SECTION 3

PISTON ASSEMBLY AND CONNECTING RODS

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ENGINE MAINTENANCE MANUAL

SECTION 3

PISTON ASSEMBLY AND CONNECTING RODS

PISTON ASSEMBLY

DESCRIPTION

The piston assembly. Fig. 3-1, consists of a cast iron alloy piston, four compression rings. and two oil control rings. A "trunnion" type piston carrier, Fig. 3-2, is used with the piston assembly to allow the piston to rotate or "float" during engine operation. The carrier supports the piston at the internal piston platform. A thrust washer, Fig. 3-2, is used between the platforn and the carrier. The carrier is held in position in the piston by a snap ring inside the piston. Oil taken up by the two oil control rings passes through the oil holes at the bottom of the piston.

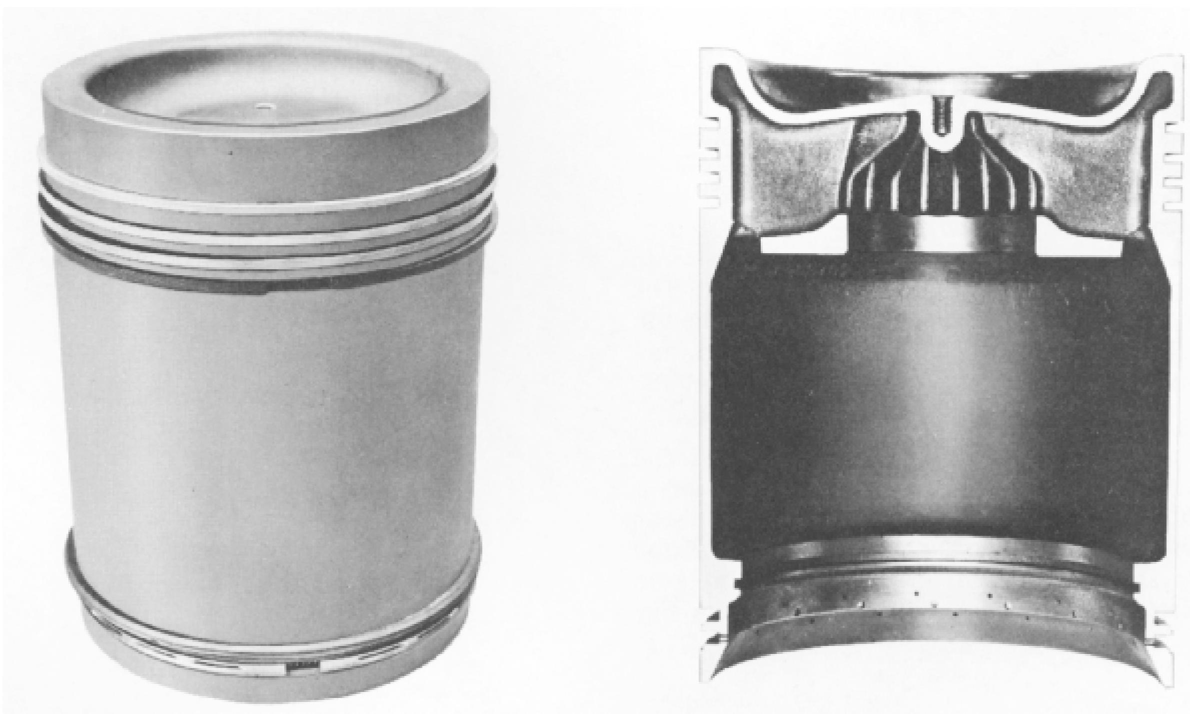


Fig. 3-1 -- Piston Assembly

Fig. 3-2 - Piston Carrier And Thrust Washer

A bearing insert, Fig. 3-3, is applied in a broached slot in the carrier. Tangs at each end of the bearing insert are bent into a counterbore on the carrier to prevent endwise movement. The highly polished piston pin, Fig. 3-3, is applied in the carrier in contact with the bearing insert, and the assembly is bolted to the upper end of the connecting rod.

Internal parts of the piston are lubricated and cooled by the piston cooling oil. Cooling oil is directed through a drilled passage in the piston carrier, circulates about the underside of the piston crown area, and then drains through two holes in the carrier located at the taper as shown in Fig. 3-3.

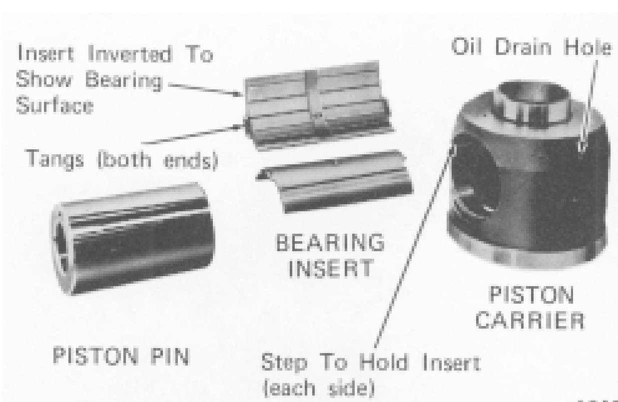


Fig. 3-3 - Piston Pin Insert And Carrier

MAINTENANCE

PISTON AND ROD INSPECTION

Piston and connecting rod assernblies, Fig. 3-4, can be inspected while installed in an engine provided the engine is shut down and the air box and oil pan inspection covers are removed.

Precautions should be taken, before proceeding, to prevent the engine from being started.

Open all cylinder test valves to facilitate rotation of the crankshaft. using the turning jack.

