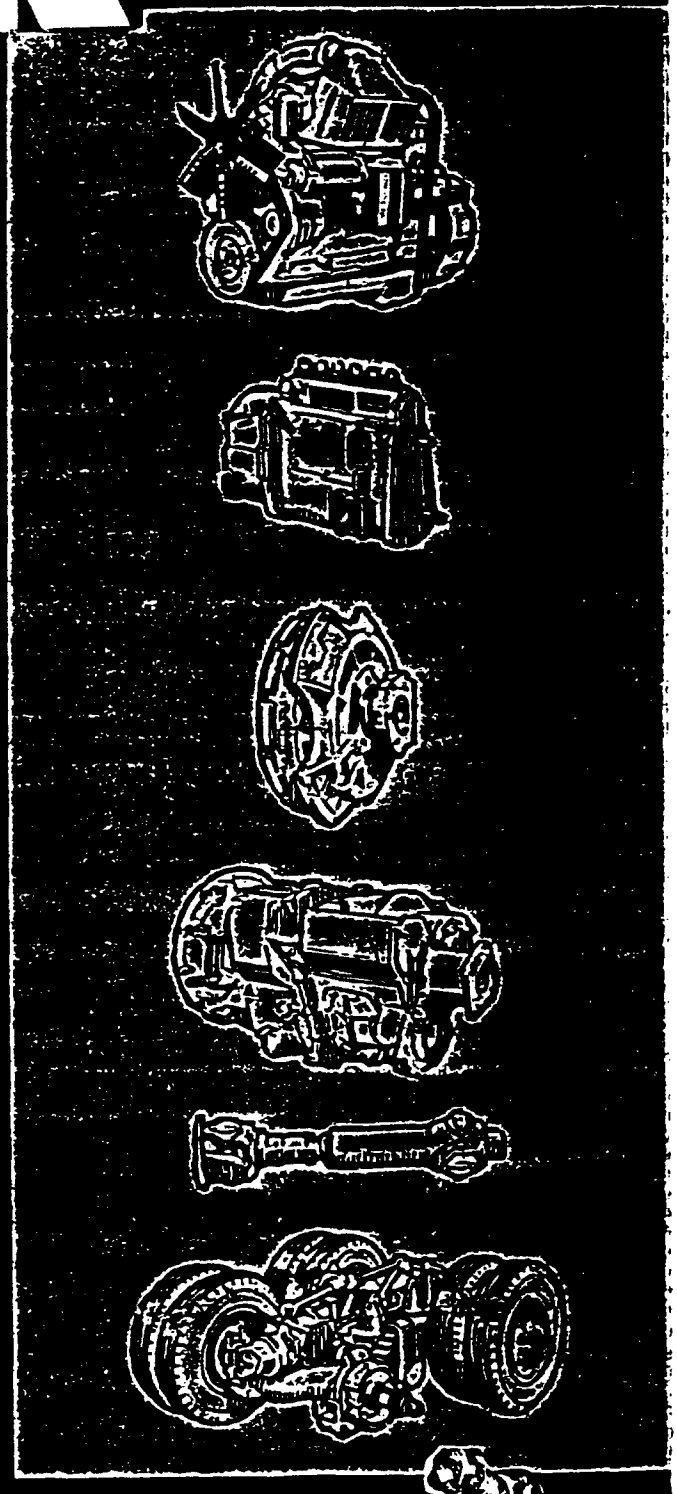
fuel system

clutch

transmission and p.t.o.

propeller shaft

rear axle and carrier



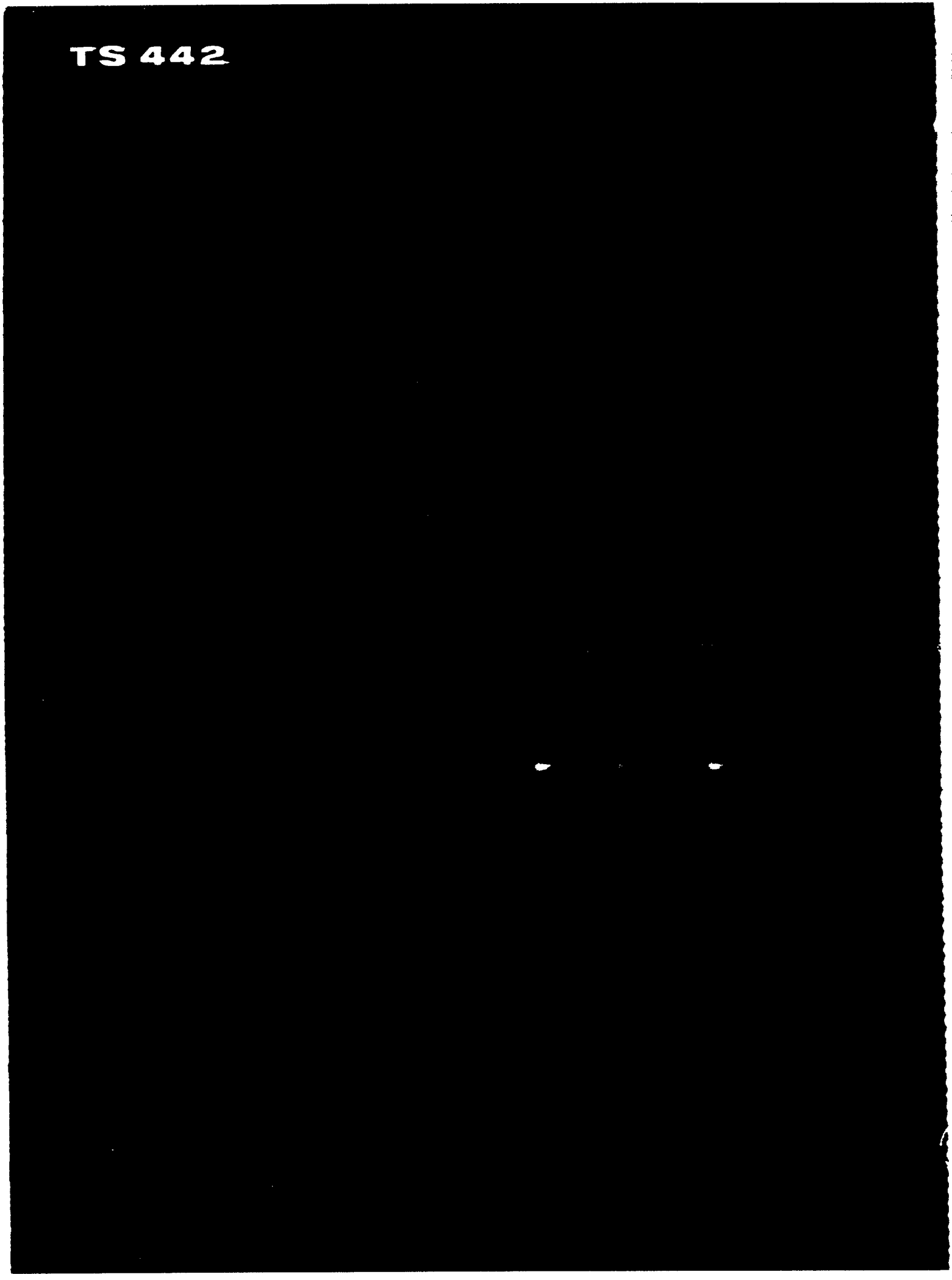
HIGHWAY VEHICLE SERVICE MANUAL

MACK TRUCKS

MACK TRUCKS, INC.

TS442		10/67	10M
TS442	REV.	3/69	10M
TS442	REV.	5/71	10M
TS442	REP.	12/72	10M
TS442	REV.	8/75	10M
TS442	REV.	9/77	18M

Printed in U.S.A.


TS 442

Core Exchange -
Schwitzer or Holset Turbocharger

1. Remove lubricating oil inlet and outlet lines.

2. Loosen clamp on compressor housing and move housing away from core assembly.

3. Support core assembly and loosen clamp on turbine housing and remove core assembly. Holset uses capscrews and washers to secure core assembly.

4. Install core assembly in reverse manner. Also be sure to prime turbocharger lubricating system. Refer to Installation Procedure.

Turbocharger Exchange - Schwitzer, AiResearch or Holset Turbochargers

1. Remove lubricating oil inlet and outlet lines.

2. Remove air inlet duct from compressor housing.

3. Remove exhaust pipe from turbine housing.

4. Remove turbocharger retaining bolts and remove turbocharger from engine exhaust manifold.

Installation Procedure

Use the following steps as a guide when installing turbocharger to engine.

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for leakage and foreign matter.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure. Be sure check valve is working properly and not restricted.

5. Inspect turbocharger mounting pad, on exhaust manifold, for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

8. Connect oil inlet line to turbocharger.

9. Crank the engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger or charge the system from an external pressurized oil source.

10. Stop cranking engine or charging system and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

Turbocharger Overhaul Procedure

NOTE

Clean exterior of turbocharger with a pressure spray of cleaning solvent and air blow dry before starting disassembly. Due to close tolerances and extremely high rpm of the turbocharger it is of utmost importance to have a clean work area.

1. Mark alignment of turbine housing and compressor housing for correct alignment with bearing housing at reassembly. Use a suitable center punch or small chisel.

2. Remove Vee clamp and separate compressor housing from bearing housing. Use care to prevent damage to compressor wheel.

3. Remove O-ring from groove in bearing housing if used.

4. Position turbocharger in a vise and mount a dial indicator with contact point on side of compressor wheel retaining nut.

5. Move compressor wheel away from indicator while pressing turbine wheel in opposite direction.

6. Zero dial indicator and check total side play of shaft by pressing compressor wheel toward indicator and turbine wheel in opposite direction. If measured movement exceeds maximum limit the turbocharger must be overhauled.

7. Check chaft endfloat using a dial indicator with tip of indicator on end of shaft. Move shaft toward dial indicator and zero dial in-

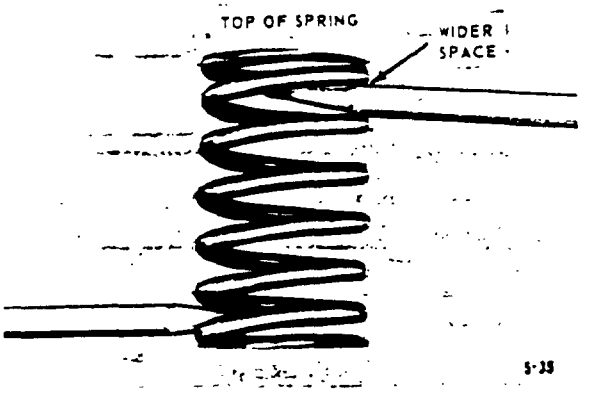


Figure 2-48. Valve Spring

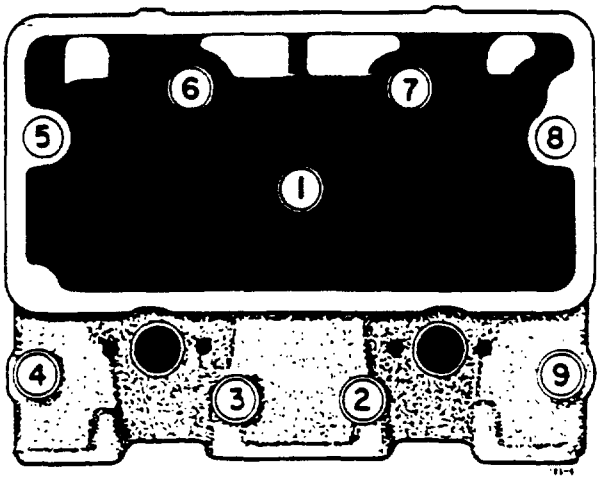


Figure 2-50. Torquing Sequence

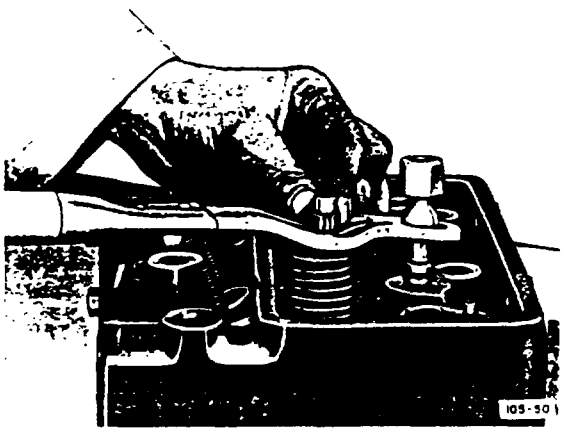


Figure 2-49. Installing Valve Keys

Installing Cylinder Heads

New cylinder head gaskets are installed on the cylinder block with "Top" mark up. Check cylinder head studs for secureness in the block; also threads for damage that may cause binding of the stud nuts. Fit cylinder heads over studs lowering on to cylinder head gasket carefully to avoid damage. Install cylinder head stud washers and nuts. Torque nuts in sequence shown with a calibrated torque wrench in progressive steps of 50, 100 and finally 140 lb. ft. (Stud threads oiled). See Figure 2-50.

Install the two water connection flanges, with gaskets, to cylinder head (connecting heads together to permit cooling water circulation through the three cylinder heads), and install front thermostat housing (outlet) and gasket to the used head. A blank plate and gasket are used on the rear head.

Valve Rocker Arm and Shaft Assembly

The valve rocker arm features a bushing. When the bushing is installed, the split must locate on the horizontal plane and face the slipper side of the arm. See Figure 2-51.

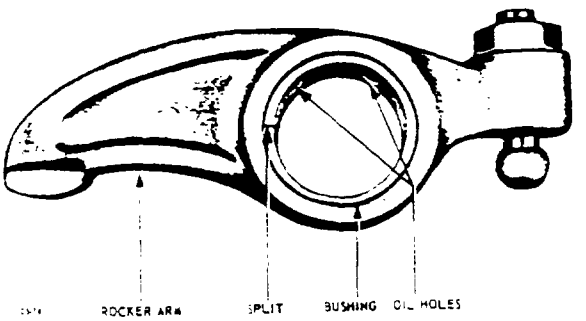


Figure 2-51. Rocker Arm Assembly

Press the bushing in so that it will come flush with the side of the hub which contacts the rocker arm shaft bracket. Two oil holes must be drilled in the bushing. They must be in alignment with the two oil holes provided on top of the arm to feed the slipper and the rocker arm to pushrod adjusting screw with lube oil. Ream bushing I. D. 0.8661 to 0.8669 in., to allow for proper running clearance with a new rocker arm shaft diameter. Check shaft O.D. at unworn area for size, before reaming new bushings to be used with old shaft. Running clearance, 0.0005 to 0.0015 in.

to 1.366 inch (37mm) is 148.37 lbs. 660N). See Figure 19.

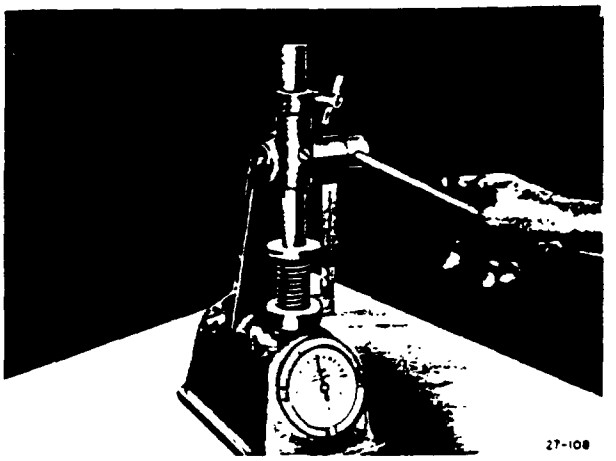


Figure 19. Checking Valve Springs

Position inner and outer valve springs over the inlet and exhaust valve stems and install washers, valve stem keys and caps using a suitable spring compressing tool. See Figure 20.

Figure 20. Installing Valve Keys

Installing Cylinder Heads

NOTE

A fire ring is formed in the cylinder head gasket when the cylinder head is torqued on the cylinder block: therefore, a new gasket must be used when installing the cylinder head. See Figure 21.

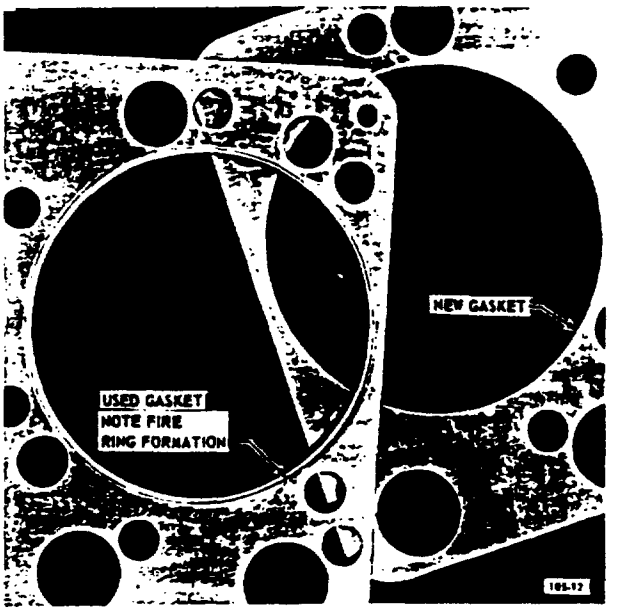


Figure 21. Cylinder Head Gasket
(Note: Fire Ring Formed in Left Gasket)

1. Clean the cylinder block deck thoroughly.

2. Check cylinder sleeve height above the deck. (See Figure 31.) Install new cylinder head gasket on deck.

NOTE

Do not use a sealing compound or soak cylinder head gasket.

3. Check gasket position. Be sure that all passages are open and not blocked by the gasket. See Figure 22.

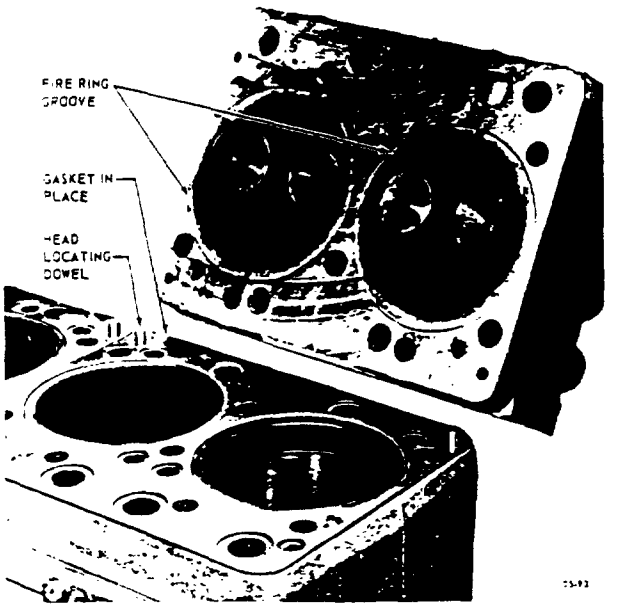


Figure 22. Gasket and Cylinder Head Over Cylinder Block

5. Measure clearance between the pump gear (12) and pump housing cover (9) to determine the gasket thickness. See Figure 62.

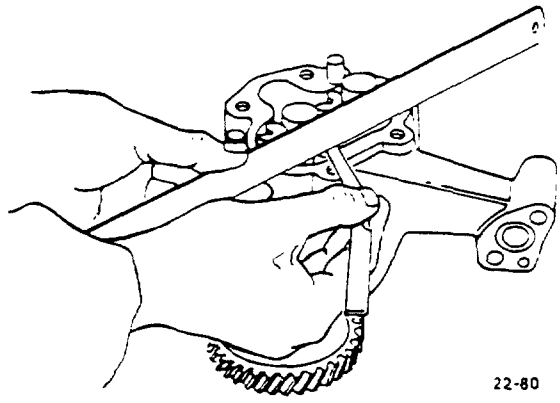


Figure 62. Checking Pump Gear to Housing Cover Clearance

NOTE

Pump Gear to pump housing cover clearance is 0.003 to 0.004 inch (0.07 to 0.10mm).

6. Determining gasket thickness:

NOTE

Pump cover to pump housing gaskets are available in sizes of 0.002, 0.003 and 0.004 inch (0.05, 0.07 and 0.10mm).

a. With a feeler gage and straight edge measure and record measurement between Pump Gear (12) and Pump Housing Cover (7).

b. Subtract 0.001 inch (0.02mm) from measurement to compensate for gasket crush.

c. Select a gasket to provide proper clearance of 0.003 to 0.004 inch (0.07 to 0.10 mm).

For Example: Assume measurement in step 6a. was 0.0014 inch (0.03mm). Subtract gasket crush 0.001 inch (0.02mm) leaving 0.0004 inch (0.01mm). Therefore an 0.003 inch (0.07mm) gasket must be selected to provide the proper clearance.

7. Place gasket in position and install pump cover (9). Torque capscrews (20) 14.75 lb. ft. (20Nm).

8. Install lock ring (5) in pump housing (16) with ring opening facing lubricating hole in housing.

9. Press one bearing (3) into housing against lock ring (5).

10. Install spacer (6) reverse housing and press in second bearing (3).

11. Install shaft (8) through bearings and press idler gear on exposed shaft.

12. Secure idler gear (2) in position by installing lock screw (1). Torque 30 lb. ft. (40Nm). (Note: Left hand thread)

13. Install key (18), pump drive gear (21), new lock washer (22) and nut (23) on exposed pump gear shaft (12).

14. Very carefully clamp idler wheel in a copper jawed vice and tighten lockscrew (1).

15. Torque pump drive gear nut (23) to 148 lb. ft. (200Nm).

16. Remove from vice and lubricate with engine lubricating oil.

Oil Pan and Pump Screen

The oil pan is a silumin casting and is provided with a cylindrical oil pump screen. The pan is so shaped that the return oil flows to the outside of the screen and the suction line of the oil pump is located inside the screen. A magnetic drain plug is provided to hold ferrous particles.

Pressure Relief Valve

The oil pressure relief valve is located in the cylinder block behind the intermediate section of the oil filter. See Figure 63.

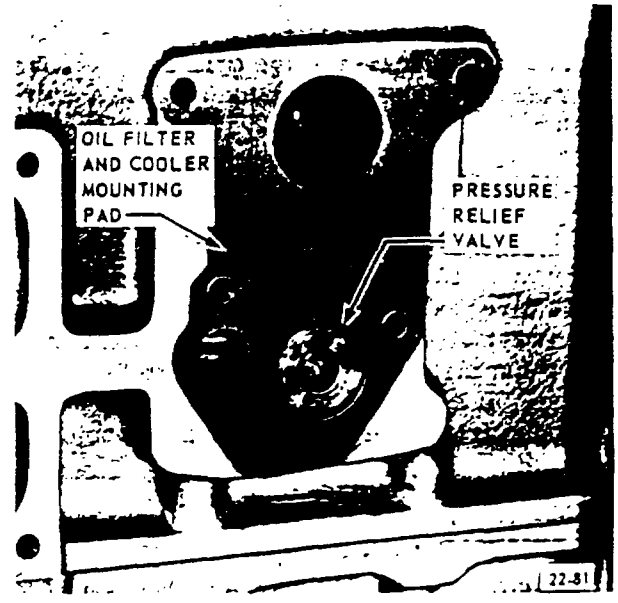


Figure 63. Oil Pressure Relief Valve Location

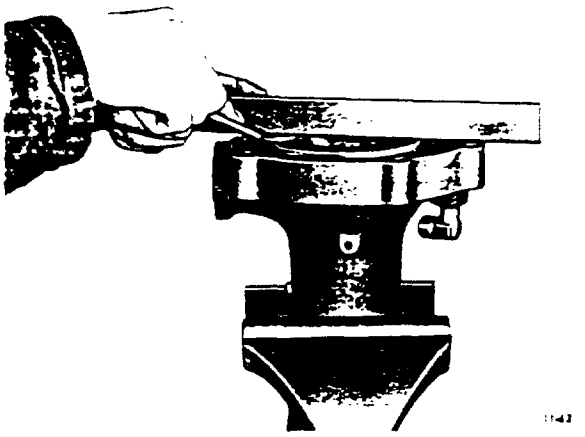


Figure 90. Checking Impeller Clearance

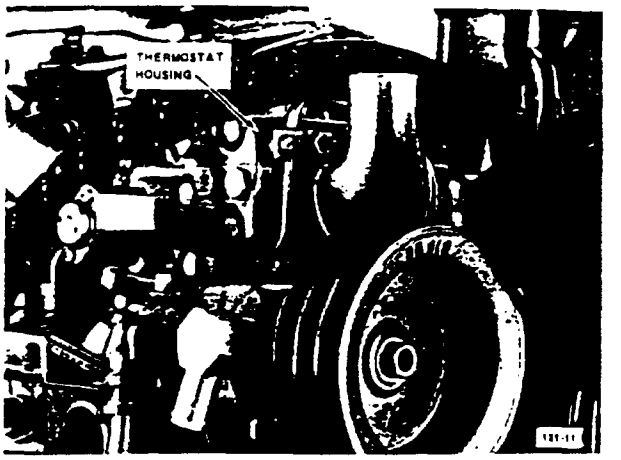


Figure 91. Thermostat Housing Location

9. Install impeller lockwasher and nut and secure.

THERMOSTAT

The thermostat is located above and to the right of the injection pump. See Figure 91.

Removal

To remove the thermostat, first drain the coolant and then remove the outlet housing. See Figure 92.

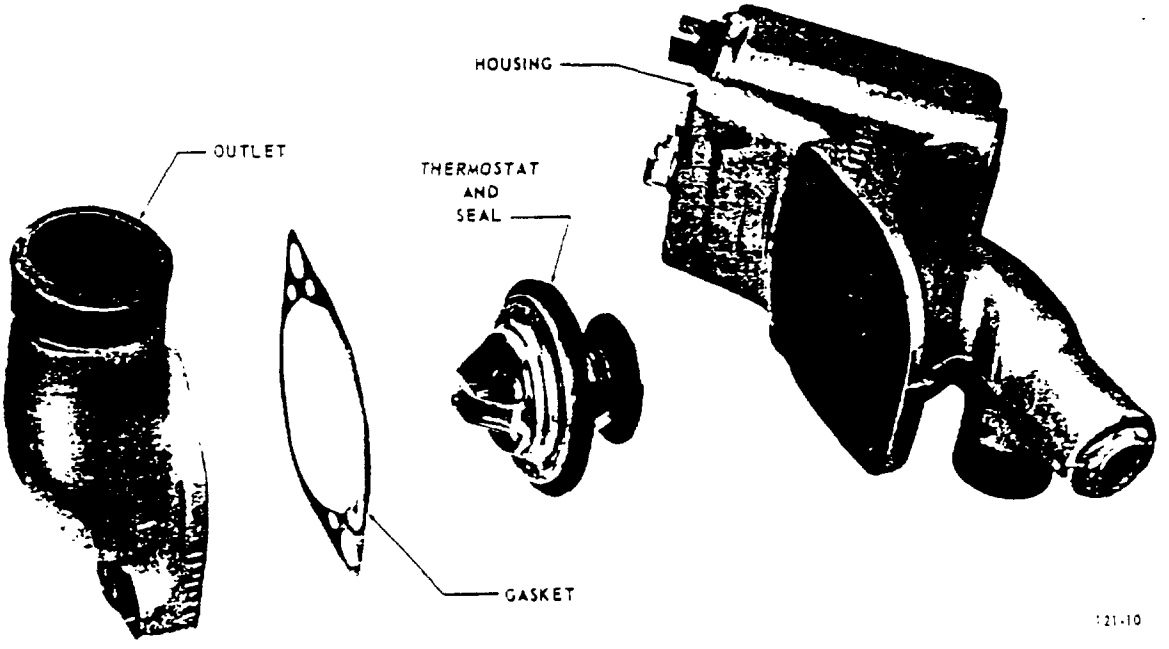


Figure 92. Thermostat Housing Exploded View

TURBOCHARGER

Preliminary

Inspect external and visible internal areas for contamination or damage before installing the unit on the engine. Check the condition of the turbine and exhaust manifold mating flanges for uneven surfaces. The smooth surface is required to assure good gasket clamping for dependable sealing and for longer gasket life.

Make certain that the air cleaner and air tubes are clean, to avoid restricted air flow. New hose connections and dependable clamps should be used and properly secured.

and drive insert into place with guide tool J-21374. Drive fit of insert in head is 0.0015 to 0.0040 in. To remove insert from head, tap a 7/8-9NC thread into insert and remove with puller S-572.

Valve Seat Inserts

The inlet and exhaust valve seat inserts are identical except for diameter. Seat angle is 30 degrees -0'/+30'. Seating width is 1/16 to 3/32 in. Maximum seat runout is 0.0015 in. See Figure 2-115.

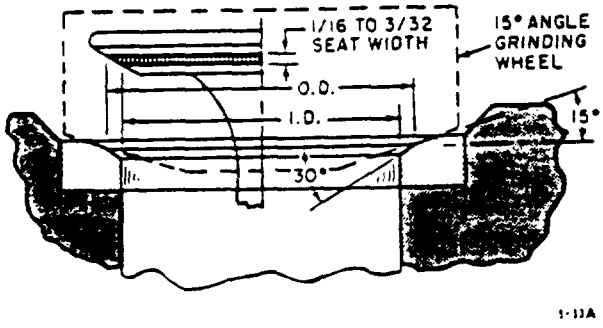


Figure 2-115. Valve Seat Dimensions

Press fit of inlet and exhaust valve seat inserts in head is 0.0025 to 0.0045 in. Standard inlet valve seat insert O.D., 2.4405 to 2.4415 in. Bore in head for standard inlet valve seat insert, 2.437 to 2.438 in. Standard exhaust valve seat insert O.D. is 2.0855 to 2.0865 in. Bore in head for standard exhaust valve seat insert is 2.082 to 2.083 in.

Valve seat inserts are available in 0.015, 0.031, 0.047 and 0.062 in. oversizes. Shrink inserts in dry ice for 20 minutes prior to installation in head.

Valve Guide

Inlet and exhaust valve guides are made of a special iron. Valve guide bore in cylinder head is 0.6860 to 0.6870 in. Outside diameter of valve guides is 0.6881 to 0.6886 in. Press fit of valve guides in head is 0.0011 to 0.0026 in. Press guides into head until top of guide extends above valve spring seating surface 1-35/64 in. See Figure 2-116.

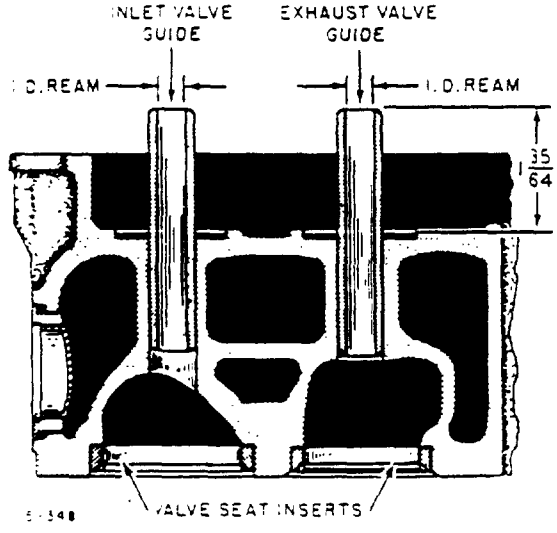


Figure 2-116. Valve Guides

Inlet Valve

Poppet type, chrome-silicon steel. Valve face angle, 30 degrees, +0'/-30'. Reamed I.D. of inlet valve guide, 0.4995 to 0.5005 in. Valve stem diameter, 0.4965 to 0.4975 in. Stem-to-guide clearance (service), 0.002 to 0.004 in. Maximum face runout (service), 0.0015 in. Stem-to-rocker arm lash setting, 0.016 in. cold static, 0.014 in. hot idle. Install new oil seals, shields and keys at overhaul.

Exhaust Valve

Poppet type. Valve face angle, 30 degrees +0'/-30'. Reamed I.D. of exhaust valve guide 0.4995 to 0.5005 in. Valve stem diameter, 0.4955 to 0.4965 in. Stem-to-guide clearance (service), 0.003 to 0.005 in. Maximum face runout (service), 0.0015 in. Stem-to-rocker arm lash setting, 0.024 in. cold static, 0.022 in. hot idle. Use new valve rotators and keys at overhaul.

Inner Valve Spring

Nominal free length, 3-1/32 in. Test for 82.1 to 90.7 lbs. when compressed to 2-1/32 in. Service limit, 77.2 lbs.

Outer Valve Spring

Nominal free length, 3-13/32 in. Test for 105.3 to 116.3 lbs. when compressed to 2-5/32 in. Service limit, 99 lbs.

Rocker Arm Shaft

Shaft O.D., 1.1286 to 1.1291 in. Drilled for bottom oil feed of rocker arms. Locating screw assures proper line-up of oil passage.

Rocker Arm

Ratio, 1.8 to 1. Shaft hole diameter, 1.1296 to 1.1301 in. Hole-to-shaft clearance is 0.0005 to 0.0015 in.

Before installing rocker arm and shaft assembly on cylinder head, be sure to fit O-ring carefully in recess at oil passage-to-rocker arm bracket on top of cylinder head.

Rocker arm bracket capscrew torque, 55 lb. ft.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets in their proper positions on the block checking that the rubber seals are correctly positioned in holes of gasket.

NOTE

Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Set cleaned cylinder heads in place separately. When in place, apply Permatex No. 2 to the accessible outer edges of gasket. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. See Figure 2-117.

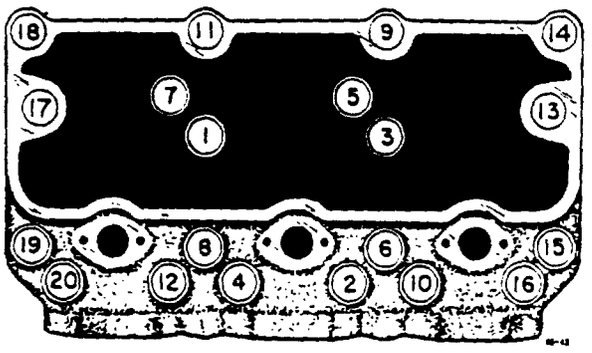


Figure 2-117. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque, following sequence in Figure 5. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring Set package for detailed instructions.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry type cylinder liners. The deck area surface must be flat within 0.002 in. Excessively eroded water holes developing at deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.020 in. above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

Cylinder Liner

Dry type special alloy iron. Part number is etched on O.D. of liner. Free O.D is 5.0945 to 5.0955 in. Cylinder block bore is 5.0945 to 5.0955 in. which allows a liner fit of 0.0010 loose to 0.0010 in. tight. Cylinder liner I.D. for standard size piston, 4.876 to 4.877 in. Cylinder liners available in 0.002, 0.004, 0.006, 0.012, 0.020, 0.030, 0.040, and 0.050 in. O.D. oversize. Extension of cylinder liners above cylinder block deck must not vary more than 0.001 in. under the same head.

When replacing cylinder liners, check cylinder block bore. If out-of-round or taper does not exceed 0.006 in., hone block for 0.002, 0.004, or 0.006 in. oversize liner as required. If out-of-round or taper exceeds 0.006 in., bore cylinder block for 0.012 in. or larger oversize liner as required.

Main bearing caps must be in place and capscrews must be torqued when cylinder block is honed or bored.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.002 in. Remove honing grit by swabbing bore with a cloth saturated with clean SAE 10 oil. Remove all traces of oil with solvent and blow dry with clean, dry compressed air. If liner enters 1/2 to 2/3 of the bore, a light press on top of liner should suffice. Stop pressing when liner is 1/2 in. from deck, clean counterbore with compressed air and then seat liner in

Exhaust Valve

Poppet type. Valve face angle, 30 degrees -0'/30'. Reamed I.D. of exhaust valve guide, 0.4995 to 0.5005 in. Valve stem diameter, 0.4955 to 0.4965 in. Stem-to-guide clearance (service), 0.003 to 0.005 in. Maximum face runout (service), 0.0015 in. Stem-to-rocker arm lash setting, 0.024 in. cold static, 0.022 in. hot idle. Use new valve rotators and keys at overhaul.

Inner Valve Spring

Nominal free length, 3-1/32 in. Test for 82.1 to 90.7 lbs. when compressed to 2-1/32 in. Service limit, 77.2 lbs.

Outer Valve Spring

Nominal free length, 3-13/32 in. Test for 105.3 to 116.3 lbs. when compressed to 2-5/32 in. Service limit, 99 lbs.

Rocker Arm Shaft

Shaft O.D., 1.1286 to 1.1291 in. Drilled for bottom oil feed of rocker arms. Locating screw assures proper line-up of oil passage.

Rocker Arm

Ratio 1.8 to 1. Shaft hole diameters, 1.1296 to 1.1301 in. Hole-to-shaft clearance is 0.0005 to 0.0015 in.

Before installing rocker arm and shaft assembly on cylinder head, be sure to fit O-ring carefully in recess at oil passage-to-rocker arm bracket on top of cylinder head.

Rocker arm bracket capscrew torque, 35 lb. ft.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil of coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets in their proper positions on the block checking that the rubber seals are correctly positioned in holes of gasket.

NOTE

Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. See Figure 2-134.

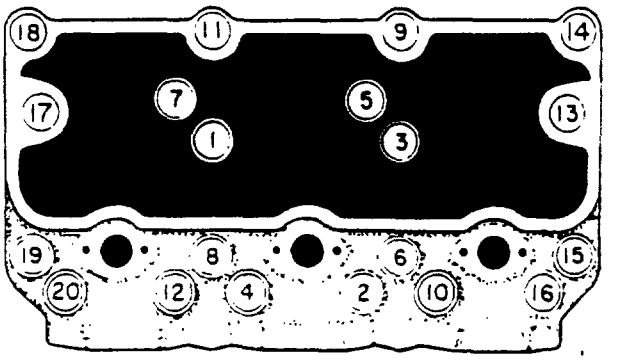


Figure 2-134. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque, following sequence in Figure 2-134. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry type cylinder liners. The deck area surface must be flat within 0.002 in. Excessively eroded water holes developing at deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush - absolute cleanliness is essential.

Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure.

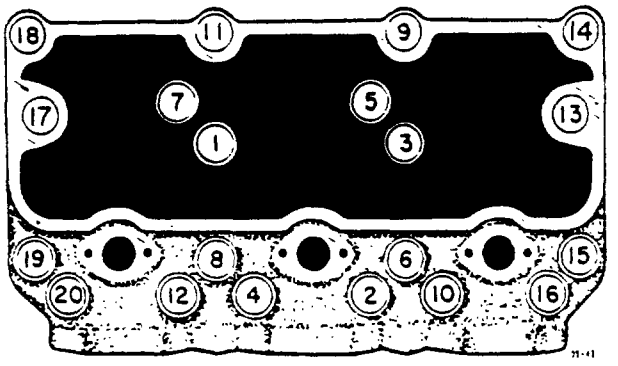


Figure 2-154. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque. following sequence in Figure 2-154. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of stud should be flush to three threads above top of the nut. After engine run-in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.002 in. Excessively eroded water holes developing at the deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.020 in. above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

Cylinder Liner

Dry type special alloy iron. Part number is etched on O.D. of liner. Free O.D. is 5.0945 to 5.0955 in. Cylinder block bore is 5.0945 to 5.0955 in. which allows a liner fit of 0.001 loose to 0.001 in. tight. Cylinder liner I.D. for standard size piston, 4.876 to 4.877 in. Cylinder liners are available in 0.002, 0.004, 0.006, 0.012 and 0.020 inch O.D. oversize. This liner is provided with a 3/64 x 0.008 in. high bead at the top outer edge of the flange. When installing liner, the flange must extend 0.0035 to 0.0075 inch above the deck surface. This is taken from the channel depth, not from top of bead, see Figure 2-155. The head embeds into the fire ring, which is a separate part of the cylinder head gasket. Extension of cylinder liners above cylinder block deck must not vary more than 0.001 in. under the same head.

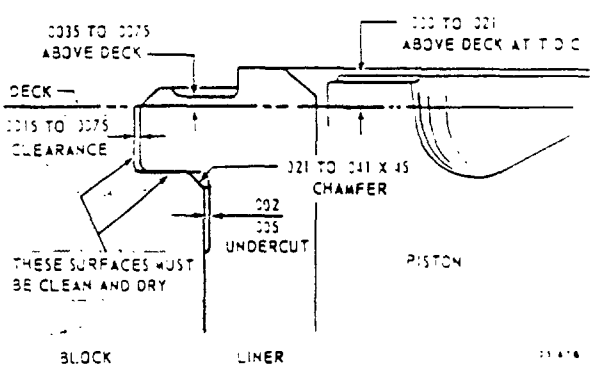


Figure 2-155. Cylinder Liner Detail

When replacing cylinder liners, check cylinder block bore. If out-of-round or taper does not exceed 0.006 in., hone block for 0.002, 0.004, or 0.006 in. oversize liner as required. If out-of-round or taper exceeds 0.006 in., bore cylinder block for 0.012 in. or larger oversize liner as required.

inch. Valve face to cylinder head deck 0.011 inch minimum. Stem-to-rocker arm lash setting, 0.024 inch static. Use new valve rotators and keys at overhaul.

Inner Valve Spring

Nominal free length, 3-1/32 inch. Test for 82.1 to 90.7 lbs. when compressed to 2-1/32 inch. Service limit, 77.2 lbs.

Outer Valve Spring

Nominal free length, 3-13/32 inch. Test for 105.3 to 116.3 lbs. when compressed to 2-5/32 inch. Service limit, 99 lbs.

Rocker Arm Shaft

Shaft O.D., 1.1286 to 1.1291 inch. Drilled for bottom oil feed of rocker arms. Locating screw assures proper line-up of oil passage.

Rocker Arm

Ratio, 1.8 to 1. Shaft hole diameter, 1.1296 to 1.1301 inch. Hole-to-shaft clearance is 0.0005 to 0.0015 inch.

