SECTION III

PISTON AND CONNECTING ROD ASSEMBLIES AND CONNECTING ROD BEARINGS

A. DESCRIPTION

1. Piston Assembly

The cast iron alloy pistons used in 567C production engines are two piece or "floating" pistons, consisting of an integral body and a piston carrier designated as the "trunnion type" shown in Fig. 3-1. The carrier supports the piston body at an internal piston platform and is held in place by an internal snap ring in the piston body. A thrust washer is used between the carrier platform and piston platform. This design allows the piston body freedom to rotate during engine operation. Three compression and two oil control rings are used. Oil taken up by the oil rings passes through a single row of holes at the upper ring and two rows at the lower oil ring, in the smooth undercrown piston.

The carrier used in the trunnion piston assembly has a circular boss located centrally on its upper platform which pilots in a bore in the center of the piston platform, and is also piloted in the piston at the carrier bottom outside diameter. A bearing insert, Fig. 3-8, is applied in a broached slot in the carrier. Tangs at each end of the bearing insert are bent into a counterbore of the carrier to prevent endwise movement. The bearing insert is steel backed, about .150" thick having .010"-.015" silver plated surface and an overlay of lead .0003"-.0006" thick. The piston pin having a polished surface is applied in the carrier bearing, then bolted to the upper end of the connecting rod, as shown in Fig. 3-1.

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, circu-

lates about the smooth piston crown area, lubricates the piston pin, and drains through two 5/8" holes in the carrier at right angles to the piston pin.

Pistons are given phosphate treatment to aid skirt lubrication during engine run-in. This process etches the surface to a dark dense porosity, which provides better oil retention. Information on treatment is given in Maintenance Instruction 1758.

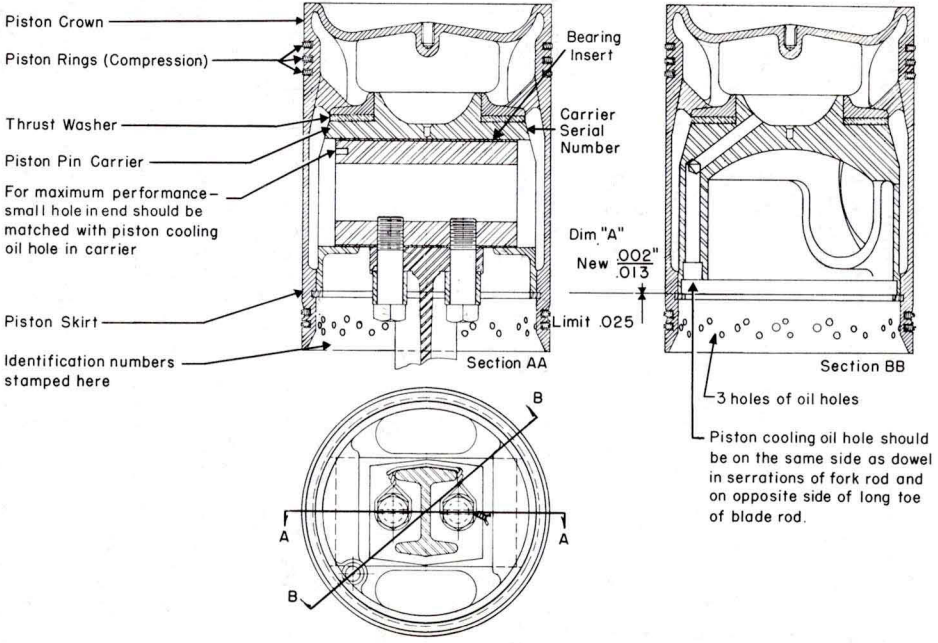
Prior to the use of the bearing insert design carrier using a polished piston pin, a piston carrier having a polished piston pin surface was used with a piston pin having a silver plated, lead overlay bearing surface. Parts of these two different assemblies are not interchangeable. Piston assemblies, however, having either design of carrier and piston pin may be used in the same engine.

2. Piston Pin

The piston pin used with the carrier having the bearing insert is made of steel alloy material, having outer surfaces carburized, ground, lapped and polished to a mirror finish. The pin is mounted at the circular contour at the top of the connecting rod and oscillates in the bearing insert in the carrier. Two 7/8" bolts, Fig. 3-1, each provided with a non-removable spacer, pass through the upper end of the connecting rod and screw into the piston pin. These bolts are tightened to 450 foot-pounds torque and lockwired.

3. Connecting Rod Assembly

The connecting rods 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 counter-bore in the fork rod. See Fig. 3-2 and Fig. 3-3.



Floating Piston Assembly
Fig. 3-1

One side of the blade rod bearing surface is longer than the other and is known as the "long toe." The blade rods are installed in the right bank of the engine, with the long toe toward the center of the engine.

The fork rods are installed in the left bank of the engine. Serrations on the bottom sides of the rod match similar serrations on the bearing basket. The bearing basket consists of two halves, bolted together at the bottom by three bolts having self locking nuts. The fork rod and basket are fastened together at the serrations by means of a dowel and capscrews. 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 purposes of matching and identification.