1. Rotate crankshaft until piston of cylinder being inspected is at bottom center.

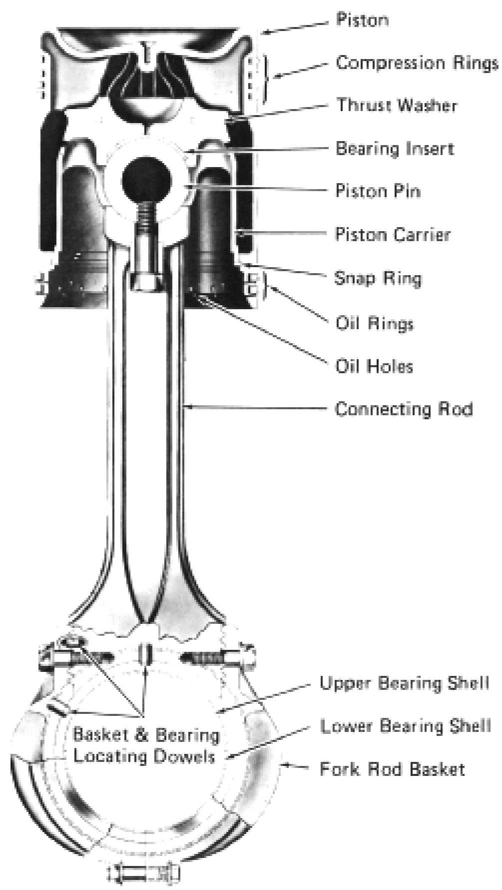


Fig. 3-4 - Piston And Connecting Rod Assembly, Cross-Section

2. Inspect cylinder wall and top of piston. A wet piston crown would indicate a leaky injector. Check cylinder walls to make sure there is no scoring and inspect for water leaks.

3. Rotate crankshaft to move piston toward TDC until compression rings are visible through liner ports.

4. Visually inspect for the following ring conditions at the liner ports.

   a. Measure side clearance of the No. 1 compression ring between the top of the ring and the ring groove using a feeler gauge.

   b. A ring in good condition will be bright and free in its groove.

   c. Broken ring. The ring face will normally be black if broken opposite the gap. Milling may also be evident above and below the liner ports.

   d. Worn ring. Replace all rings when chrome plating is worn through on first ring. While the ductile cast iron used in the chrome plated top ring will function satisfactorily in contact with the liner, the degree to which a ring is allowed to wear before replacement should be governed to some extent by the severity of the service. An engine which seldom runs at full power is more tolerant of ring condition than an engine which usually operates at or near full load. The chrome ring wear classifications shown in Fig. 3-5, used in conjunction with the description of each ring wear "type," will serve as a guide during ring inspection.

   e. Ring blow-by. Vertical brown streaks on the face of the ring indicate blow-by. Replace these rings when the condition becomes severe.

5. Inspect piston skirt for scoring or scuffing.

6. Inspect air box for foreign material and any signs of water or oil leakage.

OIL PAN INSPECTION

1. Inspect back of upper connecting rod bearing for cutting or signs of overheating.

2. To check for thrust washer, piston pin bearing, and connecting rod bearing wear, take a lead reading of piston to cylinder head clearance. Any increase since previous lead reading will indicate wear.

3. With piston at top center, inspect lower liner walls for scoring.

4. Inspect oil pan for foreign matter.

PISTON AND ROD DISASSEMBLY

NOTE: Procedures for disassembly and qualification of piston and connecting rod assembly components are contained in this section. Procedures for removal, assembly, and installation of the piston and connecting rod assembly, and of a complete cylinder power assembly are contained in Section 5.

A new or like new ring. This classification will only be evidenced during the first phase of top ring life.

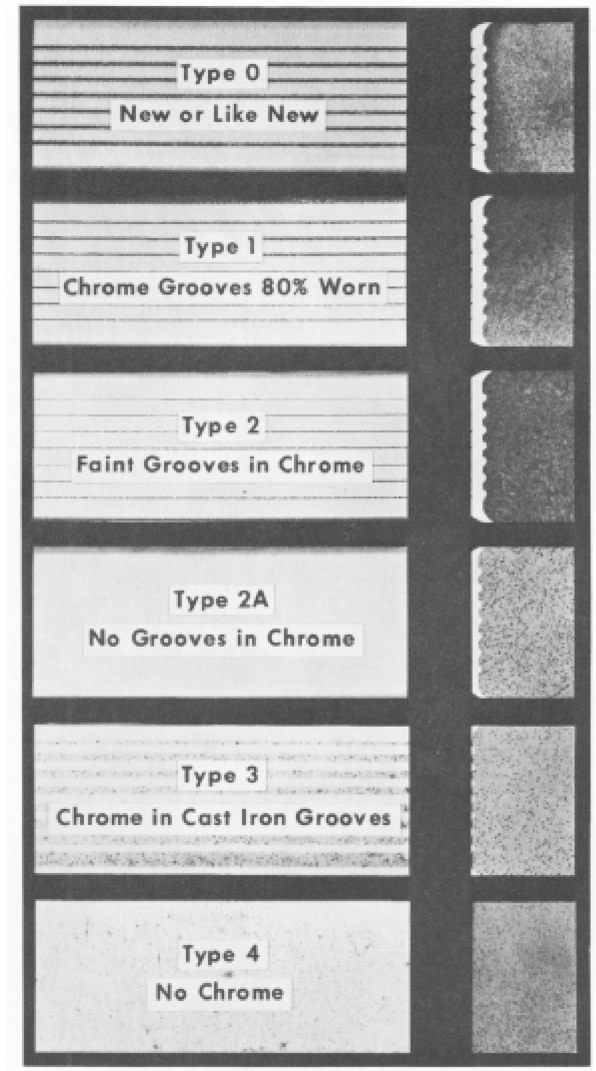
On a shallow groove ring, these classifications will be evident on the top ring for a relatively short time. On a deep groove ring, these classifications will be evident for the major portion of ring life.

Chrome grooves are completely worn away, showing only a smooth chrome face. This will exist for the major portion of shallow groove ring life. It will be evident for a short time on only a small percentage of deep groove rings.

