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September 14, 1943

ENGINES AND MAINTENANCE PARTS

GENERAL—PREPARATION OF ENGINES FOR STORAGE

This Technical Order replaces T. O. Nos. 02-1-1, dated September 8, 1942, and 02-1-1B, dated March 23, 1943.

NOTE The provisions of T. O. No. 00-20A will be complied with in this case, these instructions being entered on AAF Form 60-B and AAF Tag Form 83 for the engine affected. The work directed herein will be accomplished by depots, sub-depots, and service activities at the times specified with no exceptions or deviations permitted without express authority from Headquarters, Air Service Command, Patterson Field.

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Section 1

INTRODUCTION

1. RESPONSIBILITY.

a. Treatment. - It will be the responsibility of the Maintenance Division of each Air Service Command activity to accomplish the work of preparing engines for storage at their respective station or activity when an engine requires preservation. The work of preparing engines for storage will be construed as the full and complete preparation including the sealing of the engine envelope around the engine and the placement of the cover on the engine box; however, if the required materials to accomplish this work are not available, the Supply Division will accept the engine for storage in the Supply Warehouse with the preparation

completed to the greatest extent possible. When material becomes available, preparation of the engine for storage will be completed by the Engineering Department.

b. Re-treatment. - Within the continental limits of the United States, the Commander of the Air Service Command in whose area a given Air Service Command storage depot is located, will be responsible for constant care of the engines in storage. Sufficient personnel, adequately trained to inspect and to re-treat engines for storage, will be made available to each Air Service Command storage depot in which engines are stored. The engine storage re-treatment personnel will be permanently assigned or make periodic visits, depending on the quantity of engines in any one location.

c. Inspection and Movement.

(1) It will be the responsibility of the Maintenance Division to conduct periodic inspection of aircraft engines in Air Service Command storage and re-treat them for storage as directed by this Technical Order.

(2) When movement between warehouses, shops, etc., is necessary for the preparation of engines for storage, the Supply Division will accomplish the moving.

2. HISTORY OF TREATMENTS.

a. Upon completion of treatment for storage, the following note "Prepared for Storage - T. O. No. 02-1-1," followed by the date, and by whom, will be entered on AAF Form 83 and Form 60-B, history of engine, which will remain with the engine.

b. Entries will be made on these Forms each time the engine is re-treated to provide a complete record, including the dates of such protective treatments.

3. PROTECTION BY DEHYDRATION.

Aircraft engines are protected from corrosion by corrosion-preventive mixture and by removal of the moisture by use of silica gel. The envelope acts as a moisture barrier. The silica gel is used to absorb any moisture that may be enclosed within the envelope. If the relative humidity is maintained at a low level (less than 30 percent) corrosion may be avoided. The humidity indicator is used to determine when humidity limits have been exceeded.

4. TRAINING FILMS.

The following films covering engine preparation for storage as described in this Technical Order are available for use by the activities. These are 16-mm prints with sound effects and may be obtained from Maintenance Data Section, Air Service Command:

a. T.F. 1-728 "Preparation of Engines for Storage - Preservation"

b. T.F. 1-729 "Preparation of Engines for Storage - Re-treatment"

Section 2

PREPARATION OF SERVICEABLE ENGINES NOT INSTALLED IN AIRCRAFT

Paragraph Page

5. ENGINES REQUIRING TREATMENT.

Serviceable engines not installed will be treated as described herein after completion of the block test, except those which will be installed and operated in aircraft within 48 hours.

6. SHUT-DOWN PROCEDURE.

a. At the end of the final acceptance test or block test, the engine will be operated on grade 65 fuel, Specification No. AN-VV-F-756, at idling speed and low power (not to exceed 50 percent power) for a minimum of 15 minutes. Prior to the 15-minute run and immediately after block test the lubricating oil will be drained from the engine. If oil-in and oil-out lines are disconnected, it will be necessary to preoil the engine as described in T. O. No. 02-1-22 to avoid air locks in the oil lines. During the 15-minute run the lubricating oil inlet line will feed from the auxiliary oil tank containing the specified mixture of one part corrosion-preventive compound, Specification No.

AN-VV-C-576, to three parts of lubricating oil, Specification No. AN-VV-O-446. The inlet temperature will be maintained at such a value as to produce a crankcase outlet oil temperature of 104.4°C (220°F) to 121.1°C (250°F) where possible. The corrosion-preventive mixture may be used for 10 engines only, following which the system will be thoroughly drained and replaced with fresh mixture. Following the use on each engine a sufficient quantity of make-up corrosion-preventive mixture will be added to bring the oil level back to the original height. The mixture will be limited to use on 10 engines to avoid excessive dilution of the corrosion-preventive compound.

b. On wet sump engines it will only be necessary to drain the lubricating oil from the engine and refill the sump with the proper amount of corrosion-preventive mixture.

c. At the end of the 15-minute run the engine speed will be reduced to 800 to 1000 rpm to permit preliminary treatment of the cylinder bores by aspiration as described in the following paragraph.

7. PRELIMINARY TREATMENT OF CYLINDER BORES.

a. Aspiration with the corrosion-preventive mixture will be started while the engine is still firing and operating at 800 to 1000 rpm. The corrosion-preventive mixture of one part of corrosion-preventive compound, Specification No. AN-VV-C-576, in three parts of lubricating oil will be injected under air pressure by one of the following methods:

(1) Aspiration of the corrosion-preventive mixture through the carburetor by spraying the mixture into the carburetor air intake. Should this procedure be followed, very careful cleaning of the carburetor and its parts is necessary upon removal from the engine.

(2) Injection of the corrosion-preventive mixture from an auxiliary oil tank into an appropriate opening such as a mixture thermometer opening or the impeller section drain. This tank will be supplied with air pressure to insure rapid and positive injection of the mixture to the intake manifold.

b. The ignition will be cut at the instant a white smoke is emitted from the exhaust outlet(s), and aspiration will be continued. The quantity of corrosion-preventive compound will be sufficient to continue aspiration until the engine ceases to rotate. This will vary from a minimum of 1 quart for small engines to as much as 1 gallon for two-row radial and in-line engines.

8. PRESERVATION PROCEDURE.

The complete preparation procedure shall be accomplished as soon as possible after engine shutdown, but in every case drain the oil and coolant and drain and spray the rocker boxes immediately. The camshaft, exhaust ports, and rocker boxes will be sprayed within 6 hours maximum. The complete preservation procedure will be accomplished within 12 hours.