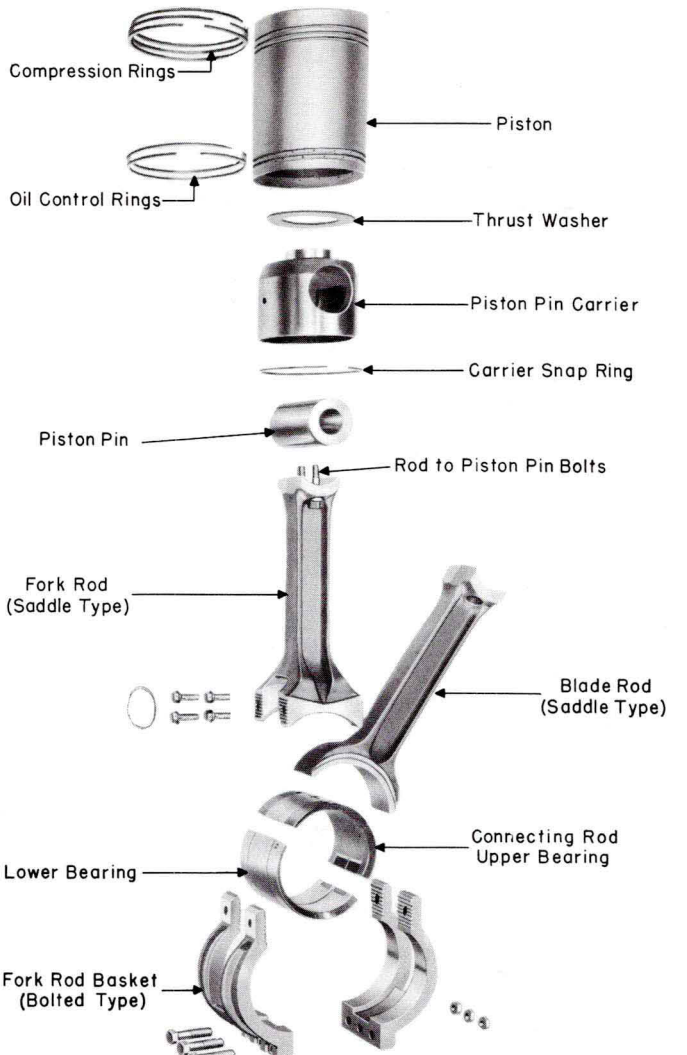
The top of each rod is machined to a contour of the piston pin. Piston pins are held to the connecting rod by two capscrews, provided with non-removable spacers.

4. Connecting Rod Bearings

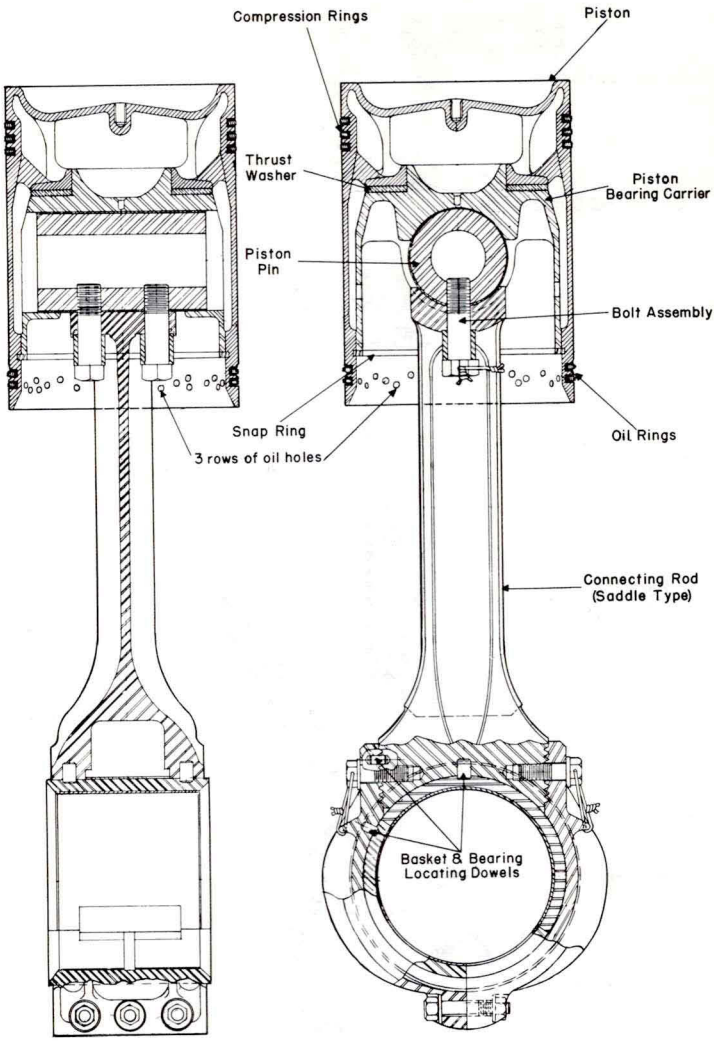
Connecting rod bearings consist of upper and lower shells, Fig. 3-2. They are semi-circular steel, having a layer of bronze covered by a lead tin coating on the inside diameter. The upper bearing also has a bearing surface in the center of the outer diameter consisting of a layer of bronze without lead tin overlay. This provides a bearing surface for the slipper of the blade connecting rod.

Dowels in the fork rod and bearing basket hold the shells in proper position. Two dowels in the fork rod hold the upper shell and the lower shell is located by a dowel in the basket.

No adjustment of connecting rod bearings is provided. When bearing clearance exceeds the limit given in the specification, replace the bearings. After bearing



Piston And Connecting Rod Assembly
Fig. 3-2



Piston And Connecting Rod (Cross-Section)
Fig. 3-3

shells are once used on a crankpin, they must not be used on any other crankpin.

Lubricating oil is supplied the crankpin bearing from an adjacent main bearing, fed through a drilled passage in the crankshaft. An oil groove at the center of the lower bearing supplies oil to a drilled passage in the upper bearing for the blade rod bearing surface. Oil is distributed over this surface by a "fishback" or oil groove down the bearing center having grooves at right angles along its length.

B. MAINTENANCE

1. Piston and Connecting Rod Inspection While Installed

Piston and Connecting rod assemblies can be inspected while installed in an engine with the engine shut down and the air box and oil pan inspection covers 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.

a. Air box inspection

(1) Rotate crankshaft so piston of cylinder being inspected is at bottom center.

(2) Inspect cylinder wall and top of piston. Check for scoring of cylinder walls and inspect for water leaks.

(3) Rotate crankshaft so rings can be inspected at the liner ports. Inspect for broken or stuck rings. Do not use a bar or piece of wood to see if rings are free. Observe for blow-by

indicated by vertical brown streaks. Rings in good condition will be bright and free in their grooves. Replace chrome rings when chrome plated surface is worn through. Replace ferrox rings when worn smooth.

(4) Inspect piston skirt for scoring or scuffing.

(5) Inspect air box for foreign material or signs of water indicating leaks.

b. Oil Pan Inspection

(1) Inspect back of upper connecting rod bearing for cutting or signs of over heating.

(2) Inspect bearing surface of piston pin by feeling along pin checking for any evidence of roughness or scuffing.

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

(4) Inspect oil pan for foreign matter.

To check thrust washer wear, measure clearance between piston and snap ring. Excessive clearance indicates worn parts. See specifications for limits.

