

SERVICE INSTRUCTION

DATE: November 24, 1967

Service Instruction No. 1047B
(Supersedes Service Instruction No. 1047A)
Engineering Aspects are
FAA (DEER) Approved

SUBJECT: Inspection and Reconditioning Procedures for Nitride Hardened Steel Cylinders

MODELS AFFECTED: All Avco Lycoming engines with nitride hardened steel cylinder barrels

TIME OF COMPLIANCE: During overhaul of the engine

Many Avco Lycoming engines are presently manufactured with cylinder assemblies that incorporate nitride hardened steel cylinder barrels. Because this cylinder barrel surface is hardened, the repair procedures are different from those for plain steel or chrome plated steel cylinders. Worn nitride hardened cylinder may be returned to Avco Lycoming to be rebuilt with new barrels.

NOTE

Nitrided cylinders are identified with blue paint in the fin area below the spark plug hole. See Service Instruction No. 1181 for complete color identification.

1. CYLINDER INSPECTION

a. Visual Inspection:- A visual inspection of the cylinder begins with observation of the top two inches of the cylinder barrel. It is in this area that the top compression ring may cause barrel wear at the point where the piston reverses travel at the top of the stroke; this appears as a "step" which may be measured and removed as described herein. In some cylinders, a small rough area may be found at either end of the barrel, extending less than .250 inch from the end. This condition is caused by manufacturing processes and has no effect on the quality or condition of the barrel.

b. Dimensional Inspection:- Dimensional inspection of the cylinder barrel is limited to the area within four inches from the bottom of the barrel. See figure 1. A bore gage, with three points of contact and fitted with a dial indicator is preferable to an inside micrometer for measuring the cylinder barrel. Dimensional inspection of the cylinder barrel should be accomplished in accordance with the following description which explains how an average measurement can be made, thereby avoiding extremes that can occur when only a single measurement is taken. The diagram, figure 2, illustrates the following description. To measure cylinder diameter:

(1) Measure diameter a and diameter b at 90° from each other, 4 inches above the bottom of the cylinder skirt.

(2) Add diameters a and b and divide the sum by 2 to obtain the average diameter.
for example: a = 5.1285
b = 5.1315

$$\frac{a + b}{2} = \frac{5.1285 + 5.1315}{2} = \frac{10.260}{2} = 5.130 \text{ in.}$$

To measure cylinder taper:

Determine average diameter at lower portion of the barrel as described above. Then determine average diameter at the top of the barrel (about 2 inches from the top). The difference between the two average diameters represent the average taper of the barrel.

$$\frac{a + b}{2} - \frac{x + y}{2} = \frac{5.131 + 5.132}{2} - \frac{5.1285 + 5.1315}{2} =$$

$$5.1315 - 5.13 = .0015 \text{ inch taper}$$

To measure cylinder out-of-round:

Subtract diameter a from diameter b; also subtract diameter x from diameter y. Add the remainders and divide by 2.

$$\frac{(a - b) + (x - y)}{2} = \frac{.003 + .001}{2} = \frac{.004}{2} = .002 \text{ in.}$$

taper

NOTE

When checking piston ring gap in nitrided barrels, make sure that the top compression piston ring, positioned at the top limit of its travel, has a gap of at least .0075 inch. See Table of Limits, Service Bulletin No. 268 for complete piston ring gap information.