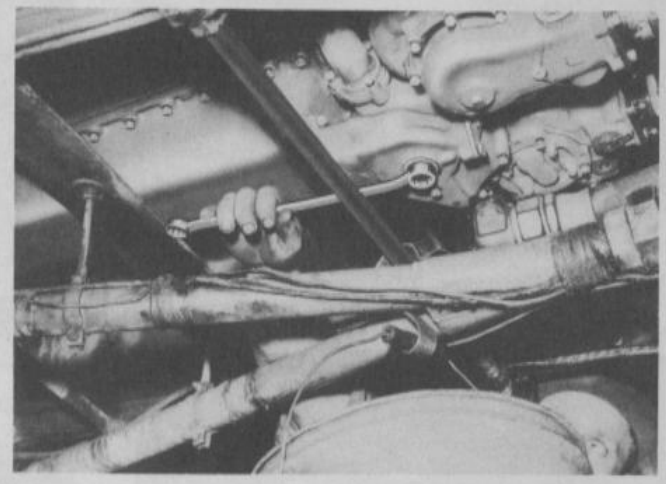


Figure 1 - Drain Oil From Crankcase After Shut-down on Block Test

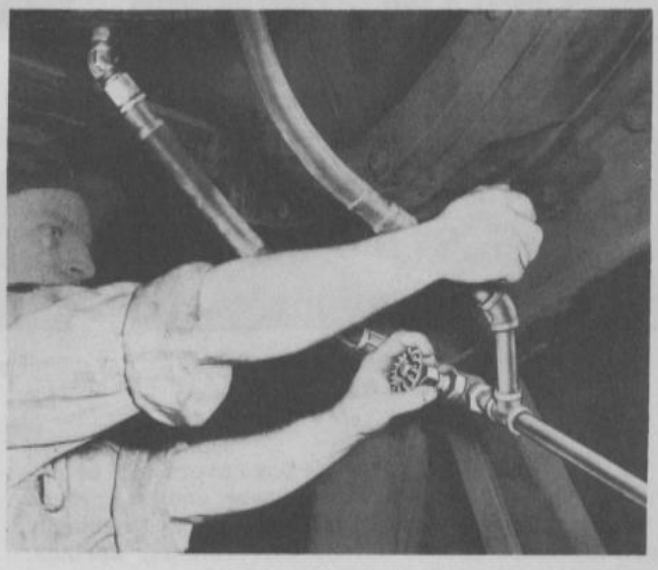


Figure 2 - Drain Coolant System - Liquid-Cooled Engines

a. Oil and Coolant Drainage. - While the engine is still warm, the lubricating oil will be drained from the crankcase, filter or screen chambers, and/or sumps. Screens or filters will be removed, cleaned, and replaced. The coolant will be drained from liquid-cooled engines, and the cooling system will be blown out with dry compressed air in accordance with section IX, paragraph 32.d. All drain plugs will be replaced and safetied.

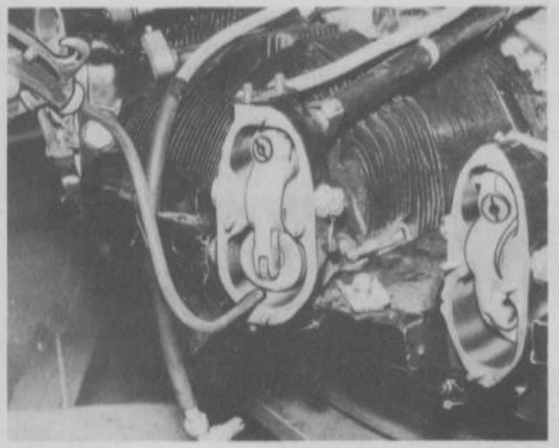


Figure 3 - Spraying Rocker Arm and Valves

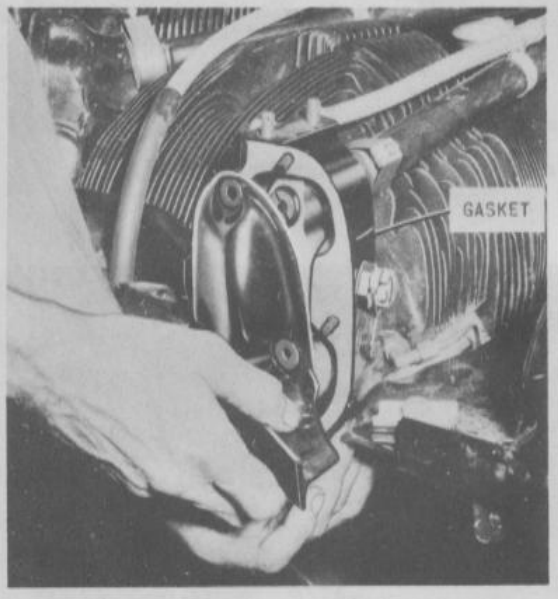


Figure 4 - Reinstall Rocker Box Cover and Gasket

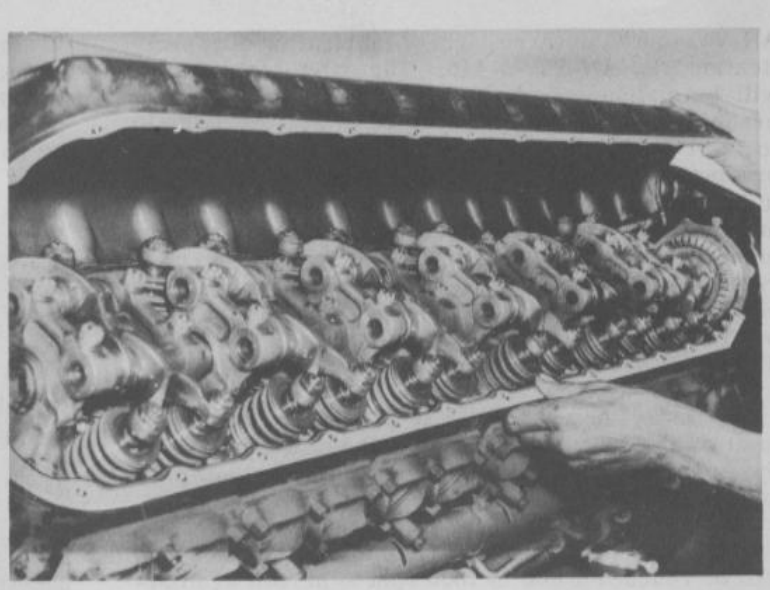


Figure 5A - Remove Camshaft Cover of In-line Engines

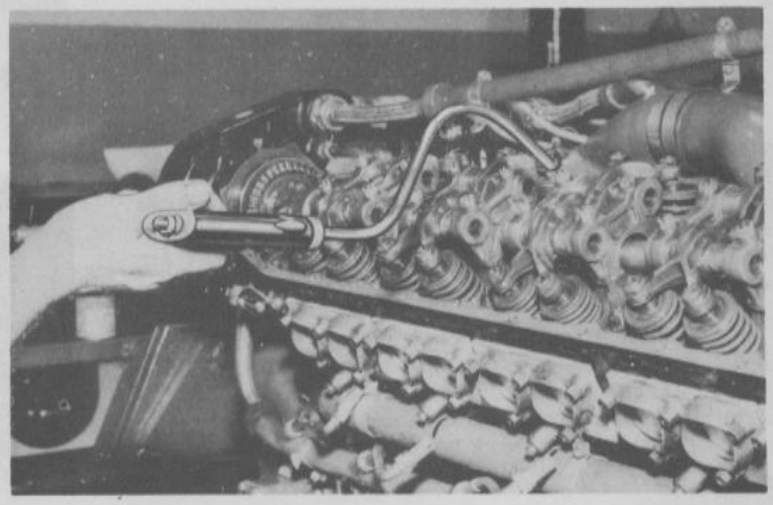


Figure 5B - Spray Camshaft and Valve Mechanism With Corrosion-Preventive Mixture

b. Rocker Boxes. - Rocker box covers will be removed and each rocker box cleaned and so sprayed with corrosion-preventive mixture as to thoroughly coat the valve rocker arms, valve stems, springs, push rods, and interior of boxes. Replace covers and gaskets and screw down to an airtight seal.

c. Camshaft and Valve Mechanism. - The camshaft covers of in-line type engines will be removed and the camshaft and valve mechanism thoroughly cleaned and sprayed with corrosion-preventive mixture while the shaft is revolved. When the entire surface of the cams and all protruding ends of the valve stems are thoroughly coated, the covers and gaskets will be reinstalled on the engines.

d. Exhaust Ports and Manifold. - Each exhaust port will be sprayed with a sufficient quantity of corrosion-preventive mixture to thoroughly coat the exhaust valve. The exhaust manifold, if shipped with the engine, will be attached. A bag containing 1/2 pound of silica gel conforming to Specification No. AN-D-6, type V, will be placed in the exhaust opening of exhaust manifold, whenever space permits, anchored in place, and the opening sealed by plastic film attached with tape conforming to Specification No. AN-T-12. The silica gel bag will not be removed from its moistureproof shipping container until immediately before being inserted in the opening. If the exhaust manifold is not to be shipped with the engine, the individual exhaust ports will be sealed by closing with gasketed oil- and moisture-resistant plates, or by using red plastic inserts, part No. 43A21578, for R-1830 engines, yellow, part No. 43A21579, for R-2800 engines, and black, part No. 43A22439, for R-2000 engines.