Before installing rocker arm and shaft assembly on cylinder head, be sure to fit O-ring carefully in recess at oil passage-to-rocker arm bracket on top of cylinder head.

Rocker arm bracket capscrew torque, 35 lb. ft.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 inch diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert the studs finger-tight into block until bottomed, then back them off 1/3 turn. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush. Absolute cleanliness is essential. Wipe deck surface to remove oil, etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

NOTE

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Cylinder heads to be aligned within 0.005 inch on exhaust port side. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. Tighten all stud nuts to 50 lb. ft. torque following sequence in Figure 6. Tighten again, in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run-in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure and do not deviate from it.

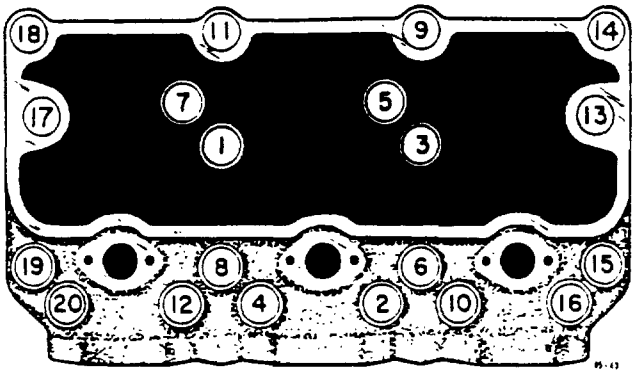


Figure 6. Cylinder Head Stud Nut Tightening Sequence

CYLINDER BLOCK

The cylinder block is an alloy casting with an integral cast water manifold to distribute coolant around the upper area of the block. Drilled passages are incorporated for transfer of coolant to the cylinder head and the proper distribution of lubricating oil to the various parts of the engine. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.0020 inch under area covered by individual head. Excessively eroded water holes at deck area must be repaired. To repair these holes,

Intercooler Header

Cast aluminum header directs turbocharged air to the top of the intercooler core and provides a protecting cover for the assembly.

Intake Manifold

Cast aluminum manifold provides the distribution point of the turbocharged aftercooled air and seat for the intercooler core. An integral part of the manifold is the front water manifold. This design feature permits the use of one compact and simple housing.

Intercooler Core

A compact plate fin heat transfer surface. The core measures 14 x 7 x 7 inches and weighs only 17-1/2 lbs. Fins are stacked on plates between each row. The places separate and direct the flow of air, i.e., second row turbocharged air; first row intercooled air, etc. The cooling side of the intercooler core can be cleaned by either of the following methods:

1. Steam Cleaning.

CAUTION

Steam pressures above 40 psi and/or temperatures above 400 degrees F. can damage core and gaskets.

2. Detergent Cleaning.

Use a solution of household laundry detergent such as "Tide". Flush through the core several times followed by a rinse with warm water. Use low pressure air to blow dry.

CAUTION

Do not under any circumstances use strong caustic solution, i.e., "Oakite", or acid, i.e., hydrochloric acid, bowl cleaners, etc., as they will corrode the core and damage gasket. Also do not use shop solvents to clean core as gasket damage will result.

ENGINE MOUNTS

Front

Two piece V-type insulator which fits over timing gear cover hub. One half fits in support bracket and other half in clamp cap. Check insulators for deterioration or wear and replace if necessary. See Figure 19.

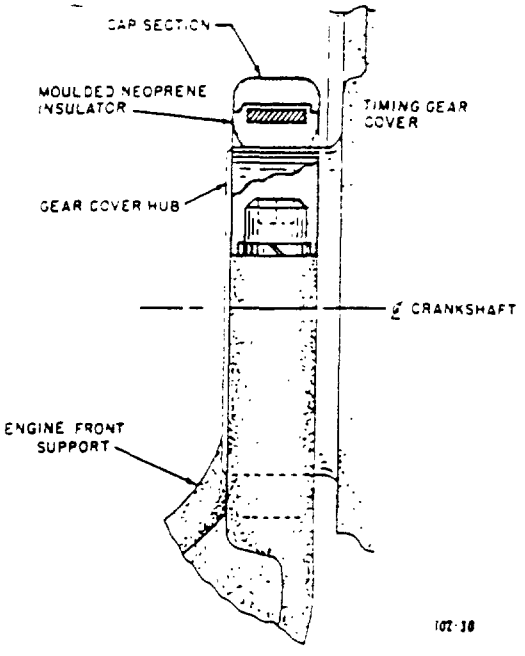


Figure 19. Engine Front Mounting

Rear

Biscuit type insulators located at each side of transmission or flywheel housing. Install new mounting insulators at overhaul and torque insulator through bolts 100 to 120 lb. ft.

Coolant Conditioner

The conditioner is a spin-on type, similar in appearance to the fuel oil filters. This unit, located on the front water manifold, can be identified by the blue color code indicating "Coolant Conditioner". The coolant conditioner has a thread size of 3/4 - 20 UNEF that will not allow it to be installed at other filter locations.

The contents consist of a chemical portion and a filter media. Automatic check valves close when the radiator pressure cap is removed. The spin-on element can then be removed without losing coolant. The check valves will reopen when the coolant pressure is restored. Under normal operating conditions, conditioner is to be changed every 16,000 miles, 300 hours, or 90 days or operation.

Fuel Filters

Two spin-on type fuel filters are used. The primary fuel filter is coded red and has 13/16-18 UNS threads. The secondary fuel filter is coded green and has a 7/8-16 UN thread. Under normal operating conditions, filters are to be changed every 16,000 miles, 300 hours, or 90 days of operation.

washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert the studs finger-tight into block until bottomed, then back them off 1/3 turn. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush. Absolute cleanliness is essential. Wipe deck surface to remove oil, etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

NOTE

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. Tighten all stud nuts to 50 lb. ft. torque following sequence in Figure 2-173. Tighten again, in sequence, to 100 lb. ft. torque. Tighten finally, in sequence to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run in procedure, and do not deviate from it.

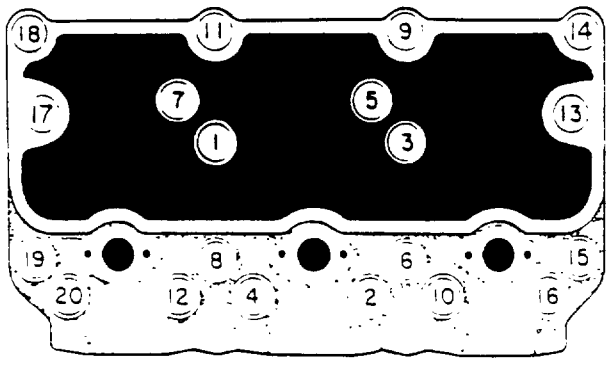


Figure 2-173. Cylinder Head Stud Nut Tightening Sequence

The cylinder block is an alloy casting with an integral cast water manifold to distribute coolant around the upper area of the block. Drilled passages are incorporated for transfer of coolant to the cylinder head and the proper distribution of lubricating oil to the various parts of the engine. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.0020 inch under area covered by individual head. Excessively eroded water holes at deck area must be repaired. To repair these holes, drill, tap and install bronze plug. Complete repair by drilling a new water hole using cylinder head gasket at template. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.021 inch above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

A machined oil pad is provided on the left hand side of the cylinder block. Porting in the pad corresponds to the porting in the oil pressure relief valve assembly.

Cylinder Liner

The cylinder liners are a special alloy cast iron with part number etched on O.D. Free O.D. is 5.0945 to 5.0955 inch. Cylinder block bore is 5.0945 to 5.0955 inch which allows a liner fit of 0.0010 inch loose to 0.0010 inch tight. Cylinder liner I.D. for standard size piston; 4.875 to 4.877 inch. Cylinder liners available in 0.002, 0.004, 0.006, 0.012, 0.020, 0.030, 0.040 and 0.050 inch O.D. oversize. This liner is provided with a 3/64 inch wide x 0.008 inch high bead, at the top outer edge of the flange. When installing liner, the flange must extend 0.0035 to 0.0075 inch above the deck surface. This is taken from the channel depth, not from top of bead. See Figure 2-174. The bead embeds into the fire ring, which is a separate part of the cylinder head gasket.

Extension of cylinder liners above cylinder block deck must not vary more than 0.001 inch under the same head.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.003 inch.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5 8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets in their proper positions on the block checking that the rubber seals are correctly positioned in holes of gasket.

NOTE

Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Set cleaned cylinder heads in place separately. When in place, apply Permatex No. 2 to the accessible outer edges of gasket. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. See Figure 2-194.

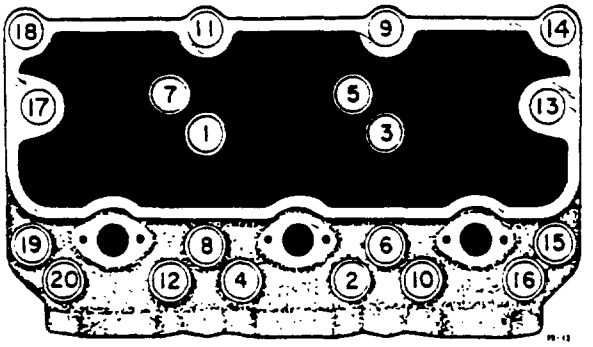


Figure 2-194. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque, following sequence in Figure 5. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of stud should be flush to three threads above top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.002 in. Excessively eroded water holes developing at the deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.020 in. above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

Two oil galleries are provided, the main oil gallery and another directly below which supplies oil for piston cooling. Tapped passages from lower oil gallery index with jet spray nozzles which spray cooling oil on the underside of the pistons.

Cylinder Liner

Dry type special alloy iron. Part number is etched on O.D. of liner. Free O.D. is 5.0945 to 5.0955 in. Cylinder block bore is 5.0945 to 5.0955 in. which allows a liner fit of 0.001 loose to 0.001 in. tight. Cylinder liner I.D. for standard size piston, 4.876 to 4.877 in. Cylinder liners available in 0.002, 0.004, 0.006, 0.012, 0.020, 0.030, 0.040 and 0.050 in. O.D. oversize. Extension of cylinder liners above cylinder block deck must not vary more than 0.001 in. under the same head. See Figure 2-195.

When replacing cylinder liners, check cylinder block bore. If out-of-round or taper does not exceed 0.006 in., hone block for 0.002, 0.004, or 0.006 in. oversize liner as required. If out-of-round or taper exceeds 0.006 in., bore cylinder block for 0.012 in. or larger oversize liner as required.

Main bearing caps must be in place and capscrews must be torqued when cylinder block is honed or bored.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.003 in.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 inch diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert the studs finger-tight into block until bottomed, then back them off 1/3 turn. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush. Absolute cleanliness is essential. Wipe deck surface to remove oil, etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

NOTE

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. Tighten all stud nuts to 50 lb. ft. torque following sequences in Figure 2-216. Tighten again, in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run in procedure, and do not deviate from it.

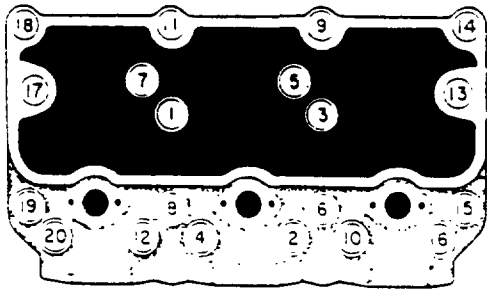


Figure 2-216. Cylinder Head Stud Nut Tightening Sequence

CYLINDER BLOCK

The cylinder block is an alloy casting with an integral cast water manifold to distribute coolant around the upper area of the block. Drilled passages are incorporated for transfer of coolant to the cylinder head and the proper distribution of lubricating oil to the various parts of the engine. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.0020 inch under area covered by individual head. Excessively eroded water holes at deck area must be repaired. To repair these holes, drill, tap, and install bronze plug. Complete repair by drilling a new water hole using cylinder head gasket as template. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.020 inch above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Produces Oil and Water Sealer or equivalent, when reinstalling plugs.

Two oil galleries are provided: the main oil gallery and another directly below which supplies oil for piston cooling. Tapped passages from the lower oil gallery index with jet spray nozzles which spray cooling oil on the underside of the pistons.

Cylinder Liner

The cylinder liners are a special alloy cast iron with part number etched on O.D. Free O.D. is 5.0945 to 5.0955 inch. Cylinder block bore is 5.0945 to 5.0955 inch which allows a liner fit of 0.0010 inch loose to 0.0010 inch tight. Cylinder liner I.D. for standard size piston, 4.875 to 4.877 inch. Cylinder liners available in 0.002, 0.004, 0.006, 0.012, 0.020, 0.030, 0.040 and 0.050 inch O.D. oversize. This liner is provided with a 3/64 inch wide x 0.008 inch high bead, at the top outer edge of the flange. When installing liner, the flange must extend 0.0035 to 0.0075 inch above the deck surface. This is taken from the channel depth, not from top of bead. See Figure 2-217. The bead embeds into the fire ring, which is a separate part of the cylinder head gasket.

Extension of cylinder liners above cylinder block deck must not vary more than 0.001 inch under the same head.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.003 inch.

NOTE

Current production auxiliary drive gears do not have timing marks and therefore, do not have to be timed.

Oil Pump Drive and Compressor Drive Coupling Gear

Oil pump drive and compressor drive coupling gear is designed with the coupling gear on one end and the oil pump drive gear on the other.

Inspect gears for wear pattern and cracked, chipped or broken teeth. See Figure 2-257. Install locating key in keyway of auxiliary shaft. Align slot in oil pump drive gear end of coupling and install gear on shaft. Install coupling washer and nut. Torque nut. Install compressor oil transfer tube in end of auxiliary driveshaft.

Tachometer Drive Assembly

Inspect tachometer shaft for wear and gear for chipped, cracked or broken gear teeth. Check housing bore for wear and flange for straightness and condition of holes.

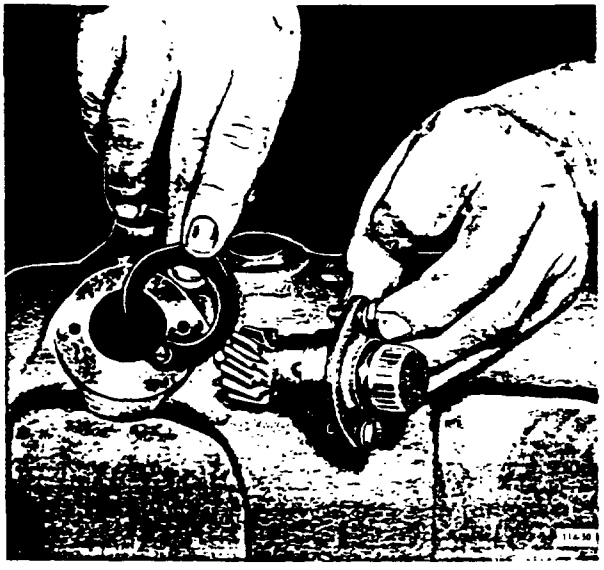


Figure 2-258. Installing Tachometer Drive Assembly

Lubricate tachometer shaft and gear and position in tachometer housing.

Install tachometer drive assembly and gasket on auxiliary drive housing. See Figure 2-258.

Injection Pump Drive Assembly

NOTE

Current production turbocharged engines use an aluminum injection pump drive housing and does not use ball bearings or bushings.

Injection pump drive assembly consists of a shaft with integral flange and tangs, a front and rear ball bearing positioned by a spacer and retained in the housing by a nut and cotter key. See Figure 2-259.

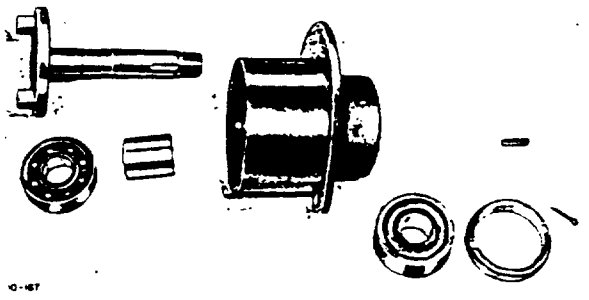


Figure 2-259. Injection Pump Drive Assembly

Inspect shaft for condition of flange and tangs. Check bearing locations for wear and galling. Check keyway slot and threads for condition. Inspect bearings for condition and free rotation. Check housing for straightness of flange, condition of bearing locations, holes and threads.

Position housing on bench with small end up. Coat bearing O.D. and recess lightly with Loctite grade B. Do not allow Loctite to enter bearing races. Install front bearing in housing with closed side up and tap into position with a suitable drift. Install bearing retaining nut; torque and lock in position with a cotter key. Allow Loctite to harden at least 12 hours at 72° F. Moderate heat may be used to accelerate hardening.

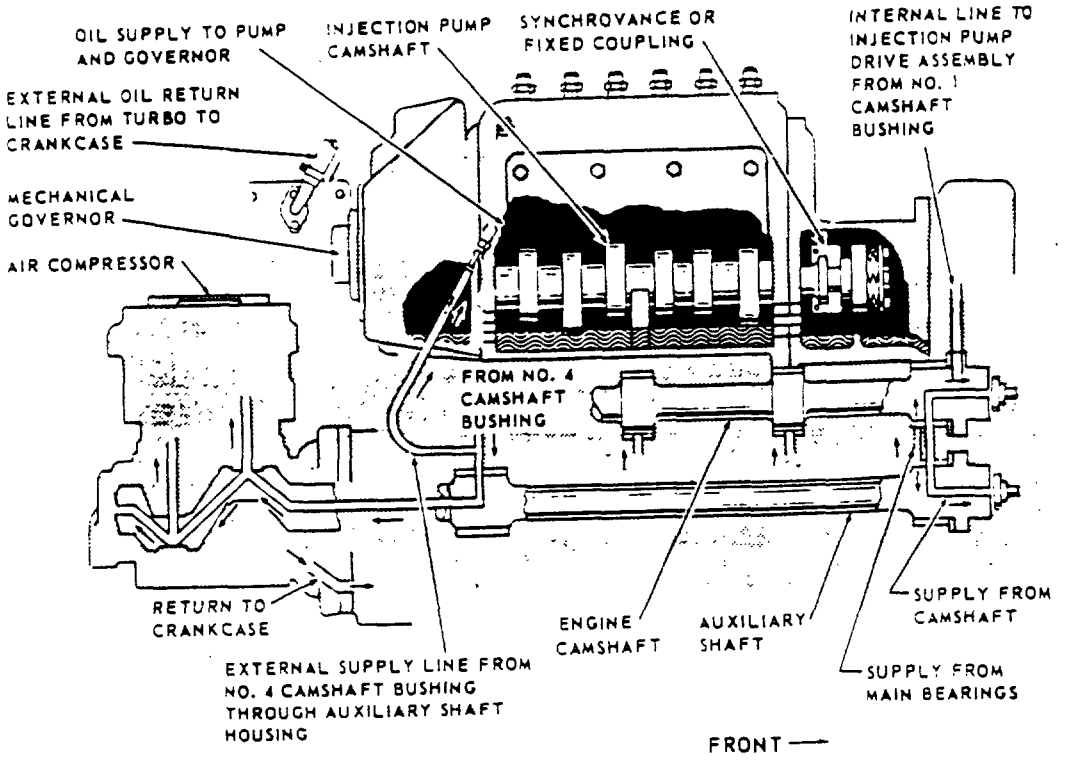


Figure 2-301. Auxiliary Drive and Injection Pump Lubrication

OIL PAN

Inspection

Inspect oil pan for dents, cracks and condition of flange, bolt holes for elongation and baffle for security. Inspect drain hole for condition of threads.

Installation

Position gasket on oil pan and position oil pan on cylinder block. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

CYLINDER HEAD STUDS

Inspection

Check cylinder head studs for condition of threads, and straightness of shank.

Installation

Apply a light coat of lubricating oil to threads of studs and install them in cylinder block finger-tight, then back off 1/3 turn.

CYLINDER HEAD INSTALLATION

CAUTION

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

Place cylinder head gasket over studs on cylinder block. Be sure that all passages are open and not blocked by gasket. Make sure fire rings are properly positioned. Cylinder gaskets are precoated; no soaking, coating or sealants are required. Use gaskets as received.

Position cylinder head over studs and gently onto cylinder block. See Figure 2-302. Be sure no foreign material is in cylinder.

Install cylinder head stud washers and nuts. Torque cylinder stud nuts in progressive steps of 50 lb. ft. using proper tightening sequence. See Figure 2-303.

Installation

1. Install rocker arm assembly to cylinder head. Be sure rocker arm bracket with oil hole is over O-ring seal.

2. Install rocker arm bracket capscrews and tighten to proper torque.

VALVE LASH ADJUSTMENT

The valve lash on standard non-brake engines can be adjusted cold static or hot idle: however, the valve lash on engines fitted with the Dynatard engine brake system can only be adjusted cold static.

To Adjust Valve Lash Cold Static

(Water Temperature Below 100 Degrees F.)

The valve lash for inlet and exhaust valves are adjusted in firing order with corresponding cylinder piston at TDC. Firing order for these engines is 1-5-3-6-2-4.

1. Set No. 1 cylinder piston TDC by use of timing marks on the vibration damper or flywheel.

2. Adjust inlet valve lash (cold static) 0.016 inch and exhaust 0.024 inch.

NOTE

Engines with Dynatard brake system use special exhaust valve adjusting tool MVT-36-6 and press downward with hand on exhaust adjusting screw while gaging valve lash.

3. Following No. 1 cylinder adjustment, turn crankshaft 1/3 turn clockwise in direction and place No. 5 cylinder at TDC. Adjust valves as outlined in step 2.

4. Continue adjusting valve lash for the remaining cylinder pistons in firing order placing each cylinder piston at TDC with respective 1/3 turns of the engine crankshaft.

5. Properly secure adjusting screw locknut after each cylinder piston valve lash adjustment.

To Adjust Valve Lash Hot Idle

(Not Recommended for Engines with the Dynatard Engine Brake System)

1. Start engine and warm up to normal operating temperature.

2. Set valve lash at hot idle (600 to 650 rpm) inlet valve 0.014 inch, exhaust 0.022 inch.

3. Properly secure adjusting screw locknut after each cylinder piston valve lash adjustment.

WATER OUTLET MANIFOLD

Inspection

Inspect water outlet manifold for restrictions. Check mounting flanges for cracks and straightness.

Installation

Place new hose and clamps between front half and rear half of the water outlet manifold. Place new gaskets between water manifold and cylinder head. Install and tighten attaching capscrews to the proper torque. Position hoses and hose clamps as applicable.

Install thermostat and by-pass fitting and thermostat housing cover and seal as applicable. See Figure 2-307.

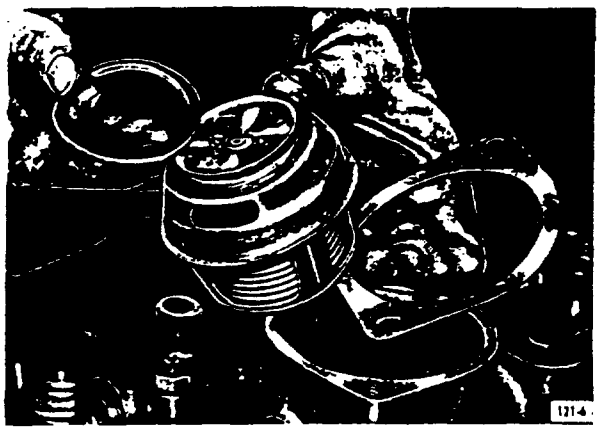


Figure 2-307. Installing Thermostat (Non-ESI)

NOTE

Thermostat on ESI engines located in front water manifold behind water conditioner and water fitting.

WATER PUMP

Description

The water pump is a centrifugal-rotor type, V-belt driven from the crankshaft. The pump cover contains the grease cavity and provisions for two, single row, ball bearings which support the shaft. The bearings

Installation - See Figure 2-310.

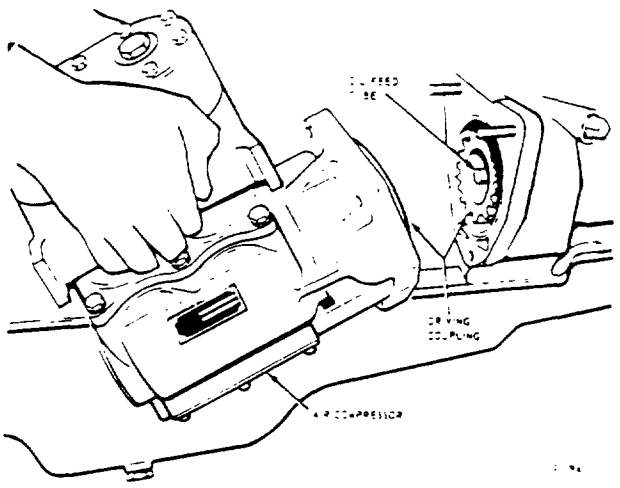


Figure 2-310. Installing Air Compressor

The air compressor is "phased" or "timed" to the engine. A tooth in the bore of the fiber coupling is shaved down to clear a pin in the drive coupling. The compressor can be installed only one way. If difficulty is experienced, recheck to insure coupling and drive are in proper mesh.

Current production engines do not require phasing or timing. The pin has been omitted from the drive coupling.

Be sure oil transfer tube is tight in end of auxiliary driveshaft.

Position air compressor adapter ring, if used, into auxiliary housing counterbore. Place gasket on air compressor and position on auxiliary housing. Install and torque air compressor retaining capscrews or nuts.

WARNING

Recheck auxiliary shaft end float after installing air compressor or vacuum pump.

FUEL INJECTION LINES, HIGH PRESSURE

Description

Fuel injection lines are seamless cold-drawn high tensile steel. All lines on one engine are of identical length and inside diameter.

Inspection

Inspect fuel injection line for chafing, dents, nicks or sharp bends. Check fittings, seat and threads for condition. Check lines to be sure they are not restricted.

Installation

Install fuel injection nozzles. Install fuel injection lines and be sure brackets are properly positioned to prevent lines from chafing.

The lines should fit without difficulty if they have not been changed around. NEVER BEND THE LINES TO MAKE THEM FIT.

Torque fuel injection lines at injection nozzles and pump locations. Torque injection line brackets.

INLET MANIFOLD

Inspection

Inspect inlet manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between inlet manifold and cylinder head. Install and tighten attaching capscrews to the proper torque.

EXHAUST MANIFOLD

Inspection

Inspect the exhaust manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between exhaust manifold and cylinder head. Install and tighten the attaching washers and nuts to the proper torque.

ROCKER ARM COVERS

Inspection

Inspect rocker arm covers for cleanliness, dents and straightness of flange. Check breather in cover, if applicable, to be sure it is not plugged.

Installation

Cement new gasket to mounting flange of rocker arm cover.

Position cover over rocker arms; install and torque cover retaining capscrews or nuts as applicable.

TURBOCHARGER

Description

The turbocharger is an exhaust gas driven air compressor. See Figure 2-311. The purpose of the turbocharger is to increase the supply of air to the cylinders and thus burn more fuel which in turn produces more power.

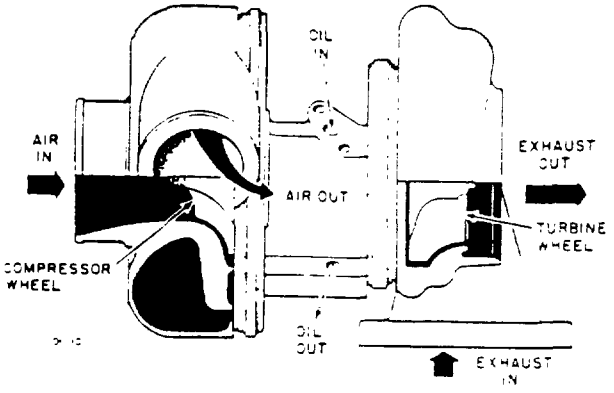


Figure 2-311. Exhaust Driven Turbocharger

The turbocharger consists of three main parts; the turbine housing, the bearing housing and the compressor housing. The turbine housing is located at one end of the bearing housing and the compressor housing is located at the other end. A common shaft connects the turbine wheel and compressor wheel.

The turbine end of the turbocharger uses exhaust gas energy normally discharged to the atmosphere. The exhaust gas enters the turbocharger through the flange connection on the exhaust manifold. The exhaust gas flows around the turbine housing and radially inward causing the turbine wheel to rotate. The exhaust gas is then discharged through the center of the turbine housing into the exhaust pipe.

The bearing housing contains the through-shaft, bearings, seals, and oil passages.

The bearings are of the floating sleeve type and are pressure lubricated from the engine oil supply system. Piston ring type oil seals are used at each end of the shaft to effectively seal off the oil.

The compressor housing contains the compressor wheel and air enters at the center of the compressor wheel and flows radially outward into the compressor housing. The air leaves through a tangential outlet on the outside of the compressor housing and is ducted to the inlet manifold.

Checks Before Removal

If turbocharger malfunction is suspected, make the following checks before removal of turbocharger from the engine.

1. Start engine and check for unusual noise or vibration from turbocharger. This will indicate out-of-balance, rubbing or damage to compressor or turbine wheels.

2. Check for leaks in the air system from turbocharger to intake manifold and from intake manifold to cylinder block. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

3. Check air cleaner and air intake system, from the air cleaner to turbocharger, for restrictions to air flow or leaks.

4. Check exhaust system, from cylinder block to turbocharger, for exhaust leaks. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

5. Check exhaust system from turbocharger to outlet for restrictions.

6. Check turbine wheel for radial and axial looseness. If radial and/or axial looseness is excessive, the turbocharger will have to be removed for overhaul. If turbocharger has to be overhauled, consult your Mack Branch or Distributor for details on turbocharger exchange program.

Cleaning

The compressor end of the turbocharger should be cleaned after 1000 to 2000 hours of operation. If the compressor wheel is not too dirty, it can be cleaned with the turbocharger on the engine.

Disconnect compressor discharge flange; remove the capscrews or clamp ring that holds the compressor housing to the bearing housing, and pull compressor housing carefully along turbocharger axis to prevent damage to the compressor wheel or the diffuser.

Use Bendix Metal Cleaner or equivalent solvent to clean compressor wheel. Do not use a caustic solution or any other type that may attack aluminum, as this will either weaken the impeller or destroy its balance. Do not use a wire brush or scraper; a brush with nylon or hog bristles is preferred.

If compressor wheel is found to be very dirty, remove turbocharger from the engine for cleaning. With compressor housing removed, immerse compressor wheel into the cleaning fluid and allow to soak. Use care not to rest weight of turbocharger on compressor wheel or on end of shaft.

The turbine end of turbocharger can be cleaned only after removal from the engine and separation of the bearing housing from the turbine housing.

Installation Guide

Use the following steps as a guide when installing turbocharger to engine.

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for foreign material.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure. Be sure check valve is working properly and not restricted.

5. Inspect turbocharger mounting pad, on exhaust manifold, for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect oil inlet line and oil drain line to turbocharger.

8. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

9. Crank engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger.

10. Stop cranking engine and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

ENGINE BREAK-IN PROCEDURE AFTER OVERHAUL OR REBUILD

Comparative tests and careful review of engine break-in methods have proven that a short run under full load is substantially more effective than the light or no load slow speed increase type of break-in. Compatibility between the critical components (piston, rings and bores) is greatly improved by raising engine speed and applying full load immediately after warm-up.

Use the recommended type and grade engine oil and fuel as required for usual operation of the vehicle.

Immediately prior to initial starting of the engine, the fuel system, oil galleries and filters are to be primed preferably by means of a pressure tank.

Check the air intake system to be sure all joints are tight and the filter element and system are clean.

After break-in procedure is complete, recheck cylinder head stud nut torque and valve clearance adjustment.

NOTE

Torque cylinder head studs. Back off each nut individually in proper sequence. See Figure 3-303. Oil threads and washer and tighten to the recommended torque.

When the vehicle is put into service, treat the engine as though it were new and follow the "Breaking in a New Vehicle" instructions listed in the Operation Manual.

1. Inspect the auxiliary shaft journals for wear and galling.

2. Inspect gear for wear pattern, cracked, chipped or broken teeth.

3. Inspect keyway slot on end of shaft for nicks and burrs.

4. Inspect the oil passage in the threaded end of the shaft and journal to insure it is not plugged.

Installation

1. Apply a light coat of oil to the journals and gear of the auxiliary shaft and position the auxiliary drive shaft in the cylinder block.

2. Install oil pump driving gear key in position on threaded end of auxiliary shaft.

3. Hold shaft in position and install the oil pump driving gear. Secure in position by installing the tabbed lockwasher and nut. Torque nut and lock by bending tabs.

4. Install new compressor oil tube using tool J2 19 10.

5. Complete assembly by installing tachometer drive, compressor and power steering pump.

NOTE

It is good assembly procedure to back the thrust button out before installing the timing gear cover.

Adjusting Auxiliary Shaft End Play

1. Clean threads of thrust button and back locknut out toward allen head. This will insure the thrust button will bottom auxiliary drive shaft before locknut contact timing gear cover.

2. Run thrust button in until it bottoms against the auxiliary driveshaft. Turn an additional turn on thrust button to insure auxiliary shaft is against the thrust plate.

3. Snug but do not tighten locknut against the timing gear cover.

4. Back out the thrust button assembly and insert proper feeler gauge between the locknut and timing gear cover.

5. Adjust the proper shaft end play by turning thrust button assembly in or out.

6. After the proper end play has been established, remove feeler gauge and securely hold thrust button assembly and lock adjustment by running locknut against the timing gear cover.

Tachometer Drive Assembly

Inspect tachometer shaft for wear and gear for chipped, cracked or broken gear teeth. Check housing bore for wear and flange for straightness and condition of holes.

Lubricate tachometer shaft and gear and position in tachometer housing.

Install tachometer drive assembly and gasket on auxiliary drive housing. See Figure 2-334.

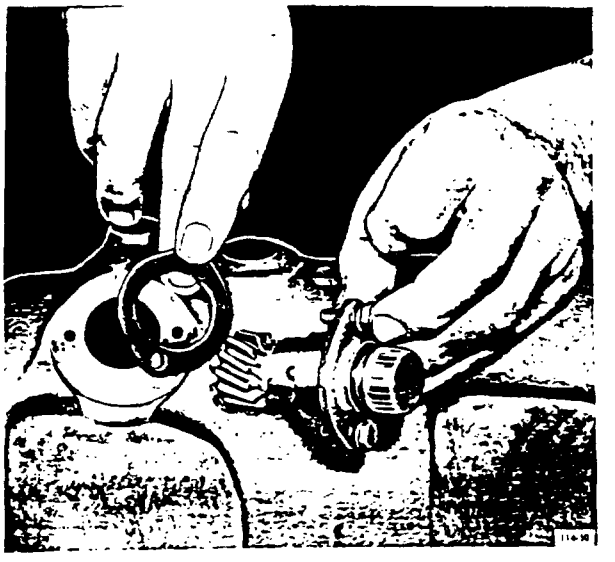


Figure 2-334. Installing Tachometer Drive Assembly

INJECTION PUMP DRIVE ASSEMBLY

Description

The injection pump drive assembly consists of an aluminum drive housing, a shaft with integral flange and tangs, driven gear and injection pump drive hub. See Figure 2-335.

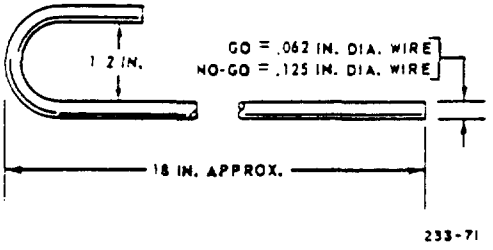


Figure 2-360. Piston Cooling Oil Nozzle Wire Gage

2. Visually sight along nozzle. Nozzle should be pointing at a location midway between side of connecting rod and inside face of piston pin boss when nozzle appears to be square with the engine centerline.

3. If nozzle is improperly positioned, bend nozzle tube to obtain proper location.

4. Slide GO wire (0.062 in.) gage over nozzle between piston skirt and nozzle tube. Gage must pass between nozzle tube and piston skirt.

5. Slide NO-GO wire (0.125 in.) gage over nozzle between piston skirt and nozzle tube. Gage must not pass between nozzle tube and piston skirt.

6. If either wire gage indicated improper nozzle tube to piston skirt clearance, bend nozzle tube sideways, fore or aft, as required.

NOTE

Recheck with both GO and NO-GO wire gages after bending nozzle tube.

7. Repeat steps 1 through 6 at numbers two and five pistons and three and four pistons.

TIMING GEAR COVER

Inspection

Inspect timing gear cover for dents, condition of threaded holes and straightness of flanges.

Installation

Install crankshaft front oil seal into timing gear cover. Use suitable tool. See Figure 2-361.

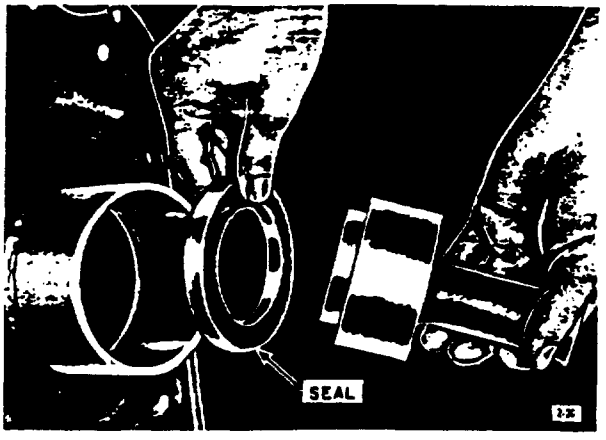


Figure 2-361. Installing Crankshaft Front Oil Seal

Install the adjustable thrust button(s) into the timing gear cover from the inside. Position the washer and jam nut on the outside of the timing gear cover.

Install suitable guide studs and position timing gear cover gasket and timing gear cover into position. Use a locally manufactured centering sleeve to align crankshaft oil seal. See Figure 2-362.

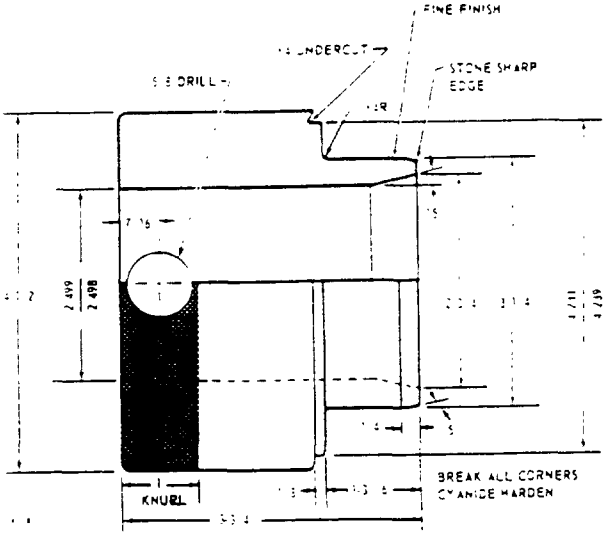


Figure 2-362. Timing Gear Cover Centering Sleeve

Install two timing gear cover screws finger-tight and tap cover lightly with a soft head hammer to align cover with oil pan bolting surface. Use a straight edge to assist alignment. See Figure 2-363. Remove guide studs. Install and torque all timing gear cover capscrews. Remove centering tools. Turn thrust button(s) in until there is no

IMPORTANT

When installing oil cooler core, notch in core header plate MUST be on same side as the oil ports so that correct flow through cover is maintained.

3. Use new gaskets and complete assembly.

OIL PUMP

Description

The oil pump is gear driven off the auxiliary driveshaft. This pump has two inlet passages which permits installing the suction tube to the sump at either the front or rear location, depending on the lower pan installation. The opposite passage is blocked off with a cover. The pump geatures a one piece oil pump shaft with integral pump gear.

Inspection

Inspect the oil pump drive gear for wear pattern and condition of teeth. Check shaft for journal wear. Insure oil holes are clean and not obstructed.

Check oil pump housing for condition of flanges, holes and oil pump gear cavity for scoring. Check idler shaft for scoring and tightness in housing.

Check oil pressure regulator body and cap for cleanliness, condition of holes, threads and spring for proper tension and ends for wear.

Assembly

1. Apply a light coat of lubricating oil to the oil pump drive gear shaft and install in pump housing.

2. Install pump drive gear to the shaft. The drive gear is keyed to the shaft and retained by a nylok type nut and washer.

3. Lubricate the idler gear shaft and install pumping idler gear.

4. Check gear end clearance, backlash and side clearance. See Figures 2-368, 2-369 and 2-370.

5. Position oil pump cover in a vise and install tab lock, pressure relief valve plunger, spring and cap into the cover. Torque cap and bend tab lock. See Figure 2-371.

6. Remove oil pump cover from the vise and position cover on oil pump body. Secure cover with capscrews and rotate oil pump shaft to insure oil pump is not binding.