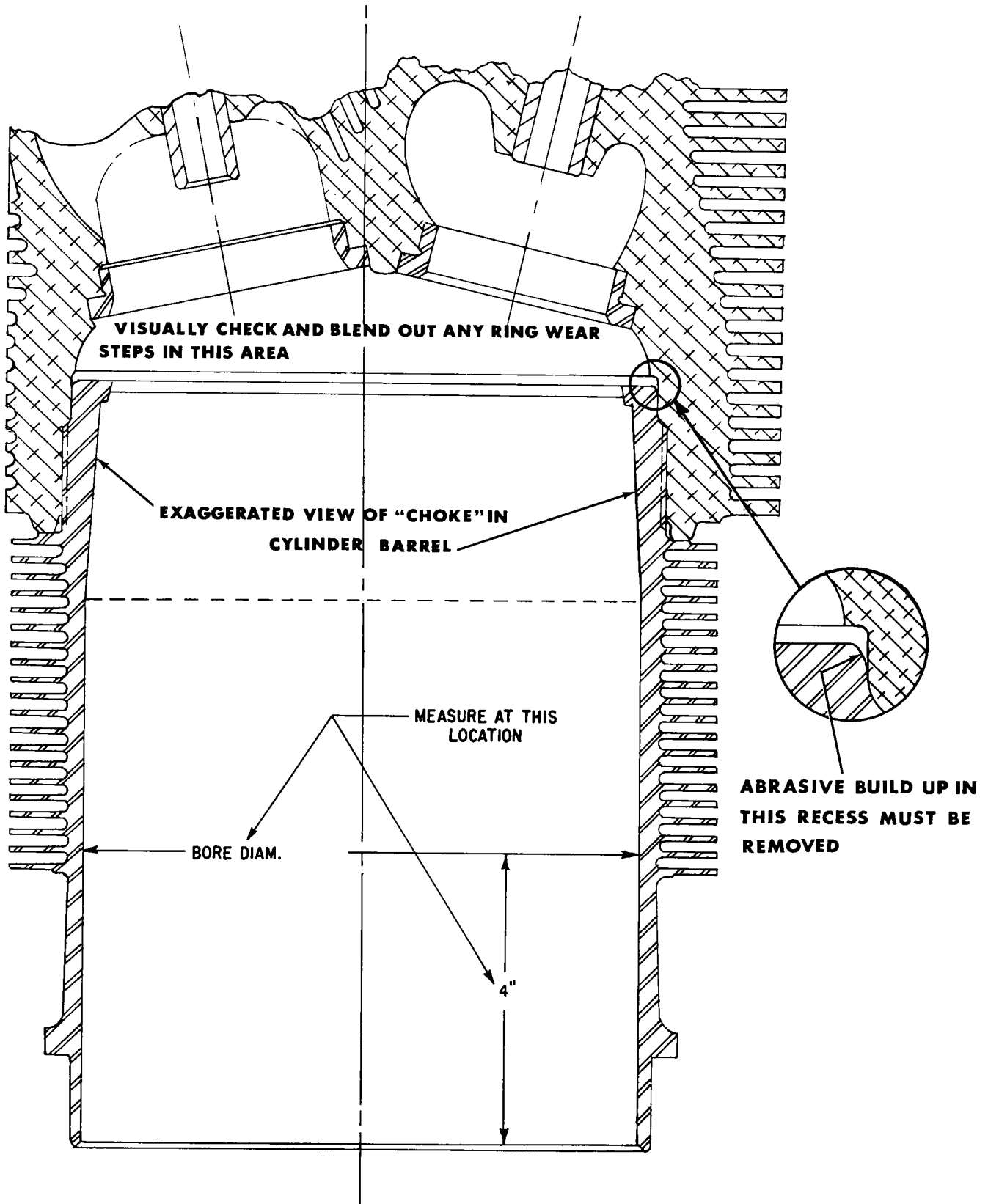


Figure 1. Section Through Cylinder Assembly Showing Locations for Checking Diameter and Removal of Wear Step

LIMITS FOR NITRIDED CYLINDER BARRELS

	For inspection of worn cylinders		For regrinding worn cylinders
	Minimum	Maximum	.010 o/s
4-7/8 inch diameter bore	4.8745	4.8805	4.884/4.886
5-1/8 inch diameter bore	5.1245	5.1305	5.1345/5.1370
Taper and out-of-round		.0045	.0025

2. REMOVAL OF CYLINDER BARREL GLAZE

If a nitride hardened steel cylinder barrel acquires a varnish or glaze on the wall surface, it can be removed by a self centering hone (Snap-O Tool Co. part no. CF-60C with CF-60C-1 abrasive cloth, or CF-60CS hone fitted with No. CF-61-12S medium grit stones - or equivalent.) The following is the procedure for glaze removal.

- a. Fasten cylinder securely in a suitable position for using the hone.
- b. Remove any hard carbon deposits within cylinder barrel and wipe out barrel with clean cloth.
- c. Dip a clean cloth, string mop or similar fabric in clean SAE 10 engine lubricating oil and swab cylinder wall surface with oil.

d. Install the deglazing hone in a low speed drill. Surface hone each cylinder using a minimum of 6 to 8 passes over glazed surface. Use a smooth up and down motion of the hone to achieve a good cross-hatch pattern on cylinder wall. The hones described above are self-centering and self-bottoming and will follow the choke in the top of the barrel. Use kerosene or light engine oil for lubrication while honing.

e. Clean hone and abrasive thoroughly before honing another cylinder.

f. When de-glazing procedure has been accomplished, wipe as much as possible of the abrasive build-up from cylinder walls and recesses. Pay particular attention to recess formed by top of cylinder barrel and bottom of cylinder head. Fabricate a hooked tool from soft wire and run the tool around in the recess to loosen build up of abrasive. This operation must be performed each time the cylinder is flushed. No abrasive must remain in this area. See figure 1. Proceed to clean cylinder as follows:

g. Flush cylinder thoroughly with a hydro-carbon solvent (Varsol or equivalent). Use solvent under air pressure. The use of a soft bristle brush is recommended in conjunction with flushing, to remove abrasive build-up in difficult to reach areas. Do not use a wire brush. At the conclusion of first flushing operation, wipe out cylinder with a clean white cloth, dipped in SAE 10 engine oil. Examine cloth carefully under a light for evidence of abrasive remaining in cylinder. If abrasive is found on the cloth repeat flushing operation.

h. After cleaning, oil the cylinder thoroughly with SAE 50 engine oil or rust preventive oil conforming with specification MIL-C-6529.