2. Pulling Piston and Rod Assembly

a. Preliminary Steps

(1) Remove cylinder test valve assembly.

(2) Remove piston cooling oil pipe.

(3) Remove cylinder head as outlined in Section II.

(4) Apply piston pulling eyebolt #8040413 in tapped hole in piston crown.

b. Fork Rod Removal

(1) Remove fork rod basket bolts and capscrews. Remove basket halves and lower bearing shell.

(2) Pull piston and rod assembly holding rod as it clears crankshaft to prevent it striking piston skirt or liner. Apply fork rod boot #8062034 and complete removal of piston and rod assembly.

c. Blade Rod Removal

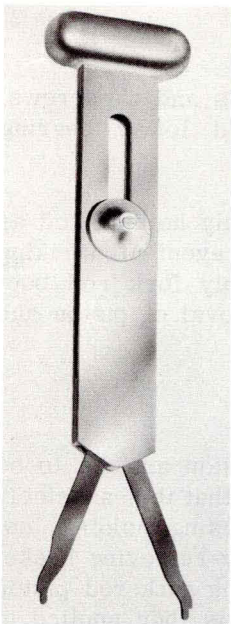
(1) If opposite fork rod and piston are not to be removed then it is essential that this assembly be held out of the way using holding tool #8052958. This is done by removing basket and lower bearing then placing fork rod piston at top center. Holding tool is then applied to outboard side of fork rod using two basket capscrews. Rotate crankshaft in normal direction so holding tool will rest in oil pan. Protect upper bearing and continue rotation to position blade rod for removal.

(2) Raise piston and blade rod assembly and carefully remove upper bearing shell. Prevent rod from striking piston skirt or liner.

(3) Apply boot #8062033 and complete removal of blade rod assembly.

3. Disassembly of Piston and Rod

a. Place piston and rod assembly on wooden topped work bench and remove piston snap ring, using



Piston Snap Ring Removal Pliers Fig. 3-4

snap ring pliers 8171633, Fig. 3-4. Care should be taken in handling piston assembly to avoid knocks or scraping of the piston skirt.

b. Place rod and carrier in holding fixture 8236589. If fixture is unavailable, a vice may be used having copper protected jaws. Place pin close to vice so pin bolts may be removed with exerted force in a vertical plane.

c. Remove pin from carrier.

4. Cleaning Pistons

To clean piston and rod assembly, follow procedure given in Maintenance Instruction 1706.

5. Connecting Rod Inspection

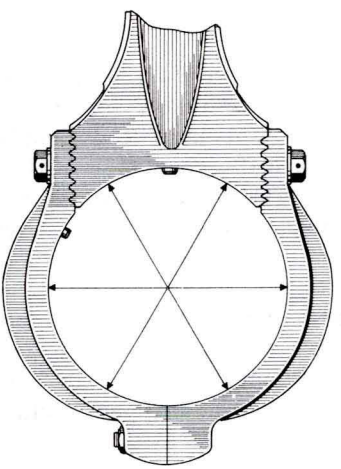
a. Fork Rod

(1) After all parts are clean, check tapped capscrew holes in the fork rod. If needed, they may be cleaned up using a 5/8"-18 tap. The basket capscrews should be inspected any time they are removed. They should be replaced if they appear bent, nicked, have worn threads, or if they cannot be run into the rod with the fingers.

(2) Fork rod serrations should be checked for nicks or burrs and cleanliness. Check tightness of upper bearing locating dowels. Step dowels are available in the event oversize dowels are required. Both visual and Magnaflux inspect for cracks in serrations and rod.

Maintenance Instruction 1754 covers connecting rod Magnaflux inspections.

(3) Check fork rod bore by fastening basket securely in place using 175 foot-pounds torque on basket cap screws. (Normal basket capscrew torque is 190-200 foot-pounds on assembly.) Torque value of lower basket bolts is 75 foot-pounds. Measure bore at points 60° apart as indicated in Fig. 3-5. The average of these dimensions must not exceed 7.626". If bore is beyond this dimension, the rod and basket should be reworked. For information on connecting rod rework see Factory Rebuild Service Bulletin #305.



Checking Fork Rod
Fig. 3-5

(4) Fork rod rework will be required for any of the following conditions:
- (a) Average of three 60° measurements across fork rod and basket bore exceeding 7.626".
- (b) Nicks, burrs or fretting on fork and basket serrations.
- (c) Damaged threads in capscrew holes; loose dowels.
- (d) Damaged or distorted basket.
- (e) Twist exceeding .006" across length of saddle.
- (f) Out of parallel in excess of .004" limit across saddle length.
- (g) Length of rod between bore centers less than the minimum of 22.990".

(h) Fork counterbore exceeding .400" maximum depth.

(5) Fork Rod assembly to be scrapped if any one or more of the following conditions exist:

(a) Fatigue cracks through basket serrations and rejectable Magnaflux indications outlined in Maintenance Instruction 1754.

(b) Heat discoloration in basket or fork.

(c) Rod bent or damaged beyond repair.

(d) Length between bore centers below 22.979".

b. Blade Rod

(1) The blade rod is checked on a 7.692" diameter mandrel to observe slipper surface for "open" or "closed" ends. See "Checking Rod Length, Twist and Bore Parallel" following. Blade surface should be bright, shiny and smooth. Rod should be scrapped if this surface shows heat discolorations.

NOTE: During the flame hardening process, a blue-black color results on the shoe of the blade rod. This discoloration is normal and has not been caused by poor operation. The slipper surface however should show no discoloration.

(2) Blade rod rework will be required for any of the following conditions.

(a) Scarred, pitted or deeply rust etched slipper surface.
(b) Ends of slipper closed in beyond .007" limit.
(c) End of slipper opened beyond .003" limit.

(d) Twist exceeding .006" along saddle length.
(e) Out of parallel exceeding .004" along saddle length.
(f) Length between bore centers below minimum allowable length of 22.990".