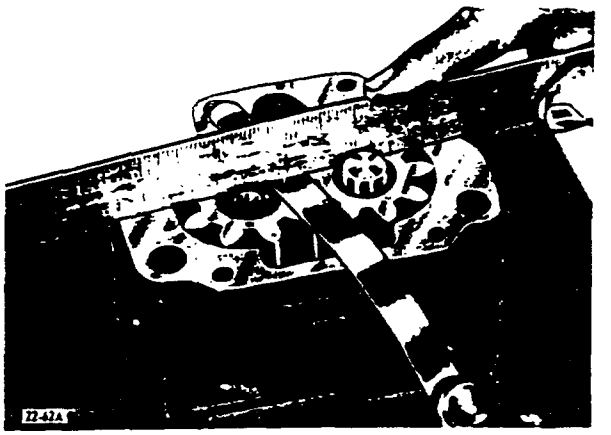


Figure 2-368. Checking Oil Pump Gear End Clearance

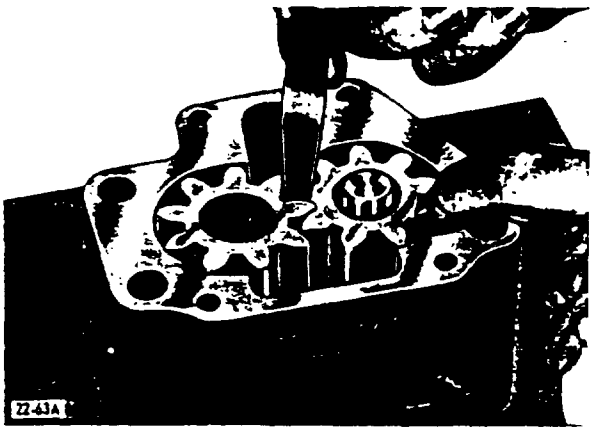


Figure 2-369. Checking Oil Pump Gear Backlash

Figure 2-370. Checking Oil Pump Gear Side Clearance

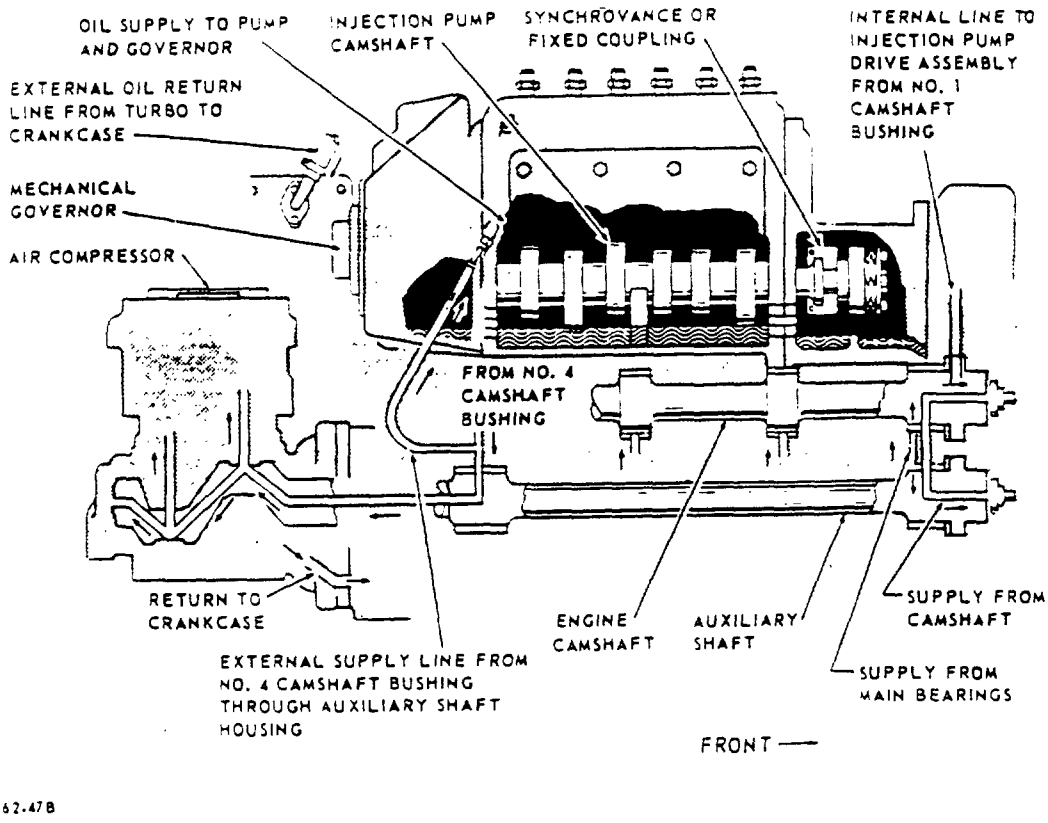


Figure 2-378. Auxiliary Drive and Injection Pump Lubrication

OIL PAN

Inspection

Inspect oil pan for dents, cracks and condition of flange, bolt holes for elongation and baffle for security. Inspect drain hole for condition of threads.

Installation

Position gasket on oil pan and position oil pan on cylinder block. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

CYLINDER HEAD STUDS

Inspection

Check cylinder head studs for condition of threads, and straightness of shank.

Installation

Apply a light coat of lubricating oil to threads of studs and install them in cylinder block finger-tight, then back off 1 3 turn.

CYLINDER HEAD INSTALLATION

CAUTION

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

Place cylinder head gasket over studs on cylinder block. Besure that all passages are open and not blocked by gasket. Make sure fire rings are properly positioned. Cylinder gaskets are precoated; no soaking, coating or sealants are required. Use gaskets as received.

Position cylinder head over studs and gently onto cylinder block. See Figure 2-379. Be sure no foreign material is in cylinder.

Apply a light coat of oil to the cylinder head stud washers and nuts and install in position. Torque cylinder stud nuts in progressive steps of 50 lb. ft. using proper tightening sequence. See Figure 2-380.

TROUBLE SHOOTING CHART (Cont)

Problem	Probable Cause	Remedy
Loss of power.	1. Plugged tip turbine fan air cleaner.	1. Check air cleaner and remove restriction.
	2. Air leak in tip turbine fan, bleed air connection.	2. Check all air connections. They must be tight.
	3. Restricted and/or damaged crossover pipe turbocharger to inlet of tip turbine fan.	3. Remove restriction and/or replace crossover pipe.
	4. Tip turbine fan exhaust port plugged.	4. Remove blockage. Exhaust port must be open at all times.
	5. Excessive dirt buildup in fan housing or wheel.	5. Clean, repair or replace unit.
	6. Turbine wheel rub.	6. Repair or replace the unit.
	7. Intercooler gasket leakage.	7. Disassemble intercooler and replace gasket.
Noisy tip turbine fan operation.	1. Plugged tip turbine fan air cleaner.	1. Check air cleaner and remove restriction.
	2. Air cleaner leaking, not sealing correctly, loose connections.	2. Check all air connections. They must be tight.
	3. Air leak at tip turbine fan, bleed connection.	3. Check port connections. They must be tight.
	4. Restricted and/or damaged crossover pipe turbocharger to inlet of tip turbine fan.	4. Remove restriction and/or replace crossover pipe.
	5. Blockage between air cleaner and tip turbine fan.	5. Remove blockage. Tip turbine fan requires unrestricted air flow.
	6. Exhaust port blocked.	6. Remove blockage. Exhaust port must be open at all times.
	7. Worn bearings.	7. Repair or replace the unit.
	8. Excessive dirt buildup in fan housing or wheel.	8. Clean, repair or replace the unit.
	9. Turbine wheel rub.	9. Repair or replace the unit.
	10. Intercooler gasket leaking.	10. Disassemble intercooler and replace gasket.

Problem	Probable Cause	Remedy
Excessive axial or radial play.	1. Oil Lay (oil delay to fan at start up).	1. Repair or replace unit. Engines should be idled for several minutes after starting to prevent oil lag.
	2. Insufficient lubrication.	2. Repair or replace unit. Maintain lubrication at proper level. Check lubricating piping must be free of sharp bends, etc. Lubricant must have unrestricted flow.
	3. Contaminated and/or improper type of lubricating oil.	3. Repair or replace unit. Drain oil, replace filters and fill with recommended lubricating oil.
Drag or bind in rotating assembly.	1. Contaminated and/or improper type of lubricating oil.	1. Repair or replace unit. Drain oil, replace filters and fill with recommended lubricating oil.
	2. Worn bearings.	2. Repair or replace unit.
	3. Excessive dirt build-up in tip turbine fan housing or wheel.	3. Clean or replace unit.

Bearing Clearance Inspection

The purpose of this procedure is to determine whether it is necessary to replace or repair the thrust bearing, radial bearings and/or rotating assembly. In most cases this bearing check can be made while the tip turbine fan is still mounted on the vehicle.

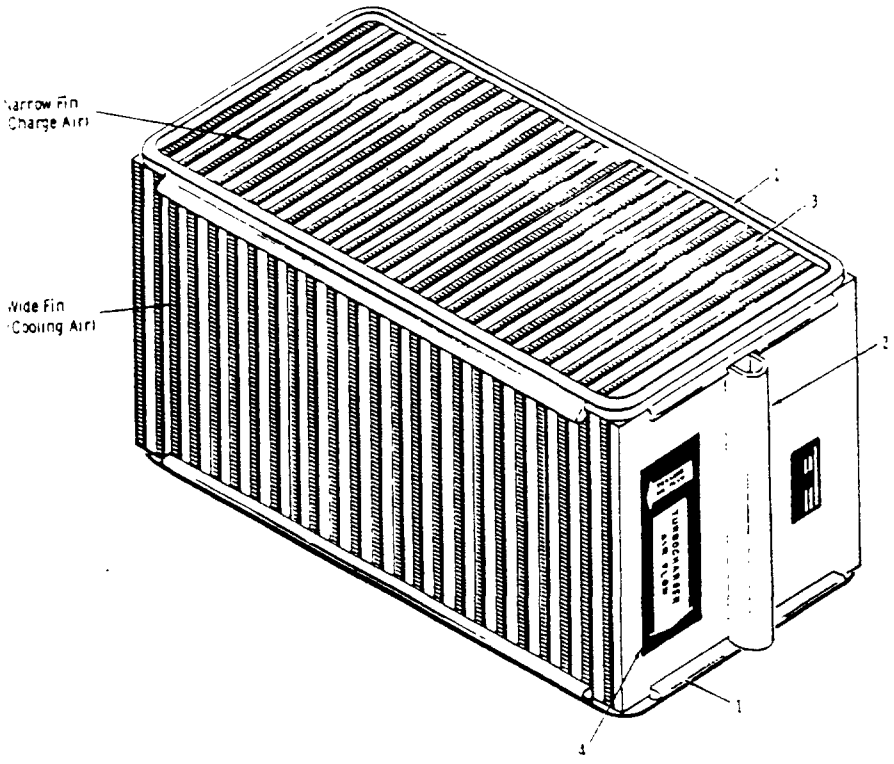
1. Radial Bearing Check - Fasten a "last word" type dial indicator to the flange of the inlet housing so that the indicator tip rests against the wheel nut shoulder. Move the shaft from side to side allowing minimum rotary movement. Total indicator reading should be from 0.006 to 0.011 inch. Any variation from these readings will require repair or replacement of the unit.

2. Axial Bearing Check - Fasten a plunger type dial indicator to the flange of the inlet housing so that the plunger rests against the end of the shaft. Move the shaft in and out. Total indicator reading should be 0.001 to 0.005 inch. Any variation from these readings will require repair or replacement of the unit.

INTERCOOLER CORE

Description

A compact plate heat exchanger assembly, it consists of a cross-flow core, two mounting/sealing gaskets and two "D" end sealing strips. See Figure 2-387. Fins are stacked on plates between each row. The plates separate and direct the flow of air, i.e., second row turbocharged; first row intercooled air, etc.



1. Gasket
2. End "D" Seal
3. Core Assembly
4. Decal

Figure 2-387. Intercooler Core Assembly

Cleaning

The cooling side of the intercooler core can be cleaned by either of the following methods:

1. Steam Cleaning.

CAUTION

Steam pressures above 40 psi and/or temperatures above 400 degrees F. can damage core and gaskets.

2. Detergent Cleaning.

Use a solution of household laundry detergent. Flush through the core several times followed by a rinse with warm water. Use low pressure air to blow dry.

CAUTION

Do not under any circumstances use strong caustic solutions, i.e., "Oakite" or acid, i.e., hydrochloric acid, bowl cleaners, etc., as they will corrode the core and damage gasket. Also do not use shop solvents to clean core as gasket damage will result.

Seal Removal

1. Pull off old gaskets.

2. With a razor blade or sharp knife, cut away excessive bonding material.

NOTE

It is not necessary to remove all the bonding material out of the depressed areas since the new gasket will seal perfectly to the slightly uneven old gasket surface.

3. Remove all loose shavings and cuttings.

Seal Replacement

NOTE

Unit must be clean and dry before attempting seal replacement.

1. Place unit on flat work bench, gasket surface up. (Turbocharger airflow arrow up or down.)

2. Soak clean rag with alcohol or trichlorethylene, and swab old gasket surface and new gasket to remove all oily residue.

3. Run a "bead" of bonding agent all around the surface to be gasketed, leaving no open gaps.

4. Place gasket on core and adjust into place.

CAUTION

Refer to diagrams on gasket shipping container for proper installation position.

5. Invert the intercooler and repeat 2, 3 and 4 for the second gasket.

NOTE

If the end seals are damaged, proceed with steps 6 and 7; otherwise, omit these steps and proceed with 8.

6. Swab the end plates of the intercooler with alcohol or trichlorethylene. Swab the new end seals with alcohol or trichlorethylene.

7. Run a double bead of bonding agent on the end seals and press into place on the end plates. Hold the end seals in position with string or tape wrapped around the entire unit.

8. Check all the gaskets to make sure they have not shifted during handling.

NOTE

Gaskets may be adjusted during the first 5 minutes while the bonding agent is curing.

9. Let the entire unit stand undisturbed for 1-1/2 hours minimum before installing.

Visually inspect the bond to make sure that the gasket is firmly attached all the way around. Gaps which are found should be filled with additional bonding agent. Let cure.

NOTE

Wipe manifold or gasket surfaces with talcum powder or Dow Corning 44 silicone grease before installing in manifold to prevent gasket sticking.

NOTE

Do not use petroleum base grease or oil for this purpose.

WATER PUMP

Description

The water pump is a centrifugal-rotor type, V-belt driven from the crankshaft. The pump cover contains the grease cavity and provisions for single and double row ball bearings which support the shaft. The bearings are sealed on one side to retain grease. A vent fitting replaces the usual grease fitting because the initial pack of grease, 1/3 full, should suffice for the life of the pump. A cartridge-type water seal with synthetic rubber bellows and carbon ring form an effective water-tight seal.

The housing, which comprises the volute (rotor casing) and water outlet to the engine is also the pump mounting.

It is usually more economical to obtain a rebuilt exchange water pump than to overhaul the old one. Contact your Mack Branch or Distributor for rebuilt exchange water pumps.

INJECTION PUMP INSTALLATION

1. Bar engine in normal direction of rotation until No. 1 cylinder is on compression stroke and flywheel timing mark indicates correct number of degrees BTC recommended on valve cover escutcheion plate. The injection pump driveshaft flange lugs should now be in a horizontal plane and indexing pin hole at 4 o'clock position, looking at face of shaft flange.

2. Grease front (non-counterbored) face of coupling and mount on pump driveshaft flange with long end of offset indexing pin pointing rearward and center the coupling ring laterally.

3. Remove pump adapter inspection hole cover.

4. Rotate pump coupling driven flange until lugs are in a vertical plane and indexing hole is at 7 o'clock position, looking from drive end of pump. See Figure 2-389.

Installation - See Figure 2-392.

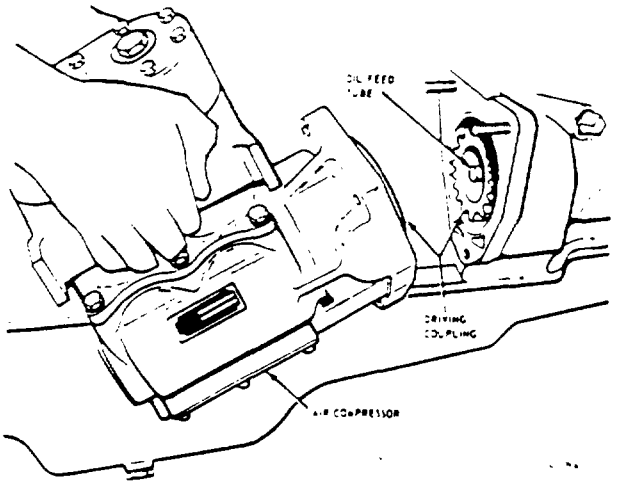


Figure 2-392. Installing Air Compressor

The oil transfer tube is assembled loose at both ends of auxiliary driveshaft.

Place silastic on air compressor mounting face and position on auxiliary housing. Install and torque air compressor retaining capscrews.

WARNING

Recheck auxiliary shaft end float after installing air compressor.

FUEL INJECTION LINES, High Pressure

Description

Fuel injection lines are seamless cold-drawn high tensile steel. All lines on one engine are of identical length and inside diameter.

Inspection

Inspect fuel injection line for chafing, dents, nicks or sharp bends. Check fittings, seat and threads for condition. Check lines to be sure they are not restricted.

Installation

Install fuel injection nozzles. Install fuel injection lines and be sure brackets are properly positioned to prevent lines from chafing.

The lines should fit without difficulty if they have not been changed around. NEVER BEND THE LINES TO MAKE THEM FIT.

Torque fuel injection lines at injection nozzles and pump locations. Torque injection line brackets.

INTAKE MANIFOLD

Description

Cast aluminum manifold provides the distribution point of the turbocharged aftercooled air and seat for the intercooler core. An integral part of the manifold is the front water manifold. This design feature permits the use of one compact and simple housing.

The thermostat housing is placed in the inlet end of the front water manifold. The coolant conditioner bolts to the flange of the front water manifold.

Inspection

Inspect intake manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between intake manifold and cylinder head. Install and tighten attaching capscrews to the proper torque.

EXHAUST MANIFOLD

Inspection

Inspect the exhaust manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between exhaust manifold and cylinder head. Install and tighten the attaching washers and nuts to the proper torque.

ROCKER ARM COVERS

Inspection

Inspect rocker arm covers for cleanliness, dents and straightness of flange. Check breather in cover, if applicable, to be sure it is not plugged.

Installation

Cement new gasket to mounting flange of rocker arm cover.

Position cover over rocker arms; install and torque cover retaining capscrews or nuts as applicable.

TURBOCHARGER

Description

The turbocharger is an exhaust gas driven air compressor. See Figure 2-393. The purpose of the turbocharger is to increase the supply of air to the cylinders and thus burn more fuel which in turn produces more power.

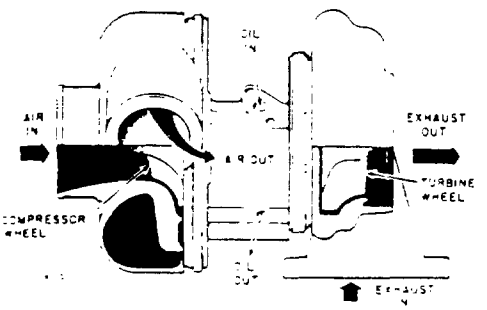


Figure 2-393. Exhaust Driven Turbocharger

The turbocharger consists of three main parts; the turbine housing, the bearing housing and the compressor housing. The turbine housing is located at one end of the bearing housing and the compressor housing is located at the other end. A common shaft connects the turbine wheel and compressor wheel.

The turbine end of the turbocharger uses exhaust gas energy normally discharged to the atmosphere. The exhaust gas enters the turbocharger through the flange connection on the exhaust manifold. The exhaust gas flows around the turbine housing and radially inward causing the turbine wheel to rotate. The exhaust gas is then discharged through the center of the turbine housing into the exhaust pipe.

The bearing housing contains the through-shaft, bearings, seals and oil passages.

The bearings are of the floating sleeve type and are pressure lubricated from the engine oil supply system. Piston ring type oil seals are used at each end of the shaft to effectively seal off the oil.

The compressor housing contains the compressor wheel and air enters at the center of the compressor wheel and flows radially outward into the compressor housing. The air leaves through a tangential outlet on the outside of the compressor housing and is ducted to the inlet manifold.

Checks Before Removal

If turbocharger malfunction is suspected, make the following checks before removal of turbocharger from the engine:

1. Start engine and check for unusual noise or vibration from turbocharger. This will indicate out-of-balance, rubbing or damage to compressor turbine wheels.

2. Check for leaks in the air system from turbocharger to intake manifold and from intake manifold to cylinder block. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

3. Check air cleaner and air intake system, from the air cleaner to turbocharger, for restrictions to air flow or leaks.

4. Check exhaust system, from cylinder block to turbocharger, for exhaust leaks. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

5. Check exhaust system from turbocharger to outlet for restrictions.

6. Check turbine wheel for radial and axial looseness. If radial and/or axial looseness is excessive, the turbocharger will have to be removed for overhaul. If turbocharger has to be overhauled, consult your Mack Branch or Distributor for details on turbocharger exchange program.

Cleaning

The compressor end of the turbocharger should be cleaned after 1000 to 2000 hours of operation. If the compressor wheel is not too dirty, it can be cleaned with the turbocharger on the engine.

Disconnect compressor discharge flange; remove the capscrews or clamp ring that holds the compressor housing to the bearing housing, and pull compressor housing carefully along turbocharge axis to prevent damage to the compressor wheel or the diffuser.

Use Bendix Metal Cleaner or equivalent solvent to clean compressor wheel. Do not use a caustic solution or any other type that may attach aluminum, as this will either weaken the impeller or destroy its balance. Do not use a wire brush or scraper; a brush with nylon or hog bristles is preferred.

If compressor wheel is found to be very dirty, remove turbocharger from the engine for cleaning. With compressor housing removed, immerse compressor wheel into the cleaning fluid and allow to soak. Use care not to rest weight of turbocharger on compressor wheel or on end of shaft.

The turbine end of turbocharger can be cleaned only after removal from the engine and separation of the bearing housing from the turbine housing.

Installation Guide

Use the following steps as a guide when installing turbocharger to engine:

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for foreign material.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure.

5. Inspect turbocharger mounting pad. on exhaust manifold, for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect oil inlet line and oil drain line to turbocharger.

8. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

9. Crank engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger.

10. Stop cranking engine and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

TIP TURBINE FAN AIR INTAKE SYSTEM

Description

A stratatube air separator provides clean air to the tip turbine fan and intercooler core. Outside air is drawn through the stratatube separator before entering the tip turbine fan. A bleed off type ejector pulls the dirty air from the separator. See Figure 2-394.

The stratatube air separator has no moving parts. All incoming air hits the fixed vanes in the separator and is swirled. The heavier, dirty air is forced to the outside of the vanes; while the lighter, cleaner air exits through the center. Bleed air from the inlet manifold enters the ejector, creating a partial vacuum which pulls the dirty air out of the separator and exhausts it into the atmosphere.

Maintenance

Basically, the stratatube air separator requires no maintenance other than a routine visual inspection making sure all parts are open and all connections tight.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets in their proper positions on the block checking that the rubber seals are correctly positioned in holes of gasket.

NOTE

Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Set cleaned cylinder heads in place separately. When in place, apply Permatex No. 2 to the accessible outer edges of gasket. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until after heads have been torqued. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. See Figure 2-400.

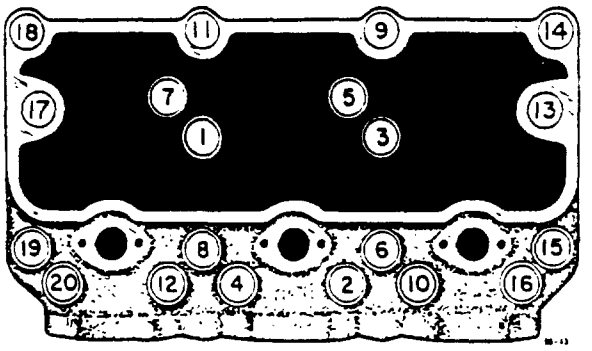


Figure 2-400. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque following sequence in Figure 5. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry type cylinder liners. The deck area surface must be flat within 0.0015 in. Excessively eroded water holes developing at deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.018 in. above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

Cylinder Liner

Dry type, special alloy iron, Rockwell C43-53. Part number etched on barrel. Standard size O.D., 5.1565 to 5.1575 inches. Cylinder liner I.D. for standard size piston, 5.0010 to 5.0020 inches to produce fit of 0.000 to 0.001 inches press.

Shoulder extension, 0.0035 to 0.0075 in. above deck. Extension of liners under same head should be within 0.001 in. Liners available in 0.002, 0.004, 0.006, 0.012 and 0.020 in. O.D. oversizes. Maximum out-of-round or taper of cylinder bore for liner, 0.002 in.

When replacing cylinder liners, check cylinder block bore. If out-of-round or taper does not exceed 0.006 in., hone block for 0.002, 0.004, or 0.006 in. oversize liner as required. If out-of-round or taper exceeds 0.006 in., bore cylinder block for 0.012 in. or larger oversize liner as required.

Main bearing caps must be in place and capscrews must be torqued when cylinder block is honed or bored.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.002 in. Remove honing grit by swabbing bore with a cloth saturated with clean SAE 10 oil. Remove all traces of oil with solvent and blow dry with clean, dry compressed air. If liner enters 1/2 to 2/3 of the bore, a light press on top of liner should suffice. Stop pressing when liner is 1/2 in. from deck, clean counterbore

Outer Valve Spring

Nominal free length, 3-13/32 inch. Test for 105.3 to 116.3 lbs. when compressed to 2-5/32 inch. Service limit, 99 lbs.

Rocker Arm Shaft

Shaft O.D., 1.1286 to 1.1291 inch. Drilled for bottom oil feed of rocker arms. Locating screw assures proper line-up of oil passage.

Rocker Arm

Ratio, 1.8 to 1. Shaft hole diameter, 1.1296 to 0.0301 inch. Hole-to-shaft clearance is 0.0005 to 0.0015 inch.

Before installing rocker arm and shaft assembly on cylinder head, be sure to fit O-ring carefully in recess at oil passage-to-rocker arm bracket on top of cylinder head.

Rocker arm bracket capscrew torque, 35 lb. ft.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 inch diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert the studs finger-tight into block until bottomed, then back them off 1/3 turn. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush. Absolute cleanliness of essential. Wipe deck surface to remove oil etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

NOTE

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. Tighten all stud nuts to 50 lb. ft. torque following sequence in Figure 2-414. Tighten again, in sequence, to 100 lbs. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run in procedure, and do not deviate from it.

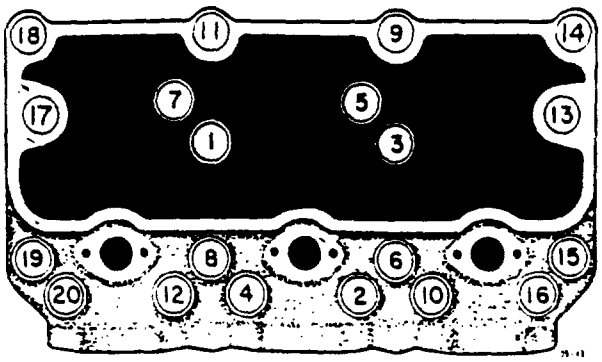


Figure 2-414. Cylinder Head Stud Nut Tightening Sequence

CYLINDER BLOCK

The cylinder block is an alloy casting with an integral cast water manifold to distribute coolant around the upper area of the block. Drilled passages are incorporated for transfer of coolant to the cylinder head and the proper distribution of lubricating oil to the various parts of the engine. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.0020 inch under area covered by individual head. Excessively eroded water holes at deck area must be repaired. To repair these holes, drill, tap and install bronze plug. Complete repair by drilling a new water hole using cylinder head gasket as template. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.018 inch above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

A machined oil pad is provided on the left hand side of the cylinder block. Porting in the pad corresponds to the porting in the oil pressure relief valve assembly.

Provisions have been made on both sides of the case to install buttress screws which fit into the main bearing cap. The buttress screws are used on both sides of all main bearing caps. They must be removed in order to remove the main bearing caps.

Block Preparation

1. Check the cylinder block deck surface for warpage. If warpage is excessive be sure that the maximum amount of material removal limit is not exceeded.

CAUTION

The piston travel above the cylinder block deck is critical and must be checked during assembly to insure proper clearance of piston with cylinder head and valve.

2. Remove all core plugs and fittings from the cylinder block and remove any accumulation of rust and sludges.

3. Check block for cracks, the condition of threaded holes and the straightness of the mating flanges.

4. Thoroughly inspect the upper edge of the cylinder sleeve counterbore in the block for signs of pitting or errosion. Rework as required. Shims are available to obtain correct sleeve height at reassembly.

5. Blow all passages thoroughly with compressed air.

6. Coat new O-ring with sealant, place on core plugs and install plugs in block.

7. Install all oil gallery plugs and gaskets using Permatex sealant or equivalent to insure positive sealing.

Cylinder Sleeve

The cylinder sleeves are wet type, centrifugal cast iron and are available in standard size. A bead is provided around top of seating flange for using a fire ring type cylinder head gasket. Clean sleeve flanges using a brass wire rotary brush to be sure of effective fire ring sealing. Check cylinder sleeve for out-of-round and taper. Use tool J5347-01 and measure each sleeve I.D. See Figure 9. Take readings in two directions at each of three levels: top, center, and bottom.

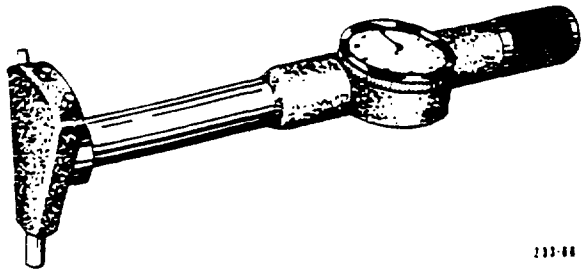


Figure 9. Cylinder Sleeve Bore Measuring Tool

Check the sleeve height above the cylinder block deck. Use gage Sweeney 6020. See Figure 10.

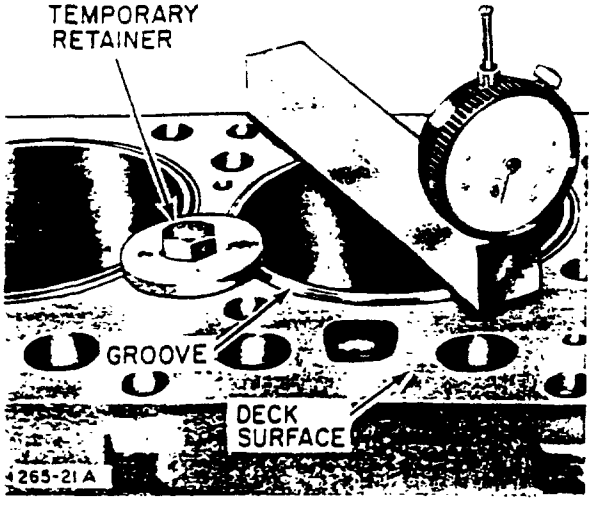


Figure 10. Checking Sleeve Height Above Block Deck

Honing

If sleeve bore when in place does not exceed out-of-round and taper limit, clean up I.D. with a suitable hone, 150 to 220 grit, to produce a diamond criss-cross pattern surface finish of 25 to 40 micro-inch rms.

Wash liner bore with a solution of household laundry detergent and air blow dry. Wipe liner bore with a clean oil soaked cloth.

Sleeve Rebore

If sleeve exceeds out-of-round and taper limit, the sleeve may be resized using boring bar equipment to receive the next applicable oversize piston. After re-sizing, hone 150 to 220 grit to produce a diamond criss-cross pattern surface finish of 25 to 40 micro-inch rms.

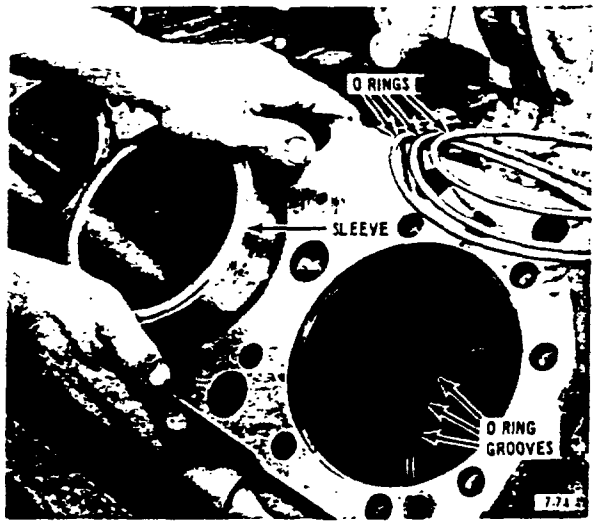


Figure 13. Installing Cylinder Sleeve

CAUTION

If for any reason the sleeve is backed out even as little as 1/8 inch, it may roll the top seal over the relief edge damaging the seal. Remove sleeve and replace seals.

8. Secure cylinder sleeve in pairs using keeper washer and capscrew at center cylinder head capscrew hole until pistons, rings and cylinder heads are installed.

Camshaft Bushings

There are two camshaft bushing widths. The front camshaft bushing is the wider bushing; the remaining bushings are of a narrower width. All bushings are located at set distances measured from the forward machined surface of the camshaft thrust washer recess to the forward edge of subsequent bushings. Use special tool kit J-21428 to install or remove bushings. Coat outer surface of the bushings with engine oil before installation. The oil supply hole in the bushing should be located to the right as viewed from above and standing to the rear of the engine. The camshaft bushing interlocking split should be installed upward. See Figure 14.

NOTE

The rear camshaft bushing can be removed, using special tool J-21385, without removing the flywheel housing.

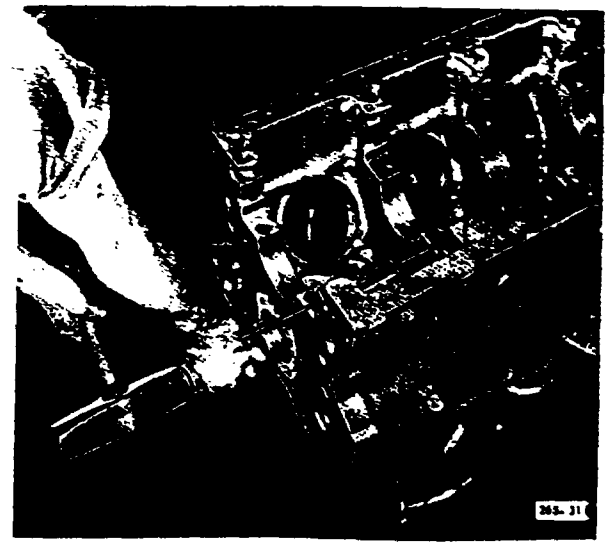


Figure 14. Installing Camshaft Bushing

Expand the front oil gallery plug to offer resistance upon entering bore. The front oil gallery plug is further secured by installing the camshaft thrust washer which partially covers the plug. Nylock countersunk Allenhead capscrews are used to secure the thrust washer in place. It is imperative that the mating surfaces be clean and new Nylock screws are used. See Figure 15.

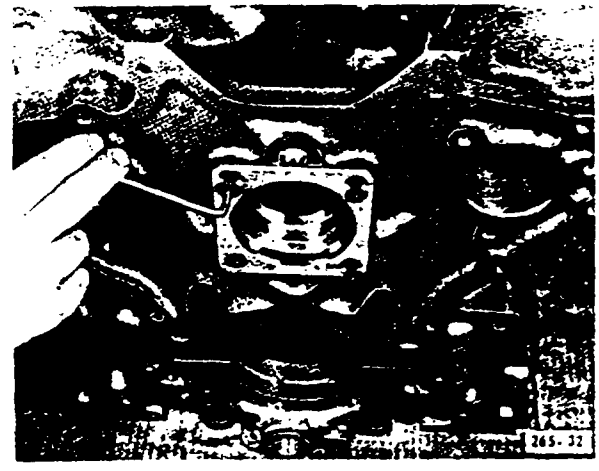


Figure 15. Installing Camshaft Thrust Washer

Apply a coat of Permatex to the rear oil gallery plug and gasket and install in rear oil gallery. See Figure 16.

5. Press gear and shaft assembly into bearing until it bottoms on shoulder on shaft.

6. Invert housing and gear and install spacer.

7. Install rear bearing with seal side outward in housing.

8. Clamp assembly in a suitable clamping fixture to hold gear and install water pump drive shaft screw. Tighten to recommended torque.

9. Install O-ring in the groove on outer periphery of the housing.

10. Lubricate O-ring seal generously and install drive assembly in cylinder block recess with flat side of housing toward camshaft gear.

NOTE

It is important to generously lubricate O-ring seal before installing in block. This will prevent the O-ring from rolling on upper surface and restricting oil supply to the water pump bearings.

11. Install three water pump housing capscrews securing assembly in position. Tighten to recommended torque.

TIMING GEAR COVER

Inspection

Inspect timing gear cover for dents, condition of threaded holes and straightness of flanges.

Installation

1. Install crankshaft front oil seal into the cover using tool J-21375.

2. Install the adjustable camshaft thrust button from the inside and position the washer and jam nut on the outside of the cover.

3. Adjust camshaft thrust button to its retracted position.

4. Install six guide studs. Two guide studs are used at the lowest point, highest point and one adjacent to the water pump drive and the final stud adjacent to the drive provision directly opposite the water pump drive.

5. Install the timing gear gasket over guide studs.

6. Install the timing gear cover over the guide studs and push cover into position.

7. Install all cover capscrews loosely.

8. Install water pump drive alignment tool J-21382 and crankshaft oil seal alignment tool J-21381. Torque all capscrews.

CRANKSHAFT VIBRATION DAMPER AND HUB

Inspection

1. Inspect crankshaft vibration damper hub for scoring, condition of flange, threaded holes and keyway.

2. Inspect the vibration damper for general condition, mounting threaded holes and housing.

Installation

1. Position crankshaft keyway UP and install key.

2. Heat crankshaft vibration damper hub in hot oil to 250 degrees F.

3. Align crankshaft hub on key and install hub. See Figure 45.

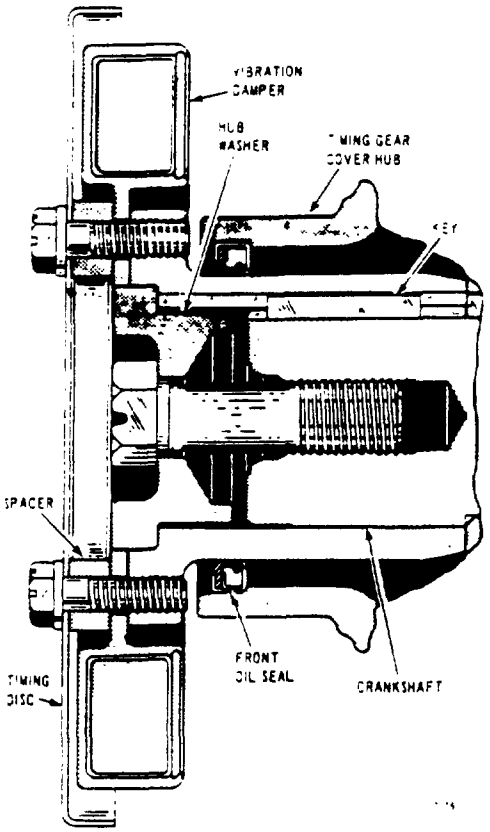


Figure 45. Vibration Damper and Hub Arrangement

4. Install hub washer and retaining screws. Torque screws.

5. Install vibration damper, spacer and timing disc on crankshaft hub; the holes will only line up one way.

6. Install retaining capscrews securing assembly.

NOTE

When all parts are assembled on the crankshaft, keyway up, the scribe mark on the damper rim must be up. The TDC mark must align with the timing indicator 30 degrees to the left of the engine centerline.

OIL PAN

Inspection

1. Inspect oil pan for dents, cracks and condition of flange.

2. Inspect and check the bolt holes for elongation and baffle for security.

3. Inspect and check drain hole for condition of threads.

Installation

1. Position gasket on oil pan and position oil pan on cylinder block.

2. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

AUXILIARY DRIVE ASSEMBLY

Description

The auxiliary drive is a complete unit sub-assembly located between the cylinder heads on the front of the engine. The auxiliary drive consists of a drive housing, idler shaft and gear assembly and drive shaft. It is gear driven from the camshaft. See Figure 46.

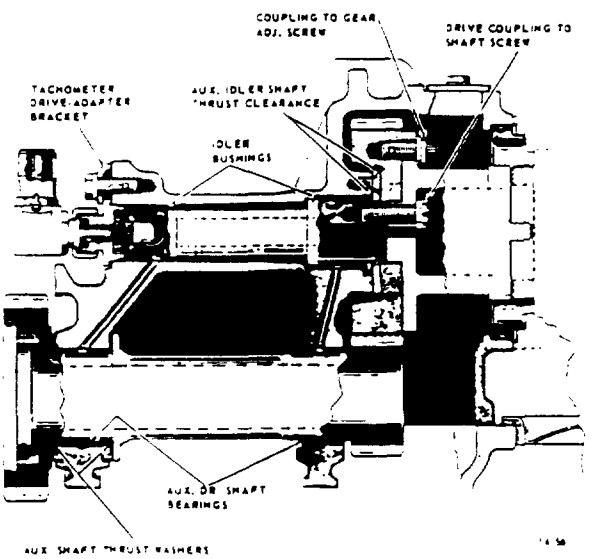


Figure 46. Auxiliary Drive Assembly

DRIVE HOUSING

Description

The auxiliary drive housing is an alloy casting and supports the drives for the injection pump, air compressor, tachometer drive and hydraulic steering pump.

Installation

1. Time auxiliary drive to camshaft gear. Install both push rods in No. 6 cylinder location. Bar engine over until movement is felt in both push rods simultaneously and the timing indicator pointer indicates TDC for No. 1 and 6 cylinders. The single punch mark on the camshaft gear will be in the upright position.

2. Install O-ring in oil passage port at right hand front top edge of cylinder block.

3. Apply a bead of 243SX32 gasket compound or equivalent to mating surfaces of the auxiliary drive housing.

4. Place auxiliary housing assembly on top of the block carefully.

NOTE

Be sure timing gear cover gasket is properly positioned and the single timing mark on the camshaft gear alignes with the single timing mark on the auxiliary drive gear.

5. Install all nine capscrews and washers hand tight.

6. Torque the two lower timing gear cover to auxiliary housing capscrews.

7. Torque all auxiliary housing to cylinder block capscrews.

8. Release the torque on the two timing gear cover to auxiliary housing capscrews then retorque the same capscrews.

NOTE

This procedure will align auxiliary housing to front face of the cylinder block and permit block surface to butt fully to mating surface of auxiliary housing.