Rings are starting to wear into the cast iron, except for the grooves, which still contain chrome.

CAUTION: To prevent liner scoring, stainless steel rings should be replaced at this time.

Chrome is completely worn off and wear is concentrated on the cast iron. Rings in this classification are to be considered worn out and should be replaced.



NOTE: When classifying chrome plated stainless steel rings, substitute references to "cast iron" with "stainless steel". In addition, stainless steel rings have five grooves instead of seven.

Fig. 3-5 -Chrome Ring Wear Classification

l. Place piston and rod assembly on a wooden topped work bench and remove piston snap ring, Fig. 3-6, using snap ring remover. Care should be taken in handling piston assembly to avoid nicking or scraping the piston skirt.

Fig. 3-6 - Removing Piston Snap Ring

2. Place rod and carrier in holding fixture, Fig. 3-7, and remove piston pin bolts. This fixture has two mandrels which enter the piston pin bore to hold the pin while the rod bolts are removed. It must be securely mounted on a work surface. If fixture is unavailable, a vise having copper protected jaws may be used to hold the connecting rod. Clamp rod horizontally with pin close to vise so pin bolts may be removed without twisting rod.

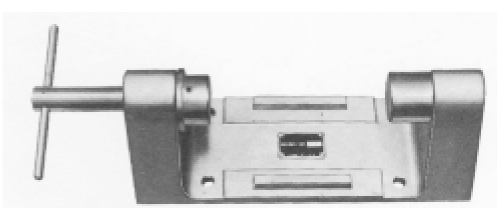


Fig. 3-7 - Carrier Holding Fixture

3. Remove pin from carrier.

4. At the time of piston and rod disassembly, check that the thickness of the thrust washer exceeds the minimum dimension listed in the Service Data.

CLEANING

Cleaning procedures should be in accord with accepted practice or as recommended by the supplier of cleaning material.

PISTONS

1. Remove the piston rings using ring expander as shown in Fig. 3-8, and discard the old rings.

2. Immerse the piston in an alkaline solvent solution and allow to remain until the carbon deposits are loosened.

3. Wash the piston using steam or hot water and blow dry using compressed air.

4. Remove any carbon deposits from the compression ring grooves. Light grit blasting or a piece of compression ring can be used for this purpose.

5. Using 3/32" and 5/32" drills in the respective holes, clean the oil passages in the oil ring grooves.

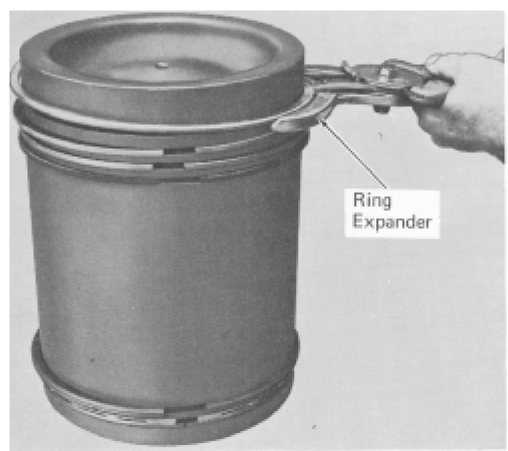


Fig. 3-8 - Removing Piston Rings

PISTON PIN AND CARRIER

CAUTION: Abrasive material, including steel wool, should not be used to clean piston pins or bearing inserts.

l. It is recommended that the piston pin and carrier assemblies be cleaned using a high flash point petroleum solvent, such as Stoddards solvent [60° C 1140° F] flash point) or equal. These parts should never be washed in an alkaline or caustic solution.

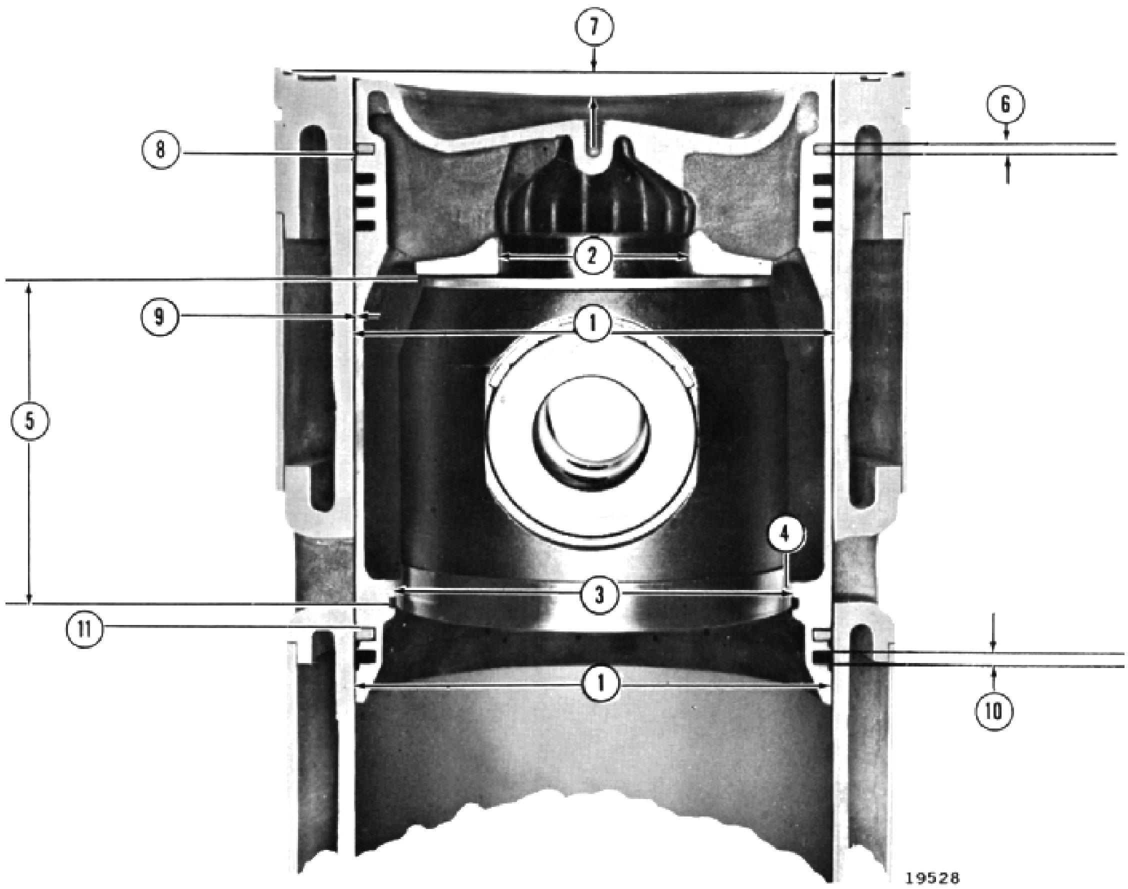
2. Clean the carbon from the oil grooves in the insert with a suitably pointed wooden stick. Embedded particles do no harm if they do not project above the bearing surface; no attempt should be made to remove them. Parts of the assembly should be adequately protected against rust and corrosion at all times.