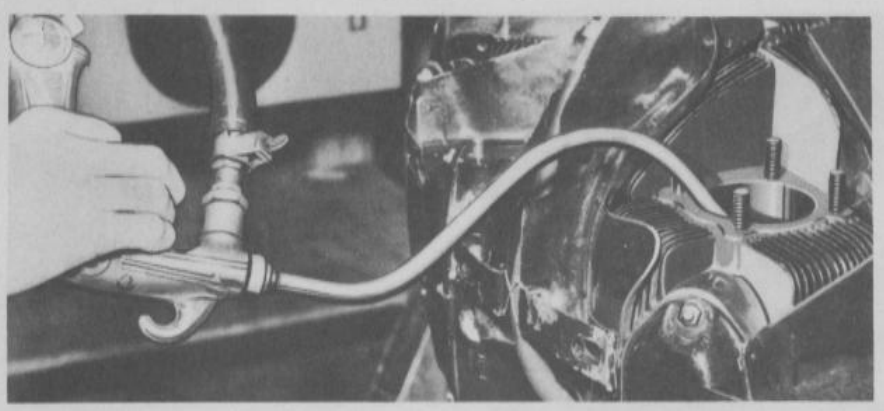


Figure 6 - Spraying Exhaust Ports With Corrosion-Preventive Mixture

Figure 7 - Caps Used to Close Exhaust Ports

e. Thrust Bearings. - When provided, thrust bearing cover plates will be removed, the thrust bearing thoroughly sprayed with corrosion-preventive mixture, and the cover plate reinstalled.

f. Accessory Drives. - The cover plates will be removed, corrosion-preventive mixture applied, and the cover plates reinstalled.

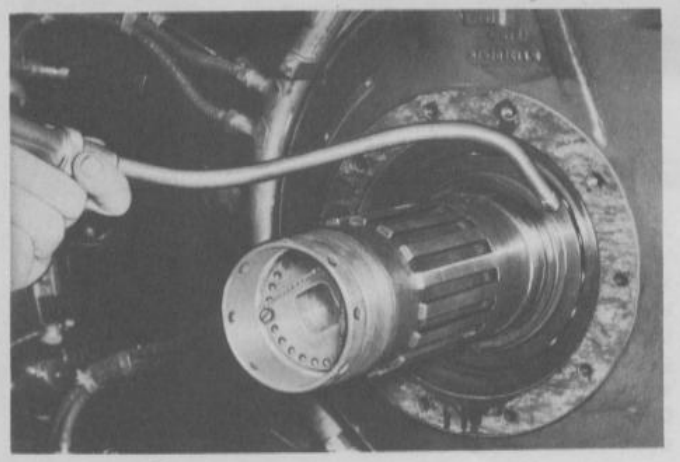


Figure 8 - Spraying Thrust Bearing With Plate Removed

g. Carburetor.

(1) The carburetor will be emptied of all residual fuel and filled with oil conforming to grade No. 1065, Specification No. AN-VV-O-446, and all interior surfaces thoroughly slushed. Care should be exercised not to damage moving parts, such as floats or needle valve. When slushing pressure-type carburetors, pressure applied to the fuel chamber or passage shall not exceed 8 pounds per square inch. Application may best be effected by introducing the oil from a pressure-type hand pump into the fuel inlet until the excess oil flows from the fuel outlet. Under no circumstances will the regulator air chambers, air passages, and/or automatic mixture control be slushed with oil; these must be kept dry at all times. Drain the excess oil and replace the plugs. Lock the throttle plates in such a position that they will not be damaged during shipment. The carburetor will then be completely sealed in a moisture-impervious envelope conforming to AAF Specification No. 17018. Two 1/2-pound bags of silica gel, Specification No. AN-D-6, will be placed within this inclosure and secured. The silica gel bag will not be removed from its moistureproof shipping container until immediately before applying to the carburetor.

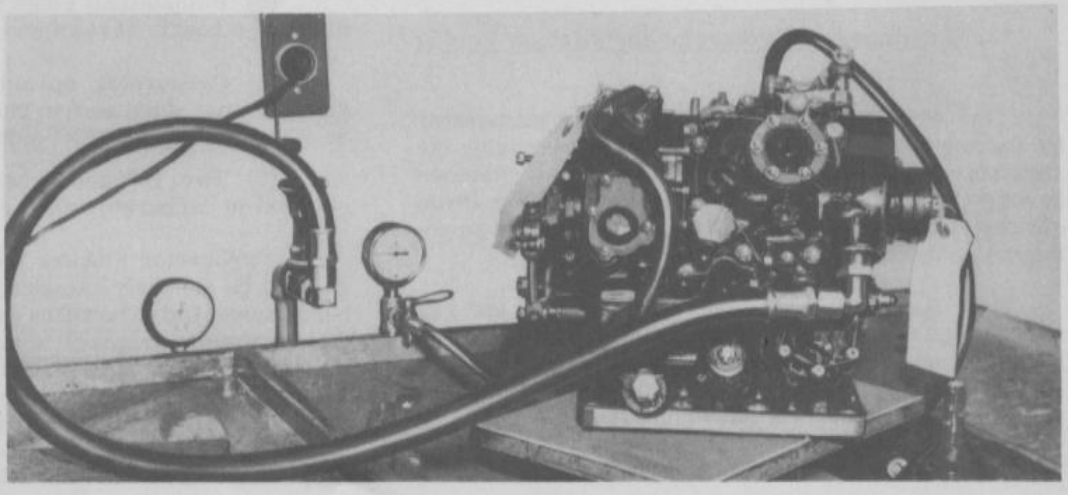


Figure 9 - Slushing the Carburetor

Figure 10 - Seal Carburetor in Moisture-Impervious Envelope

Figure 11 - Placing Selica Gel Bags in Carburetor Adapter

CAUTION

Due to the complicated linkages to the carburetor of the V-1650 engine, it is not advisable to remove the carburetor from the engine for the purpose of flushing the carburetor. Under no circumstance will the corrosion-preventive mixture be used to flush the interior of any carburetor.

(2) Treatment of Carburetor Installed on V-1650 Engines.

(a) Fuel will be drained from the carburetor by disconnecting the fuel inlet line and removing the regulator and fuel control unit drain plugs. Remove carburetor discharge nozzle tube by removing three screws at the fuel control unit and loosening the packing nut at the nozzle.

(b) Reinstall drain plugs in carburetor and remove two 1/8-inch pipe plugs from top of the carburetor regulator. Set throttle wide open and pour lubricating oil, grade 1065, Specification No. AN-VV-O-446, by means of a funnel into the rear chamber until it flows out of the front chamber of carburetor or out of discharge nozzle opening in fuel control unit.

(c) Reinstall discharge nozzle tube in nozzle adapter and rotate carburetor end of the tube upward until the mounting pad on the end of the tube is above the discharge nozzle adapter. Pour oil, lubricating, grade 1065, into the tube until full. Rotate tube downward and drain oil from tube. Remove drain plugs from the regulator and fuel control unit and drain excess oil from these units.

(d) Reinstall all plugs and safety wire plugs and discharge nozzle screws and packing nut.