9. Check backlash between camshaft gear and auxiliary drive gear. If backlash is not within limits, loosen auxiliary housing capscrews and reposition housing by tapping with a soft faced mallet. Retorque capscrews and recheck backlash.

NOTE

Care must be taken at this time to have all pipe plugs in the auxiliary drive oil gallery passages. Access to these plugs becomes increasingly difficult at later assembly points.

VALVE LIFTER COVERS

The center valve lifter cover is a steel stamping and requires a new gasket at assembly. The rear valve lifter cover is cast aluminum. At assembly apply a bead of gasket compound 243SX32 to the cover and cylinder block mating area.

INJECTION PUMP

Installation

1. Bar engine over in the normal direction of rotation until the No. 1 cylinder piston is at TDC, as indicated by the timing indicator, and the timing marks on the auxiliary drive shaft gear aligns with the timing mark on the auxiliary drive idler. The pin hole location will be at the five o'clock position and the coupling tangs are at 12 degrees 36 minutes off the horizontal. See Figure 48.

2. Bar engine back approximately 40 degrees.

3. Bar engine over in the normal direction of rotation until timing indicator reads the B.T.C. setting as specified on the injection pump name plate. In this position the tangs on the drive coupling will be approximately horizontal and the drive coupling pin hole will be approximately at the 4:30 o'clock position. The gear marks will be approximately 15 degrees 30 minutes to the right. See Figure 50.

CYLINDER HEAD INSTALLATION

NOTE

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

1. Clean the cylinder block deck thoroughly.

2. Install new cylinder head gasket on deck. Position of gasket is determined by guide pins in the upper deck.

NOTE

Do not use a sealing compound or soak cylinder head gaskets. They are all pre-coated.

3. Install new fire ring carefully fitted over circular bead on cylinder sleeve flange. See Figure 55.

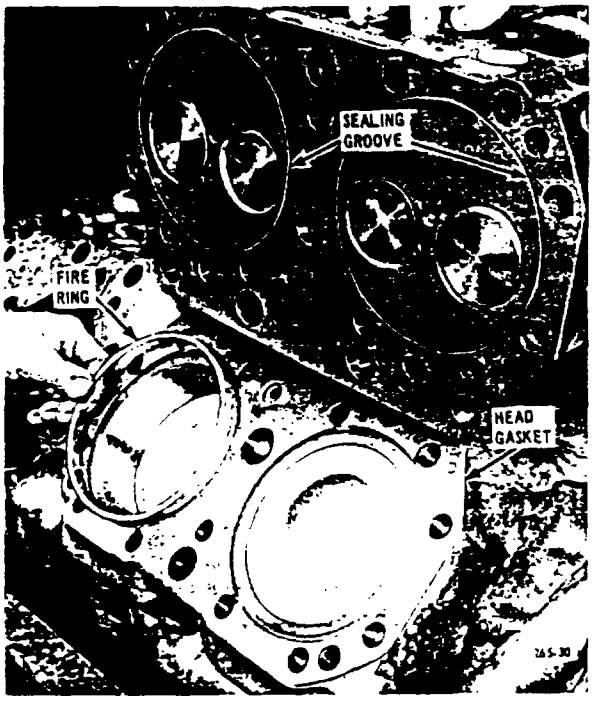


Figure 55. Cylinder Head Installation

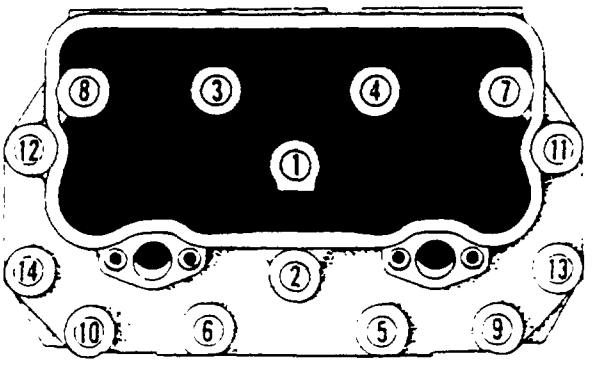
4. Clean the surface of the cylinder head and ciruclar groove for the fire ring.

5. Carefully position the cylinder head assembly over the cylinder block deck aligning the guide pins in the block with the guide holes in cylinder head.

6. Install cylinder head on block.

7. Install fourteen cylinder head capscrews.

8. Torque capscrews on each head progressively in steps of 50 to 100 to 175, and finally to 225 lb. ft. in sequence as shown. See Figure 56.



Cylinder Head Nut Tightening Sequence
ENDT865

Figure 56. Cylinder Head Tightening Sequence

PUSH RODS

Description

The push rods for the intake and exhaust valve rocker arms are tubular steel with spherical ends. Engines not fitted with the Dynatard engine brake feature identical 1/2 inch O.D. x 14-1/4 inch push rods; however, when the engine is fitted with the Dynatard engine brake system the exhaust valve rocker arm push rod is heavier 5/8 inch O.D. x 14-1/4 inch long.

Inspection

1. Inspect and check the push rods for length and straightness. Replace any that are bent.

2. Inspect and check the spherical surfaces for wear and tightness to tube.

Installation

Apply a light coat of lubricating oil to the spherical ends and install the push rods in the valve lifters.

4. Continue adjusting valve lash for the remaining cylinder pistons in firing order placing each cylinder piston at TDC with respective 1/4 turns of the engine crankshaft.

5. Properly secure aduusting screw locknut after each cylinder piston valve lash adjustment.

To Adjust Valve Lash Hot Idle (Not Recommended for Engines with the Dynatard Engine Brake System)

1. Start engine and warm up to normal operating temperature.

2. Set valve lash at hot idle (600 to 650 rpm) inlet valve 0.015 inch, exhaust 0.024 inch.

3. Properly secure adjusting screw lock nut after each cylinder piston valve lash adjustment.

WATER OUTLET MANIFOLD

Inspection

1. Inspect water outlet manifold for restrictions.

2. Inspect and check mounting flanges for cracks and straightness.

Installation

1. Place new gasket between right bank and left bank water manifold and the mating cylinder heads.

2. Install and tighten attaching capscrews to the proper torque.

3. Install thermostats in the right and left bank water manifolds.

4. Install thermostat gaskets, water outlet fittings, thermostat seals and water outlet by-pass elbows.

5. Secure assembly to the water manifold by installing the attaching capscrews.

INLET MANIFOLD

Inspection

1. Inspect and check the inlet manifolds for restrictions.

2. Inspect and check mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between the inlet manifold and cylinder head.

2. Install right and left hand inlet manifolds and lifting eyes. Secure to cylinder head by installing attaching capscrews and tighten to the recommended torque.

3. Place a new inlet manifold fitting gasket on the top of each inlet manifold and install inlet manifold inlet fitting.

4. Install tee fitting and complete inlet manifold assembly.

EXHAUST MANIFOLD

Inspection

1. Inspect and check the exhaust manifold for restrictions.

2. Inspect and check the mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between exhaust manifold and cylinder head.

2. Install and tighten the attaching capscrews and washers to the proper torque.

CYLINDER HEAD COVERS

Inspection

1. Inspect and check the cylinder head covers for cleanliness, dents and straightness of flange.

2. Inspect and check breather in cover, if applicable, to be sure it is not plugged.

Installation

1. Cement a new gasket to the mounting flange of the cylinder head cover.

2. Position the cylinder head cover over rocker arms.

3. Install and torque cover retaining capscrews.

TURBOCHARGER

Description

The turbocharger is an exhaust gas driven air compressor. See Figure 59. The purpose of the turbocharger is to increase the supply of air to the cylinders and thus burn more fuel which in turn produces more power.

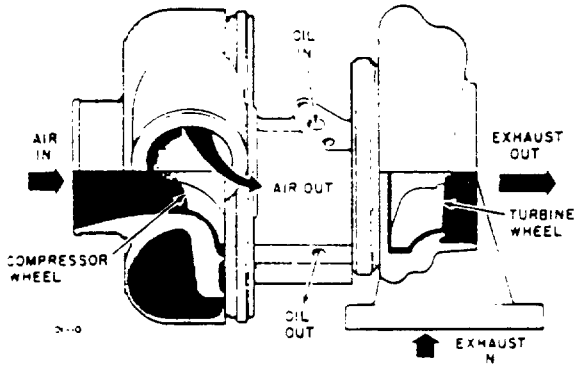


Figure 59. Exhaust Driven Turbocharger

The turbocharger consists of three main parts; the turbine housing, the bearing housing and the compressor housing. The turbine housing is located at one end of the bearing housing and the compressor housing is located at the other end. A common shaft connects the turbine wheel and compressor wheel.

The turbine end of the turbocharger uses exhaust gas energy normally discharged to the atmosphere. The exhaust gas enters the turbocharger through the flange connection on the exhaust manifold. The exhaust gas flows around the turbine housing and radially inward causing the turbine wheel to rotate. The exhaust gas is then discharged through the center of the turbine housing into the exhaust pipe.

The bearing housing contains the through-shaft, bearings, seals, and oil passages.

The bearings are of the floating sleeve type and are pressure lubricated from the engine oil supply system. Piston ring type oil seals are used at each end of the shaft to effectively seal off the oil.

The compressor housing contains the compressor wheel and air enters at the center of the compressor wheel and flows radially outward intothe compressor wheel and flows radially outward into the compressor housing. The air leaves through a tangential outlet on the outside of the compressor housing and is ducted to the inlet manifold.

Checks Before Removal

If turbocharger malfunction is suspected, make the following checks before removal of turbocharger from the engine.

1. Start engine and check for unusual noise or vibration from turbocharger. This will idicate out-of-balance, rubbing or damage to compressor or turbine wheels.

2. Check for leaks in the air system from turbocharger to intake manifold and from intake manifold to cylinder block. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

3. Check air cleaner and air intake system, from the air cleaner to turbocharger, for restrictions to air flow or leaks.

4. Check exhaust system from cylinder block to turbocharger for exhaust leaks. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

5. Check exhaust system from turbocharger to outlet for restrictions.

6. Check turbine wheel for radial and axial looseness. If radial and/or axial looseness is excessive, the turbocharger will have to be removed for overhaul. If turbocharger has to be overhauled, consult your Mack Branch or Distributor for details on turbocharger exchange program.

Cleaning

The compressor end of the turbocharger should be cleaned after 1000 to 2000 hours of operation. If the compressor wheel is not too dirty, it can be cleaned with the turbocharger on the engine.

Disconnect compressor discharge flange; remove the capscrews or clamp ring that holds the compressor housing to the bearing housing, and pull compressor housing carefully along turbocharger axis to prevent damage to the compressor wheel or the diffuser.

Use Bendix Metal Cleaner or equivalent solvent to clean compressor wheel. Do not use a caustic solution or any other type that may attack aluminum, as this will either weaken the impeller or destroy its balance. Do not use a wire brush or scraper; a brush with nylon or hog bristles is preferred.

If compressor wheel is found to be very dirty, remove turbocharger from the engine for cleaning. With compressor housing removed, immerse compressor wheel into the cleaning fluid and allow to soak. Use care not to rest weight of turbocharger on compressor wheel or on end of shaft.

The turbine end of turbocharger can be cleaned only after removal from the engine and separation of the bearing housing from the turbine housing.

Installation Guide

Use the following steps as a guide when installing turbocharger to engine.

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for foreign material.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure. Be sure check valve is working properly and not restricted.

5. Inspect turbocharger mounting pad on exhaust manifold for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect oil inlet line and oil drain line to turbocharger.

8. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

9. Crank engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger.

10. Stop cranking engine and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

ENGINE BREAK-IN PROCEDURE AFTER OVERHAUL OR REBUILD

Comparative tests and careful review of engine break-in methods have proven that a short run under full load is substantially more effective than the light or no load slow speed increase type of break-in. Compatibility between the critical components (piston, rings and bores) is greatly improved by raising engine speed and applying full load immediately after warm-up.

Use the recommended type and grade engine oil and fuel as required for usual operation of the vehicle.

Immediately prior to initial starting of the engine, the fuel system, oil galleries and filters are to be primed preferably by means of a pressure tank.

Check the air intake system to be sure all joints are tight and the filter element and system are clean.

Provisions have been made on both sides of the case to install buttress screws which fit into the main bearing cap. The buttress screws are used on both sides of all main bearing caps. They must be removed in order to remove the main bearing caps.

Block Preparation

1. Check the cylinder block deck surface for warpage. If warpage is excessive be sure that the maximum amount of material removal limit is not exceeded.

CAUTION

The piston travel above the cylinder block deck is critical and must be checked during assembly to insure proper clearance of piston with cylinder head and valve.

2. Remove all core plugs and fittings from the cylinder block and remove any accumulation of rust and sludges.

3. Check block for cracks, the condition of threaded holes and the straightness of the mating flanges.

4. Thoroughly inspect the upper edge of the cylinder sleeve counterbore in the block for signs of pitting or errosion. Rework as required. Shims are available to obtain correct sleeve height at reassembly.

5. Blow all passages thoroughly with compressed air.

6. Coat new O-ring with sealant, place on core plugs and install plugs in block.

7. Install all oil gallery plugs and gaskets using Permatex sealant or equivalent to insure positive sealing.

Cylinder Sleeve

The cylinder sleeves are wet type, centrifugal cast iron and are available in standard size. A bead is provided around top of seating flange for using a fire ring type cylinder head gasket. Clean sleeve flanges using a brass wire rotary brush to be sure of effective fire ring sealing. Check cylinder sleeve for out-of-round and taper. Use tool J5347-01 and measure each sleeve I.D. See Figure 9. Take readings in two directions at each of three levels: top, center, and bottom.

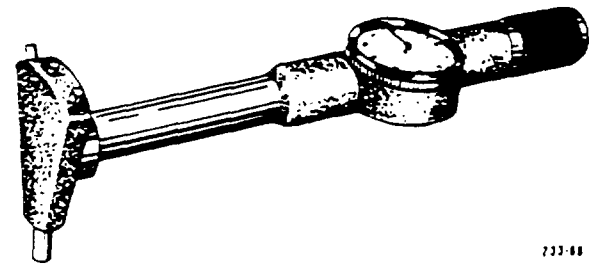


Figure 9. Cylinder Sleeve Bore Measuring Tool

Check the sleeve height above the cylinder block deck. Use gage Sweeney 6020. See Figure 10.

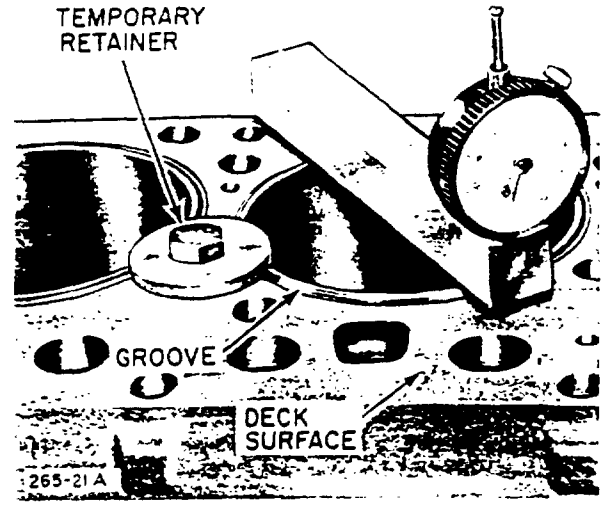


Figure 10. Checking Sleeve Height Above Block Deck

Honing

If sleeve bore when in place does not exceed out-of-round and taper limit, clean up I.D. with a suitable hone, 150 to 220 grit, to produce a diamond criss-cross pattern surface finish of 25 to 40 micro-inch rms.

Wash sleeve bore with a solution of laundry detergent and air blow dry. Wipe sleeve bore with a clean oil soaked cloth.

Sleeve Rebore

If sleeve exceeds out-of-round and taper limit, the sleeve may be resized using boring bar equipment to receive the next applicable oversize piston. After re-sizing, hone 150 to 220 grit to produce a diamond criss-cross pattern surface finish of 25 to 40 micro-inch rms.

5. Press gear and shaft assembly into bearing until it bottoms on shoulder on shaft.

6. Invert housing and gear and install spacer.

7. Install rear bearing with seal side outward in housing.

8. Clamp assembly in a suitable clamping fixture to hold gear and install water pump drive shaft screw. Tighten to recommended torque.

9. Install O-ring in the groove on outer periphery of the housing.

10. Lubricate O-ring seal generously and install drive assembly in cylinder block recess with flat side of housing toward camshaft gear.

NOTE

It is important to generously lubricate O-ring seal before installing in block. This will prevent the O-ring from rolling on upper surface and restricting oil supply to the water pump bearings.

11. Install three water pump housing capscrews securing assembly in position. Tighten to recommended torque.

TIMING GEAR COVER

Inspection

Inspect timing gear cover for dents, condition of threaded holes and straightness of flanges.

Installation

1. Install crankshaft front oil seal into the cover using tool J-21375.

2. Install the adjustable camshaft thrust button from the inside and position the washer and jam nut on the outside of the cover.

3. Adjust camshaft thrust button to its retracted position.

4. Install six guide studs. Two guide studs are used at the lowest point, highest point and one adjacent to the water pump drive and the final stud adjacent to the drive provision directly opposite the water pump drive.

5. Install the timing gear gasket over guide studs.

6. Install the timing gear cover over the guide studs and push cover into position.

7. Install all cover capscrews loosely.

8. Install water pump drive alignment tool J-21382 and crankshaft oil seal alignment tool J-21381. Torque all capscrews.

CRANKSHAFT VIBRATION DAMPER AND HUB

Inspection

1. Inspect crankshaft vibration damper hub for scoring, condition of flange, threaded holes and keyway.

2. Inspect the vibration damper for general condition, mounting threaded holes and housing.

Installation

1. Position crankshaft keyway UP and install key.

2. Heat crankshaft vibration damper hub in hot oil to 250 degrees F.

3. Align crankshaft hub on key and install hub. See Figure 45.

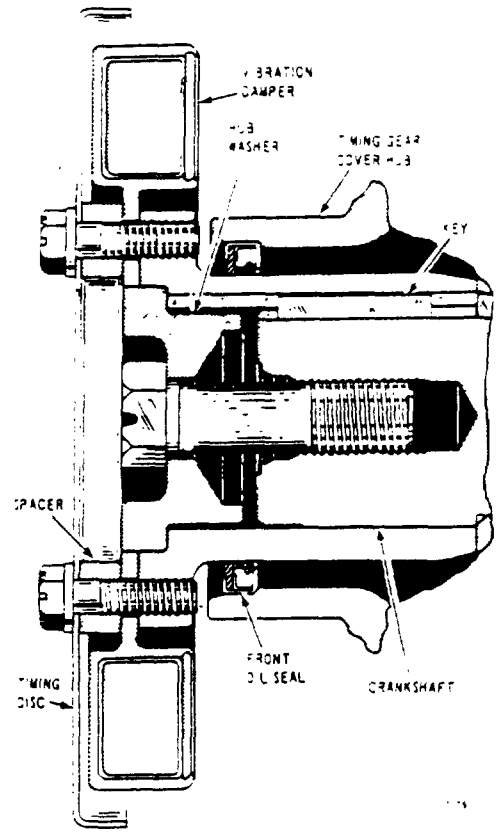


Figure 45. Vibration Damper and Hub Arrangement

4. Install hub washer and retaining screws. Torque screws.

5. Install vibration damper, spacer and timing disc on crankshaft hub; the holes will only line up one way.

6. Install retaining capscrews securing assembly.

NOTE

When all parts are assembled on the crankshaft, keyway up, the scribe mark on the damper rim must be up. The TDC mark must align with the timing indicator 30 degrees to the left of the engine centerline.

OIL PAN

Inspection

1. Inspect oil pan for dents, cracks and condition of flange.

2. Inspect and check the bolt holes for elongation and baffle for security.

3. Inspect and check drain hole for condition of threads.

Installation

1. Position gasket on oil pan and position oil pan on cylinder block.

2. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

AUXILIARY DRIVE ASSEMBLY

Description

The auxiliary drive is a complete unit sub-assembly located between the cylinder heads on the front of the engine. The auxiliary drive consists of a drive housing, idler shaft and gear assembly and drive shaft. It is gear driven from the camshaft. See Figure 46.

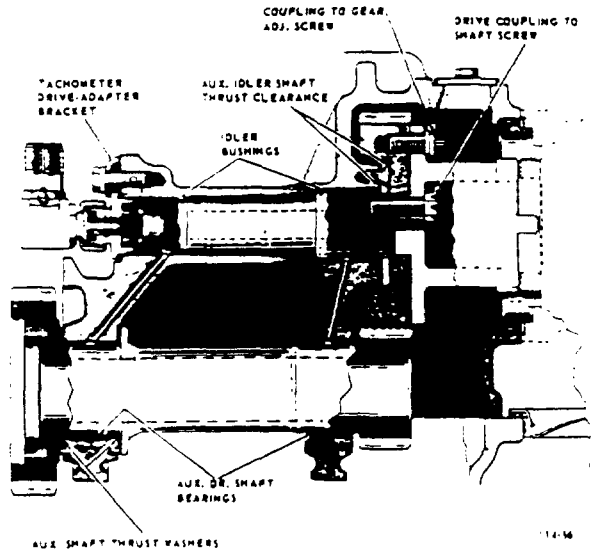


Figure 46. Auxiliary Drive Assembly

DRIVE HOUSING

Description

The auxiliary drive housing is an alloy casting and supports the drives for the injection pump, air compressor, tachometer drive and hydraulic steering pump.

CYLINDER HEAD INSTALLATION

NOTE

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

1. Clean the cylinder block deck thoroughly.

2. Install new cylinder head gasket on deck. Position of gasket is determined by guide pins in the upper deck.

NOTE

Do not use a sealing compound or soak cylinder head gaskets. They are all pre-coated.

3. Install new fire ring carefully fitted over circular bead on cylinder sleeve flange. See Figure 55.

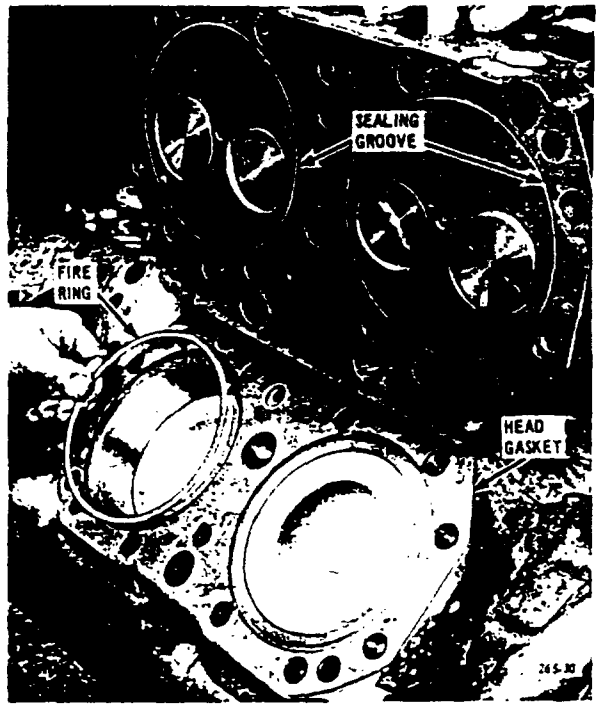


Figure 55. Cylinder Head Installation

4. Clean the surface of the cylinder head and ciruclar groove for the fire ring.

5. Carefully position the cylinder head assembly over the cylinder block deck aligning the guide pins in the block with the guide holes in cylinder head.

6. Install cylinder head on block.

7. Install fourteen cylinder head capscrews.

8. Torque capscrews on each head progressively in steps of 50 to 100 to 175, and finally to 225 lb. ft. in sequence as shown. See Figure 56.

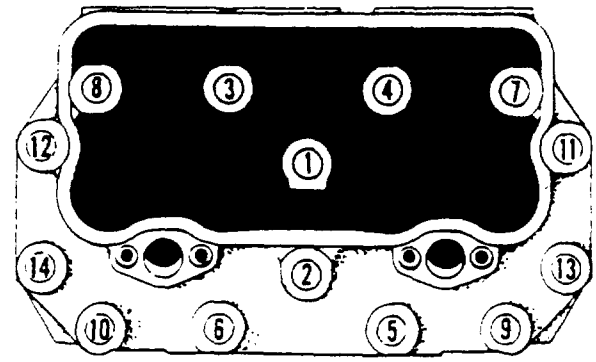


Figure 56. Cylinder Head Tightening Sequence

PUSH RODS

Description

The push rods for the intake and exhaust valve rocker arms are tubular steel with spherical ends. Engines not fitted with the Dynatard engine brake feature identical 1/2 inch O.D. x 14-1/4 inch push rods; however, when the engine is fitted with the Dynatard engine brake system the exhaust valve rocker arm push rod is heavier 5/8 inch O.D. x 14-1/4 inch long.

Inspection

1. Inspect and check the push rods for length and straightness. Replace any that are bent.

2. Inspect and check the spherical surfaces for wear and tightness to tube.

Installation

Apply a light coat of lubricating oil to the spherical ends and install the push rods in the valve lifters.

4. Continue adjusting valve lash for the remaining cylinder pistons in firing order placing each cylinder piston at TDC with respective 1/4 turns of the engine crankshaft.

5. Properly secure aduusting screw locknut after each cylinder piston valve lash adjustment.

To Adjust Valve Lash Hot Idle (Not Recommended for Engines with the Dynatard Engine Brake System)

1. Start engine and warm up to normal operating temperature.

2. Set valve lash at hot idle (600 to 650 rpm) inlet valve 0.015 inch, exhaust 0.024 inch.

3. Properly secure adjusting screw lock nut after each cylinder piston valve lash adjustment.

WATER OUTLET MANIFOLD

Inspection

1. Inspect water outlet manifold for restrictions.

2. Inspect and check mounting flanges for cracks and straightness.

Installation

1. Place new gasket between right bank and left bank water manifold and the mating cylinder heads.

2. Install and tighten attaching capscrews to the proper torque.

3. Install thermostats in the right and left bank water manifolds.

4. Install thermostat gaskets, water outlet fittings, thermostat seals and water outlet by-pass elbows.

5. Secure assembly to the water manifold by installing the attaching capscrews.

INLET MANIFOLD

Inspection

1. Inspect and check the inlet manifolds for restrictions.

2. Inspect and check mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between the inlet manifold and cylinder head.

2. Install right and left hand inlet manifolds and lifting eyes. Secure to cylinder head by installing attaching capscrews and tighten to the recommended torque.

3. Place a new inlet manifold fitting gasket on the top of each inlet manifold and install inlet manifold inlet fitting.

4. Install tee fitting and complete inlet manifold assembly.

EXHAUST MANIFOLD

Inspection

1. Inspect and check the exhaust manifold for restrictions.

2. Inspect and check the mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between exhaust manifold and cylinder head.

2. Install and tighten the attaching capscrews and washers to the proper torque.

CYLINDER HEAD COVERS

Inspection

1. Inspect and check the cylinder head covers for cleanliness, dents and straightness of flange.

2. Inspect and check breather in cover, if applicable, to be sure it is not plugged.

Installation

1. Cement a new gasket to the mounting flange of the cylinder head cover.

2. Position the cylinder head cover over rocker arms.

3. Install and torque cover retaining capscrews.

TURBOCHARGER

Description

The turbocharger is an exhaust gas driven air compressor. See Figure 59. The purpose of the turbocharger is to increase the supply of air to the cylinders and thus burn more fuel which in turn produces more power.

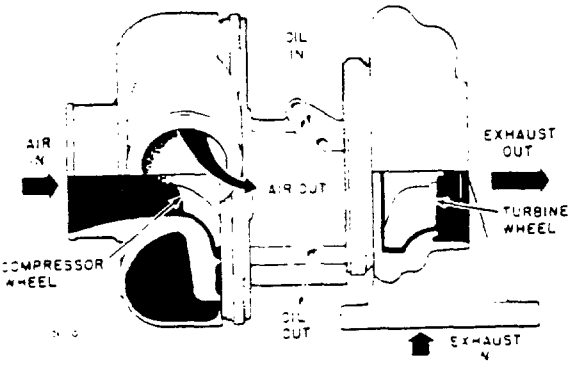


Figure 59. Exhaust Driven Turbocharger

The turbocharger consists of three main parts: the turbine housing, the bearing housing and the compressor housing. The turbine housing is located at one end of the bearing housing and the compressor housing is located at the other end. A common shaft connects the turbine wheel and compressor wheel.

The turbine end of the turbocharger uses exhaust gas energy normally discharged to the atmosphere. The exhaust gas enters the turbocharger through the flange connection on the exhaust manifold. The exhaust gas flows around the turbine housing and radially inward causing the turbine wheel to rotate. The exhaust gas is then discharged through the center of the turbine housing into the exhaust pipe.

The bearing housing contains the through-shaft, bearings, seals, and oil passages.

The bearings are of the floating sleeve type and are pressure lubricated from the engine oil supply system. Piston ring type oil seals are used at each end of the shaft to effectively seal off the oil.

The compressor housing contains the compressor wheel and air enters at the center of the compressor wheel and flows radially outward intothe compressor wheel and flows radially outward into the compressor housing. The air leaves through a tangential outlet on the outside of the compressor housing and is ducted to the inlet manifold.

Checks Before Removal

If turbocharger malfunction is suspected, make the following checks before removal of turbocharger from the engine.

1. Start engine and check for unusual noise or vibration from turbocharger. This will indicate out-of-balance, rubbing or damage to compressor or turbine wheels.

2. Check for leaks in the air system from turbocharger to intake manifold and from intake manifold to cylinder block. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

3. Check air cleaner and air intake system, from the air cleaner to turbocharger, for restrictions to air flow or leaks.

4. Check exhaust system from cylinder block to turbocharger for exhaust leaks. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

5. Check exhaust system from turbocharger to outlet for restrictions.

6. Check turbine wheel for radial and axial looseness. If radial and/or axial looseness is excessive, the turbocharger will have to be removed for overhaul. If turbocharger has to be overhauled, consult your Mack Branch or Distributor for details on turbocharger exchange program.

Cleaning

The compressor end of the turbocharger should be cleaned after 1000 to 2000 hours of operation. If the compressor wheel is not too dirty, it can be cleaned with the turbocharger on the engine.

Disconnect compressor discharge flange; remove the capscrews or clamp ring that holds the compressor housing to the bearing housing, and pull compressor housing carefully along turbocharger axis to prevent damage to the compressor wheel or the diffuser.

Use Bendix Metal Cleaner or equivalent solvent to clean compressor wheel. Do not use a caustic solution or any other type that may attack aluminum, as this will either weaken the impeller or destroy its balance. Do not use a wire brush or scraper; a brush with nylon or hog bristles is preferred.

If compressor wheel is found to be very dirty, remove turbocharger from the engine for cleaning. With compressor housing removed, immerse compressor wheel into the cleaning fluid and allow to soak. Use care not to rest weight of turbocharger on compressor wheel or on end of shaft.

The turbine end of turbocharger can be cleaned only after removal from the engine and separation of the bearing housing from the turbine housing.

Installation Guide

Use the following steps as a guide when installing turbocharger to engine.

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for foreign material.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure. Be sure check valve is working properly and not restricted.

5. Inspect turbocharger mounting pad on exhaust manifold for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect oil inlet line and oil drain line to turbocharger.

8. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

9. Crank engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger.

10. Stop cranking engine and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

ENGINE BREAK-IN PROCEDURE AFTER OVERHAUL OR REBUILD

Comparative tests and careful review of engine break-in methods have proven that a short run under full load is substantially more effective than the light or no load slow speed increase type of break-in. Compatibility between the critical components (piston, rings and bores) is greatly improved by raising engine speed and applying full load immediately after warm-up.

Use the recommended type and grade engine oil and fuel as required for usual operation of the vehicle.

Immediately prior to initial starting of the engine, the fuel system, oil galleries and filters are to be primed preferably by means of a pressure tank.

Check the air intake system to be sure all joints are tight and the filter element and system are clean.

MACK

engine

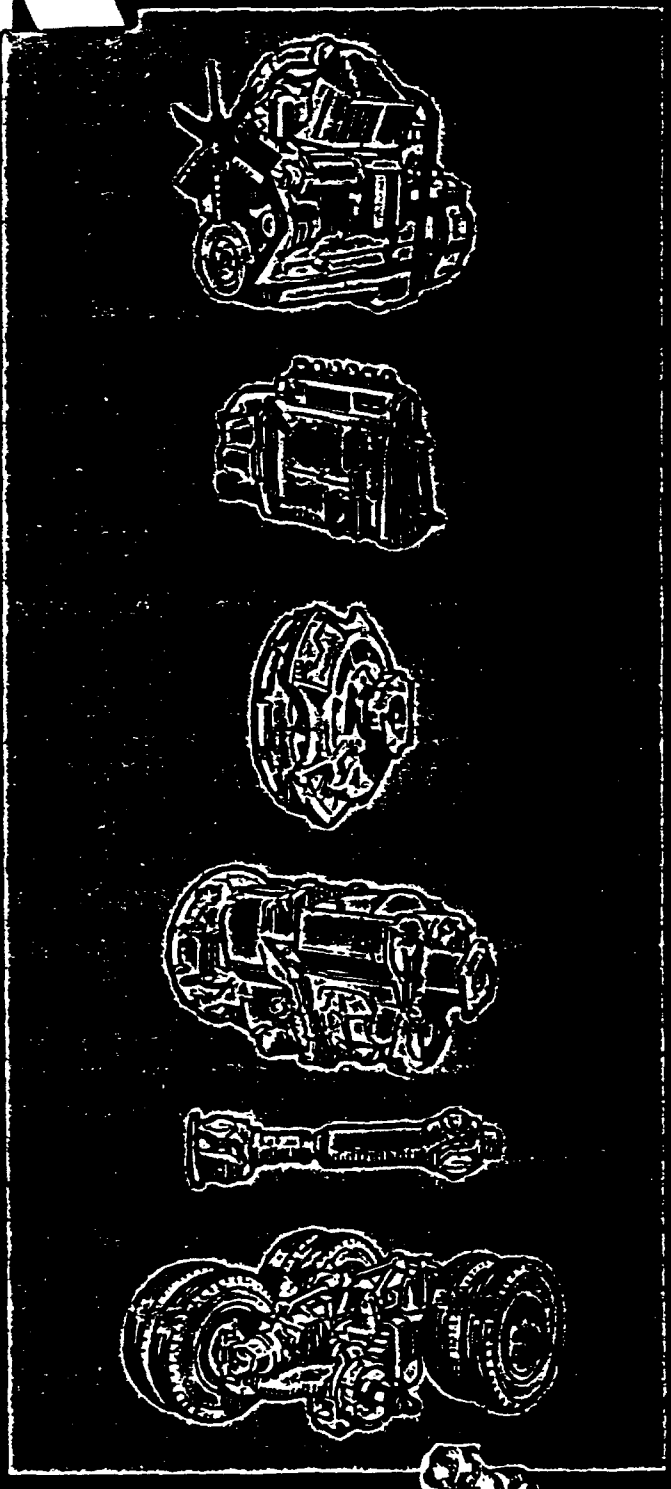
fuel system

clutch

transmission and p.t.o.

propeller shaft

rear axle and carrier



HIGHWAY VEHICLE SERVICE MANUAL

MACK TRUCKS

MACK TRUCKS, INC.
one of The Signal Companies

TS442		10/67	10M
TS442	REV.	8/69	10M
TS442	REV.	5/71	10M
TS442	REP.	12/72	10M
TS442	REV.	8/75	10M
TS442	REV.	9/77	18M

Printed in U. S. A.

Core Exchange -
Schwitzer or Holset Turbocharger

1. Remove lubricating oil inlet and outlet lines.

2. Loosen clamp on compressor housing and move housing away from core assembly.

3. Support core assembly and loosen clamp on turbine housing and remove core assembly. Holset uses capscrews and washers to secure core assembly.

4. Install core assembly in reverse manner. Also be sure to prime turbocharger lubricating system. Refer to Installation Procedure.

Turbocharger Exchange - Schwitzer, AiResearch or Holset Turbochargers

1. Remove lubricating oil inlet and outlet lines.

2. Remove air inlet duct from compressor housing.

3. Remove exhaust pipe from turbine housing.

4. Remove turbocharger retaining bolts and remove turbocharger from engine exhaust manifold.

Installation Procedure

Use the following steps as a guide when installing turbocharger to engine.

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for leakage and foreign matter.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure. Be sure check valve is working properly and not restricted.

5. Inspect turbocharger mounting pad, on exhaust manifold, for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

8. Connect oil inlet line to turbocharger.

9. Crank the engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger or charge the system from an external pressurized oil source.

10. Stop cranking engine or charging system and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

Turbocharger Overhaul Procedure

NOTE

Clean exterior of turbocharger with a pressure spray of cleaning solvent and air blow dry before starting disassembly. Due to close tolerances and extremely high rpm of the turbocharger it is of utmost importance to have a clean work area.

1. Mark alignment of turbine housing and compressor housing for correct alignment with bearing housing at reassembly. Use a suitable center punch or small chisel.

2. Remove Vee clamp and separate compressor housing from bearing housing. Use care to prevent damage to compressor wheel.

3. Remove O-ring from groove in bearing housing if used.

4. Position turbocharger in a vise and mount a dial indicator with contact point on side of compressor wheel retaining nut.

5. Move compressor wheel away from indicator while pressing turbine wheel in opposite direction.

6. Zero dial indicator and check total side play of shaft by pressing compressor wheel toward indicator and turbine wheel in opposite direction. If measured movement exceeds maximum limit the turbocharger must be overhauled.

7. Check chaft endfloat using a dial indicator with tip of indicator on end of shaft. Move shaft toward dial indicator and zero dial in-

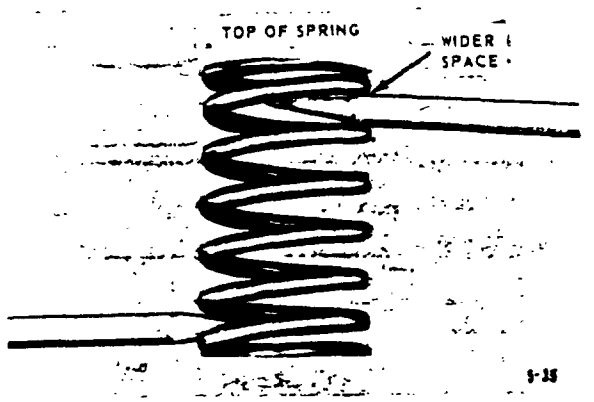


Figure 2-48. Valve Spring

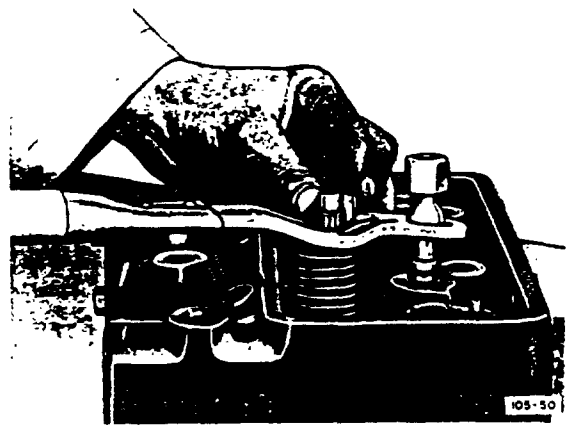


Figure 2-49. Installing Valve Keys

Installing Cylinder Heads

New cylinder head gaskets are installed on the cylinder block with "Top" mark up. Check cylinder head studs for secureness in the block; also threads for damage that may cause binding of the stud nuts. Fit cylinder heads over studs lowering on to cylinder head gasket carefully to avoid damage. Install cylinder head stud washers and nuts. Torque nuts in sequence shown with a calibrated torque wrench in progressive steps of 50, 100 and finally 140 lb. ft. (Stud threads oiled). See Figure 2-50.

Install the two water connection flanges, with gaskets, to cylinder head (connecting heads thru water to permit cooling water circulation through the three cylinder heads), and install front thermostat housing (outlet) and gasket to the used head. A blank plate and gasket are used on the rear head.

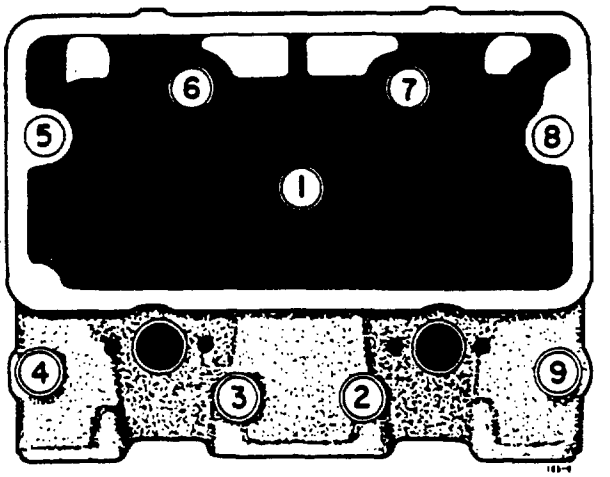


Figure 2-50. Torquing Sequence

Valve Rocker Arm and Shaft Assembly

The valve rocker arm features a bushing. When the bushing is installed, the split must locate on the horizontal plane and face the slipper side of the arm. See Figure 2-51.