INSPECTION

l. The phosphate treated surface of the piston skirt should be inspected for satisfactory condition. If the coating is worn through and bare metal in excess of approximately three square inches is exposed, the piston should be re-coated.

2. Inspect the piston surface for excessive scoring or other mutilation which would reject the piston.

3. Check all points of measurement as shown in Fig. 3-9. Discard any pistons that exceed the limits in the Service Data.



Refer to Service Data at end of section for applicable dimensions.

1. Piston Skirt Diameter
2. Piston Platform Bore
3. Piston Inside Diameter
4. Piston To Carrier Pilot Clearance
5. Piston Platform To Bottom Of Snap Ring Groove
6. Compression Ring Groove Width
7. Piston To Cylinder Head Clearance
8. Compression Ring To Head Clearance
9. Piston To Liner Clearance Clearance
10. Oil Ring Groove Width
11. Oil Ring To Land Clearare

Fig. 3-9 - Piston Measurement Points

4. Check piston ring groove wear step. Check wear step in top ring groove, Fig. 3-10. Top ring breakage can be caused by excessive wear step.

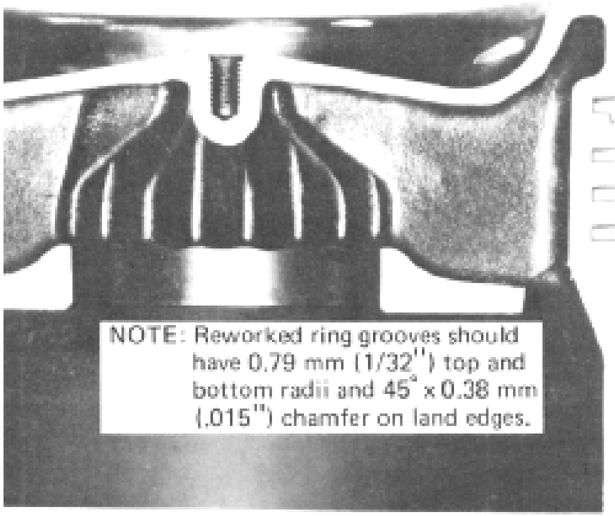


Fig. 3-10 - Typical Piston Ring Groove Wear Step

A piston ring groove gauge, Fig. 3-11, is available to make the wear step measurement. Gauges also are available for measuring wear step in oversize ring grooves. Each gauge consists of a number of separate width indicators precise to 0.001". Standard ring groove gauge has indicators from 0.194" through 0.203". See tool catalog for oversize ring gauge numbers.

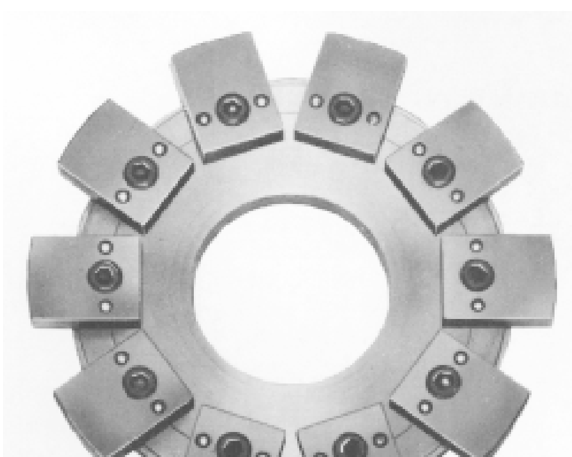


Fig. 3-11 - Piston Ring Groove Gauge

To measure wear step, it is first necessary to determine the original ring groove width, because it may vary from 4.93 to 5.00 mm (.194" to .197"). Insert gauge blocks in ring groove, and by trial, determine the largest one which enters its full depth. This will indicate the original width of the ring groove being measured. Then insert the largest block that will enter the groove up to the wear step. The size of the wear step is determined by subtracting the small block dimension from the large block dimension.

When a wear step, in excess of maximum allowable, is found in the top compression ring groove, the groove may be recut to remove the wear step, provided the finished width does not exceed 5.10 mm (.201") for use with a standard ring.

If the ring groove is worn beyond a width of 5.10 mm (.201"), it is possible to machine the top ring groove to use oversize ring. See Service Data for limits.

When performing either of the preceding operations, care must be taken to keep the ring groove faces parallel to each other and at right angles to the centerline of the piston. The surface finish must be smooth to avoid excessive wear.