(e) Carburetor openings will be sealed with suitable pipe plugs and carburetor throttle valves will be locked in the "OPEN" position.

(f) Two 1/2-pound bags of silica gel will be secured in carburetor and appropriately sealed.

h. Carburetor Adapter. - A 1/2-pound bag of silica gel will be securely anchored in the throat of the carburetor adapter. The silica gel bag will not be removed from its moistureproof shipping container until immediately before it is placed in the throat of the carburetor adapter. Carburetor adapter will then be sealed by bolting a gasketed oil- and moisture-resistant plate (obtained by local manufacture) on the adapter, using carburetor attaching studs and nuts.

Figure 12 - Coat Propeller Shaft With Compound Conforming to Specification No. AN-C-52, Type II, Grade B

Figure 13 - Wrap the Propeller Shaft With Paper, Specification No. AN-P-12, Grade A

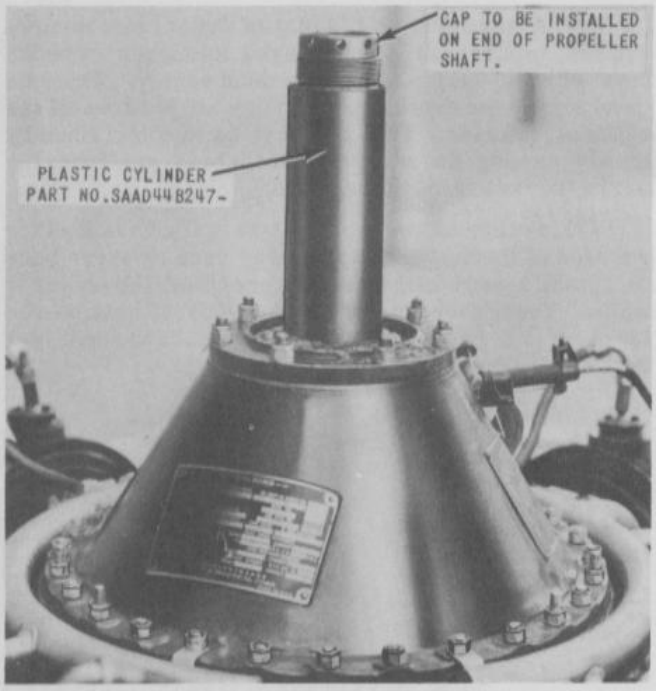


Figure 14 - Plastic Cylinder Installed on Propeller Shaft

i. Propeller Shaft. - The propeller shaft will be coated with a compound conforming to Specification No. AN-C-52, type II, grade B. Following this the propeller shaft shall be wrapped in paper conforming to Specification No. AN-P-12, grade A, or protected by a plastic cylinder, part No. SAAD44B247-1, for shaft No. 20, -2 for shaft No. 30, -3 for shaft No. 40, -4 for shaft No. 50, and -5 for shaft No. 60. Spray the interior of the propeller shaft with the corrosion-preventive mixture and place thread protector caps, part No. AN5012, over end of propeller shaft.

j. Oil Intake and Outlet. - The oil intake and outlet will be sealed with locally manufactured oil- and moisture-resistant blank caps or tape conforming to Specification No. AN-T-12.

k. Breather. - All breather openings in the engine will be adequately sealed against moisture by means of locally manufactured moisture-resistant covers or tape conforming to Specification No. AN-T-12 or dehydrating plugs. Dehydrator plug, Specification No. AN-4061-4, will be used on breather openings of engines designed by Wright, Pratt & Whitney, and Jacobs. The moisture seals of the dehydrating plugs will not be removed until immediately before screwing into the intended location.

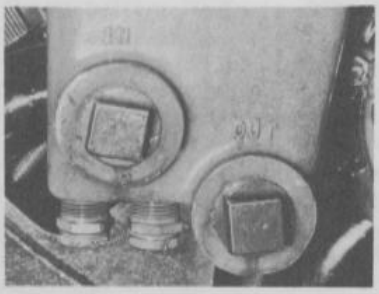


Figure 15 - Seal Oil Intake and Outlet With Caps or Waterproof Tape

Figure 16 - Seal Breather Hole With Dehydrator Plug

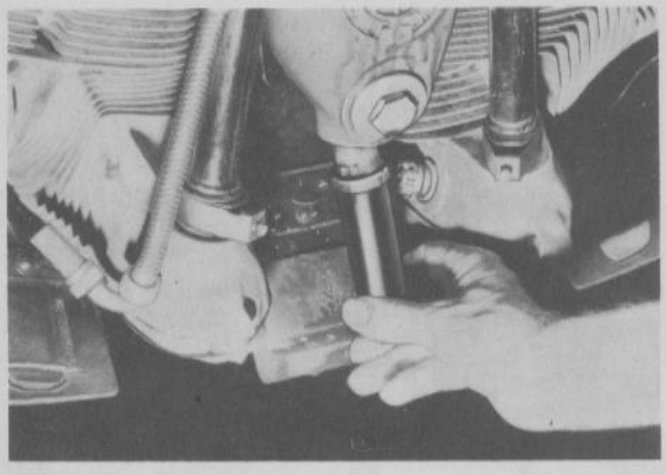


Figure 17 - Install Dehydrator Plug in Oil Sump

l. Crankcase. - The oil sump plug will be removed and replaced by a crankcase dehydrator plug, conforming to Specification No. AN-4061, which will be screwed to a tight seal. Crankcase dehydrator AN-4061-1 for engines designed by Lycoming, Kinner, Continental, and V-1650. Crankcase dehydrator AN-4061-2 for engines designed by Wright and Pratt & Whitney. Crankcase dehydrator AN-4061-3 for V-1710, Jacobs and Franklin engines. The replaced plug will be attached to the sump. The moisture seal on the plug will not be removed until immediately before screwing into the sump.

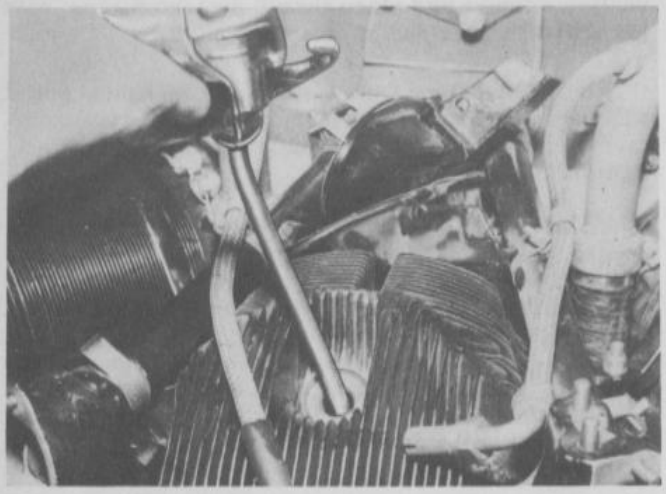


Figure 18 - Spray Cylinder Bores Through the Spark Plug Holes

m. Cylinder Bores. - Following the complete detail inspection and adjustment of valve mechanism and valve clearances required after block test and in addition to the procedure covered by section II, paragraph 7., the interior of each cylinder will be sprayed through the spark plug holes with corrosion-preventive mixture.