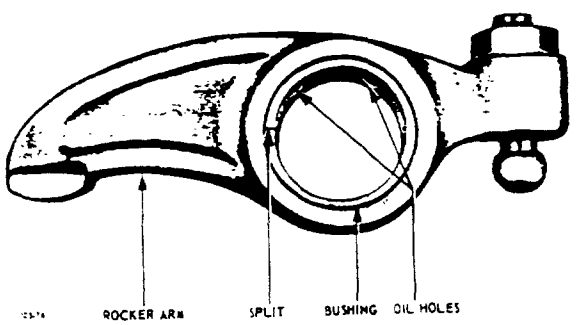


Figure 2-51. Rocker Arm Assembly

Press the bushing in so that it will come flush with the side of the hub which contacts the rocker arm shaft bracket. Two oil holes must be drilled in the bushing. They must be in alignment with the two oil holes provided on top of the arm to feed the slipper and the rocker arm to pushrod adjusting screw with lube oil. Ream bushing I. D. 0.8661 to 0.8669 in., to allow for proper running clearance with a new rocker arm shaft diameter. Check shaft O.D. at unworn area for size, before reaming new bushings to be used with old shaft. Running clearance, 0.0005 to 0.0015 in.

to 1.366 inch (37mm) is 148.37 lbs. (660N). See Figure 19.

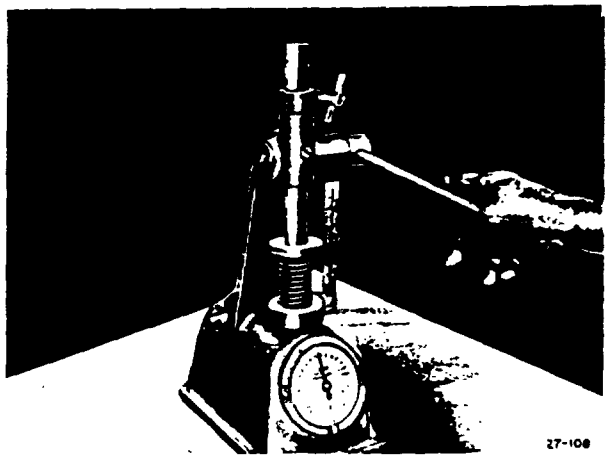


Figure 19. Checking Valve Springs

Position inner and outer valve springs over the inlet and exhaust valve stems and install washers, valve stem keys and caps using a suitable spring compressing tool. See Figure 20.

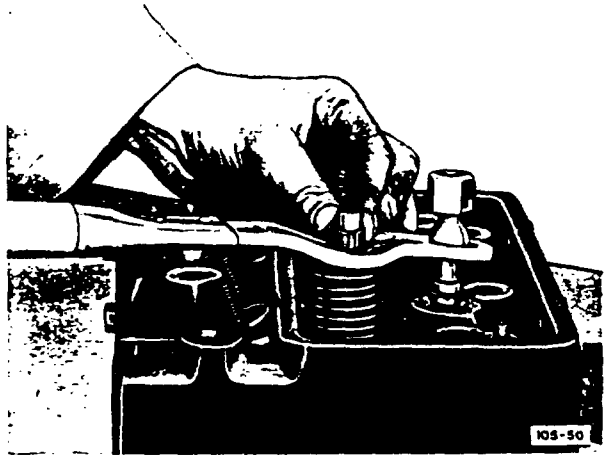


Figure 20. Installing Valve Keys

Installing Cylinder Heads

NOTE

A fire ring is formed in the cylinder head gasket when the cylinder head is torqued on the cylinder block: therefore, a new gasket must be used when installing the cylinder head. See Figure 21.

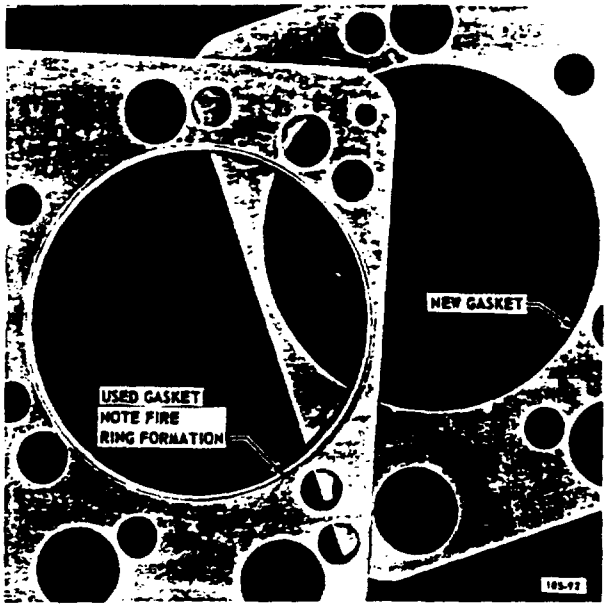


Figure 21. Cylinder Head Gasket (Note: Fire Ring Formed in Left Gasket)

1. Clean the cylinder block deck thoroughly.

2. Check cylinder sleeve height above the deck. (See Figure 31.) Install new cylinder head gasket on deck.

NOTE

Do not use a sealing compound or soak cylinder head gasket.

3. Check gasket position. Be sure that all passages are open and not blocked by the gasket. See Figure 22.

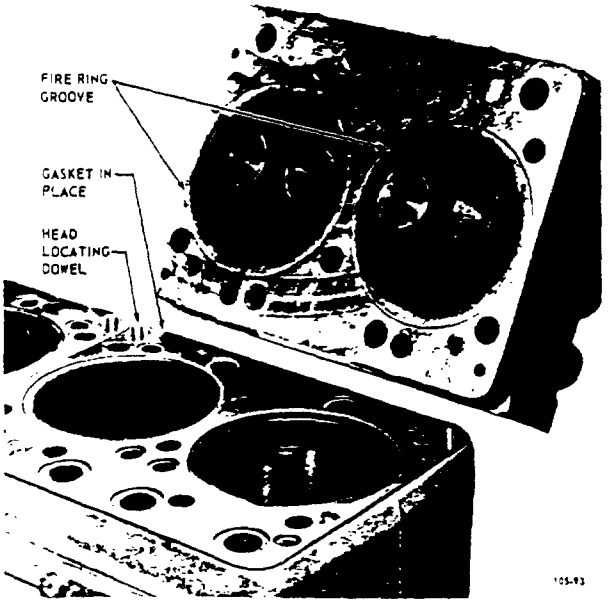


Figure 22. Gasket and Cylinder Head Over Cylinder Block

5. Measure clearance between the pump gear (12) and pump housing cover (9) to determine the gasket thickness. See Figure 62.

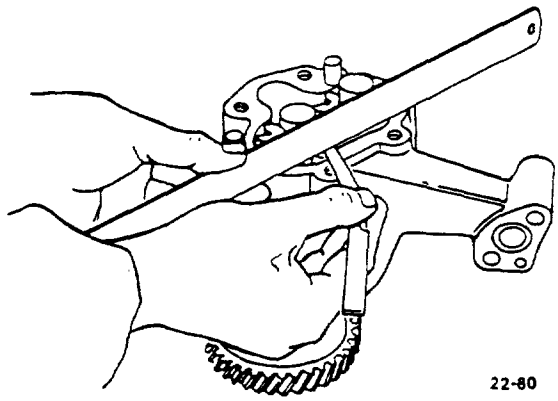


Figure 62. Checking Pump Gear to Housing Cover Clearance

NOTE

Pump Gear to pump housing cover clearance is 0.003 to 0.004 inch (0.07 to 0.10mm).

6. Determining gasket thickness:

NOTE

Pump cover to pump housing gaskets are available in sizes of 0.002, 0.003 and 0.004 inch (0.05, 0.07 and 0.10mm).

a. With a feeler gage and straight edge measure and record measurement between Pump Gear (12) and Pump Housing Cover (7).

b. Subtract 0.001 inch (0.02mm) from measurement to compensate for gasket crush.

c. Select a gasket to provide proper clearance of 0.003 to 0.004 inch (0.07 to 0.10 mm).

For Example: Assume measurement in step 6a. was 0.0014 inch (0.03mm). Subtract gasket crush 0.001 inch (0.02mm) leaving 0.0004 inch (0.01mm). Therefore an 0.003 inch (0.07mm) gasket must be selected to provide the proper clearance.

7. Place gasket in position and install pump cover (9). Torque capscrews (20) 14.75 lb. ft. (20Nm).

8. Install lock ring (5) in pump housing (16) with ring opening facing lubricating hole in housing.

9. Press one bearing (3) into housing against lock ring (5).

10. Install spacer (6) reverse housing and press in second bearing (3).

11. Install shaft (8) through bearings and press idler gear on exposed shaft.

12. Secure idler gear (2) in position by installing lock screw (1). Torque 30 lb. ft. (40Nm). (Note: Left hand thread)

13. Install key (18), pump drive gear (21), new lock washer (22) and nut (23) on exposed pump gear shaft (12).

14. Very carefully clamp idler wheel in a copper jawed vice and tighten lockscrew (1).

15. Torque pump drive gear nut (23) to 148 lb. ft. (200Nm).

16. Remove from vice and lubricate with engine lubricating oil.

Oil Pan and Pump Screen

The oil pan is a silumin casting and is provided with a cylindrical oil pump screen. The pan is so shaped that the return oil flows to the outside of the screen and the suction line of the oil pump is located inside the screen. A magnetic drain plug is provided to hold ferrous particles.

Pressure Relief Valve

The oil pressure relief valve is located in the cylinder block behind the intermediate section of the oil filter. See Figure 63.

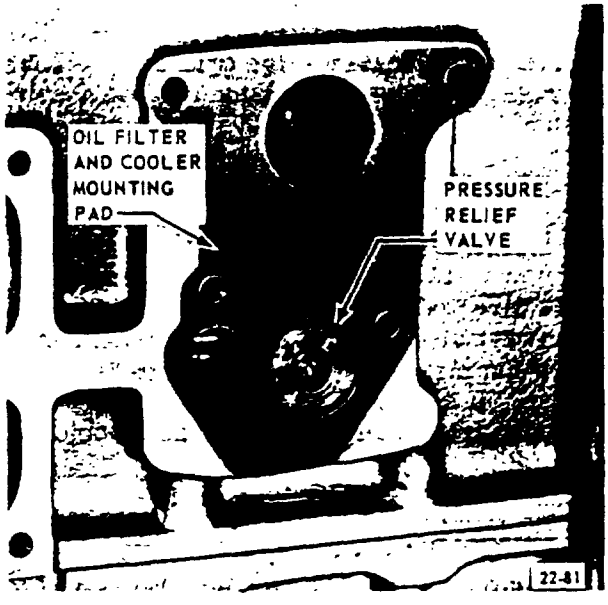


Figure 63. Oil Pressure Relief Valve Location

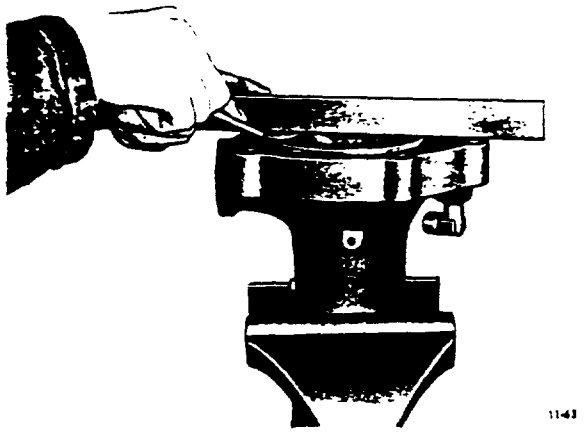


Figure 90. Checking Impeller Clearance

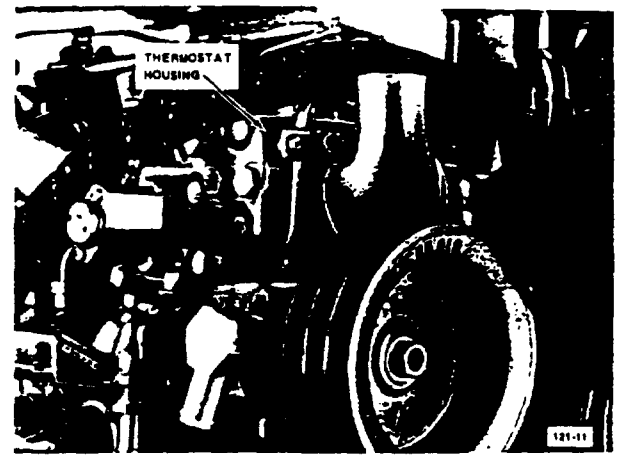


Figure 91. Thermostat Housing Location

9. Install impeller lockwasher and nut and secure.

THERMOSTAT

The thermostat is located above and to the right of the injection pump. See Figure 91.

Removal

To remove the thermostat, first drain the coolant and then remove the outlet housing. See Figure 92.

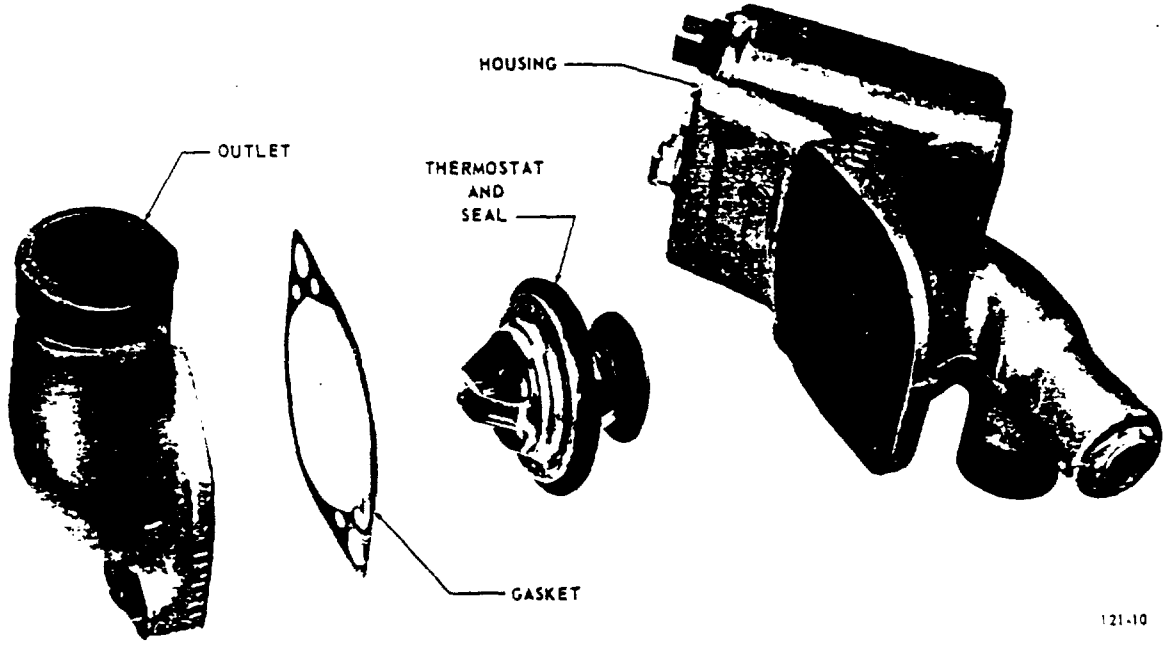


Figure 92. Thermostat Housing Exploded View

TURBOCHARGER

Preliminary

Inspect external and visible internal areas for contamination or damage before installing the unit on the engine. Check the condition of the turbine and exhaust manifold mating flanges for uneven surfaces. The smooth surface is required to assure good gasket clamping for dependable sealing and for longer gasket life.

Make certain that the air cleaner and air tubes are clean, to avoid restricted air flow. New hose connections and dependable clamps should be used and properly secured.

and drive insert into place with guide tool J-21374. Drive fit of insert in head is 0.0015 to 0.0040 in. To remove insert from head, tap a 7/8-9NC thread into insert and remove with puller S-572.

Valve Seat Inserts

The inlet and exhaust valve seat inserts are identical except for diameter. Seat angle is 30 degrees -0'/+30'. Seating width is 1/16 to 3/32 in. Maximum seat runout is 0.0015 in. See Figure 2-115.

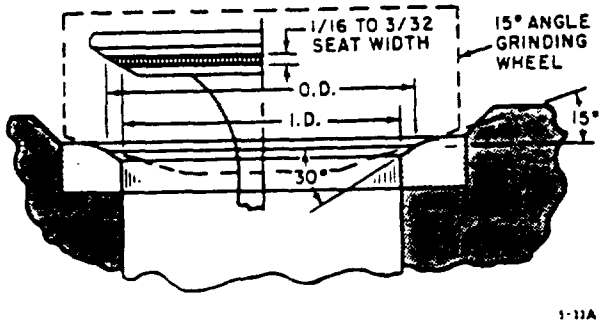


Figure 2-115. Valve Seat Dimensions

Press fit of inlet and exhaust valve seat inserts in head is 0.0025 to 0.0045 in. Standard inlet valve seat insert O.D., 2.4405 to 2.4415 in. Bore in head for standard inlet valve seat insert, 2.437 to 2.438 in. Standard exhaust valve seat insert O.D. is 2.0855 to 2.0865 in. Bore in head for standard exhaust valve seat insert is 2.082 to 2.083 in.

Valve seat inserts are available in 0.015, 0.031, 0.047 and 0.062 in. oversizes. Shrink inserts in dry ice for 20 minutes prior to installation in head.

Valve Guide

Inlet and exhaust valve guides are made of a special iron. Valve guide bore in cylinder head is 0.6860 to 0.6870 in. Outside diameter of valve guides is 0.6881 to 0.6886 in. Press fit of valve guides in head is 0.0011 to 0.0026 in. Press guides into head until top of guide extends above valve spring seating surface 1-35/64 in. See Figure 2-116.

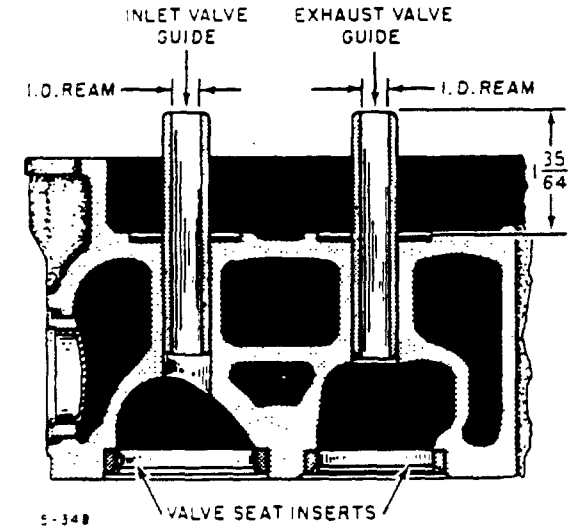


Figure 2-116. Valve Guides

Inlet Valve

Poppet type, chrome-silicon steel. Valve face angle, 30 degrees, +0'/-30'. Reamed I.D. of inlet valve guide, 0.4995 to 0.5005 in. Valve stem diameter, 0.4965 to 0.4975 in. Stem-to-guide clearance (service), 0.002 to 0.004 in. Maximum face runout (service), 0.0015 in. Stem-to-rocker arm lash setting, 0.016 in. cold static, 0.014 in. hot idle. Install new oil seals, shields and keys at overhaul.

Exhaust Valve

Poppet type. Valve face angle, 30 degrees +0'/-30'. Reamed I.D. of exhaust valve guide 0.4995 to 0.5005 in. Valve stem diameter, 0.4955 to 0.4965 in. Stem-to-guide clearance (service), 0.003 to 0.005 in. Maximum face runout (service), 0.0015 in. Stem-to-rocker arm lash setting, 0.024 in. cold static, 0.022 in. hot idle. Use new valve rotators and keys at overhaul.

Inner Valve Spring

Nominal free length, 3-1/32 in. Test for 82.1 to 90.7 lbs. when compressed to 2-1/32 in. Service limit, 77.2 lbs.

Outer Valve Spring

Nominal free length, 3-13/32 in. Test for 105.3 to 116.3 lbs. when compressed to 2-5/32 in. Service limit, 99 lbs.

Rocker Arm Shaft

Shaft O.D, 1.1286 to 1.1291 in. Drilled for bottom oil feed of rocker arms. Locating screw assures proper line-up of oil passage.

Rocker Arm

Ratio, 1.8 to 1. Shaft hole diameter, 1.1296 to 1.1301 in. Hole-to-shaft clearance is 0.0005 to 0.0015 in.

Before installing rocker arm and shaft assembly on cylinder head, be sure to fit O-ring carefully in recess at oil passage-to-rocker arm bracket on top of cylinder head.

Rocker arm bracket capscrew torque, 55 lb. ft.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets in their proper positions on the block checking that the rubber seals are correctly positioned in holes of gasket.

NOTE

Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Set cleaned cylinder heads in place separately. When in place, apply Permatex No. 2 to the accessible outer edges of gasket. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. See Figure 2-117.

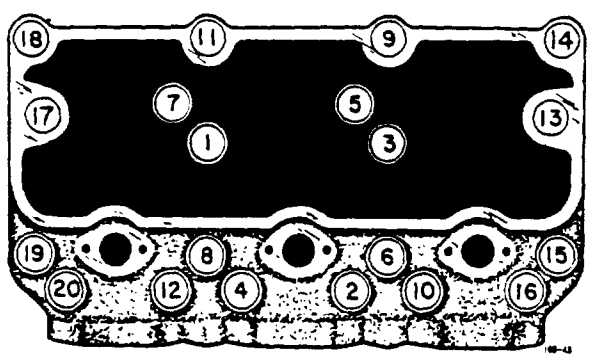


Figure 2-117. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque, following sequence in Figure 5. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring Set package for detailed instructions.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry type cylinder liners. The deck area surface must be flat within 0.002 in. Excessively eroded water holes developing at deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.020 in. above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

Cylinder Liner

Dry type special alloy iron. Part number is etched on O. D. of liner. Free O. D is 5.0945 to 5.0955 in. Cylinder block bore is 5.0945 to 5.0955 in. which allows a liner fit of 0.0010 loose to 0.0010 in. tight. Cylinder liner I. D. for standard size piston, 4.876 to 4.877 in. Cylinder liners available in 0.002, 0.004, 0.006, 0.012, 0.020, 0.030, 0.040, and 0.050 in. O. D. oversize. Extension of cylinder liners above cylinder block deck must not vary more than 0.001 in. under the same head.

When replacing cylinder liners, check cylinder block bore. If out-of-round or taper does not exceed 0.006 in., hone block for 0.002, 0.004, or 0.006 in. oversize liner as required. If out-of-round or taper exceeds 0.006 in., bore cylinder block for 0.012 in. or larger oversize liner as required.

Main bearing caps must be in place and capscrews must be torqued when cylinder block is honed or bored.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.002 in. Remove honing grit by swabbing bore with a cloth saturated with clean SAE 10 oil. Remove all traces of oil with solvent and blow dry with clean, dry compressed air. If liner enters 1/2 to 2/3 of the bore, a light press on top of liner should suffice. Stop pressing when liner is 1/2 in. from deck, clean counterbore with compressed air and then seat liner in

Exhaust Valve

Poppet type. Valve face angle, 30 degrees +0'/30'. Reamed I.D. of exhaust valve guide, 0.4995 to 0.5005 in. Valve stem diameter, 0.4955 to 0.4965 in. Stem-to-guide clearance (service), 0.003 to 0.005 in. Maximum face runout (service), 0.0015 in. Stem-to-rocker arm lash setting, 0.024 in. cold static, 0.022 in. hot idle. Use new valve rotators and keys at overhaul.

Inner Valve Spring

Nominal free length, 3-1/32 in. Test for 82.1 to 90.7 lbs. when compressed to 2-1/32 in. Service limit, 77.2 lbs.

Outer Valve Spring

Nominal free length, 3-13/32 in. Test for 105.3 to 116.3 lbs. when compressed to 2-5/32 in. Service limit, 99 lbs.

Rocker Arm Shaft

Shaft O.D., 1.1286 to 1.1291 in. Drilled for bottom oil feed of rocker arms. Locating screw assures proper line-up of oil passage.

Rocker Arm

Ratio 1.8 to 1. Shaft hole diameters, 1.1296 to 1.1301 in. Hole-to-shaft clearance is 0.0005 to 0.0015 in.

Before installing rocker arm and shaft assembly on cylinder head, be sure to fit O-ring carefully in recess at oil passage-to-rocker arm bracket on top of cylinder head.

Rocker arm bracket capscrew torque, 35 lb. ft.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil of coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets in their proper positions on the block checking that the rubber seals are correctly positioned in holes of gasket.

NOTE

Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. See Figure 2-134.

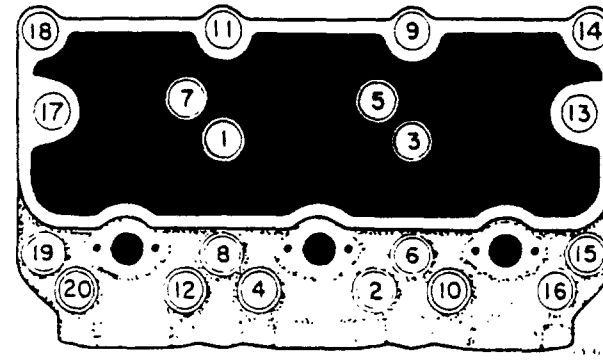


Figure 2-134. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque, following sequence in Figure 2-134. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry type cylinder liners. The deck area surface must be flat within 0.002 in. Excessively eroded water holes developing at deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush - absolute cleanliness is essential.

Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure.

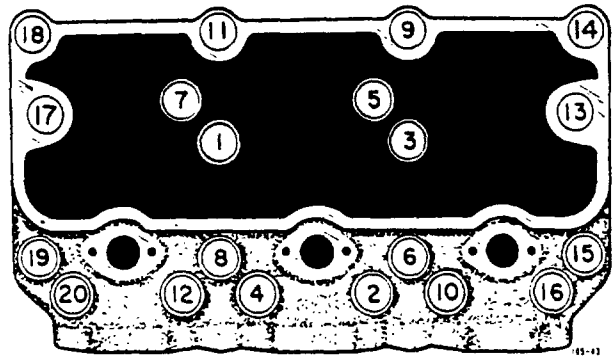


Figure 2-154. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque, following sequence in Figure 2-154. Tighten again in sequence, to 100 lb.ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of stud should be flush to three threads above top of the nut. After engine run-in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.002 in. Excessively eroded water holes developing at the deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.020 in. above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

Cylinder Liner

Dry type special alloy iron. Part number is etched on O.D. of liner. Free O.D. is 5.0945 to 5.0955 in. Cylinder block bore is 5.0945 to 5.0955 in. which allows a liner fit of 0.001 loose to 0.001 in. tight. Cylinder liner I.D. for standard size piston, 4.876 to 4.877 in. Cylinder liners are available in 0.002, 0.004, 0.006, 0.012 and 0.020 inch O.D. oversize. This liner is provided with a 3/64 x 0.008 in. high bead at the top outer edge of the flange. When installing liner, the flange must extend 0.0035 to 0.0075 inch above the deck surface. This is taken from the channel depth, not from top of bead, see Figure 2-155. The head embeds into the fire ring, which is a separate part of the cylinder head gasket. Extension of cylinder liners above cylinder block deck must not vary more than 0.001 in. under the same head.

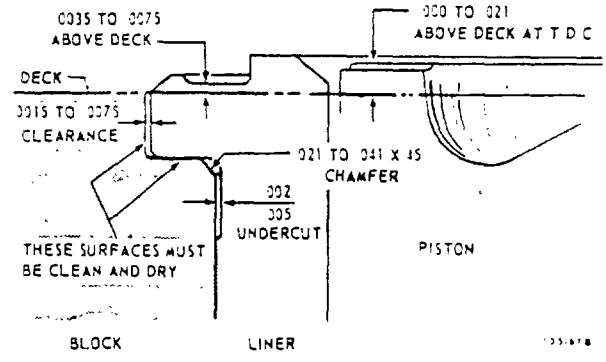


Figure 2-155. Cylinder Liner Detail

When replacing cylinder liners, check cylinder block bore. If out-of-round or taper does not exceed 0.006 in., hone block for 0.002, 0.004, or 0.006 in. oversize liner as required. If out-of-round or taper exceeds 0.006 in., bore cylinder block for 0.012 in. or larger oversize liner as required.

inch. Valve face to cylinder head deck 0.011 inch minimum. Stem-to-rocker arm lash setting, 0.024 inch static. Use new valve rotators and keys at overhaul.

Inner Valve Spring

Nominal free length, 3-1/32 inch. Test for 82.1 to 90.7 lbs. when compressed to 2-1/32 inch. Service limit, 77.2 lbs.

Outer Valve Spring

Nominal free length, 3-13/32 inch. Test for 105.3 to 116.3 lbs. when compressed to 2-5/32 inch. Service limit, 99 lbs.

Rocker Arm Shaft

Shaft O.D., 1.1286 to 1.1291 inch. Drilled for bottom oil feed of rocker arms. Locating screw assures proper line-up of oil passage.

Rocker Arm

Ratio, 1.8 to 1. Shaft hole diameter, 1.1296 to 1.1301 inch. Hole-to-shaft clearance is 0.0005 to 0.0015 inch.

Before installing rocker arm and shaft assembly on cylinder head, be sure to fit O-ring carefully in recess at oil passage-to-rocker arm bracket on top of cylinder head.

Rocker arm bracket capscrew torque, 35 lb. ft.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 inch diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert the studs finger-tight into block until bottomed, then back them off 1/3 turn. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush. Absolute cleanliness is essential. Wipe deck surface to remove oil, etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

NOTE

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Cylinder heads to be aligned within 0.005 inch on exhaust port side. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. Tighten all stud nuts to 50 lb. ft. torque following sequence in Figure 6. Tighten again, in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run-in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure and do not deviate from it.

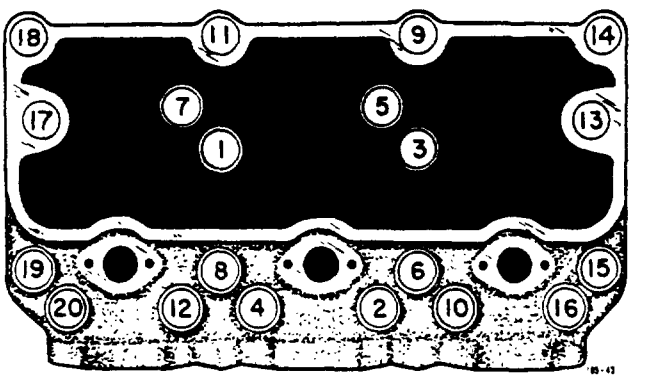


Figure 6. Cylinder Head Stud Nut Tightening Sequence

CYLINDER BLOCK

The cylinder block is an alloy casting with an integral cast water manifold to distribute coolant around the upper area of the block. Drilled passages are incorporated for transfer of coolant to the cylinder head and the proper distribution of lubricating oil to the various parts of the engine. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.0020 inch under area covered by individual head. Excessively eroded water holes at deck area must be repaired. To repair these holes,

Intercooler Header

Cast aluminum header directs turbocharged air to the top of the intercooler core and provides a protecting cover for the assembly.

Intake Manifold

Cast aluminum manifold provides the distribution point of the turbocharged aftercooled air and seat for the intercooler core. An integral part of the manifold is the front water manifold. This design feature permits the use of one compact and simple housing.

Intercooler Core

A compact plate fin heat transfer surface. The core measures 14 x 7 x 7 inches and weighs only 17-1/2 lbs. Fins are stacked on plates between each row. The places separate and direct the flow of air, i.e., second row turbocharged air; first row intercooled air, etc. The cooling side of the intercooler core can be cleaned by either of the following methods:

1. Steam Cleaning.

CAUTION

Steam pressures above 40 psi and/or temperatures above 400 degrees F. can damage core and gaskets.

2. Detergent Cleaning.

Use a solution of household laundry detergent such as "Tide". Flush through the core several times followed by a rinse with warm water. Use low pressure air to blow dry.

CAUTION

Do not under any circumstances use strong caustic solution, i.e., "Oakite", or acid, i.e., hydrochloric acid, bowl cleaners, etc., as they will corrode the core and damage gasket. Also do not use shop solvents to clean core as gasket damage will result.

ENGINE MOUNTS

Front

Two piece V-type insulator which fits over timing gear cover hub. One half fits in support bracket and other half in clamp cap. Check insulators for deterioration or wear and replace if necessary. See Figure 19.

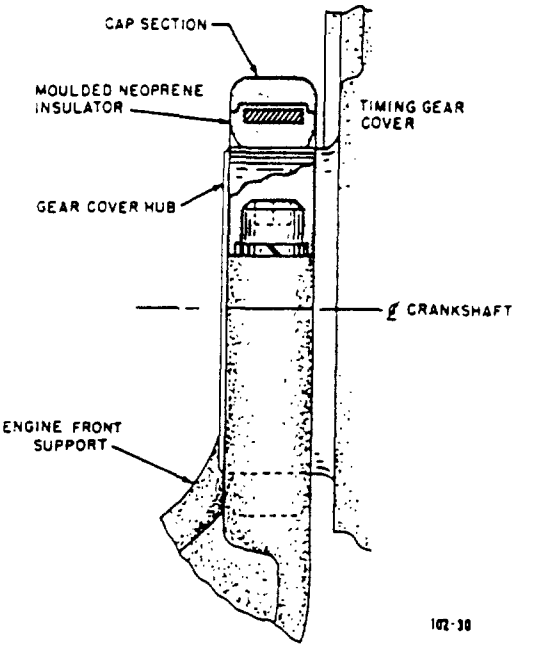


Figure 19. Engine Front Mounting

Rear

Biscuit type insulators located at each side of transmission or flywheel housing. Install new mounting insulators at overhaul and torque insulator through bolts 100 to 120 lb. ft.

Coolant Conditioner

The conditioner is a spin-on type, similar in appearance to the fuel oil filters. This unit, located on the front water manifold, can be identified by the blue color code indicating "Coolant Conditioner". The coolant conditioner has a thread size of 3/4 - 20 UNEF that will not allow it to be installed at other filter locations.

The contents consist of a chemical portion and a filter media. Automatic check valves close when the radiator pressure cap is removed. The spin-on element can then be removed without losing coolant. The check valves will reopen when the coolant pressure is restored. Under normal operating conditions, conditioner is to be changed every 16,000 miles, 300 hours, or 90 days or operation.

Fuel Filters

Two spin-on type fuel filters are used. The primary fuel filter is coded red and has 13/16-18 UNS threads. The secondary fuel filter is coded green and has a 7/8-16 UN thread. Under normal operating conditions, filters are to be changed every 16,000 miles, 300 hours, or 90 days of operation.

washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert the studs finger-tight into block until bottomed, then back them off 1/3 turn. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush. Absolute cleanliness is essential. Wipe deck surface to remove oil, etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

NOTE

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. Tighten all stud nuts to 50 lb. ft. torque following sequence in Figure 2-173. Tighten again, in sequence, to 100 lb. ft. torque. Tighten finally, in sequence to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run in procedure, and do not deviate from it.

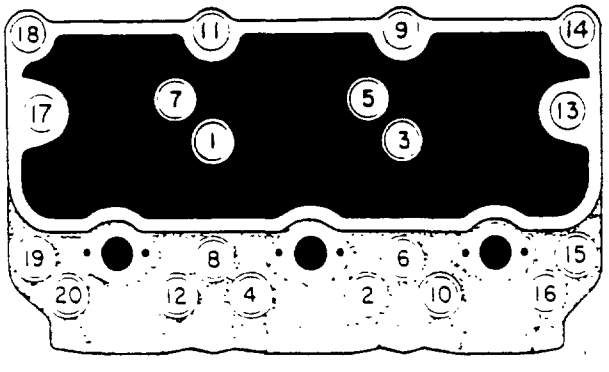


Figure 2-173. Cylinder Head Stud Nut Tightening Sequence

CYLINDER BLOCK

The cylinder block is an alloy casting with an integral cast water manifold to distribute coolant around the upper area of the block. Drilled passages are incorporated for transfer of coolant to the cylinder head and the proper distribution of lubricating oil to the various parts of the engine. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.0020 inch under area covered by individual head. Excessively eroded water holes at deck area must be repaired. To repair these holes, drill, tap and install bronze plug. Complete repair by drilling a new water hole using cylinder head gasket at template. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.021 inch above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

A machined oil pad is provided on the left hand side of the cylinder block. Porting in the pad corresponds to the porting in the oil pressure relief valve assembly.

Cylinder Liner

The cylinder liners are a special alloy cast iron with part number etched on O.D. Free O.D. is 5.0945 to 5.0955 inch. Cylinder block bore is 5.0945 to 5.0955 inch which allows a liner fit of 0.0010 inch loose to 0.0010 inch tight. Cylinder liner I.D. for standard size piston; 4.875 to 4.877 inch. Cylinder liners available in 0.002, 0.004, 0.006, 0.012, 0.020, 0.030, 0.040 and 0.050 inch O.D. oversize. This liner is provided with a 3/64 inch wide x 0.008 inch high bead, at the top outer edge of the flange. When installing liner, the flange must extend 0.0035 to 0.0075 inch above the deck surface. This is taken from the channel depth, not from top of bead. See Figure 2-174. The bead embeds into the fire ring, which is a separate part of the cylinder head gasket.

Extension of cylinder liners above cylinder block deck must not vary more than 0.001 inch under the same head.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.003 inch.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets in their proper positions on the block checking that the rubber seals are correctly positioned in holes of gasket.

NOTE

Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Set cleaned cylinder heads in place separately. When in place, apply Permatex No. 2 to the accessible outer edges of gasket. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. See Figure 2-194.

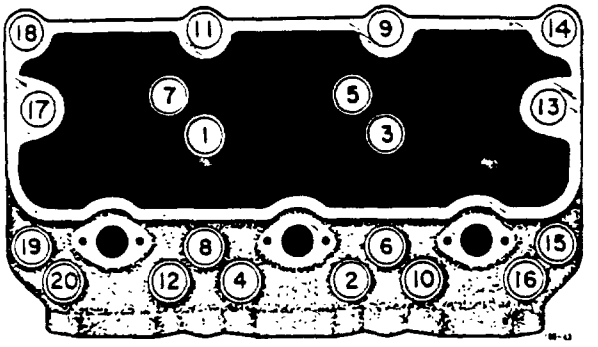


Figure 2-194. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque, following sequence in Figure 5. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of stud should be flush to three threads above top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.002 in. Excessively eroded water holes developing at the deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.020 in. above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

Two oil galleries are provided, the main oil gallery and another directly below which supplies oil for piston cooling. Tapped passages from lower oil gallery index with jet spray nozzles which spray cooling oil on the underside of the pistons.

Cylinder Liner

Dry type special alloy iron. Part number is etched on O.D. of liner. Free O.D. is 5.0945 to 5.0955 in. Cylinder block bore is 5.0945 to 5.0955 in. which allows a liner fit of 0.001 loose to 0.001 in. tight. Cylinder liner I.D. for standard size piston, 4.876 to 4.877 in. Cylinder liners available in 0.002, 0.004, 0.006, 0.012, 0.020, 0.030, 0.040 and 0.050 in. O.D. oversize. Extension of cylinder liners above cylinder block deck must not vary more than 0.001 in. under the same head. See Figure 2-195.

When replacing cylinder liners, check cylinder block bore. If out-of-round or taper does not exceed 0.006 in., hone block for 0.002, 0.004, or 0.006 in. oversize liner as required. If out-of-round or taper exceeds 0.006 in., bore cylinder block for 0.012 in. or larger oversize liner as required.

Main bearing caps must be in place and capscrews must be torqued when cylinder block is honed or bored.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.003 in.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 inch diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert the studs finger-tight into block until bottomed, then back them off 1/3 turn. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush. Absolute cleanliness is essential. Wipe deck surface to remove oil, etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

NOTE

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. Tighten all stud nuts to 50 lb. ft. torque following sequences in Figure 2-216. Tighten again, in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run in procedure, and do not deviate from it.

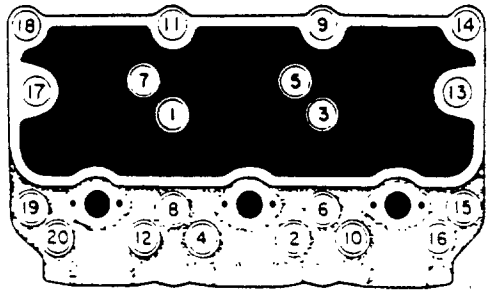


Figure 2-216. Cylinder Head Stud Nut Tightening Sequence

The cylinder block is an alloy casting with an integral cast water manifold to distribute coolant around the upper area of the block. Drilled passages are incorporated for transfer of coolant to the cylinder head and the proper distribution of lubricating oil to the various parts of the engine. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.0020 inch under area covered by individual head. Excessively eroded water holes at deck area must be repaired. To repair these holes, drill, tap, and install bronze plug. Complete repair by drilling a new water hole using cylinder head gasket as template. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.020 inch above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Produces Oil and Water Sealer or equivalent, when reinstalling plugs.

Two oil galleries are provided: the main oil gallery and another directly below which supplies oil for piston cooling. Tapped passages from the lower oil gallery index with jet spray nozzles which spray cooling oil on the underside of the pistons.

Cylinder Liner

The cylinder liners are a special alloy cast iron with part number etched on O.D. Free O.D. is 5.0945 to 5.0955 inch. Cylinder block bore is 5.0945 to 5.0955 inch which allows a liner fit of 0.0010 inch loose to 0.0010 inch tight. Cylinder liner I.D. for standard size piston, 4.875 to 4.877 inch. Cylinder liners available in 0.002, 0.004, 0.006, 0.012, 0.020, 0.030, 0.040 and 0.050 inch O.D. oversize. This liner is provided with a 3/64 inch wide x 0.008 inch high bead, at the top outer edge of the flange. When installing liner, the flange must extend 0.0035 to 0.0075 inch above the deck surface. This is taken from the channel depth, not from top of bead. See Figure 2-217. The bead embeds into the fire ring, which is a separate part of the cylinder head gasket.

Extension of cylinder liners above cylinder block deck must not vary more than 0.001 inch under the same head.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.003 inch.

NOTE

Current production auxiliary drive gears do not have timing marks and therefore, do not have to be timed.

Oil Pump Drive and Compressor Drive Coupling Gear

Oil pump drive and compressor drive coupling gear is designed with the coupling gear on one end and the oil pump drive gear on the other.