5. Inspect the piston for cracks using magnaflux procedure.

6. Remove undercrown deposits. Pistons that have been found dimensionally and structurally satisfactory for reuse, should also have the heat dam area thoroughly cleaned of undercrown deposits. Undercrown cleaning should be accomplished using a sand or grit blast cleaning in conjunction with liquid cleaning.

CARRIER

In this assembly, Fig. 3-3, a broached slot or recess in the carrier, receives a precision bearing insert. A hardened polished piston pin runs against the bearing insert.

Normal bearing wear does not affect the carrier. Maximum permissible wear on the insert piston pin, and carrier pilots are listed in Service Data. Used parts in good condition should not be interchanged. A new bearing insert should be

Used when a new piston pin is used. The piston pin should always be applied in the same relative position to the bearing insert. The small hole in the piston pin should be matched with the piston cooling oil inlet hole in the carrier as a convenient means of keeping the pin and insert in the same relative position for maximum performance.

Except in extraordinary cases of pilot wear, carriers may be expected to have an indefinitely long life. Also, tile bearing insert need not be removed for measurement unless its appearance is questionable and/or the wear on the piston pin is well advanced.

Measure the carrier to determine that the dimensions do not exceed the limits shown in the Service Data.

PISTON PIN

1 . Inspect the pin. The bearing surface should be free of any roughness and have a mirror finish.

2. Fretting on the pin, only where it contacts the connecting rod. may be removed using a fine stone.

3. Check the 7/8"-14 bolt threads in the pin by retapping. It the threads are damaged, replace the pin.

4. Check piston pin wear step.

CONNECTING ROD ASSEMBLY

DESCRIPTION

The "trunnion type" connecting rods. Fig. 3-12. are interlocking, blade and fork construction. The blade rod moves back and forth on the back of the upper crankpin bearing and is held in place by a counterbore in the fork rod.

One end of the blade rod slipper foot is longer than the other and is known as the "long toe." The blade rods are installed in the right bank with the long toe toward the center of the engine.

The fork rods are installed in the left bank. Serrations on tile sides of the rod at the bottom thatch similar serrations on the fork rod basket, Fig. 3-12. 'The rod basket consists of two halves.

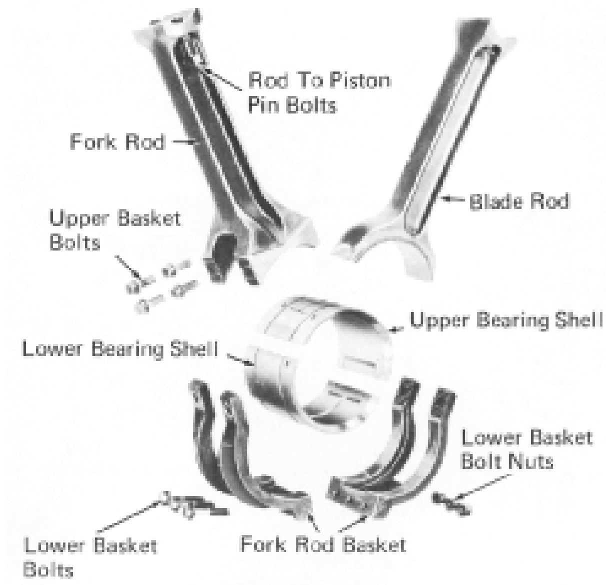


Fig. 3-12 -Connecting" Rods. Bearing Shells, And Basket

held together at the bottom by three bolts and self-locking nuts. The fork rod and basket are bolted together at the serrations. Fork rods and baskets are not interchangeable since they are line bored as an assembly. Both the fork rod and basket are stamped with an identical assembly serial number for matching and identification purposes.

MAINTENANCE

CLEANING

Cleaning procedures should be in accord with accepted practice or as recommended by the supplier of cleaning material.

The glared finish and the bearing pattern oil stain usually found on the blade rod slipper surface is considered normal, and removal s11ou1d not be attempted.

CAUTION: Abrasive material, including steel Wool, should not be used to clean connecting rods or bearing shells.

INSPECTION

FORK ROD

1. After all parts are clean, check the tapped holes in the fork rod. If threads are worn, the bolts holding the basket may loosen during operation and damage the engine.

   Plug gauge, Fig. 3-13, is available to check the fork rod bolt threads. One end of the gauge is marked "GO" and the opposite end "HI'. The gauge should be used according to the following procedure.

   a. Thread the "GO" portion of the gauge into each of the holes, Fig. 3-13, and check for binding, which may indicate damaged threads. Normally, this gauge should enter the holes freely and a slight shake or wobble is permissible.

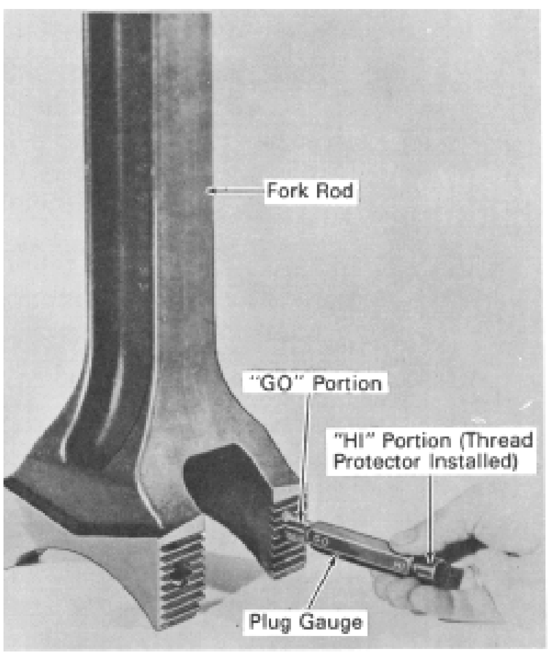


Fig.3-13 - Checking Fork Rod Bolt Threads

   b. An attempt should then be made to screw the "HI" portion of the gauge into each of the holes. This is not a "no go" gauge, therefore, rods may be entirely satisfactory even though the gauge may be screwed in the threads, even to the extent of bottoming.