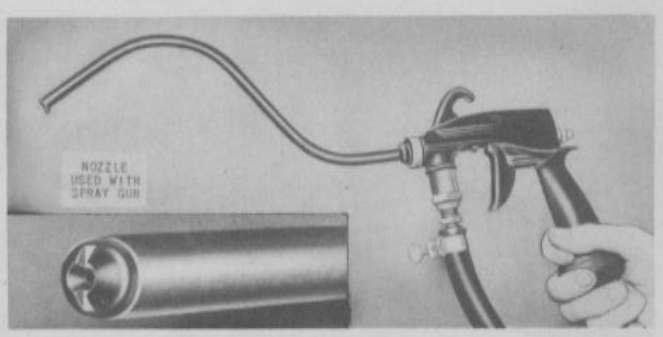


Figure 19 - Spray Gun, Specification No. 50127, or Equivalent

(1) Spray gun, AAF Specification No. 50127, or equivalent, will be used to spray the specified mixture consisting of one part corrosion-preventive compound and three parts of lubricating oil. Prior to use, this gun will be adjusted to obtain a cone-shaped spray. Tighten lock nut securely on the nozzle after adjustment.

(2) A minimum of 1/2 pint of the corrosion-preventive mixture will be sprayed into each cylinder bore with the piston at bottom dead center. Extreme care should be exercised to spray all portions of the cylinder interior. This can best be accomplished by slowly moving the nozzle of the spray gun from the top to the bottom of the cylinder.

(3) Following above procedure and with no further rotation of the crankshaft, respray each cylinder bore to obtain a seal between the piston and the cylinder walls. Thereafter, the propeller shaft will not be rotated. If the propeller shaft is rotated, the cylinder bores will be resprayed.

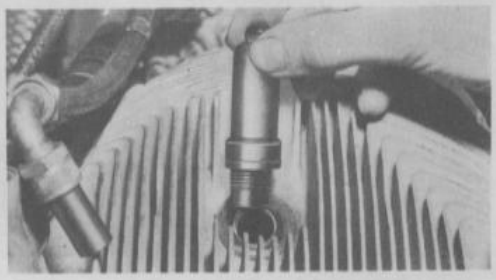


Figure 20 - Installing Dehydrator Plugs in Spark Plug Holes

(4) Engine cylinder dehydrator plugs, conforming to Specification No. AN-4062, will be installed in all spark plug openings and tightly seated. The spark plug lead will be supported in shipment by using a protector and cable support, in accordance with Specification No. AN-4060, color red. The moisture seal will not be removed from each dehydrator plug until immediately before screwing into the individual spark plug holes. Cylinder dehydrator plugs, Specification No. AN-4064-1, and ignition cable protector, color yellow, part No. 600268, are required for V-1650 engines.

Figure 21 - Fitting Engine Envelope to Mounting Plate

Figure 22 - Fitting Engine Mounting Plate and Envelope to Engine

n. Magnetos.

(1) All external openings in the magneto will be sealed with tape conforming to Specification No. AN-T-12.

(2) Magnetos as received on new engines or magnetos which have been overhauled need no further preparation for storage since the cam, springs, and all other steel parts of the breaker mechanism are coated with oil, grade 1100, Specification No. AN-VV-O-446. An inspection will be made, however, to ascertain that this has been accomplished. In the event that oil is to be applied, extreme care will be taken that no oil reaches the breaker points, as the life of the breaker points will be materially shortened by the presence of grease or oil. If breaker points come in contact with oil, they will be carefully cleaned with suitable volatile cleaners.

o. Spark Plugs. - Since only new or properly reconditioned spark plugs which have received rust-preventive treatment will be shipped with the engine, no further treatment is necessary.

p. Other Engine Openings. - All other openings in the engine will be sealed with tape, conforming to Specification No. AN-T-12, or suitable moisture-proof seals, to establish the engine wall as a moisture barrier, as far as possible.

9. PACKING PROCEDURE.

a. Radial Engines. - The engine mounting plate will be checked for roughness and properly conditioned to insure smooth surfaces. The plate will then be removed from the engine shipping case and an engine envelope of suitable size, conforming to Specification No. AN-E-1, will be fitted to the mounting plate and punched with holes for the anchor bolts. The oil and moisture-resistant gaskets on both sides of the engine envelope will be fitted to each anchor bolt hole, and the anchor bolts inserted to hold the envelope in position. The engine mounting plate and envelope will then be fitted to the engine, taking care not to tear the bag. The mounting plate will be secured to the engine by means of the engine anchor bolts. The engine will then be placed in the case and the mounting plate bolted to the case.

b. In-line and V-type Engines. - The engine mounting surface on the stand will be checked for roughness and, if necessary, will be properly conditioned to insure smooth surfaces. Oil- and moisture-resistant gaskets on both sides of the engine envelope will be fitted to each anchor bolt hole and the anchor bolts inserted to hold the envelope in position on the stand, spreading the envelope over the stand so that the envelope will not be damaged when the engine is placed on the shipping stand. The engine shall then be bolted to the stand using the full number of bolts intended, and all nuts will be safetied with lock washers if self-locking nuts are not used.