Inspect gears for wear pattern and cracked, chipped or broken teeth. See Figure 2-257. Install locating key in keyway of auxiliary shaft. Align slot in oil pump drive gear end of coupling and install gear on shaft. Install coupling washer and nut. Torque nut. Install compressor oil transfer tube in end of auxiliary driveshaft.

Tachometer Drive Assembly

Inspect tachometer shaft for wear and gear for chipped, cracked or broken gear teeth. Check housing bore for wear and flange for straightness and condition of holes.

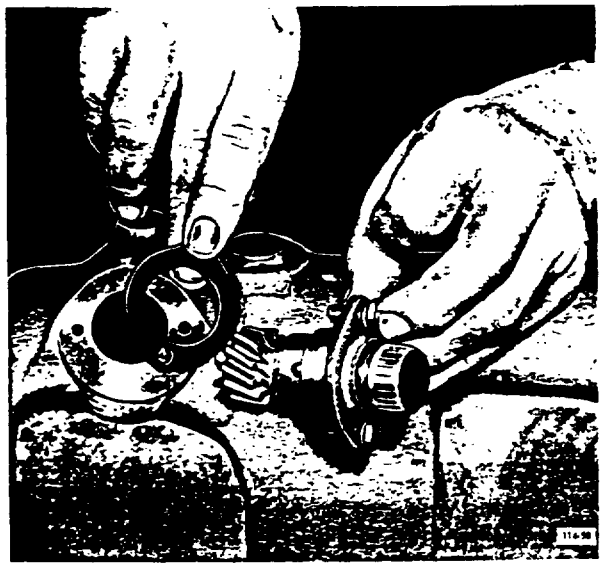


Figure 2-258. Installing Tachometer Drive Assembly

Lubricate tachometer shaft and gear and position in tachometer housing.

Install tachometer drive assembly and gasket on auxiliary drive housing. See Figure 2-258.

Injection Pump Drive Assembly

NOTE

Current production turbocharged engines use an aluminum injection pump drive housing and does not use ball bearings or bushings.

Injection pump drive assembly consists of a shaft with integral flange and tangs, a front and rear ball bearing positioned by a spacer and retained in the housing by a nut and cotter key. See Figure 2-259.

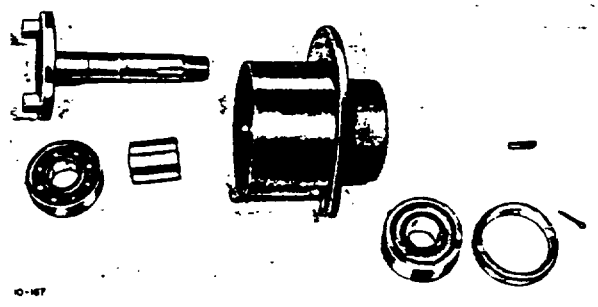


Figure 2-259. Injection Pump Drive Assembly

Inspect shaft for condition of flange and tangs. Check bearing locations for wear and galling. Check keyway slot and threads for condition. Inspect bearings for condition and free rotation. Check housing for straightness of flange, condition of bearing locations, holes and threads.

Position housing on bench with small end up. Coat bearing O.D. and recess lightly with Loctite grade B. Do not allow Loctite to enter bearing races. Install front bearing in housing with closed side up and tap into position with a suitable drift. Install bearing retaining nut; torque and lock in position with a cotter key. Allow Loctite to harden at least 12 hours at 72° F. Moderate heat may be used to accelerate hardening.

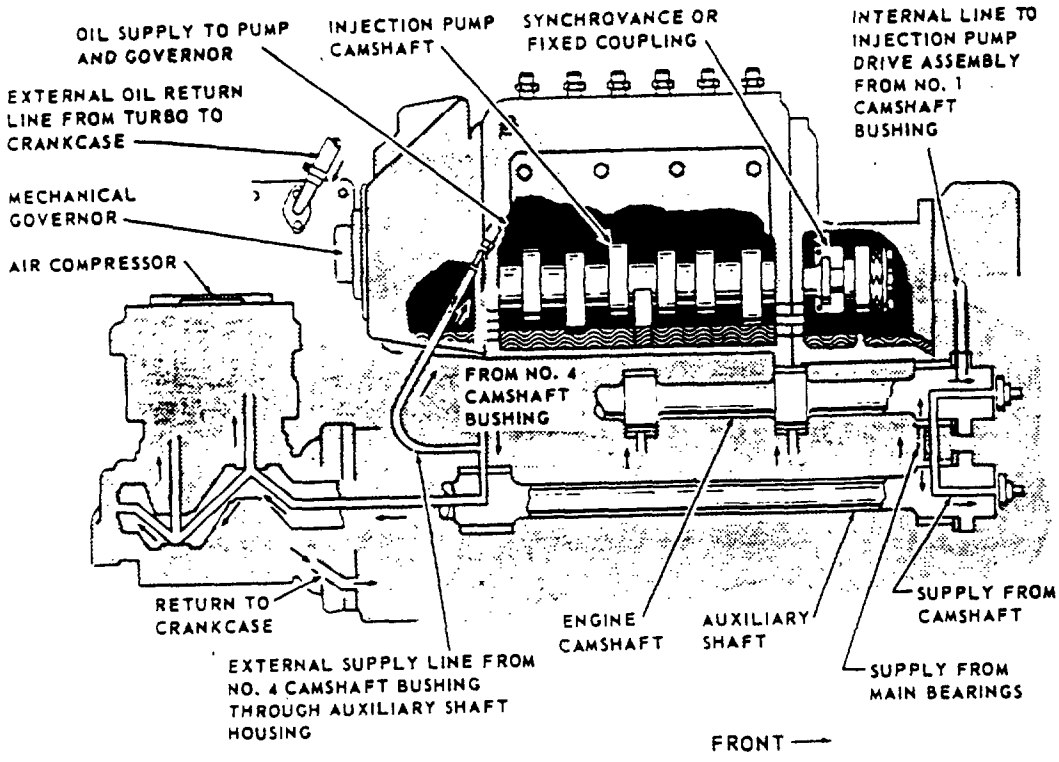


Figure 2-301. Auxiliary Drive and Injection Pump Lubrication

OIL PAN

Inspection

Inspect oil pan for dents, cracks and condition of flange, bolt holes for elongation and baffle for security. Inspect drain hole for condition of threads.

Installation

Position gasket on oil pan and position oil pan on cylinder block. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

CYLINDER HEAD STUDS

Inspection

Check cylinder head studs for condition of threads, and straightness of shank.

Installation

Apply a light coat of lubricating oil to threads of studs and install them in cylinder block finger-tight, then back off 1/3 turn.

CYLINDER HEAD INSTALLATION

CAUTION

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

Place cylinder head gasket over studs on cylinder block. Be sure that all passages are open and not blocked by gasket. Make sure fire rings are properly positioned. Cylinder gaskets are precoated; no soaking, coating or sealants are required. Use gaskets as received.

Position cylinder head over studs and gently onto cylinder block. See Figure 2-302. Be sure no foreign material is in cylinder.

Install cylinder head stud washers and nuts. Torque cylinder stud nuts in progressive steps of 50 lb. ft. using proper tightening sequence. See Figure 2-303.

Installation

1. Install rocker arm assembly to cylinder head. Be sure rocker arm bracket with oil hole is over O-ring seal.

2. Install rocker arm bracket capscrews and tighten to proper torque.

VALVE LASH ADJUSTMENT

The valve lash on standard non-brake engines can be adjusted cold static or hot idle; however, the valve lash on engines fitted with the Dynatard engine brake system can only be adjusted cold static.

To Adjust Valve Lash Cold Static

(Water Temperature Below 100 Degrees F.)

The valve lash for inlet and exhaust valves are adjusted in firing order with corresponding cylinder piston at TDC. Firing order for these engines is 1-5-3-6-2-4.

1. Set No. 1 cylinder piston TDC by use of timing marks on the vibration damper or flywheel.

2. Adjust inlet valve lash (cold static) 0.016 inch and exhaust 0.024 inch.

NOTE

Engines with Dynatard brake system use special exhaust valve adjusting tool MVT-36-6 and press downward with hand on exhaust adjusting screw while gaging valve lash.

3. Following No. 1 cylinder adjustment, turn crankshaft 1/3 turn clockwise in direction and place No. 5 cylinder at TDC. Adjust valves as outlined in step 2.

4. Continue adjusting valve lash for the remaining cylinder pistons in firing order placing each cylinder piston at TDC with respective 1/3 turns of the engine crankshaft.

5. Properly secure adjusting screw locknut after each cylinder piston valve lash adjustment.

To Adjust Valve Lash Hot Idle

(Not Recommended for Engines with the Dynatard Engine Brake System)

1. Start engine and warm up to normal operating temperature.

2. Set valve lash at hot idle (600 to 650 rpm) inlet valve 0.014 inch, exhaust 0.022 inch.

3. Properly secure adjusting screw locknut after each cylinder piston valve lash adjustment.

WATER OUTLET MANIFOLD

Inspection

Inspect water outlet manifold for restrictions. Check mounting flanges for cracks and straightness.

Installation

Place new hose and clamps between front half and rear half of the water outlet manifold. Place new gaskets between water manifold and cylinder head. Install and tighten attaching capscrews to the proper torque. Position hoses and hose clamps as applicable.

Install thermostat and by-pass fitting and thermostat housing cover and seal as applicable. See Figure 2-307.

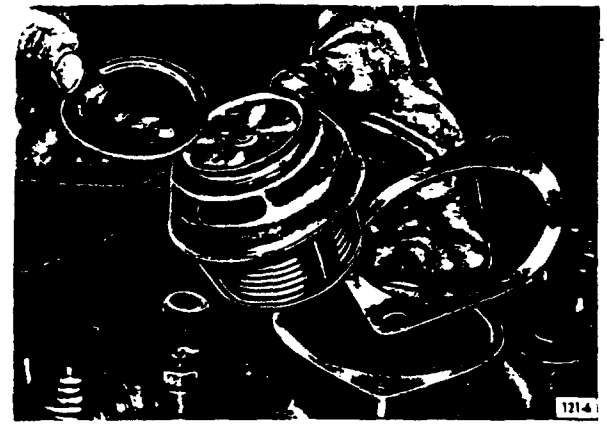


Figure 2-307. Installing Thermostat (Non-ESI)

NOTE

Thermostat on ESI engines located in front water manifold behind water conditioner and water fitting.

WATER PUMP

Description

The water pump is a centrifugal-rotor type, V-belt driven from the crankshaft. The pump cover contains the grease cavity and provisions for two, single row, ball bearings which support the shaft. The bearings

Installation - See Figure 2-310.

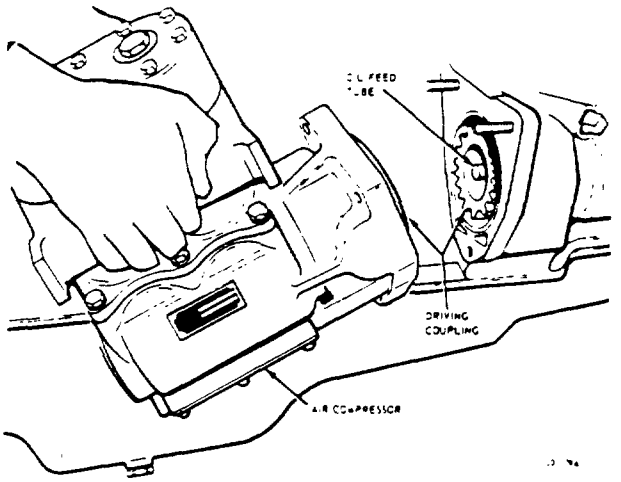


Figure 2-310. Installing Air Compressor

The air compressor is "phased" or "timed" to the engine. A tooth in the bore of the fiber coupling is shaved down to clear a pin in the drive coupling. The compressor can be installed only one way. If difficulty is experienced, recheck to insure coupling and drive are in proper mesh.

Current production engines do not require phasing or timing. The pin has been omitted from the drive coupling.

Be sure oil transfer tube is tight in end of auxiliary driveshaft.

Position air compressor adapter ring, if used, into auxiliary housing counterbore. Place gasket on air compressor and position on auxiliary housing. Install and torque air compressor retaining capscrews or nuts.

WARNING

Recheck auxiliary shaft end float after installing air compressor or vacuum pump.

FUEL INJECTION LINES, HIGH PRESSURE

Description

Fuel injection lines are seamless cold-drawn high tensile steel. All lines on one engine are of identical length and inside diameter.

Inspection

Inspect fuel injection line for chafing, dents, nicks or sharp bends. Check fittings, seat and threads for condition. Check lines to be sure they are not restricted.

Installation

Install fuel injection nozzles. Install fuel injection lines and be sure brackets are properly positioned to prevent lines from chafing.

The lines should fit without difficulty if they have not been changed around. NEVER BEND THE LINES TO MAKE THEM FIT.

Torque fuel injection lines at injection nozzles and pump locations. Torque injection line brackets.

INLET MANIFOLD

Inspection

Inspect inlet manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between inlet manifold and cylinder head. Install and tighten attaching capscrews to the proper torque.

EXHAUST MANIFOLD

Inspection

Inspect the exhaust manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between exhaust manifold and cylinder head. Install and tighten the attaching washers and nuts to the proper torque.

ROCKER ARM COVERS

Inspection

Inspect rocker arm covers for cleanliness, dents and straightness of flange. Check breather in cover, if applicable, to be sure it is not plugged.

Installation

Cement new gasket to mounting flange of rocker arm cover.

Position cover over rocker arms; install and torque cover retaining capscrews or nuts as applicable.

TURBOCHARGER

Description

The turbocharger is an exhaust gas driven air compressor. See Figure 2-311. The purpose of the turbocharger is to increase the supply of air to the cylinders and thus burn more fuel which in turn produces more power.

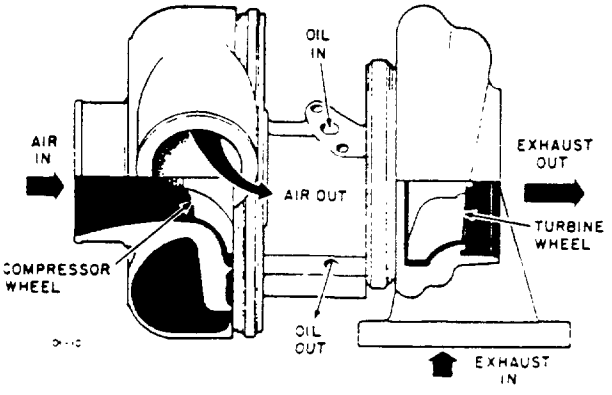


Figure 2-311. Exhaust Driven Turbocharger

The turbocharger consists of three main parts; the turbine housing, the bearing housing and the compressor housing. The turbine housing is located at one end of the bearing housing and the compressor housing is located at the other end. A common shaft connects the turbine wheel and compressor wheel.

The turbine end of the turbocharger uses exhaust gas energy normally discharged to the atmosphere. The exhaust gas enters the turbocharger through the flange connection on the exhaust manifold. The exhaust gas flows around the turbine housing and radially inward causing the turbine wheel to rotate. The exhaust gas is then discharged through the center of the turbine housing into the exhaust pipe.

The bearing housing contains the through-shaft, bearings, seals, and oil passages.

The bearings are of the floating sleeve type and are pressure lubricated from the engine oil supply system. Piston ring type oil seals are used at each end of the shaft to effectively seal off the oil.

The compressor housing contains the compressor wheel and air enters at the center of the compressor wheel and flows radially outward into the compressor housing. The air leaves through a tangential outlet on the outside of the compressor housing and is ducted to the inlet manifold.

Checks Before Removal

If turbocharger malfunction is suspected, make the following checks before removal of turbocharger from the engine.

1. Start engine and check for unusual noise or vibration from turbocharger. This will indicate out-of-balance, rubbing or damage to compressor or turbine wheels.

2. Check for leaks in the air system from turbocharger to intake manifold and from intake manifold to cylinder block. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

3. Check air cleaner and air intake system, from the air cleaner to turbocharger, for restrictions to air flow or leaks.

4. Check exhaust system, from cylinder block to turbocharger, for exhaust leaks. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

5. Check exhaust system from turbocharger to outlet for restrictions.

6. Check turbine wheel for radial and axial looseness. If radial and/or axial looseness is excessive, the turbocharger will have to be removed for overhaul. If turbocharger has to be overhauled, consult your Mack Branch or Distributor for details on turbocharger exchange program.

Cleaning

The compressor end of the turbocharger should be cleaned after 1000 to 2000 hours of operation. If the compressor wheel is not too dirty, it can be cleaned with the turbocharger on the engine.

Disconnect compressor discharge flange; remove the capscrews or clamp ring that holds the compressor housing to the bearing housing, and pull compressor housing carefully along turbocharger axis to prevent damage to the compressor wheel or the diffuser.

Use Bendix Metal Cleaner or equivalent solvent to clean compressor wheel. Do not use a caustic solution or any other type that may attack aluminum, as this will either weaken the impeller or destroy its balance. Do not use a wire brush or scraper; a brush with nylon or hog bristles is preferred.

If compressor wheel is found to be very dirty, remove turbocharger from the engine for cleaning. With compressor housing removed, immerse compressor wheel into the cleaning fluid and allow to soak. Use care not to rest weight of turbocharger on compressor wheel or on end of shaft.

The turbine end of turbocharger can be cleaned only after removal from the engine and separation of the bearing housing from the turbine housing.

Installation Guide

Use the following steps as a guide when installing turbocharger to engine.

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for foreign material.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure. Be sure check valve is working properly and not restricted.

5. Inspect turbocharger mounting pad, on exhaust manifold, for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect oil inlet line and oil drain line to turbocharger.

8. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

9. Crank engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger.

10. Stop cranking engine and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

ENGINE BREAK-IN PROCEDURE AFTER OVERHAUL OR REBUILD

Comparative tests and careful review of engine break-in methods have proven that a short run under full load is substantially more effective than the light or no load slow speed increase type of break-in. Compatibility between the critical components (piston, rings and bores) is greatly improved by raising engine speed and applying full load immediately after warm-up.

Use the recommended type and grade engine oil and fuel as required for usual operation of the vehicle.

Immediately prior to initial starting of the engine, the fuel system, oil galleries and filters are to be primed preferably by means of a pressure tank.

Check the air intake system to be sure all joints are tight and the filter element and system are clean.

After break-in procedure is complete, recheck cylinder head stud nut torque and valve clearance adjustment.

NOTE

Torque cylinder head studs. Back off each nut individually in proper sequence. See Figure 3-303. Oil threads and washer and tighten to the recommended torque.

When the vehicle is put into service, treat the engine as though it were new and follow the "Breaking in a New Vehicle" instructions listed in the Operation Manual.

1. Inspect the auxiliary shaft journals for wear and galling.

2. Inspect gear for wear pattern, cracked, chipped or broken teeth.

3. Inspect keyway slot on end of shaft for nicks and burrs.

4. Inspect the oil passage in the threaded end of the shaft and journal to insure it is not plugged.

Installation

1. Apply a light coat of oil to the journals and gear of the auxiliary shaft and position the auxiliary drive shaft in the cylinder block.

2. Install oil pump driving gear key in position on threaded end of auxiliary shaft.

3. Hold shaft in position and install the oil pump driving gear. Secure in position by installing the tabbed lockwasher and nut. Torque nut and lock by bending tabs.

4. Install new compressor oil tube using tool J2 19 10.

5. Complete assembly by installing tachometer drive, compressor and power steering pump.

NOTE

It is good assembly procedure to back the thrust button out before installing the timing gear cover.

Adjusting Auxiliary Shaft End Play

1. Clean threads of thrust button and back locknut out toward allen head. This will insure the thrust button will bottom auxiliary drive shaft before locknut contact timing gear cover.

2. Run thrust button in until it bottoms against the auxiliary driveshaft. Turn an additional turn on thrust button to insure auxiliary shaft is against the thrust plate.

3. Snug but do not tighten locknut against the timing gear cover.

4. Back out the thrust button assembly and insert proper feeler gauge between the locknut and timing gear cover.

5. Adjust the proper shaft end play by turning thrust button assembly in or out.

6. After the proper end play has been established, remove feeler gauge and securely hold thrust button assembly and lock adjustment by running locknut against the timing gear cover.

Tachometer Drive Assembly

Inspect tachometer shaft for wear and gear for chipped, cracked or broken gear teeth. Check housing bore for wear and flange for straightness and condition of holes.

Lubricate tachometer shaft and gear and position in tachometer housing.

Install tachometer drive assembly and gasket on auxiliary drive housing. See Figure 2-334.

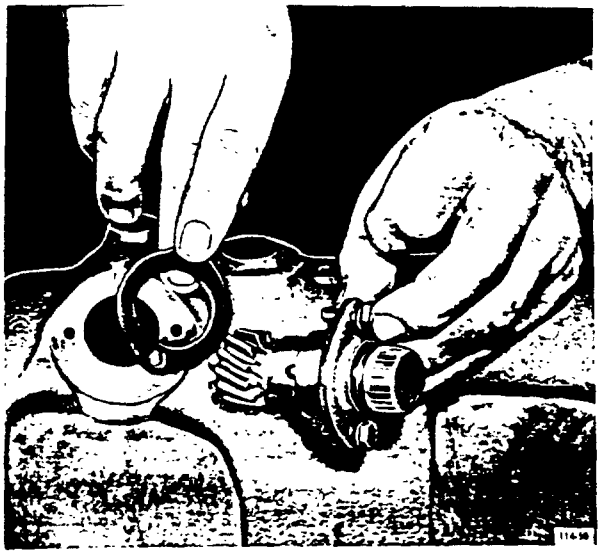


Figure 2-334. Installing Tachometer Drive Assembly

INJECTION PUMP DRIVE ASSEMBLY

Description

The injection pump drive assembly consists of an aluminum drive housing, a shaft with integral flange and tangs, driven gear and injection pump drive hub. See Figure 2-335.

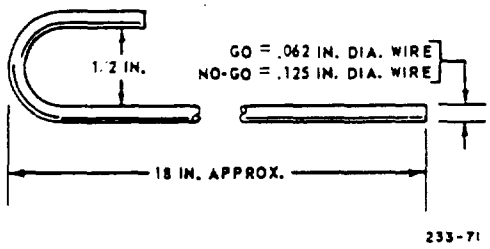


Figure 2-360. Piston Cooling Oil Nozzle Wire Gage

2. Visually sight along nozzle. Nozzle should be pointing at a location midway between side of connecting rod and inside face of piston pin boss when nozzle appears to be square with the engine centerline.

3. If nozzle is improperly positioned, bend nozzle tube to obtain proper location.

4. Slide GO wire (0.062 in.) gage over nozzle between piston skirt and nozzle tube. Gage must pass between nozzle tube and piston skirt.

5. Slide NO-GO wire (0.125 in.) gage over nozzle between piston skirt and nozzle tube. Gage must not pass between nozzle tube and piston skirt.

6. If either wire gage indicated improper nozzle tube to piston skirt clearance, bend nozzle tube sideways, fore or aft, as required.

NOTE

Recheck with both GO and NO-GO wire gages after bending nozzle tube.

7. Repeat steps 1 through 6 at numbers two and five pistons and three and four pistons.

TIMING GEAR COVER

Inspection

Inspect timing gear cover for dents, condition of threaded holes and straightness of flanges.

Installation

Install crankshaft front oil seal into timing gear cover, use suitable tool. See Figure 2-361.

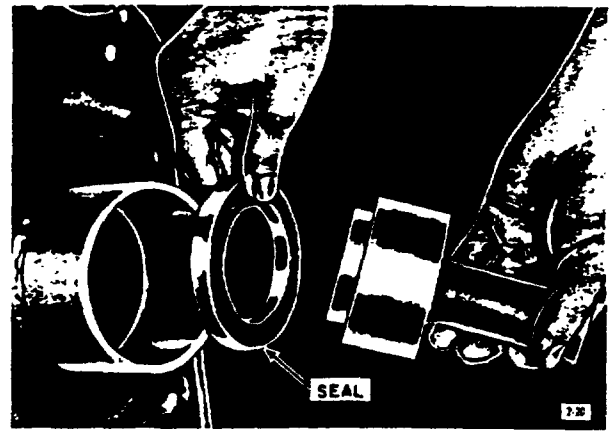


Figure 2-361. Installing Crankshaft Front Oil Seal

Install the adjustable thrust button(s) into the timing gear cover from the inside. Position the washer and jam nut on the outside of the timing gear cover.

Install suitable guide studs and position timing gear cover gasket and timing gear cover into position. Use a locally manufactured centering sleeve to align crankshaft oil seal. See Figure 2-362.

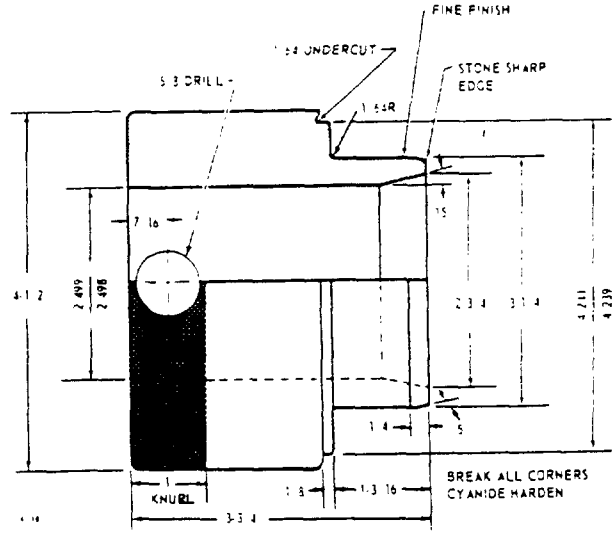


Figure 2-362. Timing Gear Cover Centering Sleeve

Install two timing gear cover screws finger-tight and tap cover lightly with a soft head hammer to align cover with oil pan bolting surface. Use a straight edge to assist alignment. See Figure 2-363. Remove guide studs. Install and torque all timing gear cover capscrews. Remove centering tools. Turn thrust button(s) in until there is no

IMPORTANT

When installing oil cooler core, notch in core header plate MUST be on same side as the oil ports so that correct flow through cover is maintained.

3. Use new gaskets and complete assembly.

OIL PUMP

Description

The oil pump is gear driven off the auxiliary driveshaft. This pump has two inlet passages which permits installing the suction tube to the sump at either the front or rear location, depending on the lower pan installation. The opposite passage is blocked off with a cover. The pump geatures a one piece oil pump shaft with integral pump gear.

Inspection

Inspect the oil pump drive gear for wear pattern and condition of teeth. Check shaft for journal wear. Insure oil holes are clean and not obstructed.

Check oil pump housing for condition of flanges, holes and oil pump gear cavity for scoring. Check idler shaft for scoring and tightness in housing.

Check oil pressure regulator body and cap for cleanliness, condition of holes, threads and spring for proper tension and ends for wear.

Assembly

1. Apply a light coat of lubricating oil to the oil pump drive gear shaft and install in pump housing.

2. Install pump drive gear to the shaft. The drive gear is keyed to the shaft and retained by a nylok type nut and washer.

3. Lubricate the idler gear shaft and install pumping idler gear.

4. Check gear end clearance, backlash and side clearance. See Figures 2-368, 2-369 and 2-370.

5. Position oil pump cover in a vise and install tab lock, pressure relief valve plunger, spring and cap into the cover. Torque cap and bend tab lock. See Figure 2-371.

6. Remove oil pump cover from the vise and position cover on oil pump body. Secure cover with capscrews and rotate oil pump shaft to insure oil pump is not binding.

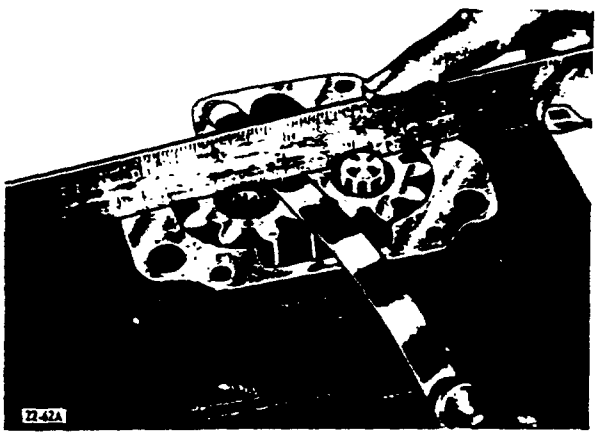


Figure 2-368. Checking Oil Pump Gear End Clearance

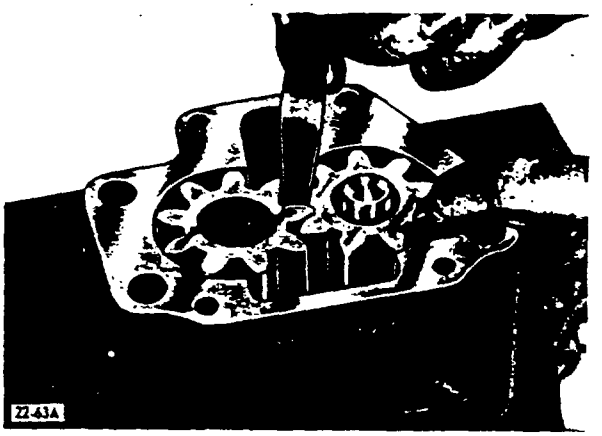


Figure 2-369. Checking Oil Pump Gear Backlash

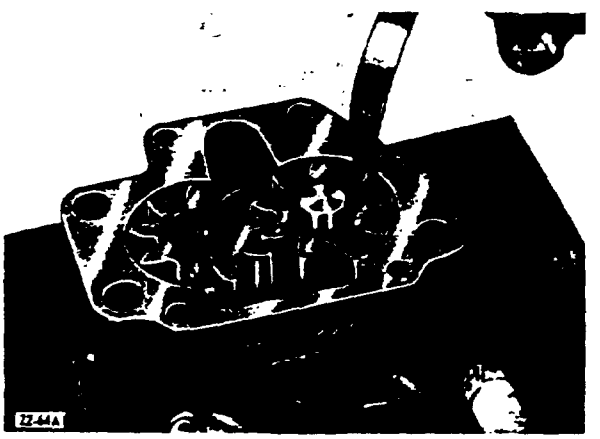


Figure 2-370. Checking Oil Pump Gear Side Clearance

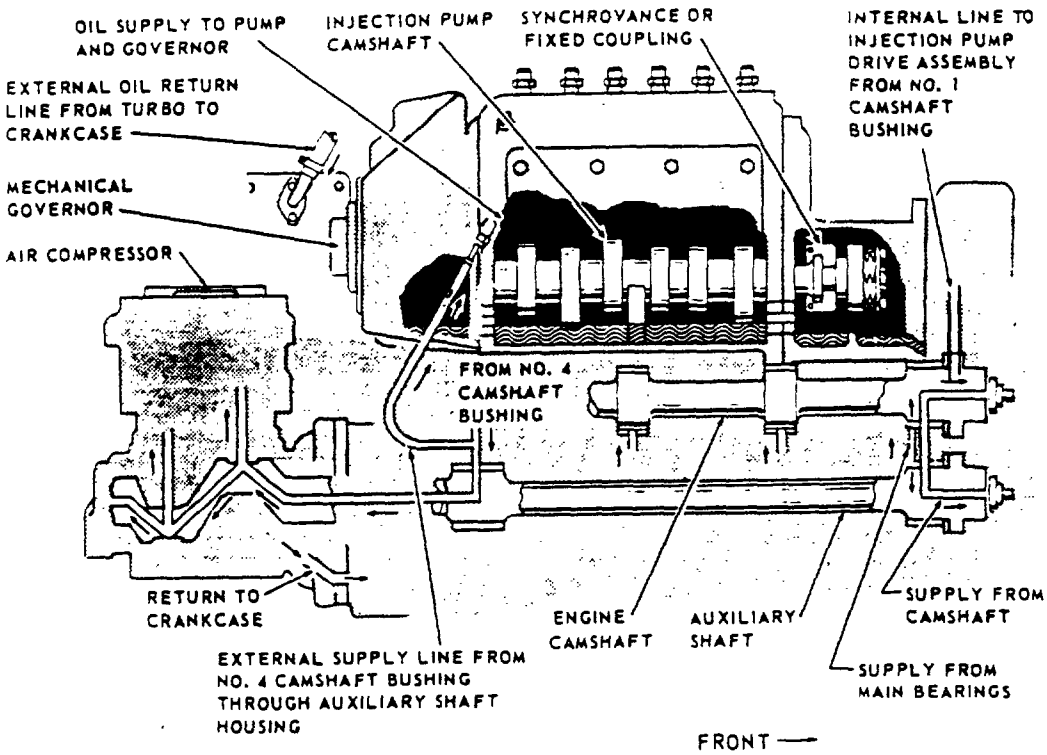


Figure 2-378. Auxiliary Drive and Injection Pump Lubrication

OIL PAN

Inspection

Inspect oil pan for dents, cracks and condition of flange, bolt holes for elongation and baffle for security. Inspect drain hole for condition of threads.

Installation

Position gasket on oil pan and position oil pan on cylinder block. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

CYLINDER HEAD STUDS

Inspection

Check cylinder head studs for condition of threads, and straightness of shank.

Installation

Apply a light coat of lubricating oil to threads of studs and install them in cylinder block finger-tight, then back off 1/3 turn.

CYLINDER HEAD INSTALLATION

CAUTION

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

Place cylinder head gasket over studs on cylinder block. Besure that all passages are open and not blocked by gasket. Make sure fire rings are properly positioned. Cylinder gaskets are precoated; no soaking, coating or sealants are required. Use gaskets as received.

Position cylinder head over studs and gently onto cylinder block. See Figure 2-379. Be sure no foreign material is in cylinder.

Apply a light coat of oil to the cylinder head stud washers and nuts and install in position. Torque cylinder stud nuts in progressive steps of 50 lb. ft. using proper tightening sequence. See Figure 2-380.

Problem	Probable Cause	Remedy
Loss of power.	1. Plugged tip turbine fan air cleaner.	1. Check air cleaner and remove restriction.
	2. Air leak in tip turbine fan, bleed air connection.	2. Check all air connections. They must be tight.
	3. Restricted and/or damaged crossover pipe turbocharger to inlet of tip turbine fan.	3. Remove restriction and/or replace crossover pipe.
	4. Tip turbine fan exhaust port plugged.	4. Remove blockage. Exhaust port must be open at all times.
	5. Excessive dirt buildup in fan housing or wheel.	5. Clean, repair or replace unit.
	6. Turbine wheel rub.	6. Repair or replace the unit.
	7. Intercooler gasket leakage.	7. Disassemble intercooler and replace gasket.
Noisy tip turbine fan operation.	1. Plugged tip turbine fan air cleaner.	1. Check air cleaner and remove restriction.
	2. Air cleaner leaking, not sealing correctly, loose connections.	2. Check all air connections. They must be tight.
	3. Air leak at tip turbine fan, bleed connection.	3. Check port connections. They must be tight.
	4. Restricted and/or damaged crossover pipe turbocharger to inlet of tip turbine fan.	4. Remove restriction and/or replace crossover pipe.
	5. Blockage between air cleaner and tip turbine fan.	5. Remove blockage. Tip turbine fan requires unrestricted air flow.
	6. Exhaust port blocked.	6. Remove blockage. Exhaust port must be open at all times.
	7. Worn bearings.	7. Repair or replace the unit.
	8. Excessive dirt buildup in fan housing or wheel.	8. Clean, repair or replace the unit.
	9. Turbine wheel rub.	9. Repair or replace the unit.
	10. Intercooler gasket leaking.	10. Disassemble intercooler and replace gasket.

TROUBLE SHOOTING CHART (Cont)

Problem	Probable Cause	Remedy
Excessive axial or radial play.	1. Oil Lay (oil delay to fan at start up).	1. Repair or replace unit. Engines should be idled for several minutes after starting to prevent oil lag.
	2. Insufficient lubrication.	2. Repair or replace unit. Maintain lubrication at proper level. Check lubricating piping must be free of sharp bends, etc. Lubricant must have unrestricted flow.
	3. Contaminated and/or improper type of lubricating oil.	3. Repair or replace unit. Drain oil, replace filters and fill with recommended lubricating oil.
Drag or bind in rotating assembly.	1. Contaminated and/or improper type of lubricating oil.	1. Repair or replace unit. Drain oil, replace filters and fill with recommended lubricating oil.
	2. Worn bearings.	2. Repair or replace unit.
	3. Excessive dirt build-up in tip turbine fan housing or wheel.	3. Clean or replace unit.

Bearing Clearance Inspection

The purpose of this procedure is to determine whether it is necessary to replace or repair the thrust bearing, radial bearings and/or rotating assembly. In most cases this bearing check can be made while the tip turbine fan is still mounted on the vehicle.

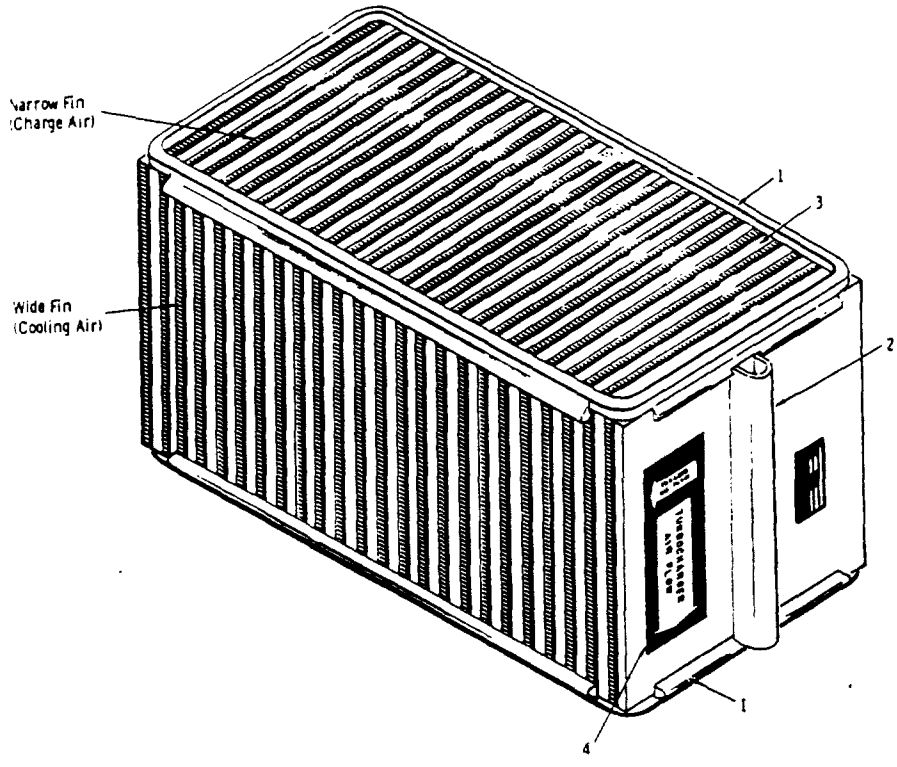
1. Radial Bearing Check - Fasten a "last word" type dial indicator to the flange of the inlet housing so that the indicator tip rests against the wheel nut shoulder. Move the shaft from side to side allowing minimum rotary movement. Total indicator reading should be from 0.006 to 0.011 inch. Any variation from these readings will require repair or replacement of the unit.

2. Axial Bearing Check - Fasten a plunger type dial indicator to the flange of the inlet housing so that the plunger rests against the end of the shaft. Move the shaft in and out. Total indicator reading should be 0.001 to 0.005 inch. Any variation from these readings will require repair or replacement of the unit.

INTERCOOLER CORE

Description

A compact plate heat exchanger assembly, it consists of a cross-flow core, two mounting/sealing gaskets and two "D" end sealing strips. See Figure 2-387. Fins are stacked on plates between each row. The plates separate and direct the flow of air, i.e., second row turbocharged; first row intercooled air, etc.



1. Gasket
2. End "D" Seal
3. Core Assembly
4. Decal

Figure 2-387. Intercooler Core Assembly

Cleaning

The cooling side of the intercooler core can be cleaned by either of the following methods:

1. Steam Cleaning.

CAUTION

Steam pressures above 40 psi and/or temperatures above 400 degrees F. can damage core and gaskets.

2. Detergent Cleaning.

Use a solution of household laundry detergent. Flush through the core several times followed by a rinse with warm water. Use low pressure air to blow dry.

CAUTION

Do not under any circumstances use strong caustic solutions, i.e., "Oakite" or acid, i.e., hydrochloric acid, bowl cleaners, etc., as they will corrode the core and damage gasket. Also do not use shop solvents to clean core as gasket damage will result.

Seal Removal

1. Pull off old gaskets.

2. With a razor blade or sharp knife, cut away excessive bonding material.

NOTE

It is not necessary to remove all the bonding material out of the depressed areas since the new gasket will seal perfectly to the slightly uneven old gasket surface.

3. Remove all loose shavings and cuttings.

Seal Replacement

NOTE

Unit must be clean and dry before attempting seal replacement.

1. Place unit on flat work bench, gasket surface up. (Turbocharger airflow arrow up or down.)

2. Soak clean rag with alcohol or trichlorethylene, and swab old gasket surface and new gasket to remove all oily residue.

3. Run a "bead" of bonding agent all around the surface to be gasketed, leaving no open gaps.

4. Place gasket on core and adjust into place.

CAUTION

Refer to diagrams on gasket shipping container for proper installation position.

5. Invert the intercooler and repeat 2, 3 and 4 for the second gasket.

NOTE

If the end seals are damaged, proceed with steps 6 and 7; otherwise, omit these steps and proceed with 8.

6. Swab the end plates of the intercooler with alcohol or trichlorethylene. Swab the new end seals with alcohol or trichlorethylene.

7. Run a double bead of bonding agent on the end seals and press into place on the end plates. Hold the end seals in position with string or tape wrapped around the entire unit.