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

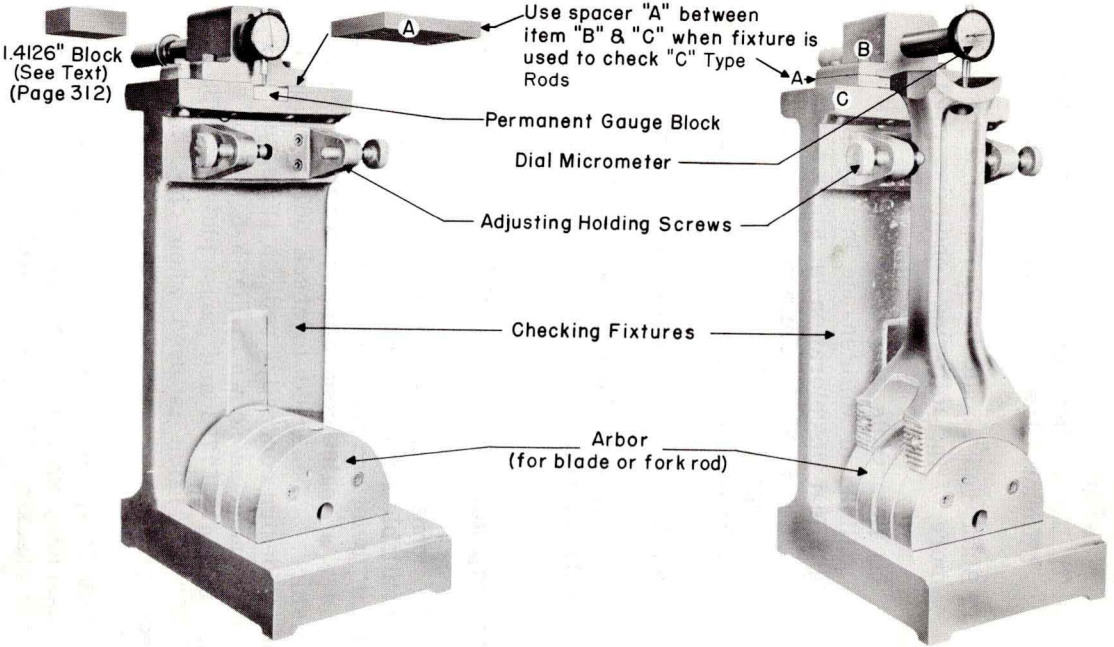
(a) Rejectable Magnaflux indications as outlined in Maintenance Instruction 1754.
(b) Heat discoloration on slipper surface.
(c) Below .335" minimum flange thickness on slipper shoulder.
(d) Twist, out-of-parallel or damage beyond repair.
(e) Length between bore centers below 22.979".

NOTE: Refer also to Factory Rebuild Service Bulletin #305 for return and rework of connecting rods.

6. Checking Rod Length, Twist And Bore Parallel

The connecting rod checking fixture 8257730, Fig. 3-6, is available for accurate inspection of the connecting rod length, twist and piston pin surface or bore parallel. All 567 series engine connecting rods can be checked on this fixture. When used to check 567C engine bolted piston pin design connecting rods, a 1" spacer plate "A" 8257739 is used as shown in Fig. 3-6. Also, short indicator button 8257733 and gauge plate 8257738 having a 1.4126" dimension is used when checking "C" type connecting rods.

With 1" spacer plate 8257739 applied under indicator assembly when using the fixture as shown in Fig. 3-6, for checking "C" type connecting rods, place the 1.4126" indicator gauge plate on fixture permanent gauge block and with indicator button on the 1.4126" plate



Checking Connecting Rods
Fig. 3-6

set indicator to "0." Place rod on fixture and place indicator button at bottom of contour, or by checking at each top edge of contour, adjust screws to bring rod to vertical position and tighten screws.

Check for open ends of slipper surface by trying a .003" feeler gauge at each toe end, between slipper surface and arbor. Blade rods with open end slipper surfaces may be used providing a .003" feeler gauge cannot be inserted more than two (2) inches from each end of slipper when mounted on the 7.692" arbor. Close-in of the slipper surface is evidenced by ends having no clearance and slipper surface open. Rods may be used having closed-in slipper surface, providing a clearance no greater than .005" is obtained when measured any place between ends of slipper on 7.692" arbor.

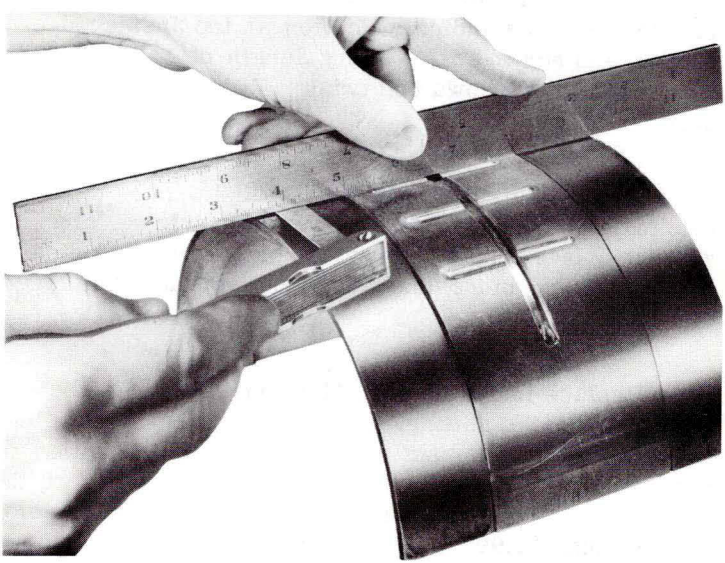
After adjusting indicator and placing rod in vertical position, set indicator button at top inside edge of saddle, and run indicator along length of saddle. Indicator deflection shows rod twist. Twist should not exceed .006".

Place indicator at bottom of saddle, note indicator reading. Check along length of saddle bottom, circumventing bolt holes, to check out of parallel. Indicator must not show more than .004" deflection along length of saddle.

Replace indicator on 1.4126" gauge plate and check indicator dial "0" setting. Slide indicator button off block to bottom of saddle and note deflection. Deflection or reading must not exceed .010" to allow re-use of the rod, to give a generated rod bore centerline dimension not less than 22.990". A .021" indicator reading shows the rod bore centerline dimension of 22.979", which scraps the rod.