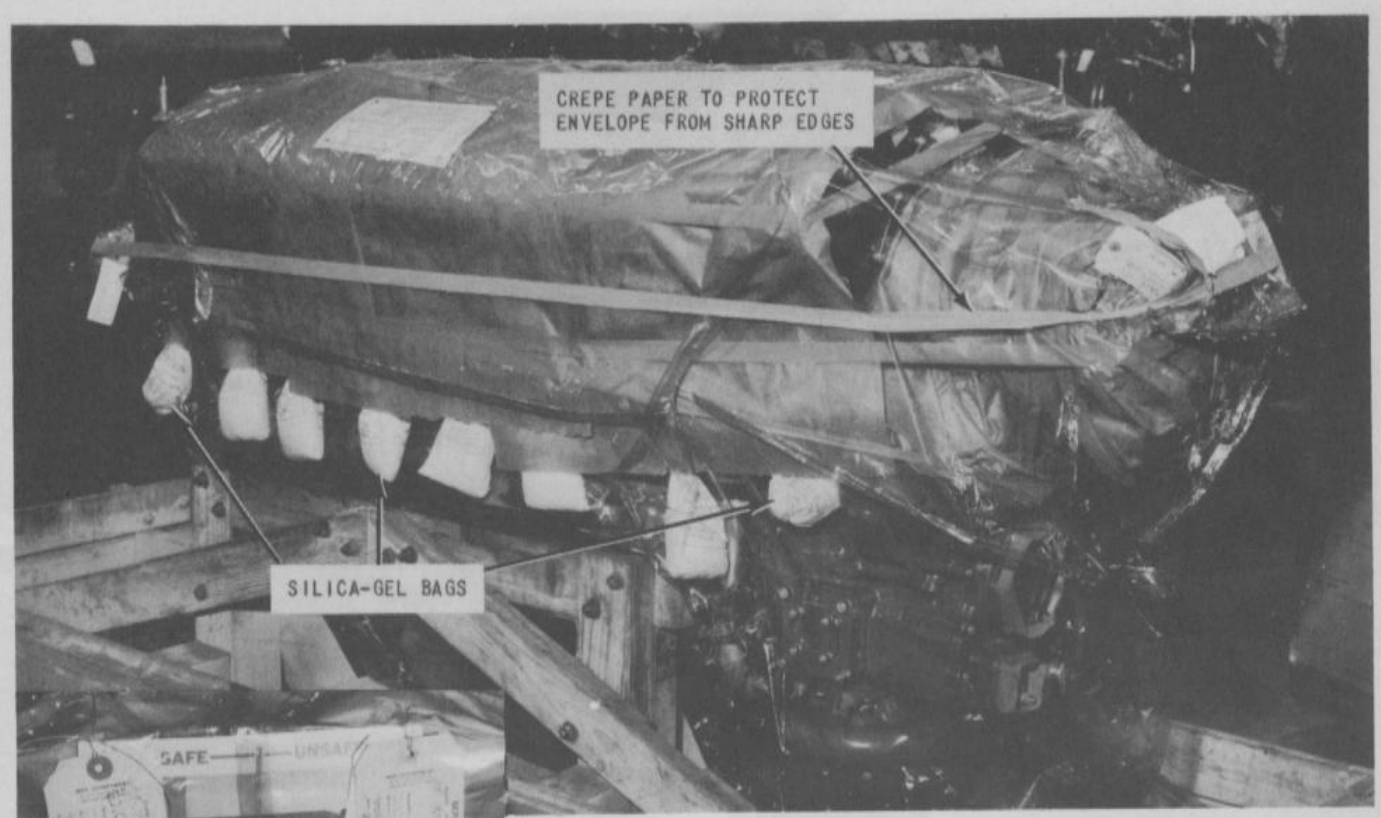


Figure 23 - Engine Encased in Envelope on Mounting Plate

Figure 24 - Humidity Indicator Chart Secured to Engine

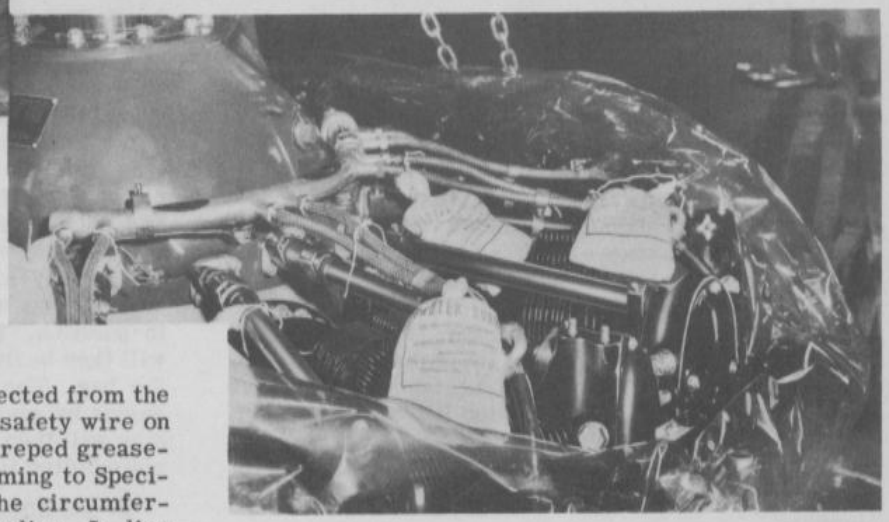


Figure 25 - Distribution of Silica Gel Bags

c. The engine envelope will be protected from the sharp edges of the rocker boxes and safety wire on radial engines by means of 130-pound creped greaseproof paper, 24 inches in width, conforming to Specification No. AN-P-12, placed around the circumference of the engine and attached by stapling. In-line engines will have a similar covering fabricated from this paper, covering the top and extending down the sides sufficiently far to protect the engine envelope from all sharp edges of the engine.

d. Humidity Indicator Chart. - A humidity indicator chart, conforming to Specification No. AN-7511, will be secured to the engine in such a manner that it will face out from the engine and be located opposite a hinged inspection door in the shipping case in a manner as to be readily observed from the outside.

e. Distribution of Silica Gel. - Silica gel, conforming to Specification No. AN-D-6, type V, will be symmetrically hung about the periphery and the fore-and-aft sections of the engine at the rate of 1 pound (two 1/2-pound bags) of dehydrated agent per cylinder up to and including a maximum of 14 cylinders, plus 1 pound for each additional 2 cylinders over 14. The silica gel bags will not be removed from the moisture-resistant container until immediately before application to the engine and sealing the envelope.

f. Sealing of Engine Envelope. - Immediately after the silica gel has been attached to the engine, heat seal all but a small opening of the envelope with plastic film sealing iron, AAF Specification No. 40399. Following this, collapse the envelope about the engine or remove the excess air by means of a slight vacuum. Complete the sealing of the envelope. Care will be exercised in folding the engine bag to avoid more than one thickness of envelope between the humidity indicator and inspection door. Instructions printed on the engine envelope will be followed.

g. Enclosure of Engine Box. - Extreme care will be exercised in lowering the engine box cover over the engine to avoid rupture of the engine envelope. Suitable guides shall be installed in two opposite corners of the old style engine case to facilitate lowering the box cover.

h. Exceptions. - The above procedure will be followed unless it is definitely known that the engine will be placed in service within 30 days, in which case all items covered under section II, paragraph 9. may be omitted. However, under extremely adverse atmospheric or storage conditions where deterioration of the engine interior might occur before the engine could normally be expected to be operated, the complete procedure will be used.

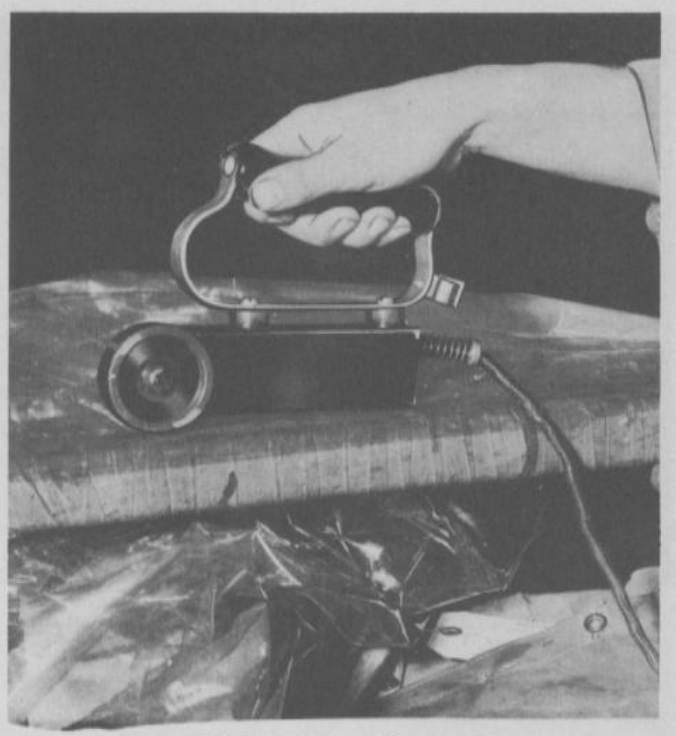


Figure 26 - Sealing of Engine Envelope

Section 3

PREPARATION OF ENGINES FOR SERVICE AFTER TREATMENT

10. PREPARATION PROCEDURE.

Serviceable engines not mounted in aircraft will be prepared for service as follows:

a. Remove Engine Envelope.

(1) Cut the engine envelope along its top edge close to the heat seal.

(2) Carefully fold the engine envelope down around the engine.

(3) Remove the engine and mounting plate on radial engines from the engine box stand.

(4) On radial engines, remove the mounting plate from the engine. Care will be exercised to avoid damage to accessories.

(5) After removal, the engine envelope will be carefully cleaned with a cloth and folded to preserve for subsequent re-use. Prior to re-use, the envelope should be inspected for tears and holes and repaired if necessary. Every care should be exercised to assure a maximum service life for these envelopes.

b. Remove the following:

(1) Silica gel bags.

(2) All seals and/or enclosures.

(3) Dehydrator plugs.