8. Check all the gaskets to make sure they have not shifted during handling.

NOTE

Gaskets may be adjusted during the first 5 minutes while the bonding agent is curing.

9. Let the entire unit stand undisturbed for 1-1/2 hours minimum before installing.

Visually inspect the bond to make sure that the gasket is firmly attached all the way around. Gaps which are found should be filled with additional bonding agent. Let cure.

NOTE

Wipe manifold or gasket surfaces with talcum powder or Dow Corning 44 silicone grease before installing in manifold to prevent gasket sticking.

NOTE

Do not use petroleum base grease or oil for this purpose.

WATER PUMP

Description

The water pump is a centrifugal-rotor type, V-belt driven from the crankshaft. The pump cover contains the grease cavity and provisions for single and double row ball bearings which support the shaft. The bearings are sealed on one side to retain grease. A vent fitting replaces the usual grease fitting because the initial pack of grease, 1/3 full, should suffice for the life of the pump. A cartridge-type water seal with synthetic rubber bellows and carbon ring form an effective water-tight seal.

The housing, which comprises the volute (rotor casing) and water outlet to the engine is also the pump mounting.

It is usually more economical to obtain a rebuilt exchange water pump than to overhaul the old one. Contact your Mack Branch or Distributor for rebuilt exchange water pumps.

INJECTION PUMP INSTALLATION

1. Bar engine in normal direction of rotation until No. 1 cylinder is on compression stroke and flywheel timing mark indicates correct number of degrees BTC recommended on valve cover escutcheion plate. The injection pump driveshaft flange lugs should now be in a horizontal plane and indexing pin hole at 4 o'clock position, looking at face of shaft flange.

2. Grease front (non-counterbored) face of coupling and mount on pump driveshaft flange with long end of offset indexing pin pointing rearward and center the coupling ring laterally.

3. Remove pump adapter inspection hole cover.

4. Rotate pump coupling driven flange until lugs are in a vertical plane and indexing hole is at 7 o'clock position, looking from drive end of pump. See Figure 2-389.

Installation - See Figure 2-392.

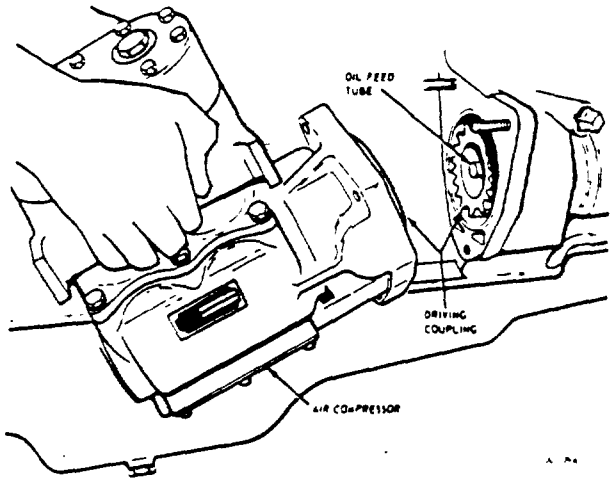


Figure 2-392. Installing Air Compressor

The oil transfer tube is assembled loose at both ends of auxiliary driveshaft.

Place silastic on air compressor mounting face and position on auxiliary housing. Install and torque air compressor retaining capscrews.

WARNING

Recheck auxiliary shaft end float after installing air compressor.

FUEL INJECTION LINES, High Pressure

Description

Fuel injection lines are seamless cold-drawn high tensile steel. All lines on one engine are of identical length and inside diameter.

Inspection

Inspect fuel injection line for chafing, dents, nicks or sharp bends. Check fittings, seat and threads for condition. Check lines to be sure they are not restricted.

Installation

Install fuel injection nozzles. Install fuel injection lines and be sure brackets are properly positioned to prevent lines from chafing.

The lines should fit without difficulty if they have not been changed around. NEVER BEND THE LINES TO MAKE THEM FIT.

Torque fuel injection lines at injection nozzles and pump locations. Torque injection line brackets.

INTAKE MANIFOLD

Description

Cast aluminum manifold provides the distribution point of the turbocharged aftercooled air and seat for the intercooler core. An integral part of the manifold is the front water manifold. This design feature permits the use of one compact and simple housing.

The thermostat housing is placed in the inlet end of the front water manifold. The coolant conditioner bolts to the flange of the front water manifold.

Inspection

Inspect intake manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between intake manifold and cylinder head. Install and tighten attaching capscrews to the proper torque.

EXHAUST MANIFOLD

Inspection

Inspect the exhaust manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between exhaust manifold and cylinder head. Install and tighten the attaching washers and nuts to the proper torque.

ROCKER ARM COVERS

Inspection

Inspect rocker arm covers for cleanliness, dents and straightness of flange. Check breather in cover, if applicable, to be sure it is not plugged.

Installation

Cement new gasket to mounting flange of rocker arm cover.

Position cover over rocker arms; install and torque cover retaining capscrews or nuts as applicable.

TURBOCHARGER

Description

The turbocharger is an exhaust gas driven air compressor. See Figure 2-393. The purpose of the turbocharger is to increase the supply of air to the cylinders and thus burn more fuel which in turn produces more power.

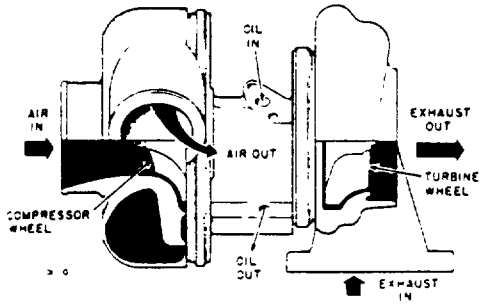


Figure 2-393. Exhaust Driven Turbocharger

The turbocharger consists of three main parts; the turbine housing, the bearing housing and the compressor housing. The turbine housing is located at one end of the bearing housing and the compressor housing is located at the other end. A common shaft connects the turbine wheel and compressor wheel.

The turbine end of the turbocharger uses exhaust gas energy normally discharged to the atmosphere. The exhaust gas enters the turbocharger through the flange connection on the exhaust manifold. The exhaust gas flows around the turbine housing and radially inward causing the turbine wheel to rotate. The exhaust gas is then discharged through the center of the turbine housing into the exhaust pipe.

The bearing housing contains the through-shaft, bearings, seals and oil passages.

The bearings are of the floating sleeve type and are pressure lubricated from the engine oil supply system. Piston ring type oil seals are used at each end of the shaft to effectively seal off the oil.

The compressor housing contains the compressor wheel and air enters at the center of the compressor wheel and flows radially outward into the compressor housing. The air leaves through a tangential outlet on the outside of the compressor housing and is ducted to the inlet manifold.

Checks Before Removal

If turbocharger malfunction is suspected, make the following checks before removal of turbocharger from the engine:

1. Start engine and check for unusual noise or vibration from turbocharger. This will indicate out-of-balance, rubbing or damage to compressor turbine wheels.

2. Check for leaks in the air system from turbocharger to intake manifold and from intake manifold to cylinder block. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

3. Check air cleaner and air intake system, from the air cleaner to turbocharger, for restrictions to air flow or leaks.

4. Check exhaust system, from cylinder block to turbocharger, for exhaust leaks. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

5. Check exhaust system from turbocharger to outlet for restrictions.

6. Check turbine wheel for radial and axial looseness. If radial and/or axial looseness is excessive, the turbocharger will have to be removed for overhaul. If turbocharger has to be overhauled, consult your Mack Branch or Distributor for details on turbocharger exchange program.

Cleaning

The compressor end of the turbocharger should be cleaned after 1000 to 2000 hours of operation. If the compressor wheel is not too dirty, it can be cleaned with the turbocharger on the engine.

Disconnect compressor discharge flange; remove the capscrews or clamp ring that holds the compressor housing to the bearing housing, and pull compressor housing carefully along turbocharge axis to prevent damage to the compressor wheel or the diffuser.

Use Bendix Metal Cleaner or equivalent solvent to clean compressor wheel. Do not use a caustic solution or any other type that may attach aluminum, as this will either weaken the impeller or destroy its balance. Do not use a wire brush or scraper; a brush with nylon or hog bristles is preferred.

If compressor wheel is found to be very dirty, remove turbocharger from the engine for cleaning. With compressor housing removed, immerse compressor wheel into the cleaning fluid and allow to soak. Use care not to rest weight of turbocharger on compressor wheel or on end of shaft.

The turbine end of turbocharger can be cleaned only after removal from the engine and separation of the bearing housing from the turbine housing.

Installation Guide

Use the following steps as a guide when installing turbocharger to engine:

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for foreign material.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure.

5. Inspect turbocharger mounting pad, on exhaust manifold, for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect oil inlet line and oil drain line to turbocharger.

8. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

9. Crank engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger.

10. Stop cranking engine and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

TIP TURBINE FAN AIR INTAKE SYSTEM

Description

A stratatube air separator provides clean air to the tip turbine fan and intercooler core. Outside air is drawn through the stratatube separator before entering the tip turbine fan. A bleed off type ejector pulls the dirty air from the separator. See Figure 2-394.

The stratatube air separator has no moving parts. All incoming air hits the fixed vanes in the separator and is swirled. The heavier, dirty air is forced to the outside of the vanes; while the lighter, cleaner air exits through the center. Bleed air from the inlet manifold enters the ejector, creating a partial vacuum which pulls the dirty air out of the separator and exhausts it into the atmosphere.

Maintenance

Basically, the stratatube air separator requires no maintenance other than a routine visual inspection making sure all parts are open and all connections tight.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets in their proper positions on the block checking that the rubber seals are correctly positioned in holes of gasket.

NOTE

Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Set cleaned cylinder heads in place separately. When in place, apply Permatex No. 2 to the accessible outer edges of gasket. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until after heads have been torqued. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. See Figure 2-400.

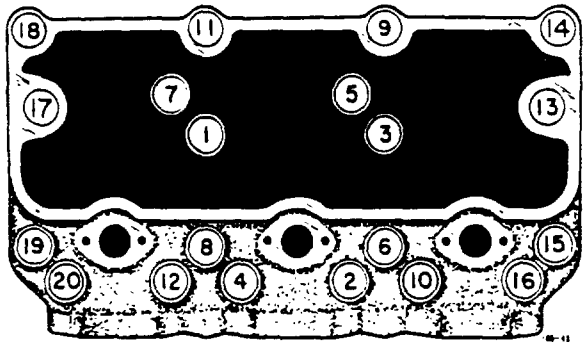


Figure 2-400. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque following sequence in Figure 5. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry type cylinder liners. The deck area surface must be flat within 0.0015 in. Excessively eroded water holes developing at deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.018 in. above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

Cylinder Liner

Dry type, special alloy iron, Rockwell C43-53. Part number etched on barrel. Standard size O.D., 5.1565 to 5.1575 inches. Cylinder liner I.D. for standard size piston, 5.0010 to 5.0020 inches to produce fit of 0.000 to 0.001 inches press.

Shoulder extension, 0.0035 to 0.0075 in. above deck. Extension of liners under same head should be within 0.001 in. Liners available in 0.002, 0.004, 0.006, 0.012 and 0.020 in. O.D. oversizes. Maximum out-of-round or taper of cylinder bore for liner, 0.002 in.

When replacing cylinder liners, check cylinder block bore. If out-of-round or taper does not exceed 0.006 in., hone block for 0.002, 0.004, or 0.006 in. oversize liner as required. If out-of-round or taper exceeds 0.006 in., bore cylinder block for 0.012 in. or larger oversize liner as required.

Main bearing caps must be in place and capscrews must be torqued when cylinder block is honed or bored.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.002 in. Remove honing grit by swabbing bore with a cloth saturated with clean SAE 10 oil. Remove all traces of oil with solvent and blow dry with clean, dry compressed air. If liner enters 1/2 to 2/3 of the bore, a light press on top of liner should suffice. Stop pressing when liner is 1/2 in. from deck, clean counterbore

Outer Valve Spring

Nominal free length, 3-13/32 inch. Test for 105.3 to 116.3 lbs. when compressed to 2-5/32 inch. Service limit, 99 lbs.

Rocker Arm Shaft

Shaft O.D., 1.1286 to 1.1291 inch. Drilled for bottom oil feed of rocker arms. Locating screw assures proper line-up of oil passage.

Rocker Arm

Ratio, 1.8 to 1. Shaft hole diameter, 1.1296 to 0.0301 inch. Hole-to-shaft clearance is 0.0005 to 0.0015 inch.

Before installing rocker arm and shaft assembly on cylinder head, be sure to fit O-ring carefully in recess at oil passage-to-rocker arm bracket on top of cylinder head.

Rocker arm bracket capscrew torque, 35 lb. ft.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 inch diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert the studs finger-tight into block until bottomed, then back them off 1/3 turn. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush. Absolute cleanliness of essential. Wipe deck surface to remove oil, etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

NOTE

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud Nuts, one head at a time, using the following procedure. Tighten all stud nuts to 50 lb. ft. torque following sequence in Figure 2-414. Tighten again, in sequence, to 100 lbs. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run in procedure, and do not deviate from it.

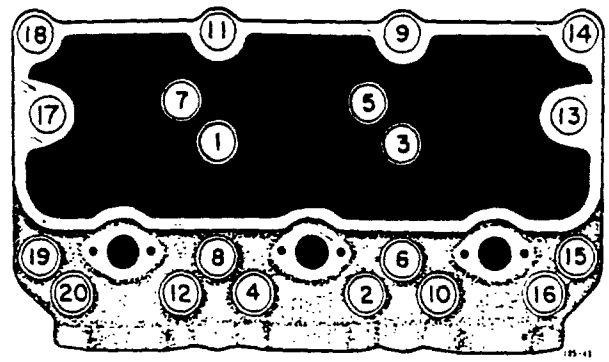


Figure 2-414. Cylinder Head Stud Nut Tightening Sequence

CYLINDER BLOCK

The cylinder block is an alloy casting with an integral cast water manifold to distribute coolant around the upper area of the block. Drilled passages are incorporated for transfer of coolant to the cylinder head and the proper distribution of lubricating oil to the various parts of the engine. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.0020 inch under area covered by individual head. Excessively eroded water holes at deck area must be repaired. To repair these holes, drill, tap and install bronze plug. Complete repair by drilling a new water hole using cylinder head gasket as template. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.018 inch above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

A machined oil pad is provided on the left hand side of the cylinder block. Porting in the pad corresponds to the porting in the oil pressure relief valve assembly.

Provisions have been made on both sides of the case to install buttress screws which fit into the main bearing cap. The buttress screws are used on both sides of all main bearing caps. They must be removed in order to remove the main bearing caps.

Block Preparation

1. Check the cylinder block deck surface for warpage. If warpage is excessive be sure that the maximum amount of material removal limit is not exceeded.

CAUTION

The piston travel above the cylinder block deck is critical and must be checked during assembly to insure proper clearance of piston with cylinder head and valve.

2. Remove all core plugs and fittings from the cylinder block and remove any accumulation of rust and sludges.

3. Check block for cracks, the condition of threaded holes and the straightness of the mating flanges.

4. Thoroughly inspect the upper edge of the cylinder sleeve counterbore in the block for signs of pitting or errosion. Rework as required. Shims are available to obtain correct sleeve height at reassembly.

5. Blow all passages thoroughly with compressed air.

6. Coat new O-ring with sealant, place on core plugs and install plugs in block.

7. Install all oil gallery plugs and gaskets using Permatex sealant or equivalent to insure positive sealing.

Cylinder Sleeve

The cylinder sleeves are wet type, centrifugal cast iron and are available in standard size. A bead is provided around top of seating flange for using a fire ring type cylinder head gasket. Clean sleeve flanges using a brass wire rotary brush to be sure of effective fire ring sealing. Check cylinder sleeve for out-of-round and taper. Use tool J5347-01 and measure each sleeve I.D. See Figure 9. Take readings in two directions at each of three levels: top, center, and bottom.

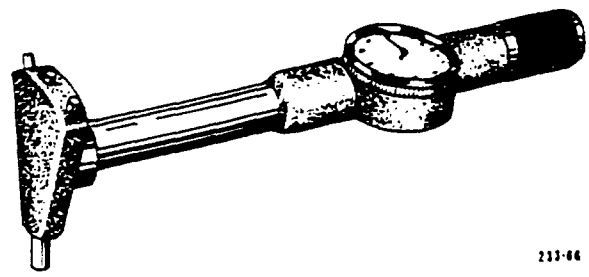


Figure 9. Cylinder Sleeve Bore Measuring Tool

Check the sleeve height above the cylinder block deck. Use gage Sweeney 6020. See Figure 10.

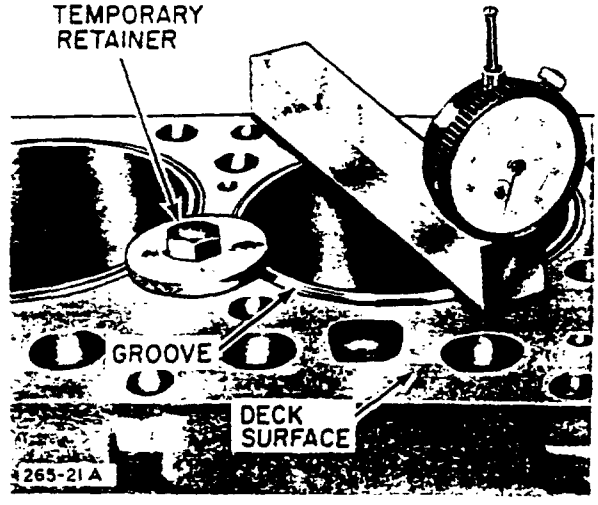


Figure 10. Checking Sleeve Height Above Block Deck

Honing

If sleeve bore when in place does not exceed out-of-round and taper limit, clean up I.D. with a suitable hone, 150 to 220 grit, to produce a diamond criss-cross pattern surface finish of 25 to 40 micro-inch rms.

Wash liner bore with a solution of household laundry detergent and air blow dry. Wipe liner bore with a clean oil soaked cloth.

Sleeve Rebore

If sleeve exceeds out-of-round and taper limit, the sleeve may be resized using boring bar equipment to receive the next applicable oversize piston. After re-sizing, hone 150 to 220 grit to produce a diamond criss-cross pattern surface finish of 25 to 40 micro-inch rms.

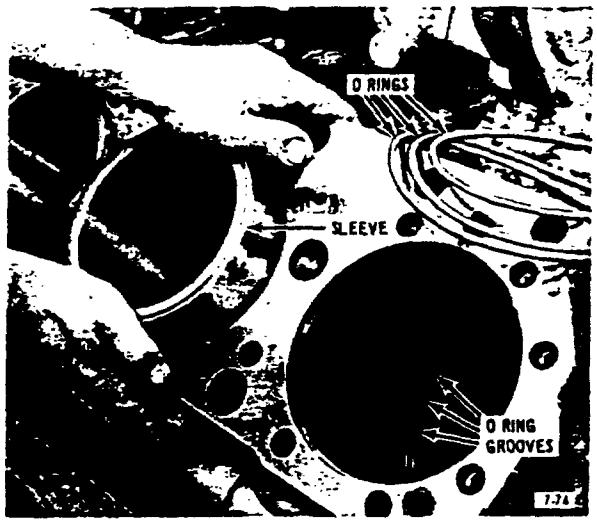


Figure 13. Installing Cylinder Sleeve

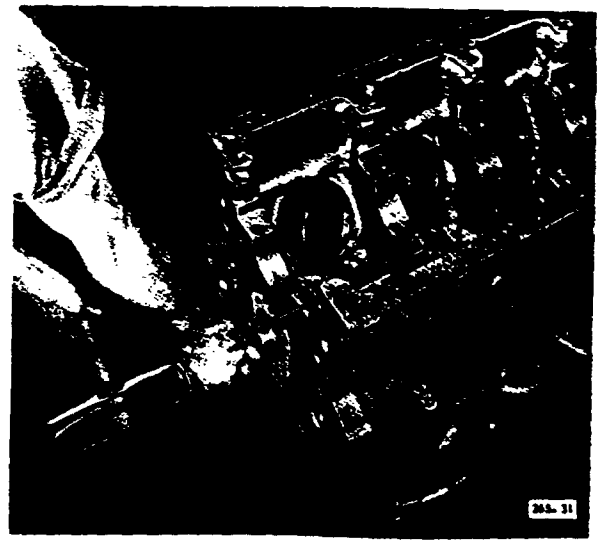


Figure 14. Installing Camshaft Bushing

CAUTION

If for any reason the sleeve is backed out even as little as 1/8 inch, it may roll the top seal over the relief edge damaging the seal. Remove sleeve and replace seals.

8. Secure cylinder sleeve in pairs using keeper washer and capscrew at center cylinder head capscrew hole until pistons, rings and cylinder heads are installed.

Camshaft Bushings

There are two camshaft bushing widths. The front camshaft bushing is the wider bushing; the remaining bushings are of a narrower width. All bushings are located at set distances measured from the forward machined surface of the camshaft thrust washer recess to the forward edge of subsequent bushings. Use special tool kit J-21428 to install or remove bushings. Coat outer surface of the bushings with engine oil before installation. The oil supply hole in the bushing should be located to the right as viewed from above and standing to the rear of the engine. The camshaft bushing interlocking split should be installed upward. See Figure 14.

NOTE

The rear camshaft bushing can be removed, using special tool J-21385, without removing the flywheel housing.

Expand the front oil gallery plug to offer resistance upon entering bore. The front oil gallery plug is further secured by installing the camshaft thrust washer which partially covers the plug. Nylock countersunk Allenhead capscrews are used to secure the thrust washer in place. It is imperative that the mating surfaces be clean and new Nylock screws are used. See Figure 15.

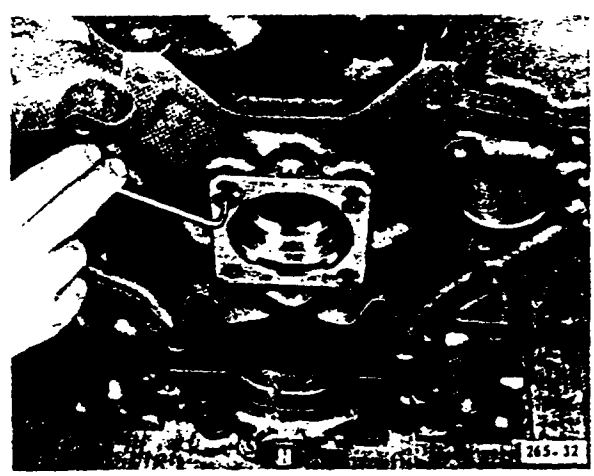


Figure 15. Installing Camshaft Thrust Washer

Apply a coat of Permatex to the rear oil gallery plug and gasket and install in rear oil gallery. See Figure 16.

5. Press gear and shaft assembly into bearing until it bottoms on shoulder on shaft.

6. Invert housing and gear and install spacer.

7. Install rear bearing with seal side outward in housing.

8. Clamp assembly in a suitable clamping fixture to hold gear and install water pump drive shaft screw. Tighten to recommended torque.

9. Install O-ring in the groove on outer periphery of the housing.

10. Lubricate O-ring seal generously and install drive assembly in cylinder block recess with flat side of housing toward camshaft gear.

NOTE

It is important to generously lubricate O-ring seal before installing in block. This will prevent the O-ring from rolling on upper surface and restricting oil supply to the water pump bearings.

11. Install three water pump housing capscrews securing assembly in position. Tighten to recommended torque.

TIMING GEAR COVER

Inspection

Inspect timing gear cover for dents, condition of threaded holes and straightness of flanges.

Installation

1. Install crankshaft front oil seal into the cover using tool J-21375.

2. Install the adjustable camshaft thrust button from the inside and position the washer and jam nut on the outside of the cover.

3. Adjust camshaft thrust button to its retracted position.

4. Install six guide studs. Two guide studs are used at the lowest point, highest point and one adjacent to the water pump drive and the final stud adjacent to the drive provision directly opposite the water pump drive.

5. Install the timing gear gasket over guide studs.

6. Install the timing gear cover over the guide studs and push cover into position.

7. Install all cover capscrews loosely.

8. Install water pump drive alignment tool J-21382 and crankshaft oil seal alignment tool J-21381. Torque all capscrews.

CRANKSHAFT VIBRATION DAMPER AND HUB

Inspection

1. Inspect crankshaft vibration damper hub for scoring, condition of flange, threaded holes and keyway.

2. Inspect the vibration damper for general condition, mounting threaded holes and housing.

Installation

1. Position crankshaft keyway UP and install key.

2. Heat crankshaft vibration damper hub in hot oil to 250 degrees F.

3. Align crankshaft hub on key and install hub. See Figure 45.

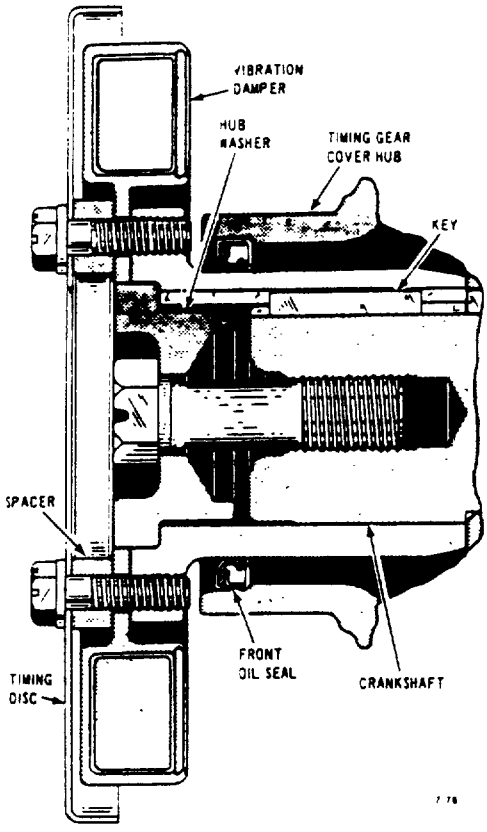


Figure 45. Vibration Damper and Hub Arrangement

4. Install hub washer and retaining screws. Torque screws.

5. Install vibration damper, spacer and timing disc on crankshaft hub; the holes will only line up one way.

6. Install retaining capscrews securing assembly.

NOTE

When all parts are assembled on the crankshaft, keyway up, the scribe mark on the damper rim must be up. The TDC mark must align with the timing indicator 30 degrees to the left of the engine centerline.

OIL PAN

Inspection

1. Inspect oil pan for dents, cracks and condition of flange.

2. Inspect and check the bolt holes for elongation and baffle for security.

3. Inspect and check drain hole for condition of threads.

Installation

1. Position gasket on oil pan and position oil pan on cylinder block.

2. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

AUXILIARY DRIVE ASSEMBLY

Description

The auxiliary drive is a complete unit sub-assembly located between the cylinder heads on the front of the engine. The auxiliary drive consists of a drive housing, idler shaft and gear assembly and drive shaft. It is gear driven from the camshaft. See Figure 46.

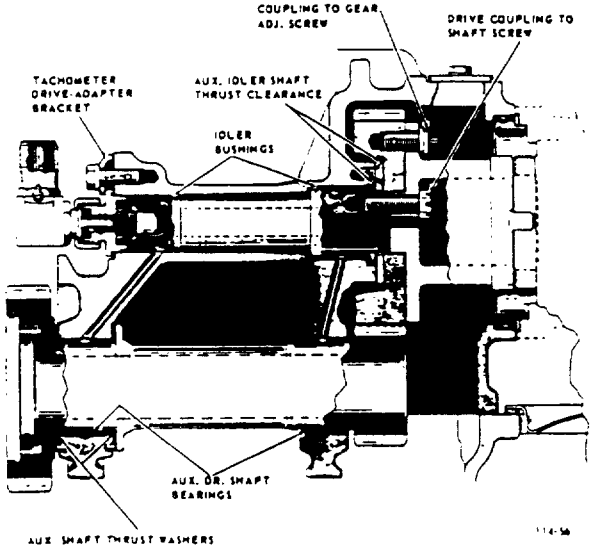


Figure 46. Auxiliary Drive Assembly

DRIVE HOUSING

Description

The auxiliary drive housing is an alloy casting and supports the drives for the injection pump, air compressor, tachometer drive and hydraulic steering pump.

Installation

1. Time auxiliary drive to camshaft gear. Install both push rods in No. 6 cylinder location. Bar engine over until movement is felt in both push rods simultaneously and the timing indicator pointer indicates TDC for No. 1 and 6 cylinders. The single punch mark on the camshaft gear will be in the upright position.

2. Install O-ring in oil passage port at right hand front top edge of cylinder block.

3. Apply a bead of 243SX32 gasket compound or equivalent to mating surfaces of the auxiliary drive housing.

4. Place auxiliary housing assembly on top of the block carefully.

NOTE

Be sure timing gear cover gasket is properly positioned and the single timing mark on the camshaft gear alignes with the single timing mark on the auxiliary drive gear.

5. Install all nine capscrews and washers hand tight.

6. Torque the two lower timing gear cover to auxiliary housing capscrews.

7. Torque all auxiliary housing to cylinder block capscrews.

8. Release the torque on the two timing gear cover to auxiliary housing capscrews then retorque the same capscrews.

NOTE

This procedure will align auxiliary housing to front face of the cylinder block and permit block surface to butt fully to mating surface of auxiliary housing.

9. Check backlash between camshaft gear and auxiliary drive gear. If backlash is not within limits, loosen auxiliary housing capscrews and reposition housing by tapping with a soft faced mallet. Retorque capscrews and recheck backlash.

NOTE

Care must be taken at this time to have all pipe plugs in the auxiliary drive oil gallery passages. Access to these plugs becomes increasingly difficult at later assembly points.

VALVE LIFTER COVERS

The center valve lifter cover is a steel stamping and requires a new gasket at assembly. The rear valve lifter cover is cast aluminum. At assembly apply a bead of gasket compound 243SX32 to the cover and cylinder block mating area.

INJECTION PUMP

Installation

1. Bar engine over in the normal direction of rotation until the No. 1 cylinder piston is at TDC, as indicated by the timing indicator, and the timing marks on the auxiliary drive shaft gear aligns with the timing mark on the auxiliary drive idler. The pin hole location will be at the five o'clock position and the coupling tangs are at 12 degrees 36 minutes off the horizontal. See Figure 48.

2. Bar engine back approximately 40 degrees.

3. Bar engine over in the normal direction of rotation until timing indicator reads the B.T.C. setting as specified on the injection pump name plate. In this position the tangs on the drive coupling will be approximately horizontal and the drive coupling pin hole will be approximately at the 4:30 o'clock position. The gear marks will be approximately 15 degrees 30 minutes to the right. See Figure 50.

CYLINDER HEAD INSTALLATION

NOTE

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

1. Clean the cylinder block deck thoroughly.

2. Install new cylinder head gasket on deck. Position of gasket is determined by guide pins in the upper deck.

NOTE

Do not use a sealing compound or soak cylinder head gaskets. They are all pre-coated.

3. Install new fire ring carefully fitted over circular bead on cylinder sleeve flange. See Figure 55.

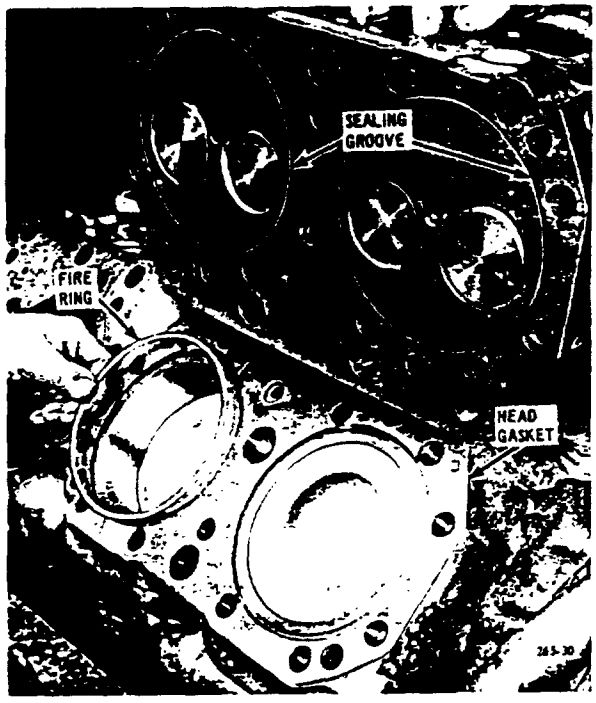


Figure 55. Cylinder Head Installation

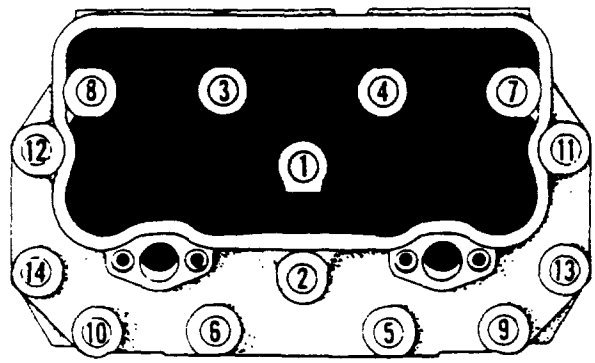
4. Clean the surface of the cylinder head and ciruclar groove for the fire ring.

5. Carefully position the cylinder head assembly over the cylinder block deck aligning the guide pins in the block with the guide holes in cylinder head.

6. Install cylinder head on block.

7. Install fourteen cylinder head capscrews.

8. Torque capscrews on each head progressively in steps of 50 to 100 to 175, and finally to 225 lb. ft. in sequence as shown. See Figure 56.



Cylinder Head Nut Tightening Sequence
ENDT865

Figure 56. Cylinder Head Tightening Sequence

PUSH RODS

Description

The push rods for the intake and exhaust valve rocker arms are tubular steel with spherical ends. Engines not fitted with the Dynatard engine brake feature identical 1/2 inch O.D. x 14-1/4 inch push rods; however, when the engine is fitted with the Dynatard engine brake system the exhaust valve rocker arm push rod is heavier 5/8 inch O.D. x 14-1/4 inch long.

Inspection

1. Inspect and check the push rods for length and straightness. Replace any that are bent.

2. Inspect and check the spherical surfaces for wear and tightness to tube.

Installation

Apply a light coat of lubricating oil to the spherical ends and install the push rods in the valve lifters.

4. Continue adjusting valve lash for the remaining cylinder pistons in firing order placing each cylinder piston at TDC with respective 1/4 turns of the engine crankshaft.

5. Properly secure aduusting screw locknut after each cylinder piston valve lash adjustment.

To Adjust Valve Lash Hot Idle (Not Recommended for Engines with the Dynatard Engine Brake System)

1. Start engine and warm up to normal operating temperature.

2. Set valve lash at hot idle (600 to 650 rpm) inlet valve 0.015 inch, exhaust 0.024 inch.

3. Properly secure adjusting screw lock nut after each cylinder piston valve lash adjustment.

WATER OUTLET MANIFOLD

Inspection

1. Inspect water outlet manifold for restrictions.

2. Inspect and check mounting flanges for cracks and straightness.

Installation

1. Place new gasket between right bank and left bank water manifold and the mating cylinder heads.

2. Install and tighten attaching capscrews to the proper torque.

3. Install thermostats in the right and left bank water manifolds.

4. Install thermostat gaskets, water outlet fittings, thermostat seals and water outlet by-pass elbows.

5. Secure assembly to the water manifold by installing the attaching capscrews.

INLET MANIFOLD

Inspection

1. Inspect and check the inlet manifolds for restrictions.

2. Inspect and check mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between the inlet manifold and cylinder head.

2. Install right and left hand inlet manifolds and lifting eyes. Secure to cylinder head by installing attaching capscrews and tighten to the recommended torque.

3. Place a new inlet manifold fitting gasket on the top of each inlet manifold and install inlet manifold inlet fitting.

4. Install tee fitting and complete inlet manifold assembly.

EXHAUST MANIFOLD

Inspection

1. Inspect and check the exhaust manifold for restrictions.

2. Inspect and check the mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between exhaust manifold and cylinder head.

2. Install and tighten the attaching capscrews and washers to the proper torque.

CYLINDER HEAD COVERS

Inspection

1. Inspect and check the cylinder head covers for cleanliness, dents and straightness of flange.

2. Inspect and check breather in cover, if applicable, to be sure it is not plugged.

Installation

1. Cement a new gasket to the mounting flange of the cylinder head cover.

2. Position the cylinder head cover over rocker arms.

3. Install and torque cover retaining capscrews.

TURBOCHARGER

Description

The turbocharger is an exhaust gas driven air compressor. See Figure 59. The purpose of the turbocharger is to increase the supply of air to the cylinders and thus burn more fuel which in turn produces more power.

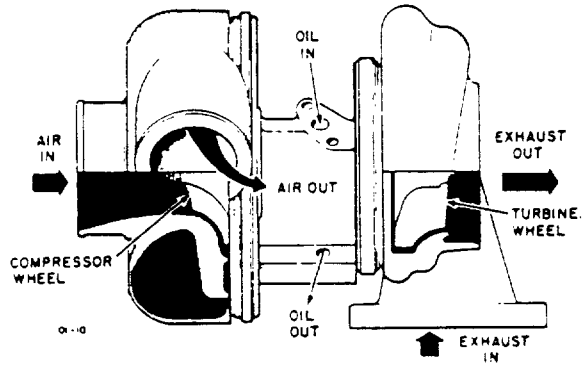


Figure 59. Exhaust Driven Turbocharger

The turbocharger consists of three main parts; the turbine housing, the bearing housing and the compressor housing. The turbine housing is located at one end of the bearing housing and the compressor housing is located at the other end. A common shaft connects the turbine wheel and compressor wheel.

The turbine end of the turbocharger uses exhaust gas energy normally discharged to the atmosphere. The exhaust gas enters the turbocharger through the flange connection on the exhaust manifold. The exhaust gas flows around the turbine housing and radially inward causing the turbine wheel to rotate. The exhaust gas is then discharged through the center of the turbine housing into the exhaust pipe.

The bearing housing contains the through-shaft, bearings, seals, and oil passages.

The bearings are of the floating sleeve type and are pressure lubricated from the engine oil supply system. Piston ring type oil seals are used at each end of the shaft to effectively seal off the oil.

The compressor housing contains the compressor wheel and air enters at the center of the compressor wheel and flows radially outward intothe compressor wheel and flows radially outward into the compressor housing. The air leaves through a tangential outlet on the outside of the compressor housing and is ducted to the inlet manifold.

Checks Before Removal

If turbocharger malfunction is suspected, make the following checks before removal of turbocharger from the engine.

1. Start engine and check for unusual noise or vibration from turbocharger. This will idicate out-of-balance, rubbing or damage to compressor or turbine wheels.

2. Check for leaks in the air system from turbocharger to intake manifold and from intake manifold to cylinder block. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

3. Check air cleaner and air intake system, from the air cleaner to turbocharger, for restrictions to air flow or leaks.

4. Check exhaust system from cylinder block to turbocharger for exhaust leaks. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

5. Check exhaust system from turbocharger to outlet for restrictions.

6. Check turbine wheel for radial and axial looseness. If radial and/or axial looseness is excessive, the turbocharger will have to be removed for overhaul. If turbocharger has to be overhauled, consult your Mack Branch or Distributor for details on turbocharger exchange program.

Cleaning

The compressor end of the turbocharger should be cleaned after 1000 to 2000 hours of operation. If the compressor wheel is not too dirty, it can be cleaned with the turbocharger on the engine.

Disconnect compressor discharge flange; remove the capscrews or clamp ring that holds the compressor housing to the bearing housing, and pull compressor housing carefully along turbocharger axis to prevent damage to the compressor wheel or the diffuser.

Use Bendix Metal Cleaner or equivalent solvent to clean compressor wheel. Do not use a caustic solution or any other type that may attack aluminum, as this will either weaken the impeller or destroy its balance. Do not use a wire brush or scraper; a brush with nylon or hog bristles is preferred.

If compressor wheel is found to be very dirty, remove turbocharger from the engine for cleaning. With compressor housing removed, immerse compressor wheel into the cleaning fluid and allow to soak. Use care not to rest weight of turbocharger on compressor wheel or on end of shaft.

The turbine end of turbocharger can be cleaned only after removal from the engine and separation of the bearing housing from the turbine housing.

Installation Guide

Use the following steps as a guide when installing turbocharger to engine.

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for foreign material.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure. Be sure check valve is working properly and not restricted.

5. Inspect turbocharger mounting pad on exhaust manifold for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect oil inlet line and oil drain line to turbocharger.

8. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

9. Crank engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger.

10. Stop cranking engine and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

ENGINE BREAK-IN PROCEDURE AFTER OVERHAUL OR REBUILD

Comparative tests and careful review of engine break-in mehtods have proven that a short run under full load is substantially more effective than the light or no load slow speed increase type of break-in. Compatibility between the critical components (piston, rings and bores) is greatly improved by raising engine speed and applying full load immediately after warm-up.

Use the recommended type and grade engine oil and fuel as required for usual operation of the vehicle.

Immediately prior to initial starting of the engine, the fuel system, oil galleries and filters are to be primed preferably by means of a pressure tank.

Check the air intake system to be sure all joints are tight and the filter element and system are clean.

Provisions have been made on both sides of the case to install buttress screws which fit into the main bearing cap. The buttress screws are used on both sides of all main bearing caps. They must be removed in order to remove the main bearing caps.

Block Preparation

1. Check the cylinder block deck surface for warpage. If warpage is excessive be sure that the maximum amount of material removal limit is not exceeded.

CAUTION

The piston travel above the cylinder block deck is critical and must be checked during assembly to insure proper clearance of piston with cylinder head and valve.

2. Remove all core plugs and fittings from the cylinder block and remove any accumulation of rust and sludges.

3. Check block for cracks, the condition of threaded holes and the straightness of the mating flanges.

4. Thoroughly inspect the upper edge of the cylinder sleeve counterbore in the block for signs of pitting or errosion. Rework as required. Shims are available to obtain correct sleeve height at reassembly.