7. Checking Connecting Rod Bearings

The connecting rod bearings should be checked for out-of-round 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. Tighten basket capscrews to 175 foot-pounds torque and measure across the bearing bore at points 60° apart. This is similar to the procedure used on checking fork rod basket bore, Fig. 3-5. The average of these three readings must not be less than is necessary to insure a clearance between crankpin journal and bearing of at least .006", or a maximum of .015". A maximum out-of-round of .006" must not be exceeded. It is permissible to tap the basket with a soft mallet in order to maintain the out-of-round limit. After operation, rod bearings may give indication of being tight across the split line when loose on the crankpin. However, rod bearings in-



Checking Upper Connecting Rod Bearing Shell
Fig. 3-7

tended 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. 3-7. This will indicate blade rod bearing surface wear. Step thickness should not be less than .027".

Bearing shells showing indication of scoring must be replaced.

8. Piston Pin and Carrier Limits, Inspection and Cleaning

The currently used three piece carrier, using the bearing insert and polished piston pin and the prior used two piece assembly having a polished bore and using a bearing type piston pin is shown in Fig. 3-8. The parts of these two assemblies are not interchangeable. However, either complete assembly may be applied in a piston and the piston assemblies installed in the same engine.

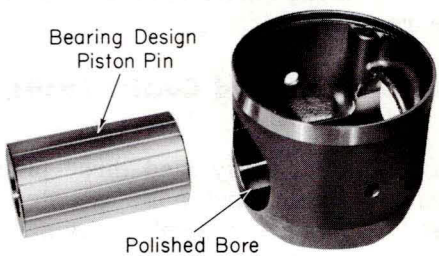
It is recommended that the piston pin and carrier assemblies be cleaned using a high flash point petroleum solvent, such as Stoddards solvent 140° F. flash point or equal. These parts should never be washed in alkaline or caustic water solution.

No abrasive material of any kind, nor steel wool, should be used to clean the bearing insert, piston pins or polished pin bore of the carrier. Clean the carbon from the oil grooves in the insert and piston pin using 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.

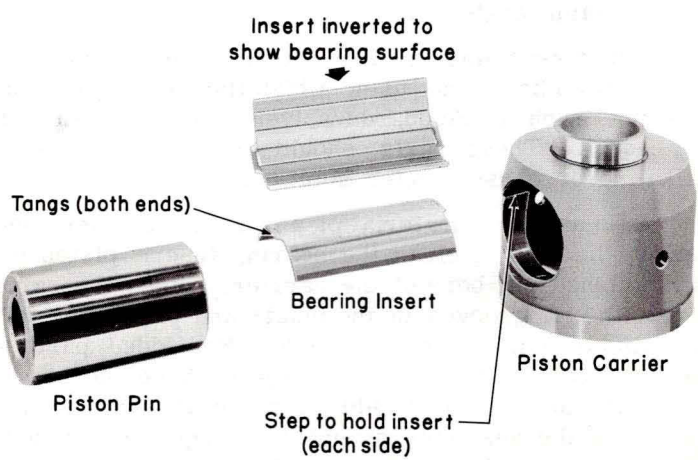
Fretting on the pin, only where it contacts the connecting rod, may be removed using a fine stone. Clean the 7/8"-14 bolt threads in the pin by re-tapping. If the threads are damaged, replace the pin.

a. Three piece, carrier, bearing insert and polished piston pin assembly.

In this assembly, Fig. 3-8, a broached slot or recess in the carrier, receives a precision, steel backed, silver bearing insert having a lead overlay. A hardened polished piston pin runs against the bearing insert.



Two Piece Piston Pin And Carrier



Three Piece Carrier Insert And Piston Pin

Piston Pin And Carrier Assemblies
Fig. 3-8

The bearing insert is installed in the carrier by centering the insert so that the slotted tang, when bent into the carrier counterbore, will prevent endwise movement of the insert. Carefully wipe out the insert slot in the carrier. Also, examine the insert to make sure it is clean. Apply the insert by entering it at one end of the carrier slot, and sliding it along the carrier bore. Center the insert so that the tang slot when bent will be adjacent the counterbore of the carrier. Using a pointed, but not sharp, tool having about a 1/16" radius at the center of the tang, strike the tool with a sharp blow, so as to bend the tang into the carrier counterbore.

Primary bearing wear does not affect the carrier. Maximum permissible wear on the insert, piston pin and carrier pilots are given under specifications at the end of this section. Used parts in good condition may be interchanged. However, a new bearing insert should be used when a new unworn piston pin is used. The piston pin should always be applied in the same relative position to the carrier 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, the bearing insert need not be removed for measurement unless its appearance is questionable and/or the wear on the piston pin is well advanced.

b. Bearing Piston Pin and Carrier Assembly, Fig. 3-8.

Piston pins used with this assembly have six oil grooves, and silver bearing surface having a lead overlay. (Original bearing piston pins had thirteen oil grooves and may also be used if within specifications.)

A piston pin should be retained with its original carrier as long as possible. The carrier pin bore to

platform dimension is the limiting factor in determining if a carrier may be reused. If the original pin and carrier are used together in the same relative position, .010" more wear is permissible. (The hole in the end of the piston pin is matched with the piston cooling oil inlet hole in the carrier as a convenient means of keeping the pin and carrier in the same relative position for maximum performance.)

The piston pin minimum diameter is 3.678". Flaking of the bearing surface of the piston pin is the cause for rejection.

Limits of the bearing piston pin and carrier assembly are given in the following. Measurement of carrier bore wear is to be made by measuring distance from top of carrier bore to platform face, each side.

Carrier - top pilot diameter	Min. 3.557"
Carrier - bottom pilot diameter	Min. 7.480"
Carrier height (platform to bottom)	Min. 5.992"
*Top of pin bore to platform	
a. When re-using same pin	Min. .690"
b. When interchanging pins or using new pin	Min. .700"
Top of pin bore not parallel to platform face	Max. .003"

*These limits assume no wear on carrier platform. If carrier height (5.997" New) indicates platform wear, the amount of wear can be subtracted from the .690" or .700" dimension accordingly. For example:

Example #1 - When re-using old pin.

Carrier height	5.997"

Top of pin bore to platform	
One side	.691"
Opposite side	.693"
Pin bore to platform out of parallel	.002"

In this case the carrier height of 5.997", indicates no wear on platform, so no correction need be made to the .691" or .693" dimension. The difference between the pin bore to platform measurements (.002") is less than the maximum of .003" allowed. The .691" measurement is above the minimum (.690") dimension between top of pin bore and platform. Carrier can be re-used only if same pin is re-used.