3. REMOVAL OF WEAR STEP

Since wear steps generally occur at a localized area at top and bottom of ring travel, a step with a depth of .0025 inch may be removed. The procedure for removal is the same as for glaze removal described in paragraph 2. If nitrided steel barrel contains a wear step exceeding .0025 inch in depth, the cylinder must be reground oversize or reconditioned by chrome plating, as described in paragraphs 4 and 5. Measurement of the wear step can be made by using the dial bore gage usually used for measuring cylinder diameter.

4. CHROME PLATING NITRIDE HARDENED CYLINDERS

When a nitrided barrel has worn beyond service limits it can be reconditioned at one of the approved

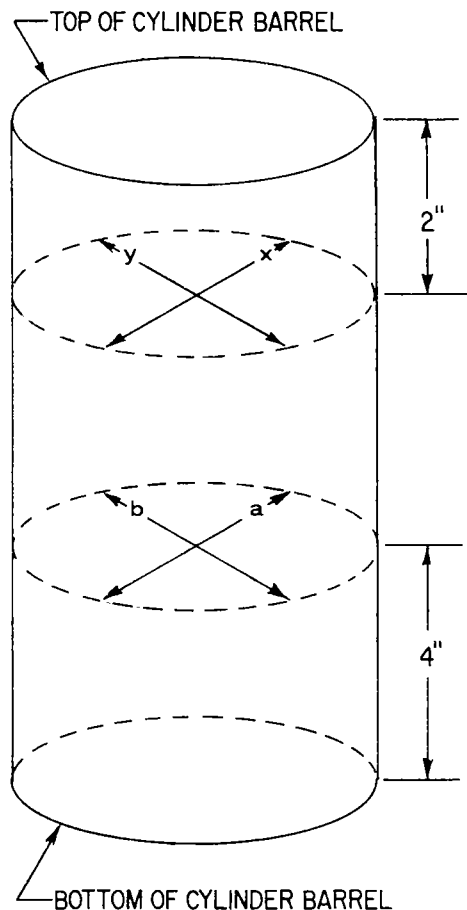


Figure 2. Diagram of Cylinder Barrel Showing Locations of Measurements

chrome plating facilities listed in Service Instruction No. 1054. Before plating to standard size, the cylinder bores are ground from .015 to .018 inch oversize.

5. REGRINDING NITRIDE HARDENED CYLINDERS

NOTE

The following procedure for regrinding nitride hardened cylinder barrels is restricted to low compression engines O-360-B, -D and O-540-B series.

Although the depth of the nitride hardened surface is determined during the manufacturing process, the hardness of the nitrided steel decreases quite rapidly beyond .005 inch from the surface. However, it is possible to remove as much as .010 inch from a nitrided barrel and still maintain a surface that is somewhat harder than an unhardened barrel. True, reground nitrided cylinder barrels are not equivalent to new cylinders; however, regrinding is comparatively inexpensive and the service life of the reground barrels has been found to be comparable to cylinders restored by plating or rebarreling. The regrinding operation may be performed as described in the Direct Drive Overhaul Manual. If possible, employ a profile grinding method that will retain the choke in the upper end of the barrel. In an engine that is being overhauled, if one or more cylinders require regrinding, all of the cylinders should be similarly reground. The dimensional limits for regrinding the cylinders are shown in the above table.

6. REASSEMBLY PRECAUTIONS

Replace the chrome plated piston rings used in nitrided cylinders with plain piston rings when going to chrome cylinders. Under no circumstances should

NOTE: Revision "B" to Service Instruction No. 1047 adds color code note; changes out-of-round and taper limit. Changes inspection procedure. Adds procedure for regrinding nitride hardened cylinder barrels.

13272 - 13179 - These numbers for Avco Lycoming reference only.

chrome plated piston rings be assembled in chrome plated barrels. When nitrided cylinders have been reconditioned by chrome plating, the color identification on cylinder head fins between shroud tubes must be changed from blue to orange. Also, certain compression piston rings, .010 o/s for use in .010 o/s cylinder barrels have a ring gap of only .025 inch. This is insufficient gap for cylinders with choke barrel. Therefore make sure to check for minimum ring gap as indicated at reference no. 615 in Table of Limits.

7. PRESERVATION OF ENGINES WITH NITRIDED CYLINDERS

The following preservation procedures are recommended for oiling and preserving engines removed from service.

- a. Remove top spark plugs. Start with cylinder No. 1 making certain that the piston is just at the bottom of the compression stroke.
- b. Fill the cylinder with preservative oil conforming to specification MIL-L-6529. If preservative oil is not available, use aviation SAE No. 30.
- c. Rotate crankshaft until piston is at top dead center. Oil will spill out of the spark plug hole. In order to preserve the top wall of the cylinder, it will be necessary to either rock the engine, or blow dry compressed air at a very light pressure into the spark plug hole.
- d. Following the engine firing order, preserve the remainder of the cylinders in the same manner.
- e. Replace top spark plugs, or install dehydrator plugs.