

THE WARNER AIRCRAFT CORPORATION  
20283 HOOVER AVENUE  
DETROIT 5, MICH.

Sheet No. 1  
No. of Sheets: 4

August 1, 1944

SERVICE LETTER A-15

**Subject:** Cylinder Attaching Studs - Proper Maintenance,  
Inspection and Assembly Procedure

**To:** All Owners of Warner Scarab 125 HP Engines  
All Owners of Warner Super Scarab 145 HP Engines  
All Owners of Warner Super Scarab Model 165 (165 HP) Engines  
All Authorized Warner Aircraft Service Representatives

**NOTE:** The instructions contained in this Service Letter supersede the instructions in Section III of Service Letter A-13, which herewith become obsolete.

1. Cylinder Stud Failures can be classified into two distinctly different groups:
  - (a) Breakage of the stud at the root of the 5/16 thread due to overstressing.
  - (b) Screwing or pulling of undamaged studs out of the crankcase due to tightening or loosening nuts while engine is hot.
2. Avoid overstressing of studs during assembly and periodic inspection as follows:
  - (a) When installing a cylinder, oil the thread on studs and tighten nuts with 200 inch pounds desired, 225 inch pounds maximum. Preferably use a torque wrench as outlined on Page 4, or the 10" long handle of Warner Wrench FA-33-A as a "T" handle, placing center of each fist approximately 3" from center of wrench not applying more than 35 pounds with each hand.
  - (b) During subsequent periodic checks, apply 180 inch pounds desired, 200 inch pounds maximum torque to cylinder attaching nuts.
  - (c) Insufficient tightness of the cylinder attaching nut is as detrimental as overstressing studs by overtightening. Insufficient tightness of these nuts is more often caused by the cylinder gasket continuing taking permanent sets, thereby losing the .002" to .003" stretch in the stud corresponding to the preloading. When this takes place, the stud is subjected to alternating loads leading ultimately to fatigue failures. Gaskets continuing to take permanent sets can be detected during regular inspections by the cylinder attaching nuts turning appreciably during periodic checks.

- (d) The dark colored fiber gaskets referred to in Service Letter No. A-13, Section III, Paragraph (3) are fiber gaskets with a thin synthetic rubber coating on each side, called HyCar. These gaskets are approximately .015" thick and due to the coating, take a permanent set. Therefore, they must be replaced by the latest plain fiber gaskets which are approximately .010" thick and blue in color. For identification purposes, the following new part numbers have been assigned:

Engine Model	Part No. New Gasket (.010 Thick)	Replaces Old Gasket No.
Scarab 125 HP	10717	7153
Super Scarab 145 HP	10718	7520
Super Scarab 165 HP	10719	8027

- (e) Following the installation of new cylinder gaskets, the cylinder attaching nuts should be checked after 20 hours of service.
- (f) If a failure of several studs occurs on a cylinder pad, all studs on the pad should be replaced due to the old studs having been overstressed.

3. During overhauls inspect studs as follows:

- (a) With a magnifying glass, carefully inspect the lower end of the 5/16" thread for reduction in diameter and increased pitch of the thread due to stretching. Even on stretched studs there are no Magnaflux indications up to the failure itself.
- (b) On engines which have been used extremely severely or serviced improperly or which have been subjected to severe vibrations in the operating range due to improperly attended motor mounts, all cylinder base studs should be replaced during major overhauls.
- (c) On engines built prior to 1942, it is advisable to check for hardness of cylinder studs by examining the protruding end of the stud. If they do not show the small circular impression left from the Rockwell test at the factory, check at the top end of the stud only with a fine cut Swiss file. Soft studs will nick more readily than properly hardened studs.
- (d) Inspect studs for being partially pulled or screwed out of the crankcase. They should protrude 23/32" plus or minus 1/64".

4. When replacing cylinder attaching studs in a crankcase, observe the following:

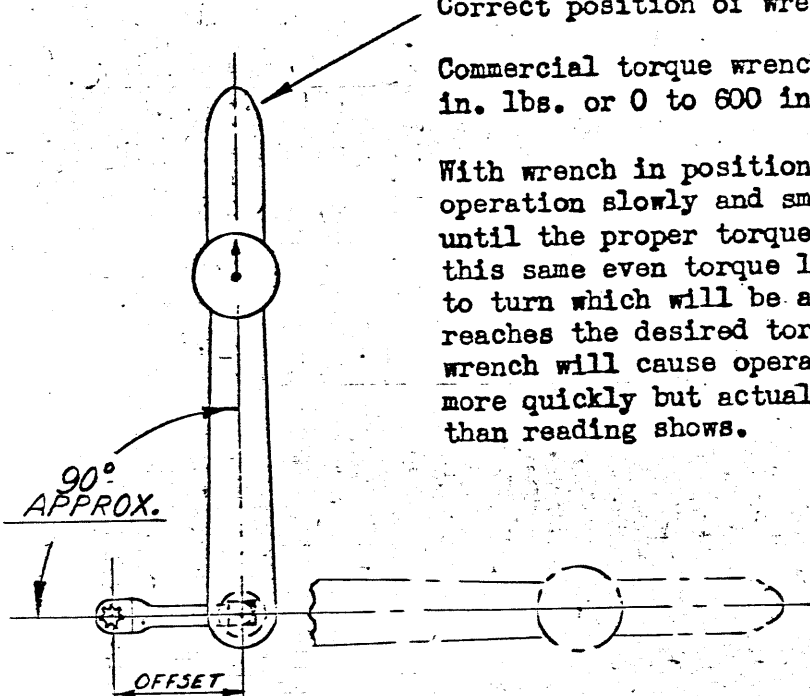
- (a) If the thread in the crankcase is not damaged, a stud with a .003" to .005" larger pitch diameter of the 3/8-24 thread than standard (Warner Part S-506-0) by the old oversize part designation, S-506/.005 by the new designation) must be installed as follows:

- (1) With an 11/32" diameter drill or ream in a tee-handled tap wrench, enlarge the minor diameter of the thread in the crankcase to provide clearance at the root of the thread on the stud, then clean out the burrs in the thread with a standard pitch diameter 3/8-24 tap.
  - (2) The studs can be installed by tightening two 5/16" nuts on the stud against each other with a maximum torque of 200 inch pounds, then turning the stud by means of the upper nut to install, and the lower nut to extract. Where studs are set regularly, stud drivers should be used. The torque for installing studs in crankcases must be within 50 and 150 inch pounds and a torque wrench is recommended for setting studs.
  - (3) If regular oversize studs are found to require more than the permissible torque to install, reduce the PD of the 3/8 thread by dipping in a cold 3-1/2% aqueous solution of nitric acid (5 cc of concentrated 70% nitric acid in 95 cc of water, which can be purchased from any drug store) as follows:
    - a. Dip the stud in solution for not more than one minute. This will decrease PD approximately .0005" to .0006".
    - b. Rinse repeatedly in water to remove all traces of acid.
    - c. Give etched thread a fine wire brushing.
    - d. Try again for torque and if found high, repeat the operation. The total etching time should not exceed 3-1/2 minutes.
  - (4) If oversize studs are not available, a standard stud can be converted into an oversize stud by having the 3/8 thread only cadmium plated approximately .0020 to .0025 thick in order to make the thread oversize. Care must be taken to clean these studs after plating to avoid accumulation of the plating on the edges. Furthermore, if after this plating it is found that the torque limit given above is exceeded when trying to install the stud, the plating can be reduced by dipping the plated end of the stud in cadmium stripping solution containing 10 grams of chromic acid, 3 cc concentrated sulphuric acid, and 100 cc of water. Dipping a stud in this solution for one minute removes approximately .0015" from the PD. Do not dip longer than for one minute. After the final dip, rinse in running water to remove all traces of acid.
- (b) If the stud has been pulled so that the thread in the crankcase is damaged, the hole must be drilled out with a 25/64" drill and the hole must then be tapped 7/16-20 using a ground tap. The PD of the tap should be .4050-.4063, which corresponds to No. 4 tolerance. If only No. 3 tolerance taps are available, the PD of the tap must be measured and a tap used which corresponds to the above PD limits. Oversize shoulder studs S-506-OS, according to the old oversize designation, or S-506/.062, according to the new oversize designation, must be installed, which stud has a 7/16-20 thread instead of the 3/8-24 thread at the large end.

Correct position of wrench (90° to offset).

Commercial torque wrench. Range of dial 0 to 300 in. lbs. or 0 to 600 in. lbs.

With wrench in position shown perform the tightening operation slowly and smoothly without interruption until the proper torque has been applied. Maintain this same even torque load until the part has ceased to turn which will be a few seconds after indicator reaches the desired torque reading. Jerking of the wrench will cause operator to reach the torque reading more quickly but actual torque applied will be less than reading shows.



90° APPROX.

Wrong position of wrench (in line with offset)

FIGURE 1

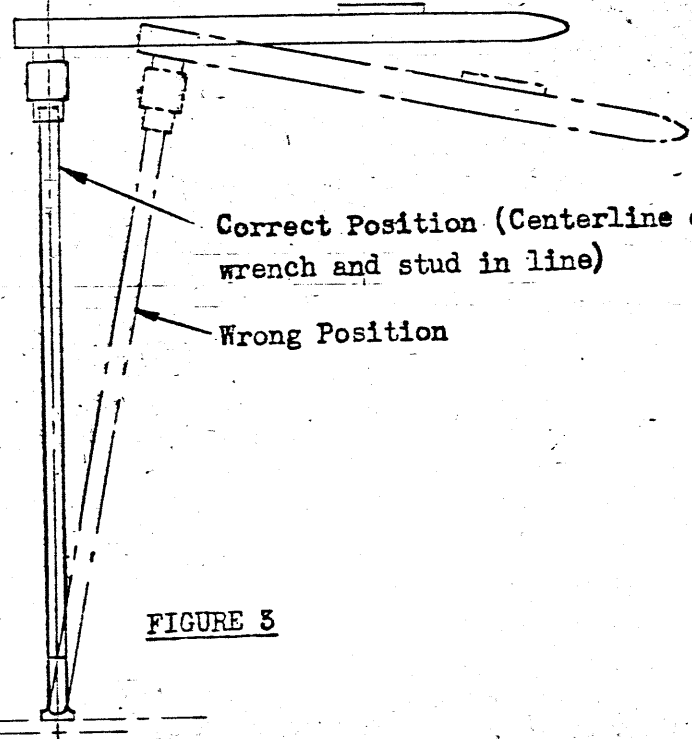
If it is desired to use a torque wrench with FA-33-A wrench grind upper end of wrench to a 1/2 square and use suitable adapter between this wrench and torque wrench.

STUD



Warner FA-33-A or equiv.

FIGURE 2



Correct Position (Centerline of wrench and stud in line)

Wrong Position

FIGURE 3