Example #2 - When using new pin.

Carrier height	5.994"
Top of pin bore to platform	
One side	.698"
Opposite side	.698"
Pin bore to platform out of parallel	.000"

In this case the carrier height of 5.994", indicates .003" wear on the platform, so .003" can be subtracted from the .700" limit, resulting in .697". There is no out of parallel condition and the .698" measurement is .001" above the low limit (.697" compensated) for the carrier pin bore when using a new pin.

For carrier Magnaflux instructions see Maintenance Instruction 1754. For other piston carrier dimensions and limits see Specifications at end of this section.

9. Removing and Installing Piston Rings

Use piston ring expander 8194036 when removing or installing rings. See Fig. 3-9. This tool prevents twisting or over expanding which distorts the ring. New

Removing Piston Rings
Fig. 3-9

rings should be used on each piston installation, to insure quick seating and avoid difficulties caused by damaged rings. Used rings once disturbed may not "seat-in." After new rings are applied, engines should be worked hard to aid ring seating.

10. Piston Inspection

Limits are listed under specifications at end of section. See Fig. 3-10 for Piston and Ring Clearances.

Pistons that have been found dimensionally and structurally satisfactory for reuse, should also have the heat dam area thoroughly cleaned of undercrown deposits. Undercrown deposit cleaning should be accomplished using a sand or grit blast cleaning in conjunction with liquid cleaning. Maintenance Instruction 1759 outlines a recommended procedure and details of construction of a fixture for the grit blast cleaning of pistons.

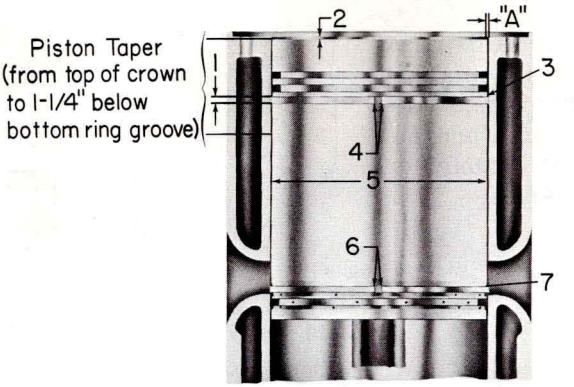
a. Check piston for cracks. For Magnaflux instructions, see Maintenance Instruction 1754.

b. Measure piston diameter 2" below the compression ring grooves and below the oil ring grooves. Take two readings at each location 90° to each other.

c. Measure thrust washer thickness.

d. Check clearance of carrier retainer snap ring to piston carrier.

e. Check ring groove wear step.



1. Compression and oil ring groove width	New .251" - .254"
Maximum width using standard rings	.260"
Maximum wear step on ring groove lower face	.003"
#1 compression ring may be recut for (see text):	
1/64" Oversize width rings .266" + .003" - .000"	Max. width .275"
1/32" Oversize width rings .282" + .003" - .000"	Max. width .291"
2. Piston to cylinder head clearance (see text) (All 567 series except 567CDF - dual fuel)	New Min. .026" Max. .068"

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

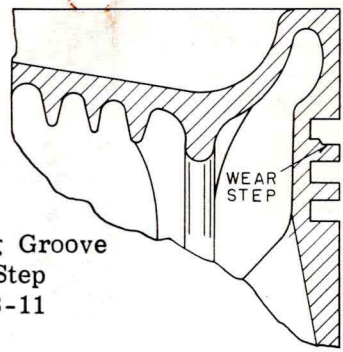
3. Compression ring to land clearance

Ring	8263017	8235299-8257707	8166641
New clearance	.004" - .008"	.008" - .012"	.004" - .008"
#1 ring groove - Max.	.014"		.014"
#2 and #3 ring groove - Max.		.014"	.010"

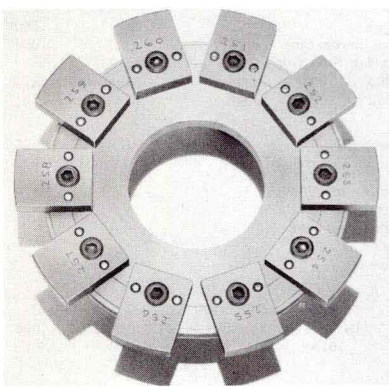
4. Compression ring gap in 8.500" liner	New Min. .035" Max. .045"
Condemn ring - chrome face	When chrome is worn through
ferrox	When worn to bottom of ferrox groove
5. Piston diameter (.005" out-of-round permissible)	New 8.488" - 8.490" Min. 8.485"
6. Oil ring gap in 8.500" liner	New .015" - .025" Max. .070"
7. Oil ring to land clearance	New .002" - .006" Max. .010"
Piston to liner clearance	
"A"	New .0485" - .0525"
When measured 6" below top of liner, except at liner ports	New .0095" - .0135" Max. .018"

Pistons And Ring Clearance
Fig. 3-10

NOTE: Reworked ring grooves should have 1/32" top and bottom radii and 45° × .015" chamfer on land edges.



Piston Ring Groove
Wear Step
Fig. 3-11



Wear Step
Measure Gauge
Fig. 3-12

Check wear step on ring groove lower face. See Fig. 3-11. Top ring breakage is usually the result of excessive wear step. The maximum wear step allowable on any 567C engine piston ring groove land is .003".

Wear step gauges such as the standard gauge 8225256, Fig. 3-12, are available to make the wear step measurement. Gauges also are available for measuring wear step in the oversize ring grooves. Each gauge consists of a number of separate width indicators precise to .001". Gauge 8225256 has indicators from .251" through .260". See Tool Catalog for gauge numbers.

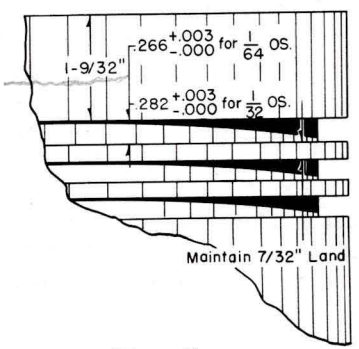
To measure wear step, it is first necessary to determine the original ring groove width, because it may vary from .251" to .254". By trial, insert gauge blocks in ring groove to determine which one enters its full depth. This will show the original width to be the dimension of that particular gauge block. Then insert

largest block that will enter groove up to the wear step. By subtracting the smaller block dimension from the largest one to enter, the wear step is determined.