      Normally, in rods having little wear, this gauge will be difficult to thread into the holes more than a couple of turns. In many cases, however, the gauge can be threaded into the rod but will be snug and tight. While threaded in, check for shake or wobble, taking care that the gauge is not bottomed in the hole, which would cause binding and a false reading.

      The fork should be scrapped if shake or wobble is experienced with the "HI" gauge. To further ensure proper torque values, it is recommended that new bolts be used. However, old bolts may be used if they are qualified by careful inspection. Discard any that may be bent or have threads showing signs of galling, wear, nicks or other imperfections.

2. Fork rod serrations should be checked for nicks, burrs, and cleanliness. Check tightness of upper bearing locating dowels. Step dowels are available in the event oversize dowels are required. Inspect for cracks in serrations and rod visually and by magnaflux.

3. To ensure proper clamping between the piston pin and rod saddle, protrusions in the saddle caused by nicks or fretting must be removed. Use grade 150 abrasive paper or a fine cylindrical stone.

4. Check fork rod bore by fastening basket securely in place using 238 N-m (175 ft-lbs) torque on upper basket bolts, Fig. 3-12. (Normal upper basket bolt torque is 258 N-m [190 ft-lbs] on assembly.) Torque lower basket (split line) bolts to specified value. Measure bore at points 60° apart as indicated in Fig. 3-14. Take one set of measurements at generator end of bore and one set at accessory end of bore. The average of each set of dimensions must not exceed the specified maximum. If bore is beyond this dimension, the rod and basket should be reworked.

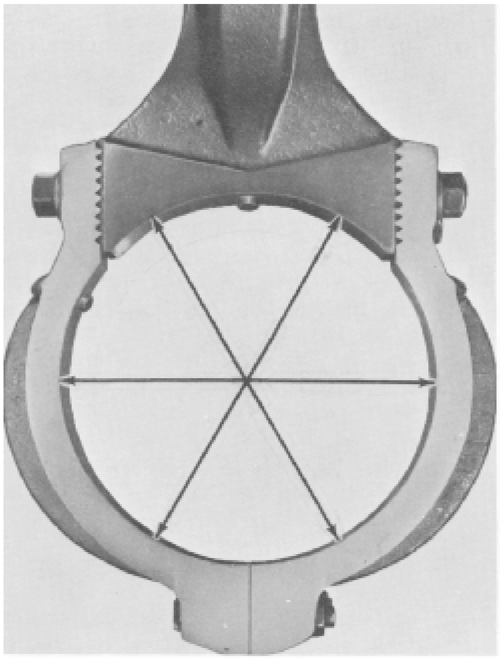


Fig. 3-14 - Checking Fork Rod Bore

5. Fork rod rework will be required for any of the following conditions:

   a. Average of three 60° measurements across fork rod and basket bore exceeds specified maximum.

   b. Nicks, burrs, or fretting on fork and basket serrations.

   c. Damaged threads in bolt holes (see Step 1), or loose dowels.

   d. Damaged or distorted basket.

   e. Out-of-parallel in excess of limit in length of saddle.

   f. Length of rod between bore centers is less than the minimum shown in Service Data.

   g. Fork counter bore exceeds maximum depth.

6. Fork rod assembly should be scrapped if any one or more of the following conditions exist:

   a. Fatigue cracks through basket serr a t rations o n s and rejectable magnaflux indications.

   b. Heat discoloration in basket or fork.

   c. Rod twisted, bent, out-of-parallel, or damaged beyond repair.

   d. Length of rod between bore centers is less than minimum shown in Service Data.

BLADE ROD

1. The blade rod is checked on a 7.692" diameter mandrel to observe slipper surface for "open" or "closed" ends. Blade surface should be smooth. Rod should be scrapped if this surface shows heat discolorations.

NOTE: The flame hardening process produces a blue black color on the top side of the blade rod slipper foot. This discoloration is normal and has not been caused by overheating during operation. The slipper surface, however, should show no discoloration.

2. To ensure proper clamping between the piston pin and rod saddle, protrusions in the saddle caused by nicks or fretting must be removed. Use grade 150 abrasive paper or a fine cylindrical stone.

3. Blade rod rework will be required for any of the following conditions.

   a. Scarred, pitted or deeply rust-etched slipper surface.

   b. End of slipper closed in beyond limit.

   c. End of slipper opened beyond limit.

   d. Out-of-parallel exceeds limit along saddle length.

   e. Length of rod between bore centers is less than minimum shown in Service Data.

4. Blade rod should be scrapped if any one or more of the following conditions exist.

   a. Rejectable magnaflux indications.

   b. Heat discoloration on slipper surface.

   c. Less than minimum flange thickness on slipper shoulder.

d. Rod twisted, bent, out-of-parallel, or damage beyond repair.

e. Length of rod between bore centers is less than minimum rework limit shown in Service Data.

CHECKING ROD LENGTH, TWIST, AND BORE PARALLELISM

A connecting rod checking fixture is available for accurate inspection of the connecting rod length, twist, and parallelism of piston pin saddle to bearing bore. Refer to Service Data for tool part number.

The following Steps provide a general guideline for checking connecting rods using the tool mentioned above.

1. Set dial indicator reading to "0" using gauge block provided with checking fixture.

2. Place connecting rod on checking fixture, being sure that checking fixture mandrel and rod are clean.

3. Using the dial indicator reading at each top edge of piston pin saddle contour, center rod on mandrel by adjusting the vertical centering thumb screws.

4. Check slipper surface on blade rods for open ends by trying a .003" feeler gauge between slipper surface and mandrel, at each end. Blade rods with open ends may be used providing a .003" feeler gauge cannot be inserted more than 51 mm (2") at either end. A closed in slipper surface is evidenced by the ends having no clearance and the bearing surface being open. Rods with closed-in bearing surface may be used, provided a clearance less than the limit is obtained when measured any place between ends of the slipper surface and the mandrel.