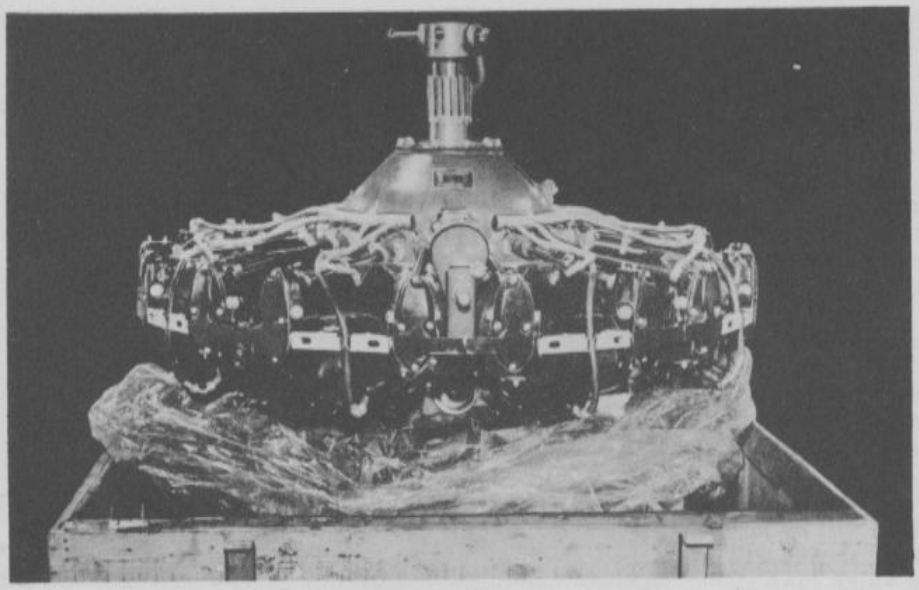


Figure 27 - Removal of Engine Envelope

Figure 28 - Clean Cuna Oil Filters in Suitable Solvent

c. Remove the Cuno Oil Strainer.

(1) The Cuno oil strainer (filter) will be removed and cleaned by washing it in a solvent such as kerosene, or a half-and-half mixture of carbon tetrachloride and benzol. Make certain to remove all foreign material adhering to the cartridge. To facilitate cleaning, rotate the cartridge while immersed in solvent. Some cartridges are built without support rods and are maintained in alignment by the piloted end of the cleaner blade rod which enters a mating hole in the filter housing. Such a cartridge, if rotated while out of its housing (as above in cleaning), must be realigned before reinstallation. Under no circumstances should a hard, edged, or pointed tool be used to scrape or pick at the cartridge.

CAUTION

AN AIR JET FOR CLEANING THE CARTRIDGE WILL NOT BE USED.

(2) Immediately after washing, lubricate the disc by immersing in clean engine oil.

(3) Reinstall the Cuno oil filter.

d. Remove supercharger fuel drain valve, if installed, clean and check for proper operation, lubricate with engine oil and reinstall.

e. Fuel drain screens, if installed, should be checked by using a short hose and mouth pressure.

f. Drain Cylinder Bores. - Before installing the spark plugs, remove any excess corrosion-preventive mixture from the cylinder bores with a hand pump or by draining.

(1) A check will be made for sticking valves by rotating the crankshaft four or five revolutions with a propeller wrench.

(2) Any valves that are found to be sticking will have the stems generously lubricated with a mixture of gasoline and lubricating oil. Continue to turn the engine over by hand, until all evidence of sticking valves has been eliminated. If the mixture of gasoline and lubricating oil does not free all the valves, the necessary repairs will be made before the engine is placed in service.

g. Drain Blower Section.

(1) When installing radial engines that have been treated for storage, any corrosion-preventive mixture in the blower section will be permitted to drain into the lower intake pipes for at least 24 hours at a room temperature of 60°F (15.6°C) or higher, before operating the engine. This can be accomplished by placing the airplane in flying position during installation, or by suspending or mounting the engine with the crankshaft horizontal prior to installation. This can also be accomplished with the engine mounted in a shipping box, by turning the box so that the mixture will drain into the lower intake pipes with the crankshaft in a horizontal position. However, in all cases before the crankshaft is rotated following the drainage of the blower section, the lowermost intake pipes (two pipes on single-row engines and three pipes on two-row engines) will be removed and inspected for excess mixture collection. If excess mixture is found, the adjacent intake pipes on each side of those removed will also be examined. This inspection will be continued toward the top cylinder until intake pipes are found that are free of excess mixture.

(2) When removing intake pipes, the packing gland nut at the crankcase should be loosened or removed, prior to loosening the intake pipe at the clyinder. These operations will be performed in the reverse order when reinstalling intake pipes. This precaution will prevent damage to intake pipes and attaching flanges.

(3) New intake pipe seals will be installed on all intake pipes removed.

h. Before starting the engine after installation, one spark plug from each cylinder, if installed, will be removed and the crankshaft turned by hand at least four complete revolutions for final check to determine that there is no excess corrosion-preventive mixture in any cylinder.

i. No inspection and adjustment of the valve mechanism will be made by operating organizations or subdepots prior to initial operation, except for proper operation of the valve mechanism.

11. PREOILING AND GROUND RUN-UP.

a. Prior to ground testing the engine or engines, sufficient oil will be placed in the oil tank or tanks to insure completion of the ground test. In general, one-half the tank capacity will be adequate for this purpose. However, in some airplanes it will be necessary to fill the oil tank to a higher level. To obtain gravity oil flow to the engine pump inlet in certain installations, the tank or tanks will have to be completely filled; otherwise, it will be necessary to raise the tail of the airplane due to its attitude in ground position. In each case the oil level in the tank will be level with, or higher than the oil inlet connection to the engine.

b. Preoil the engine as described in T. O. No. 02-1-22. This will include lubrication of the exhaust rocker boxes of radial or air-cooled engines which will be accomplished as follows:

(1) One-half pint of engine oil of grade 1120 will be placed in each exhaust rocker box of air-cooled radial engines equipped with automatic valve lubrication.

(2) On those models of engines equipped with rocker box drainage system, it is only necessary to place oil in the exhaust rocker boxes of the cylinders above the horizontal line, in which case the oil will drain into the rocker boxes of the cylinders below the horizontal line.

(3) On engines on which the external drainage system has been eliminated from the cylinders above the horizontal line, it will be necessary to place 1/2 pint of oil in the exhaust rocker box of each cylinder, above the horizontal line. The remaining rocker boxes will be lubricated by placing a sufficient quantity of oil in the first rocker box on each side of the engine above the horizontal line. This quantity should be approximately 1/2 pint per cylinder.

(4) On engines not equipped with external drainage systems, one of the two optional methods will be employed to service the oil to the rocker boxes below the horizontal center line of the engine.

(a) Congeal the oil in dry ice in which state it can be placed in the exhaust rocker boxes below the horizontal line of the engine, provided the covers are immediately installed. The congealing of the oil will be accomplished by using two containers, one for the oil and one for the dry ice. The oil container should be of sufficient size to accommodate the quantity of oil required for one engine. The dry ice container should be of such size that the dry ice can be placed around the container containing the oil.

(b) If the engine is equipped with the type of push rod tubes or housings which are attached at the crankcase and by means of a hose connection and clamps, the clamps may be loosened, the hose slid back over the push rod toward the cylinder head, and the specified quantity of oil for each rocker box poured into the open end of the tube.

c. Ground Operation. - The engine will be ground tested by operation for a period of approximately 30 minutes. Warming-up speeds of 800 to 1000 rpm are recommended. Operation at rated power will be limited to short bursts of only sufficient duration to obtain instrument readings and check the acceleration of the engine. Maximum cylinder or oil temperatures will not be exceeded. To insure maximum cooling during ground test, no engine cowling except the primary or engine ring cowl will be installed.

d. (1) After the engine or engines have been ground tested, the lubricating oil will be drained from the oil system. The oil system will then be filled with new oil and T. O. No. 02-1-22 again complied with.

(2) This drained oil is not suitable for flight operation of aircraft engines until such time as it is re-refined to meet Specification No. AN-VV-O-466. The used aircraft engine oil, either with or without the corrosion-preventive compound in it, will be accumulated in tanks or drums at all activities within the continental limits of the United States.