When step wear greater than .003" is found on the lower face on the top compression ring groove, the groove may be recut to remove the wear step, provided the finished width does not exceed .260" when finished for use with a standard ring.

If the ring groove is worn beyond a width of .260", it is possible to machine the top ring groove to use a 1/64" or 1/32" oversize ring. For condemning limits see Figs. 3-10 and 3-13.

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 center line of the piston. The surface finish must be smooth to avoid excessive wear.



Ring Groove
Oversize Dimension
Fig. 3-13

Pistons and ring oversizes are available. For details see the Parts Catalog. For return of pistons for reconditioning, consult Factory Rebuild Service Bulletin #308.

11. Assembling Piston and Rod

Assemble connecting rod, piston pin and carrier. (For insert application to carrier see Item 8.) Examine all surfaces for smoothness and cleanliness. Oil pin and carrier before placing pin in the carrier. (Install piston pin so hole in pin end is matched with the piston cooling oil inlet hole in the carrier.) Insert piston pin in carrier, and manually oscillate pin while moving it slowly across the carrier to check fit freeness. Place the connecting rod on the pin and apply the connecting rod to piston pin bolts. Place assembly in holding fixture 8236589 to

torque bolts. (If fixture is not available, place rod in vise with pin close to vise and torque in vertical plane.) Torque value of rod to pin bolts is 400-450 foot-pounds. To torque saddle rod pin bolts, a 300 foot-pound torque wrench 8157121 is used with an extension 8210136. One end of extension with plug and socket fits bolt head and 3/4" torque wrench drive is inserted at other end. To torque bolts to 450 foot-pounds, a torque reading of 300 foot-pounds is required using the extension. When lockwiring bolts after assembly, lockwire is twisted at bolt head, but not where wire passes over the rod. Use lockwire 8116933 (200 foot roll) which is approximately .072" in diameter. Pin bolts now have three lockwire holes to facilitate assembly.

When assembling rod and carrier, the piston cooling oil hole in the carrier must be on the same side as the dowel pin in the serrations of the fork rod and on the opposite side to the "long toe" of the blade rod. This will assure proper position of the hole when assembly is installed in the engine.

Oil surfaces, place thrust washer on piston platform, and apply carrier and rod assembly. Install piston snap ring and rotate carrier in piston to check freeness. Check snap ring to piston carrier clearance.

12. Installing Piston and Rod

Before installing piston and rod, the liner should be serviced as outlined in Section 4.

a. Set piston ring compressor and guide 8034087 standard size (8065452 - .030" O.S., 8065453 - .060" O.S.) in place on cylinder liner. Oil cylinder wall, ring compressor and piston. Place crankpin on bottom center.

b. Apply connecting rod boot, then lower assembly into liner, using eye bolt in piston crown. Be

sure piston cooling oil hole is positioned to outboard side of engine, on same side as short toe on blade rod and dowel in serration of fork rod.

c. Suspend piston and rod assembly and prepare connecting rod bearing for application. Oil inside and outside of bearing shells and install upper bearing in position on crankpin.

d. Lower blade rod to rest on upper bearing. Remove eye bolt from piston and apply to fork rod piston. Apply boot to fork rod and lower rod to bearing. Check fork rod dowels that they enter bearing dowel holes without binding. Remove piston eye bolt.

e. Apply lower bearing to doweled basket half and install basket half to fork rod, tightening basket to fork rod capscrews just sufficient to mesh the serration and hold the bearing in place. Then apply other basket half to fork rod, tightening rod capscrews to mesh the serrations.

When applying the fork rod baskets be sure that the serial number on prong of dowel half is on the dowel side of the rod. Current assembly basket halves without dowel holes have the serial number at the bottom, making it easy to spot misapplication of this basket half to the dowel side, if applied.

If fork rod 5/8"-18 tapped holes are damaged or give a loose fit with the capscrew, replace the fork rod.

f. Apply the three 1/2" lower basket bolts, washers and lock nuts. Torque value of these bolts is 75 foot-pounds.

NOTE: Current lower basket bolts 8259128 and hardened washers 8260114 replace prior used parts. The

new bolt can be identified by a shoulder at the head end. Service and replacement of these split line bolts should be as follows:

(1) Whenever an engine is overhauled or basket bolts are removed, replace the old style bolts and washers with the new parts.

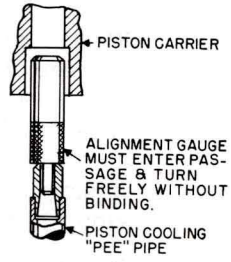
(2) Every time the split line basket bolts are removed, replace the lock nuts.

(3) Until such time as the old style bolts are replaced, it is suggested that they be checked for tightness at monthly inspection. If found loose replace with current bolts, nuts and washers.

g. Complete basket to fork rod capscrew application by tightening to 190-200 foot-pounds torque, and apply lockwire. Retighten assembly according to the Scheduled Maintenance Program.

h. Install cylinder head as outlined in Section 2.

i. Install piston cooling oil pipe and check alignment. Use piston cooling pipe gauge 8071720, Fig. 3-14. Insert small end of gauge in "Pee" pipe. Turn crankshaft slowly to bring piston to its lowest position. At same time rotate gauge by hand to make sure it does not bind in hole. If gauge indicates misalignment, replace pipe assembly. Do not use gauge to align pipe. Piston cooling "Pee" pipes should be checked before application, with cleaning tool 8087086.



"Pee" Pipe Alignment
Fig. 3-14

13. Piston to Cylinder Head Clearance

The piston to cylinder head clearance governs to a great extent the efficiency of the engine and should be maintained within specified limits for best operation. In addition, if regular inspections are made, piston to head clearance may be used as an indication of wear in the parts of the piston and connecting rod assembly. Recorded or charted clearance readings will aid in the prevention of serious trouble from excessive wear of parts, as their condition will be indicated by comparing the successive piston to head clearance.