5. Set dial indicator point at top inside edge of saddle. Sweep indicator along length of saddle. Indicator deflection shows rod twist in the length of the saddle which should not exceed limit shown in the Service Data.

6. Place indicator point at one end of bottom of saddle and note indicator reading. Check along length of saddle bottom, circumventing bolt holes, to check out-of-parallel. Indicator must not show more than maximum deflection along length of saddle.

7. To determine rod length, place dial indicator point on gauge plate and check "0" setting. Slide indicator button off block to bottom of saddle and not reading. Minimum reuseable and minimum rework rod dimensions are shown in the Service Data.

CONNECTING ROD BEARINGS

DESCRIPTION

Connecting rod bearings consist of upper and lower shells, Fig. 3-12. They are semicircular in shape and have a steel back with a layer of lead bronze bearing material covered by a lead tin coating on the inside diameter. The upper bearing has, in addition, a bearing surface in the center of the outer diameter consisting of a layer of bronze bearing material with a pure lead-flash overlay. This provides a bearing surface for the slipper of the blade connecting rod.

Dowels in the fork rod and basket hold the bearing shells in proper position. Two dowels in the fork rod locate the upper shell and one dowel in the basket locates the lower shell.

There is no provision for connecting rod bearing adjustment. When bearing clearance exceeds the limit given in Service Data, they should be replaced. After bearing shells are once used on a crankpin and have accumulated numerous dirt scratches, they must not be used on any other crankpin.

MAINTENANCE

CHECKING CONNECTING ROD BEARINGS

The connecting rod bearings should be checked whenever the piston and rod assembly is removed from the engine. To make this check, apply bearings to fork rod and basket in which they are to be used. Torque upper basket bolts to 258 N-m (190 ft-lbs), and torque lower basket (split line) bolts to 102 N-m (75 ft-lbs). Measure bearing bore at three points 60° apart. This is similar to the procedure used when checking fork rod basket bore, Fig. 3-14. The average of these three readings must not be less than is necessary to ensure a clearance between crankpin journal and bearing within the specified limits. After oper ation, rod bearings may give indication of being tight across the split line when loose on the crankpin. However, rod bearings intended for use should be mounted in the fork rod and then checked.

NOTE: After bearings have once been used, they should not be used on any other journal.

Check upper bearing step thickness as shown in Fig. 3-15. This will indicate blade rod bearing surface wear. Step thickness should not be less than minimum limit.

Bearing shells will usually be dirt scratched to some degree, but unless condition is severe, the bearings can be reused.

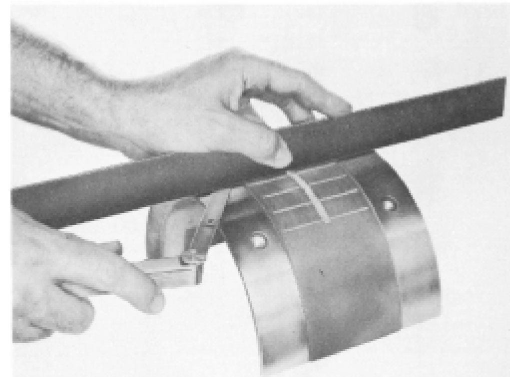


Fig. 3-15 - Checking Rod Upper Bearing Shell

SERVICE DATA

PISTON ASSEMBLY AND CONNECTING RODS

SPECIFICATIONS

Clearance and dimensional limits listed below are defined as follows:

1. *New limits are those to which new parts are manufactured. (Drawing tolerances.)*
2. *Minimum, maximum, and tolerance measurements are provided as service limits. A1 time of rebuild or any time unscheduled maintenance is performed, the service limits should not be exceeded. Engine components within these limits may be reused with the assurance that they will perform satisfactorily until the next scheduled overhaul.*

Connecting Rod
Connecting rod basket bore (see text) -
New . . . . 193.62-193.68 mm (7.623"-7.625")
Max. . . . . 193.70 mm (7.626")
Max. difference of any two readings at each end of bore (out of round) . . . 0.23 mm (.009")
Blade rod bearing seat diameter (See text) - New. . . . . 195.38-195.40 mm (7.692"-7.693")

Clearance between shoulder on blade rod and counterbore in fork rod -
New . . . . 0.20-0.33 mm (.008"-.013")
Max. . . . . 0.64 mm (.025")
(This clearance measured by placing feeler gauge between blade rod and top of upper bearing.)

Depth of counterbore in fork rod for slipper on blade rod -
New . . . . 9.780-9.817 mm (.3850"-.3865")
*Max. . . . . 10.16 mm (.400")
(*Provided the preceding maximum 0.64 mm (.025") clearance is held.)

Blade rod shoulder thickness -
New . . . . 8.750-8.790 mm (.3445"-.3460")
*Min. . . . . 8.51 mm (.335")
(*Provided the preceding maximum 0.64 mm (.025") clearance is held.)

Connecting rod length - New . . . . 584.15-584.25 mm (22.998"-23.002")
(Generated bore centerline dimension) -
Min. . . . . 583.95 mm (22.990")
Min. rework . . . . 583.69 mm (22.980")

Saddle end for piston pin
Twist in length of saddle - Max. . . . . 0.15 mm (.006")
Parallelism in length of saddle - Max. . . . . 0.10 mm (.004")

Blade rod slipper surface
"Closed in" - Max. . . . . 0.18 mm (.007")
"Opened out" - Max. . . . . 0.08 mm (.003")

Connecting Rod Bearings
Bearing inside diameter (Average of three 60° measurements) -
New . . . . 165.268-165.354 mm (6.5066"-6.5100")
Bearing to crankpin clearance -
New . 0.18-0.28 mm (.007"-.011 ")
Max. . . . . 0.38 mm (.015")
Upper connecting rod step thickness - Min. . . . . 0.69 mm (.027")

Piston

1 - Refer to Fig. 3-9 - circled numbers coincide with callouts on illustration.
Piston skirt diameter -

New	229.84-229.90 mm (9.049"-9.051")
Min.	229.77 mm (9.046")
Out-of-round - Max.	0.13 mm (.005")

(Check diameter below the oil ring grooves and at 63.5 mm to 69.8 mm [2.50" to 2.75"] below the compression ring grooves. Take two readings 90° to each other, at each location.)