5. Blow all passages thoroughly with compressed air.

6. Coat new O-ring with sealant, place on core plugs and install plugs in block.

7. Install all oil gallery plugs and gaskets using Permatex sealant or equivalent to insure positive sealing.

Cylinder Sleeve

The cylinder sleeves are wet type, centrifugal cast iron and are available in standard size. A bead is provided around top of seating flange for using a fire ring type cylinder head gasket. Clean sleeve flanges using a brass wire rotary brush to be sure of effective fire ring sealing. Check cylinder sleeve for out-of-round and taper. Use tool J5347-01 and measure each sleeve I.D. See Figure 9. Take readings in two directions at each of three levels: top, center, and bottom.

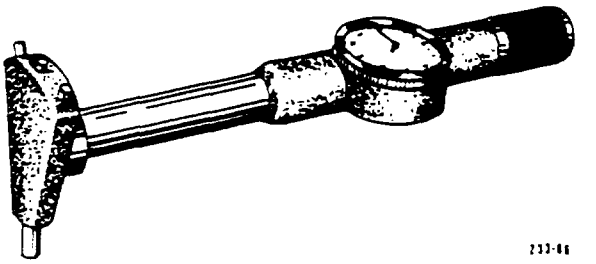


Figure 9. Cylinder Sleeve Bore Measuring Tool

Check the sleeve height above the cylinder block deck. Use gage Sweeney 6020. See Figure 10.

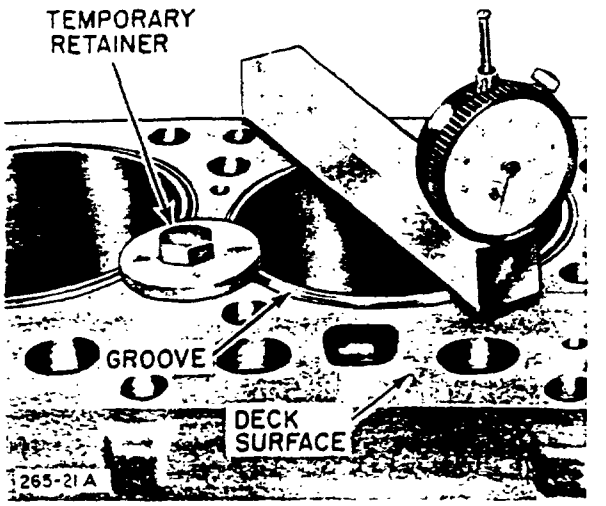


Figure 10. Checking Sleeve Height Above Block Deck

Honing

If sleeve bore when in place does not exceed out-of-round and taper limit, clean up I.D. with a suitable hone, 150 to 220 grit, to produce a diamond criss-cross pattern surface finish of 25 to 40 micro-inch rms.

Wash sleeve bore with a solution of laundry detergent and air blow dry. Wipe sleeve bore with a clean oil soaked cloth.

Sleeve Rebore

If sleeve exceeds out-of-round and taper limit, the sleeve may be resized using boring bar equipment to receive the next applicable oversize piston. After re-sizing, hone 150 to 220 grit to produce a diamond criss-cross pattern surface finish of 25 to 40 micro-inch rms.

5. Press gear and shaft assembly into bearing until it bottoms on shoulder on shaft.

6. Invert housing and gear and install spacer.

7. Install rear bearing with seal side outward in housing.

8. Clamp assembly in a suitable clamping fixture to hold gear and install water pump drive shaft screw. Tighten to recommended torque.

9. Install O-ring in the groove on outer periphery of the housing.

10. Lubricate O-ring seal generously and install drive assembly in cylinder block recess with flat side of housing toward camshaft gear.

NOTE

It is important to generously lubricate O-ring seal before installing in block. This will prevent the O-ring from rolling on upper surface and restricting oil supply to the water pump bearings.

11. Install three water pump housing capscrews securing assembly in position. Tighten to recommended torque.

TIMING GEAR COVER

Inspection

Inspect timing gear cover for dents, condition of threaded holes and straightness of flanges.

Installation

1. Install crankshaft front oil seal into the cover using tool J-21375.

2. Install the adjustable camshaft thrust button from the inside and position the washer and jam nut on the outside of the cover.

3. Adjust camshaft thrust button to its retracted position.

4. Install six guide studs. Two guide studs are used at the lowest point, highest point and one adjacent to the water pump drive and the final stud adjacent to the drive provision directly opposite the water pump drive.

5. Install the timing gear gasket over guide studs.

6. Install the timing gear cover over the guide studs and push cover into position.

7. Install all cover capscrews loosely.

8. Install water pump drive alignment tool J-21382 and crankshaft oil seal alignment tool J-21381. Torque all capscrews.

CRANKSHAFT VIBRATION DAMPER AND HUB

Inspection

1. Inspect crankshaft vibration damper hub for scoring, condition of flange, threaded holes and keyway.

2. Inspect the vibration damper for general condition, mounting threaded holes and housing.

Installation

1. Position crankshaft keyway UP and install key.

2. Heat crankshaft vibration damper hub in hot oil to 250 degrees F.

3. Align crankshaft hub on key and install hub. See Figure 45.

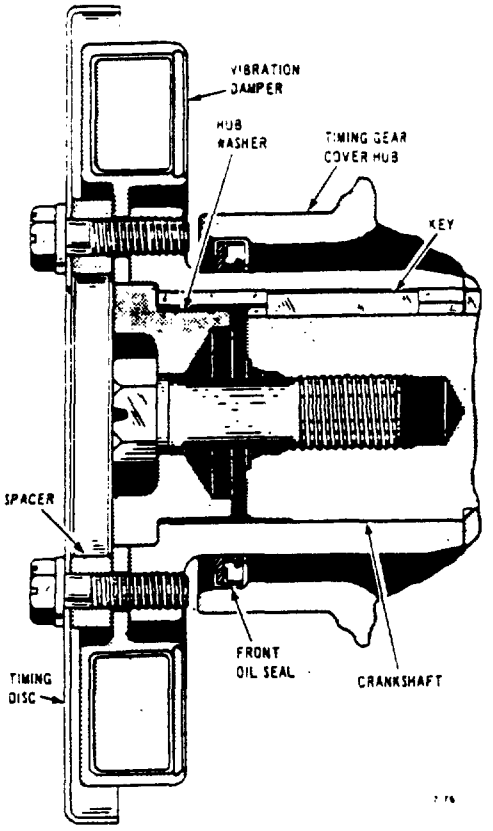


Figure 45. Vibration Damper and Hub Arrangement

4. Install hub washer and retaining screws. Torque screws.

5. Install vibration damper, spacer and timing disc on crankshaft hub; the holes will only line up one way.

6. Install retaining capscrews securing assembly.

NOTE

When all parts are assembled on the crankshaft, keyway up, the scribe mark on the damper rim must be up. The TDC mark must align with the timing indicator 30 degrees to the left of the engine centerline.

OIL PAN

Inspection

1. Inspect oil pan for dents, cracks and condition of flange.

2. Inspect and check the bolt holes for elongation and baffle for security.

3. Inspect and check drain hole for condition of threads.

Installation

1. Position gasket on oil pan and position oil pan on cylinder block.

2. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

AUXILIARY DRIVE ASSEMBLY

Description

The auxiliary drive is a complete unit sub-assembly located between the cylinder heads on the front of the engine. The auxiliary drive consists of a drive housing, idler shaft and gear assembly and drive shaft. It is gear driven from the camshaft. See Figure 46.

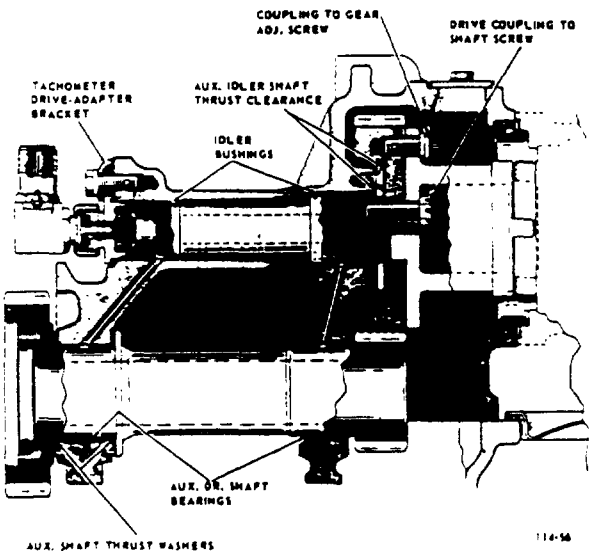


Figure 46. Auxiliary Drive Assembly

DRIVE HOUSING

Description

The auxiliary drive housing is an alloy casting and supports the drives for the injection pump, air compressor, tachometer drive and hydraulic steering pump.

CYLINDER HEAD INSTALLATION

NOTE

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

1. Clean the cylinder block deck thoroughly.

2. Install new cylinder head gasket on deck. Position of gasket is determined by guide pins in the upper deck.

NOTE

Do not use a sealing compound or soak cylinder head gaskets. They are all pre-coated.

3. Install new fire ring carefully fitted over circular bead on cylinder sleeve flange. See Figure 55.

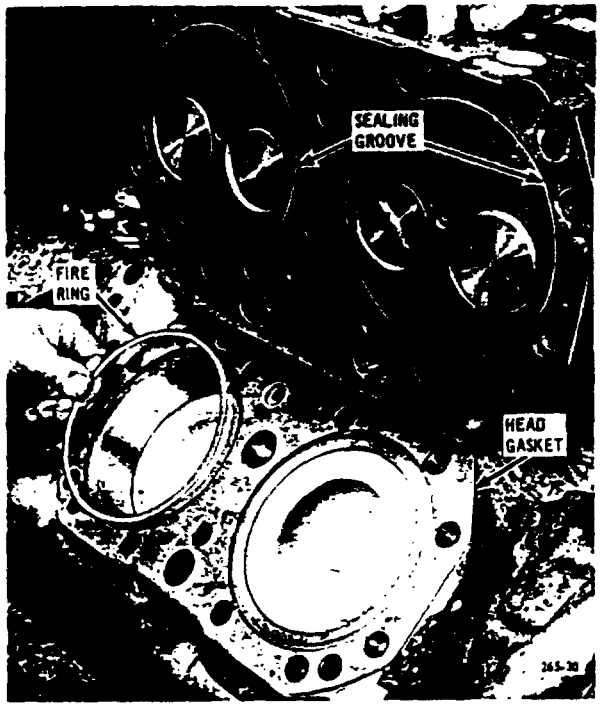


Figure 55. Cylinder Head Installation

4. Clean the surface of the cylinder head and ciruclar groove for the fire ring.

5. Carefully position the cylinder head assembly over the cylinder block deck aligning the guide pins in the block with the guide holes in cylinder head.

6. Install cylinder head on block.

7. Install fourteen cylinder head capscrews.

8. Torque capscrews on each head progressively in steps of 50 to 100 to 175, and finally to 225 lb. ft. in sequence as shown. See Figure 56.

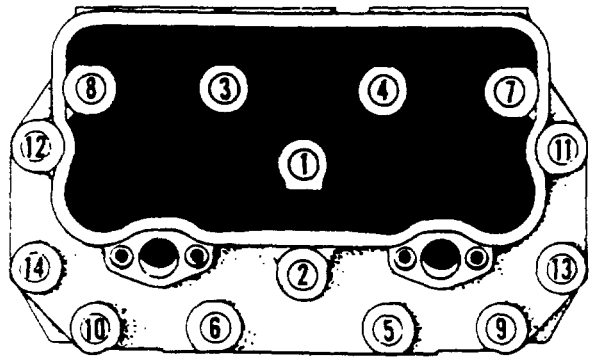


Figure 56. Cylinder Head Tightening Sequence

PUSH RODS

Description

The push rods for the intake and exhaust valve rocker arms are tubular steel with spherical ends. Engines not fitted with the Dynatard engine brake feature identical 1/2 inch O.D. x 14-1/4 inch push rods; however, when the engine is fitted with the Dynatard engine brake system the exhaust valve rocker arm push rod is heavier 5/8 inch O.D. x 14-1/4 inch long.

Inspection

1. Inspect and check the push rods for length and straightness. Replace any that are bent.

2. Inspect and check the spherical surfaces for wear and tightness to tube.

Installation

Apply a light coat of lubricating oil to the spherical ends and install the push rods in the valve lifters.

4. Continue adjusting valve lash for the remaining cylinder pistons in firing order placing each cylinder piston at TDC with respective 1/4 turns of the engine crankshaft.

5. Properly secure aduusting screw locknut after each cylinder piston valve lash adjustment.

To Adjust Valve Lash Hot Idle (Not Recommended for Engines with the Dynatard Engine Brake System)

1. Start engine and warm up to normal operating temperature.

2. Set valve lash at hot idle (600 to 650 rpm) inlet valve 0.015 inch, exhaust 0.024 inch.

3. Properly secure adjusting screw lock nut after each cylinder piston valve lash adjustment.

WATER OUTLET MANIFOLD

Inspection

1. Inspect water outlet manifold for restrictions.

2. Inspect and check mounting flanges for cracks and straightness.

Installation

1. Place new gasket between right bank and left bank water manifold and the mating cylinder heads.

2. Install and tighten attaching capscrews to the proper torque.

3. Install thermostats in the right and left bank water manifolds.

4. Install thermostat gaskets, water outlet fittings, thermostat seals and water outlet by-pass elbows.

5. Secure assembly to the water manifold by installing the attaching capscrews.

INLET MANIFOLD

Inspection

1. Inspect and check the inlet manifolds for restrictions.

2. Inspect and check mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between the inlet manifold and cylinder head.

2. Install right and left hand inlet manifolds and lifting eyes. Secure to cylinder head by installing attaching capscrews and tighten to the recommended torque.

3. Place a new inlet manifold fitting gasket on the top of each inlet manifold and install inlet manifold inlet fitting.

4. Install tee fitting and complete inlet manifold assembly.

EXHAUST MANIFOLD

Inspection

1. Inspect and check the exhaust manifold for restrictions.

2. Inspect and check the mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between exhaust manifold and cylinder head.

2. Install and tighten the attaching capscrews and washers to the proper torque.

CYLINDER HEAD COVERS

Inspection

1. Inspect and check the cylinder head covers for cleanliness, dents and straightness of flange.

2. Inspect and check breather in cover, if applicable, to be sure it is not plugged.

Installation

1. Cement a new gasket to the mounting flange of the cylinder head cover.

2. Position the cylinder head cover over rocker arms.

3. Install and torque cover retaining capscrews.

TURBOCHARGER

Description

The turbocharger is an exhaust gas driven air compressor. See Figure 59. The purpose of the turbocharger is to increase the supply of air to the cylinders and thus burn more fuel which in turn produces more power.

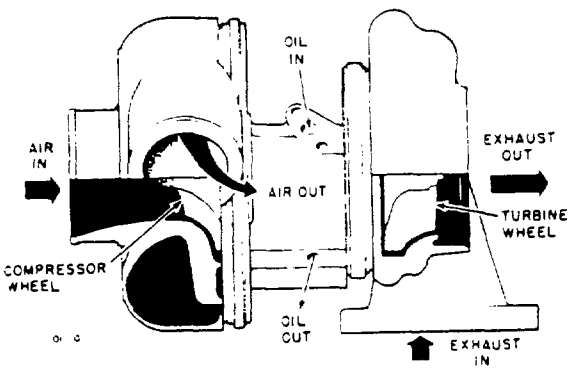


Figure 59. Exhaust Driven Turbocharger

The turbocharger consists of three main parts; the turbine housing, the bearing housing and the compressor housing. The turbine housing is located at one end of the bearing housing and the compressor housing is located at the other end. A common shaft connects the turbine wheel and compressor wheel.

The turbine end of the turbocharger uses exhaust gas energy normally discharged to the atmosphere. The exhaust gas enters the turbocharger through the flange connection on the exhaust manifold. The exhaust gas flows around the turbine housing and radially inward causing the turbine wheel to rotate. The exhaust gas is then discharged through the center of the turbine housing into the exhaust pipe.

The bearing housing contains the through-shaft, bearings, seals, and oil passages.

The bearings are of the floating sleeve type and are pressure lubricated from the engine oil supply system. Piston ring type oil seals are used at each end of the shaft to effectively seal off the oil.

The compressor housing contains the compressor wheel and air enters at the center of the compressor wheel and flows radially outward intothe compressor wheel and flows radially outward into the compressor housing. The air leaves through a tangential outlet on the outside of the compressor housing and is ducted to the inlet manifold.

Checks Before Removal

If turbocharger malfunction is suspected, make the following checks before removal of turbocharger from the engine.

1. Start engine and check for unusual noise or vibration from turbocharger. This will idicate out-of-balance, rubbing or damage to compressor or turbine wheels.

2. Check for leaks in the air system from turbocharger to intake manifold and from intake manifold to cylinder block. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

3. Check air cleaner and air intake system, from the air cleaner to turbocharger, for restrictions to air flow or leaks.

4. Check exhaust system from cylinder block to turbocharger for exhaust leaks. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

5. Check exhaust system from turbocharger to outlet for restrictions.

6. Check turbine wheel for radial and axial looseness. If radial and/or axial looseness is excessive, the turbocharger will have to be removed for overhaul. If turbocharger has to be overhauled, consult your Mack Branch or Distributor for details on turbocharger exchange program.

Cleaning

The compressor end of the turbocharger should be cleaned after 1000 to 2000 hours of operation. If the compressor wheel is not too dirty, it can be cleaned with the turbocharger on the engine.

Disconnect compressor discharge flange; remove the capscrews or clamp ring that holds the compressor housing to the bearing housing, and pull compressor housing carefully along turbocharger axis to prevent damage to the compressor wheel or the diffuser.

Use Bendix Metal Cleaner or equivalent solvent to clean compressor wheel. Do not use a caustic solution or any other type that may attack aluminum, as this will either weaken the impeller or destroy its balance. Do not use a wire brush or scraper; a brush with nylon or hog bristles is preferred.

If compressor wheel is found to be very dirty, remove turbocharger from the engine for cleaning. With compressor housing removed, immerse compressor wheel into the cleaning fluid and allow to soak. Use care not to rest weight of turbocharger on compressor wheel or on end of shaft.

The turbine end of turbocharger can be cleaned only after removal from the engine and separation of the bearing housing from the turbine housing.

Installation Guide

Use the following steps as a guide when installing turbocharger to engine.

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for foreign material.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure. Be sure check valve is working properly and not restricted.

5. Inspect turbocharger mounting pad on exhaust manifold for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect oil inlet line and oil drain line to turbocharger.

8. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

9. Crank engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger.

10. Stop cranking engine and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

ENGINE BREAK-IN PROCEDURE AFTER OVERHAUL OR REBUILD

Comparative tests and careful review of engine break-in mehtods have proven that a short run under full load is substantially more effective than the light or no load slow speed increase type of break-in. Compatibility between the critical components (piston, rings and bores) is greatly improved by raising engine speed and applying full load immediately after warm-up.

Use the recommended type and grade engine oil and fuel as required for usual operation of the vehicle.

Immediately prior to initial starting of the engine, the fuel system, oil galleries and filters are to be primed preferably by means of a pressure tank.

Check the air intake system to be sure all joints are tight and the filter element and system are clean.

MACK

frame

cooling

front axle

steering

springs and suspension

wheels

brakes

electrical

cabs

HIGHWAY VEHICLE SERVICE MANUAL

MACK TRUCKS

MACK TRUCKS, INC.
one of The Signal Companies

TS442		10/67	10M
TS442	REV.	8/69	10M
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TS442	REP.	12/72	10M
TS442	REV.	8/75	10M
TS442	REV.	9/77	18M

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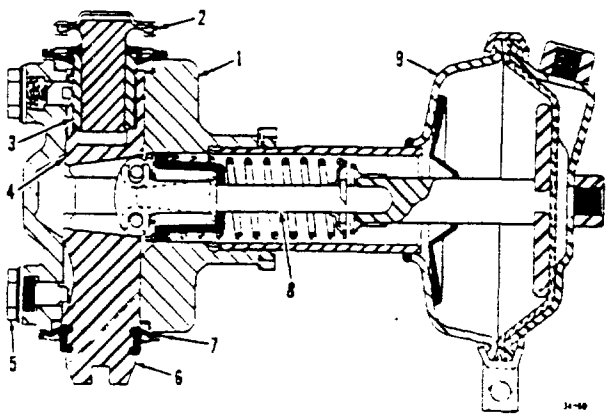
The system for actuating the wedge brake has an air chamber power unit threaded into the wedge bore of the plunger housing. Air applied to the diaphragm pushrod pushes the wedge rod against the plungers. See Figure 8-13.



1. Plunger Housing
2. Adjusting Bolt Assembly
3. Adjusting Sleeve (Actuator)
4. Adjusting Plunger
5. Guide Screw
6. Anchor Plunger (solid)
7. Plunger Seal and Retainer
8. Wedge Assembly
9. Brake Air Chamber Assembly

Figure 8-13. Wedge Actuation - Air Chamber

Disc Brakes

Front axles that incorporate disc brakes are of the sliding caliper, dual piston design. The dual pistons are actuated by hydraulic pressure which is multiplied through the use of an air over hydraulic fluid intensifier. Hydraulic pressure is increased over air pressure by a ratio of 17 to 1 or 23.5 to 1, depending on the model intensifier.

The master cylinder includes both air and hydraulic systems. They should be considered as separate systems, although operating together. Air pressure actuates a diaphragm in the master air chamber which actuates a plunger in the hydraulic master cylinder, creating pressure to the disc brake units. See Figures 8-14 and 8-15.

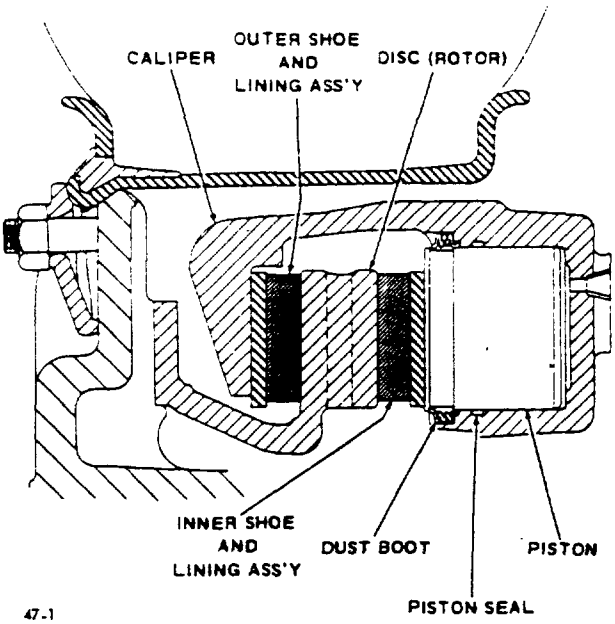


Figure 8-14. Disc Brake Assembly

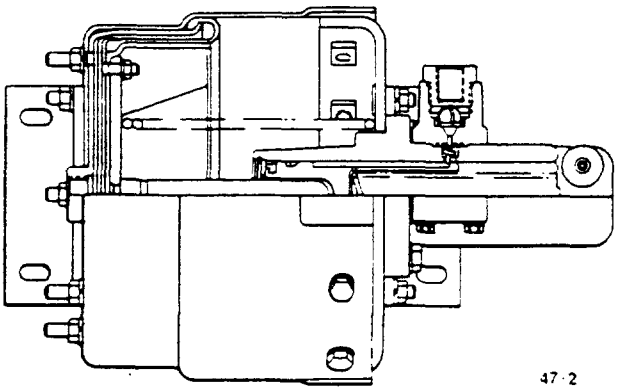


Figure 8-15. Air Hydraulic Intensifier

Adjustment

Cam Brakes

Initial adjustment on cam brakes is done by adjusting the slack adjusters, which can be either the manual or automatic type. Maintaining correct drum to lining clearance requires periodic readjustment of the manual slack adjusters, usually monthly or at approximately 8,000 miles. Under severe braking conditions, adjustments may be needed at more frequent intervals.

Accuracy of the wheel bearing adjustment cannot be overemphasized as it has a direct effect on brake performance. You cannot properly adjust a brake if the wheel bearing has not been correctly adjusted. It is therefore important that a torque wrench be used in the adjusting and that you adhere to the manufacturer's specification.

NOTE

Do not adjust brakes when drums are hot because the brakes will

drag when the drums cool - always adjust brakes when the drums are cool or at room temperature.

The routine of adjusting brakes to a drag and then relieving the drag should be supplemented with a feeler gauge check. This is the only true means of establishing what the actual clearances are at the three vital positions of cam, center and anchor on both shoes. When self-centering of the shoes in the drum is possible we should utilize this feature by applying the brakes a few times and rechecking the clearances. Be certain that the initial adjustment at time of reline affords extra lining to drum clearance because of lining swell. A clearance of .020 between lining and drum should be adhered to on a newly relined vehicle. After the break-in period .010 clearance would be the rule.

Actual brake to drum adjustment procedure is covered under Slack Adjuster section.

Wedge Brakes

Two types of adjustable plungers are in use - manual and automatic. The manually adjusted plunger has an adjusting bolt threaded into the plunger proper. The bolt head is scalloped to facilitate adjustment and carries a detent arrangement which engages the brake shoe web and prevents accidental rotation of the bolt.

Manual Adjustment Type

To adjust manual adjusters.

1. Jack or hoist wheels free of ground.

2. Remove dust cover from adjusting slot - two places on each brake. The adjusting slots are below the forward and above the rear power unit.

If star-wheel adjusting bolts are not found at these positions, the brake had been assembled on the wrong side of the vehicle.

3. Adjusting bolts have right hand threads. With an adjusting spoon, turn the star-wheel until a heavy drum drag is developed. Then back off the bolt to a very light drag on the drum. Repeat for other shoe on the brake. Replace dust covers in adjusting slots. Repeat for other brakes.

NOTE

Recommended adjusting spoons, are Snap-On-Blue-Point S-9523, Wizard 4-H-2530 and Proto 2006.

Automatic Adjustment Type

The automatic type maintains the correct lining-to-drum clearance. This is accomplished by the action of an adjusting bolt and sleeve fitted into a hollowed plunger body working with an adjusting pawl, a spring, and a retainer cap screw. The end of the pawl has saw-tooth teeth which engage similar teeth on the outside of the adjusting sleeve. See Figure 8-16.

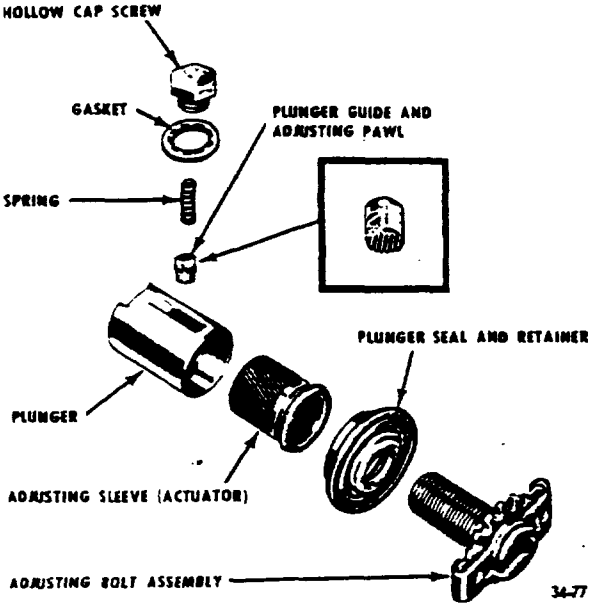


Figure 8-16. Automatic Adjustment Components

When the brake is actuated, the plunger, sleeve, and bolt are forced outward applying the brakes. The sloping teeth on the adjusting sleeve push the pawl back against the spring. At this point, the pawl teeth disengage from the sleeve teeth. If the brake shoes have traveled sixty thousandths of an inch (.060) or less to apply the brakes, all adjusting parts will return to their original position when the brake is released.

As the lining wears and shoe to drum clearance exceeds sixty thousandths of an inch (.060), the pawl climbs over and drops into the next tooth space on the sleeve. When the brake is released, the new tooth position causes the sleeve to rotate, advancing the adjuster bolt.

Current production models of the wedge brake incorporate a limited travel adjusting bolt to prevent over adjustment and possible sleeve damage. This is accomplished by using a snap ring retainer located around the bottom of the adjusting bolt. The snap ring acts as a stop against a shoulder in the adjusting sleeve.

Disc Brakes

No manual adjustment required. Brakes adjust automatically during braking operation. The square-cut piston seal is distorted when pressure is applied to piston. When braking pressure is released, the seal returns to its normal condition and pulls the piston away from the lining. This action, plus some slight rotor lateral runout ("wobble"), considerednormal, provides adequate running clearance.

Disassembly and Assembly

When brakes are relined or disassembled for other repairs, all parts should be inspected for wear and worn parts should be replaced as required.

Cam Brakes - (See Figure 8-10)

Disassembly

1. Remove shoe return spring.

2. Remove lock rings, retainers, and felts from brake shoe anchor pins.

3. Cut lock wire and remove anchor pin lock screws.

4. Remove anchor pins and shoe assemblies.

5. Remove brake shoe roller retaining clip (or screw) and remove roller.

6. Remove slack adjuster lock ring and spacing washers.

7. Remove camshaft, washer, and felt seal (if used).

8. Remove nylon bushings if replacement is necessary. Use suitable tool for both removal and installation of bushing. See Figure 8-17.

NOTE

On brakes where lip type seals are used, these will have to be removed and replaced if nylon bushings are replaced.

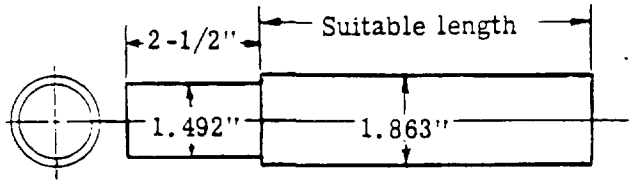


Figure 8-17. Bushing Removal and Installation Tool

Assembly

1. Install new nylon bushings, if required, using suitable tool. (Install new lip type seal if used.)

2. Install brake shoe rollers and retainers. Make certain rollers are of proper size. See instructions relative to brake shoe "Cam Roll-Over."

3. Install camshaft, washer, and felt seals. (if used.)

4. Position brake shoe assembly over spider and tap anchor pin into position with brass punch, "flat" in line with lock screw hole.

5. Install lock screws, tighten securely and thread with lockwire.

6. Position felts, retainers, and lock rings on anchor pins.

7. Install shoe return spring. New springs should be used with each brake reline. Tension loss occurs from normal use and heat build up. New springs will ensure that shoes are returned to fully relaxed position, and not in contact with drum, which would cause premature wear.

8. Assemble slack adjuster on splined end of camshaft; using spacers and washers on each side of adjuster to obtain .030-.060 end play.

Wedge Brakes - (See Figure 8-12)

Disassembly

1. Remove shoe return springs. Use brake spring pliers. (Do Not use screwdriver.)

2. Remove brake shoe assembly.

3. Remove plunger guide screws and gaskets from plunger housing. If brake is automatic adjusting, remove hollow capscrew, gaskets, spring and adjusting pawl. It may be necessary to use a magnet to remove the adjusting pawl.

4. Using a suitable screwdriver, pry the seals loose and remove anchor (solid) plungers, adjusting plungers, adjusting sleeves (actuators) and adjusting bolts.

5. Thoroughly inspect and clean all parts including the housing plunger and seal bores and shoe rest pads. DO NOT solvent clean any rubber parts (plunger seals or gaskets).

Wire brush plunger parts and adjusting bolt threads to remove caked on dirt and corrosion.

Carefully inspect plunger seals and gaskets for tears, cuts or deterioration, and replace if necessary. Also check the angled plunger roller faces for pits, grooves or nicks and replace if necessary.

NOTE

Brakes have one adjusting plunger and one anchor (solid) plunger per plunger housing. The anchor plungers are marked on the shoe slot end, "R" for right hand brakes and "L" for left hand brakes. DO NOT mix at reassembly.

Assembly - Anchor (Solid) Plunger

1. To assemble seals into plungers, apply a film of grease to inside surfaces of seals. See Figure 8-13.

2. Inspect nose for burrs. Mask brake shoe web slot in the plunger nose with masking tape to protect seal.

Carefully push the double lip seal onto the plunger, stretching the outer seal lip over the plunger nose end, until the inner seal lip is completely in the second plunger groove and the outer seal lip is in the first plunger groove. Remove masking tape. (Brakes employing single grooved plungers and single lip seals should be assembled in the same manner except masking tape is not used.)

IMPORTANT: DO NOT ASSEMBLE SEALS INTO PLUNGER HOUSING FIRST. THIS WILL RESULT IN COMPLETE LACK OF SEALING OF INTERNAL PLUNGER HOUSING COMPONENTS.

3. Coat all plunger bores with grease.

4. Make sure anchor plungers marked "L" are installed in left hand brake and anchor plungers marked "R" are installed in the right hand brake.

5. Coat entire anchor plunger with grease, packing cavity behind seal, and insert plunger and seal into housing with plunger keyway slot aligned with guide screw hole. Make certain the plunger goes all the way into the plunger bore and seats on bosses at the bottom.

6. Seat plunger seal in plunger housing with correct seal driver tool. Driver must be centered over seal retainer to prevent damage to seal assembly.

NOTE

If seal driver is not available, a 1-3/4" wrench socket can be used for spider mounted brakes and 1-3/8" wrench socket can be used for backing plate mounted brakes.

7. Assemble gasket and guide screw into plunger housing. Make certain guide screw end enters the plunger key-way slot so plunger can slide freely in housing bore. Tighten guide screws to 15-20 ft. lbs. torque.

CAUTION

Wedge and plunger assemblies are 12° or 14° angles. Also "Right" and "Left" plungers. Any inter-mixing of these parts will cause erratic and uneven braking.

Assembly (Manual Adjusting Plungers)

1. Apply film of grease to inside surfaces of seals.

2. Push the inner seal lip over the threaded hole end of the plunger until the lip completely enters the plunger seal groove.

3. Apply grease to outside of plunger and install plunger and seal into plunger housing in the same manner. Refer to Assembly-Anchor (solid) Plunger steps 5, 6 and 7.

4. Coat adjusting bolt threads with grease and turn bolt into the adjusting plunger by working it through the hole in the outer seal flap, being careful not to pinch the seal on the threads. Turn adjusting bolt in just short of the seal. DO NOT bottom bolt on the seal.

Assembly (Automatic Adjusting Plungers)

Two types of automatic adjusting plungers are being used. The latest designed parts are readily identified since the new plunger seal has only a single sealing lip instead of a double lip. The adjusting bolt of the latest design also has a retaining ring.

leading to the bottom of the container. The air then rises through the alcohol and passes into the line to the compressor, carrying alcohol in the form of vapor with it. The alcohol, thus introduced into the air system acts as an anti-freeze.

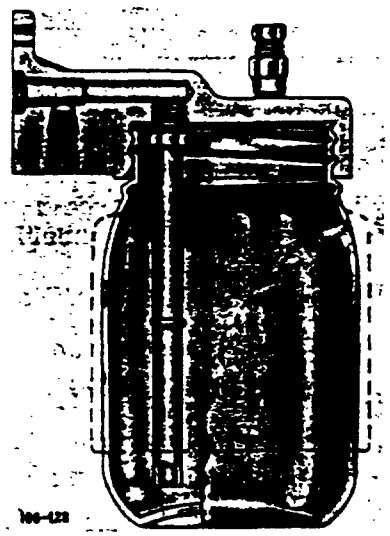


Figure 8-55. Alcohol Evaporator

Preventive Maintenance

Every 1,000 Miles or as Determined by Actual Usage

Check alcohol level and if necessary replenish with 188 proof methanol alcohol. In cold weather, alcohol level should be at least 2/3 full.

NOTE

If alcohol is not being consumed, it indicates the evaporator is inoperative and should be inspected.

Every 1,800 Operating Hours or 50,000 Miles

Remove strainer if present in bottom of evaporator body and clean thoroughly in solvent.

Every Year, 3,600 Operating Hours or 100,000 Miles

Disassembly evaporator unit and clean thoroughly. Inspect all parts for cracks and be sure evaporator tube is not clogged with dirt. Replace all gaskets and rubber parts.

Inspection

When the compressor is compressing air, air bubbles should be passing through the alcohol. If air bubbles are not present when the compressor is compressing air, then the alcohol evaporator is not functioning properly. Check to be sure all connections are tight. Check condition of filler cap gasket and cover gasket.

RELINING & RECONDITIONING

Drum-Type Brakes

After supporting the axle on stands, cage the springs in the spring brake chambers. Remove the tires, wheels, and drums as an assembly, and inspection drums for heat checks, cracks, distortion or other damage.

Close inspection of all worn brake parts may lead to clues for corrective action to improve lining life and future drum damage.

Scored Drum

Only the tops of the ridges will contact brake lining. Since a small percentage of the brake lining is required to do all the work, hard pedal and fade will result. A scored drum must be reconditioned in a lathe. See Figure 8-56.

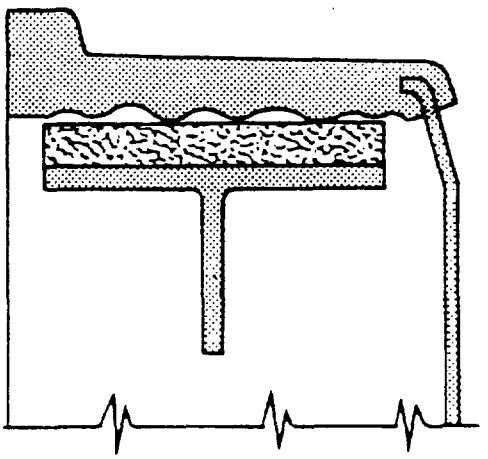


Figure 8-56. Scored Durm

Hard Spots

Hard spots are "islands" of steel in the cast iron surface. They result from a change in metallurgy caused by the heat of braking Hard spots must be ground out or brake performance will be poor and erratic. See Figure 8-57.

Bell-Mouthed Drum

If a drum is bell-mouthed or flared, full lining to drum contact cannot be achieved. Hard pedal, fade and noise can be expected. A bell-mouthed drum must be trued in a lathe in order to procure full lining to drum contact. See Figure 8-58.

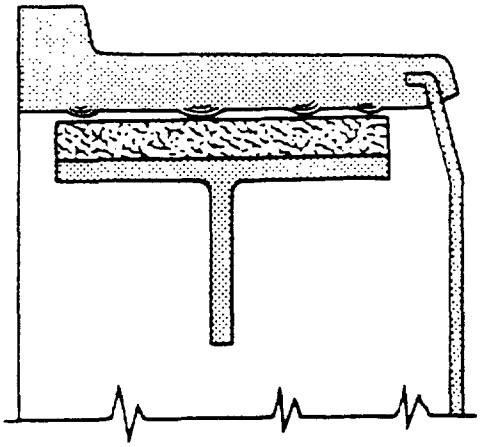


Figure 57. Hard Spots

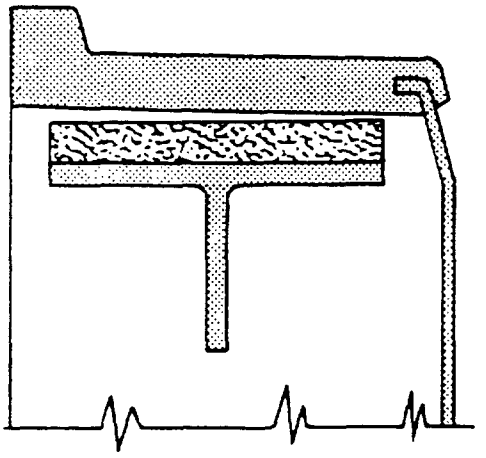


Figure 8-58. Bell Mouthed Drum.

Heat checking and discoloration, if only superficial, can be corrected by resurfacing the drum, otherwise replace drum.

Drums having more than .010" out of round, or any of the conditions described above should be resurfaced. Use only those drums which produce a satisfactory surface finish.

CAUTION

Drum manufacturer and state vehicle inspection laws (where applicable) govern the amount of drum diameter increase allowed when resurfacing. Most drums are stamped by manufacturers as to maximum oversize allowable.

Excessive removal of drum material could result in drum failure or unsatisfactory brake performance and is illegal in some states.

NOTE

When reconditioning brakes, it is important that the brake assemblies on each side of the same axle be serviced in exactly the same manner. This will avoid unequal braking performance. (Drums on the same axle should be resurfaced within .010 of each other.

Cam Roll-Over

Increasing the drum diameter will permit the cam to rotate beyond its maximum lift when the lining becomes worn. To prevent cam "Roll-Over," oversize roller cam followers are available.

Standard (1.250" O. D.)

Standard rollers are used when installing standard linings with standard drums, "X" lining (1/16 oversize) with 1/16 oversize drums, and "XX" lining (1/8 oversize) with 1/8 overside drums.

1/8" Oversize (1.375")

1/8" oversize rollers are to be used with the installation of standard linings with worn or trued drums which are 1/32" oversize. 1/8" oversize rollers should be installed and the liners circle ground a few thousandths less than drum diameter.

1/4" Oversize (1.500")

Where "X" linings have been installed with 1/16" oversize drums and standard rollers, these rollers should be removed and 1/4" oversize installed before the lining becomes worn to a point where the brake cam is no longer effective with the standard rollers.

1/2" Oversize (1.750")

Where "XX" linings and 1/8" oversize drums have been used, the standard rollers should be removed when the linings become approximately 50% worn and 1/2" oversize rollers installed.

Brake Linings

Linings must be the correct material for a specific application, and the same type lining should be used for each wheel on the same axle.

Handle lining carefully to prevent grease, oil, or any other type of contamination to come in contact with lining surface.