The engine records that are furnished include piston to head clearance readings taken at the time of manufacture. Such readings are listed for each cylinder and should be checked against subsequent readings that are taken to determine condition of the assembly. By recording the original and each successive reading in its proper place on a chart, a definite condition of the parts will be shown. Readings of the piston to head clearance may also be started on reinstalled piston and rod assemblies, by taking the clearance of the newly installed assembly.

It is recommended that compression lead readings be taken on all cylinders at intervals specified in the Scheduled Maintenance Program. More frequent inspections should be made on assemblies which show excessive or dangerous rates of increase in the clearance.

The following method is recommended to obtain the piston to head clearance. Rotate the crankshaft to place the piston to be checked at bottom dead center. Place a 1/8" soft lead or solder wire shaped to the contour of the piston crown, with the ends of the wire not over 8-1/4" apart, on top of the piston, through the liner ports. Position the lead wire directly above the piston pin parallel to the engine crankshaft. The engine is then

barred over one revolution and the wire removed and both ends measured with a micrometer. The clearance reading will be the average of the two measurements taken. If the difference between the two ends of the wire is more than .005", the clearance should be rechecked as the wire may have rotated on the piston to be at right angles to the piston pin.

The time necessary for taking readings on an engine may be lessened considerably with a saving of wire by using wire holder 8243220 and wire as listed in the Equipment List. Also, observing the location of various pistons as crankshaft is rotated, will enable all readings to be taken in two revolutions of the crankshaft.

The limits of piston to head clearance on a new engine only are .026" minimum and .068" maximum; with the readings on the average engine about .040" to .055". The condemning limits of piston to head clearance is .030" over the original assembly piston to head clearance. The limit of .030" also applies to cylinder assemblies applied in the field and leaded as outlined. When a gain of .030" is reached, the parts of the assembly should be removed and checked, replacing the worn parts. However, any sudden increase in lead reading should be investigated. The condemning limits of various individual parts of the assembly govern their respective replacement. These limits may be found under Specifications of this Section.

In conjunction with the piston to head clearance, the snap ring clearance should also be checked. If it is found that the piston to head clearance is within the .030" limit, but the snap ring clearance is at, or sufficiently near, the condemning limit, the piston assembly should be removed and the piston thrust washer checked.

C. SPECIFICATIONS

Connecting Rod:	
Fork rod and basket bore	New 7.624" - 7.625" Max. - See Text

Bearing seat diameter of blade rod	New 7.692" - 7.693"
Clearance between shoulder on blade rod and counterbore in fork rod	New .008" - .012" Max. .025"
(This measured by placing feeler gauge between the blade rod and top of upper bearing.)	
Depth of counterbore from bearing bore to counterbore	New .385" - .3865" Max. .400", provided the above .025" max. clearance is held.
Thickness of shoulder on blade rod	New. .3445" - .346" Min. .335", provided the above .025" max. clearance is held.

Connecting Rod Bearings:

Bearing inside diameter (Average of three 60° measurements)	New 6.5066" - 6.510"
Bearing to crankpin clearance	New .007" - .011" Max. .015"
Bearing shell step height	New .030" - .031" Min. .027"
Bearing shell thickness	New .5587" - .5595"
Minimum wall thickness	Standard - .5530" Undersize 1/32" - .5686" Undersize 1/16" - .5843" Undersize 3/32" - .5999" Undersize 1/8" - .6155"

Piston (trunnion design)	
Number of compression rings	3
Number of oil control rings	2
Piston and ring wear	See Fig. 3-10
Piston skirt diameter	New 8.488" - 8.490"
	Min. 8.485"
Piston platform bore (upper pilot for carrier - check 2 places 90° to each other)	New 3.565" - 3.567"
	Max. dia. 3.570"
Piston inside diameter (lower pilot for carrier - check 2 places 90° to each other)	New 7.487" - 7.490"
	Max. dia. 7.496"
Clearance - piston to carrier pilot (upper and lower)	New .003" - .007"
	Max. .011"
Piston platform to bottom of snap ring groove	New 6.376" - 6.380"
	Max. 6.387"
Carrier (trunnion design)	
Carrier height (top at platform to bottom of carrier)	New 5.997"
	Min. 5.992"
Carrier top pilot diameter	New 3.560" - 3.562"
	Min. 3.557"
Carrier bottom pilot diameter	New 7.483" - 7.484"
	Min. 7.480"
Clearance - carrier to piston snap ring	New .002" - .012"
	Max. .025"
Carrier pin bore condemning limit (carrier without insert)	See Maintenance Item 8, b in Text
Carrier bearing insert thickness (carrier with insert)	New .150" - .151"
	Min. .146"
Piston pin (trunnion design)	
Piston pin diameter	
Polished steel pin design	New 3.684" - 3.685"
	Min. 3.664"
Grooved, silver-plated pin design	New 3.681" - 3.682"
	Min. 3.678"
Thrust washer (trunnion assembly)	
Thickness	New .185" - .188"
	Min. .175"
Thickness variation	Max. .003"

D. EQUIPMENT LIST

	Part No.
Piston pulling eye bolt	8040413
Fork rod boot	8062034
Fork rod holding tool	8052958
Blade rod boot	8062033
Snap ring pliers	8171633
Motor driven flexible shaft buffer 115 V.	8084282
Motor driven flexible shaft buffer 230 V.	8084283
Piston ring expander	8194036
Piston ring guide (standard size)	8034087
(.030" oversize)	8065452
(.060" oversize)	8065453
Piston cooling "Pee" pipe alignment gauge	8071720
Piston cooling "Pee" pipe cleaning tool	8087086
Connecting rod checking fixture	8257730
Piston wear step gauge	
Standard (.251" - .260")	8225256
1/64" Oversize (.266" - .275")	8275378
1/32" Oversize (.282" - .290")	8225257
Extension (used with torque wrench 8157121)	8210136
Carrier, pin-rod, assembly and disassembly 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., used with holder 8243220 or alone 5 lb. spool)	8243661
Wire (lead, 1/8" dia. - 50 lb. spool)	8136471

0.251" — 0.254"

$$0.251'' = \begin{cases} 6,350 \\ +0.025 \\ \hline 6,375 \text{ mm} \end{cases}$$

$$0.254'' = \begin{cases} 6,350 \\ +0.102 \\ \hline 6,452 \end{cases}$$

25.4
7.14
32.54