2 - Piston platform bore (upper carrier pilot) -

New	90.55-90.60 mm (3.565"-3.567")
Max.	90.68 mm (3.570")

(Check at two places 90° to each other.) Piston platform should be square to piston O. D. within 0.08 mm (.003') total indicator reading.

3 - Piston inside diameter (lower carrier pilot) -

New	190.17-190.25 mm (7.487"-7.490")
Max.	190.35 mm (7.494")

4 - Piston to carrier pilot clearance -

New	0.08-0.18 mm (.003"-.007")
Max.	0.28 mm (.011 ")

5 - Piston platform to bottom of snap ring groove -

New	161.95-162.15 mm (6.376"-6.384")
Max.	162.28 mm (6.389")

6 - No. 1 compression ring groove width w/standard ring -

New	4.93-5.00 mm (.194"-.197")
Wear - Max.	5.10 mm (.201")
W/0.40 mm (1/64") O.S. ring	
Remachined	5.31-5.38 mm (.209"-.212")
Wear - Max.	5.49 mm (.216")
W/0.79 mm (1/32") O.S. ring	
Remachined	5.72-5.79 mm (.225"-.228")
Wear - Max.	5.89 mm (.232")
Wear step-Max.	0.08 mm (.003")

7 - Piston to cylinder head clearance -

New Min.	0.51 mm (.020")
New Max.	1.73 mm (.068")
Differential reading between ends of lead wire	0.13 mm (.005")

An increase in compression clearance of 0.76 mm (.030") from the assembly value at the time of installation condemns the assembly. Any sudden increase should be investigated immediately.

8 - Compression ring to land clearance –

No. 1 groove chrome ring -	
New	0.102-0.216 mm (.0040"-.0085")
Max. limit for ring installation	0.30 mm (.012")
No. 2 and 3 groove chrome ring -	
New	0.190-0.305 mm (.0075"-.0120")
Max.	0.41 mm (.016")
No. 4 groove, taper ferrox ring -	
New	0.190-0.292 mm (.0075"-.0115")
Max.	0.41 mm (.016")

SERVICE DATA

PISTON ASSEMBLY AND CONNECTING RODS

9 - Piston to liner clearance
Measured 152.40 mm (6") below liner gasket face -

New	0.216-0.330 mm (.0085"-.0130")
Max.	0.56 mm (.022")

NOTE: Maximum piston to liner clearance of 0.56 mm (.022") determines the maximum wear limit of a liner at the 152.40 mm (6") dimension. If pistons are selectively fitted to liners, a liner at 230.45 mm (9.073") could be used with a 229.90 mm (9.051") piston. If pistons and liners are not selectively fitted, the maximum wear limit of the liner at the 152.40 mm (6") dimension would be 230.33 mm (9.068") as the minimum wear limit of a used piston is 229.77 mm (9.046").

10 - Oil ring groove width -

New	6.38-6.45 mm (.251"-.254")

11 - Oil ring to land clearance -

New	0.05-0.15 mm (.002"-.006")

Piston rings

Top compression ring gap (new ring in 9.062" gauge)	1.02-1.52 mm (.040"-.060")
Second and third compression ring gap	1.02-1.27 mm (.040"-.050")
Fourth compression ring gap	0.89-1.27 mm (.035"-.050")

Carrier

Carrier height (top of platform to bottom of carrier) -

New	152.37-152.27 mm (5.999"-5.995")
Min.	152.20 mm (5.992")

Carrier top pilot diameter -

New	90.42-90.47 mm (3.560"-3.562")
Min.	90.35 mm (3.557")

Carrier bottom pilot diameter -

New	190.04-190.09 mm (7.482"-7.484")
Min.	189.99 mm (7.480")

Clearance (carrier to piston snap ring)

New	0.05-0.38 mm (.002"-.015")
Max.	0.64 mm (.025")

Carrier bearing insert thickness

New	3.81-3.83 mm (.150"-.151")
Min.	3.78 mm (.149")

Piston Pin

Diameter -

New	93.57-93.60 mm (3.684"-3.685")
Wear step - Max.	0.05 mm (.002")

Piston thrust Washer

Thickness -

New	. . . .	4.70-4.78 mm (.185"-.188")
Min.	. . . .	4.44 mm (.175")

Thickness variation -

Max. . . . . 0.08 mm (.003")

EQUIPMENT LIST

	Part No.
Feeler gauge set.	8067337
Piston cooling pipe cleaning tool	8087086
Torque wrench, (3/4" drive [0-300 ft-lbs])	8157121
Snap ring remover	8171633
Torque wrench extension (used with torque wrench 8157121)	8210136
Piston carrier holding fixture	8236589
Wire holder (has contour of piston crown to hold small lengths of lead wire for piston to head clearance).	8243220
Wire, lead, 1/8" dia., 5 lb spool (used with holder 8243220 or alone)	8243661
Fork connecting rod basket thread gauge.	8265955
Piston ring groove gauge	
Standard (.194-.203")	8275503
1/64" O.S. (.210"-.219")	8331113
1/32" O.S. (.225"-.234").	8331043
Piston ring expander	8349892
Connecting rod checking fixture.	8257730
Motor driven flexible shaft buffer, 115 V	9082182
Motor driven flexible shaft buffer, 230 V	9082183