Section 4

PREPARATION OF ENGINES MOUNTED IN AIRCRAFT

12. SHORT STORAGE.

Aircraft inoperative for more than 1 day and to be operated within 7 days will be classified as short storage and will be treated as follows:

a. On alternate days the engine will be given a ground run-up until the "oil in" temperature reaches normal operating temperature for the particular installation. Excessive ground operation other than stated above should be avoided, and sandy and dusty areas should be avoided, if possible.

b. On intervening alternate days the propellers will be rotated at least four complete revolutions by hand. If the condition of the engine or the airplane is such that the engine cannot be operated on alternate days, the propellers will be rotated at least four revolutions by hand each day.

c. Short storage periods will not be extended or repeated. If the time the engine is to be inoperative is not definitely known to be less than 7 days, it is best to prepare the engine for temporary or extended storage.

d. Engines prepared for short storage require no preparation for service.

13. TEMPORARY STORAGE.

Aircraft inoperative for more than 7 days and less than 30 days will be classified as temporary storage and will be treated as follows:

a. Drain the oil immediately after operation by removing the sump drain plug.

b. Rocker Boxes.

(1) Remove rocker box covers.

(2) In the case of radial engines not having automatic valve gear lubrication, the rocker boxes will be drained, cleaned, and regreased. The camshaft covers of the V-type engines will be removed and the cams and valve mechanisms sprayed with corrosion-preventive mixture. The rocker boxes of radial engines with automatic valve gear lubrication will be cleaned and sprayed with the corrosion-preventive mixture.

(3) Replace gaskets and covers and screw down to an airtight seal.

c. Wire the sump plug to the engine and install in crankcase, dehydrator plug, conforming to Specification No. AN-4061, in the sump outlet. Crankcase dehydrator AN-4061-1 for engines designed by Lycoming, Kinner, Continental, and V-1650. Crankcase dehydrator AN-4061-2 for engines designed by Wright and Pratt & Whitney and crankcase dehydrator AN-4061-3 for V-1710, Jacobs and Franklin engines.

d. Spray the exhaust valves with corrosion-preventive mixture. This spraying will be accomplished through the exhaust port with the exhaust valves fully open except in engines having exhaust collectors that are difficult to remove, in which case the spraying may be done through the spark plug holes with the exhaust valves fully open.

e. Spray the corrosion-preventive mixture into each cylinder bore with the piston at the bottom of the stroke in such a manner as to cover all the interior surfaces. The corrosion-preventive mixture, consisting of three parts of lubricating oil in one part of corrosion-preventive compound, will be used at all times for spraying.

f. Following this, respray each cylinder bore through the spark plug opening without further rotation of the crankshaft. If the crankshaft is rotated, the cylinder bores will be resprayed.

g. Install cylinder bore dehydrator plugs, conforming to Specification No. AN-4062, into the spark plug holes. The spark plug lead will be supported by using a protector and cable support in accordance with Specification No. AN-4060, color red. Cylinder dehydrator plugs, Specification No. AN-4064-1, and ignition cable protector, color yellow, part No. 600268, are required for V-1650 engines.

h. Application of Silica Gel.

(1) A minimum of one each 1/2-pound bags of silica gel will be placed in the exhaust outlet (s), space permitting, and in the carburetor intake.

(2) The ends thereof will be covered with moisture-impervious film, conforming to Specification No. AN-O-P-406, suitably anchored with tape. Complete sealing of manifold by placing tape, conforming to Specification No. AN-T-12, over all manifold collector joints.

i. In liquid-cooled engines the coolant will remain in the system. As ethylene glycol is hygroscopic (will absorb and retain moisture), the following will be accomplished:

(1) When the coolant is still warm the system will be inspected and filled to avoid air spaces.

(2) Seal relief valve and other outlets with tape, conforming to Specification No. AN-T-12.

j. Seal distributor vents, engine and supercharger breathers, and all other engine openings with tape, conforming to Specification No. AN-T-12.

k. Inspections. - Engine cylinder and sump dehydrator plugs will be inspected weekly and changed as soon as their color indicates unsafe conditions of storage. If one-half or more of the dehydrator plugs are replaced, the dehydrator bags in the air intake and exhaust manifolds shall also be replaced. Replacement of the dehydrator plugs or bags should not be made on highly humid or rainy days.

l. Preparation for Service.

(1) Remove dehydrator plugs and silica gel bags, cover plates, nipples, tape, plugs, etc., which have been installed to close lines or other engine openings.

(2) Reinstall fuel and oil lines, controls, etc.

(3) Before installing spark plugs, remove any excessive corrosion-preventive mixture by means of a hand pump or by draining. A check will be made for sticking valves by rotating the crankshaft four or five revolutions by means of a propeller wrench. Lubricate sticking valves with a mixture of gasoline and lubricating oil.

(4) Preoil the engine as described in section III, paragraph 11.

14. EXTENDED STORAGE.

Engines installed in aircraft that are not to be operated for a period of 30 days or longer will be treated as follows:

a. Operation on Corrosion-Preventive Mixture. - Engines will be operated at idling speeds (not to exceed 50 percent power) for at least 15 minutes, using the corrosion-preventive mixture as a lubricant. The mixture will consist of one part of corrosion-preventive compound, Specification No. AN-VV-C-576, in three parts of engine lubricating oil, Specification No. AN-VV-O-446.

(1) Prior to this 15-minute run, the oil in the engine and in the oil tank will be drained immediately after operation into clean containers and used to service other aircraft returning to service status.

(2) Refill the tanks with a sufficient quantity of the mixture to insure proper lubrication during operation.

(3) Fuel conforming to service requirements will be used, if grade 65 fuel is not available.

(4) The oil coolers will be blanked off or bypassed to produce a mixture outlet temperature of 104.4°C (220°F) to 121.1°C (250°F).

(5) Operate the engine for 15 minutes at less than 50 percent power with the mixture in the lubricating system.

(6) Aspiration of the mixture into the induction system will be accomplished as described in section II, paragraph 7. If portable tank supplied with air pressure is not available, the mixture may be injected by means of a short hose leading from a gallon container into the impeller section drain.

(7) Drain the mixture from the engine and oil tank while the engine is still warm. Disconnect the oil-in and oil-out lines to remove any remaining mixture, and seal lines with locally manufactured plugs. The mixture drained from the engine may be used for run-out of 10 engines.

(8) Replace the sump plug with a crankcase dehydrator plug, conforming to Specification No. AN-4061. (See section IV, paragraph 13.c. for specific type and use.)

b. CARBURETOR FLUSHING.

(1) Fuel will be drained from the carburetor by disconnecting the fuel inlet line and removing the regulator and fuel control unit drain plugs. Remove carburetor discharge nozzle tube by removing three screws at the fuel control unit and loosening packing nut at the nozzle.

(2) Reinstall drain plugs in carburetor and remove 2-1/8 inch pipe plugs from top of the carburetor regulator. Set throttle wide open and pour lubricating oil, grade 1065, Specification No. AN-VV-O-446, by means of a funnel into the rear chamber until it flows out of the front chamber of carburetor or out of discharge nozzle opening in fuel control unit.

(3) Reinstall discharge nozzle tube in nozzle adapter and pour lubricating oil, grade 1065, into tube until full. Remove and drain tube and then reinstall on the carburetor. Remove drain plugs in the regulator and fuel control units and drain excess oil from the carburetor.

(4) Reinstall all plugs and safety wire plugs and discharge nozzle, screws, and packing nut.

(5) Carburetor openings will be sealed with suitable pipe plugs, and carburetor throttle valves will be locked in the "OPEN" position.

c. Fuel Pumps.

(1) Fuel will be drained from all fuel pumps.

(2) Fuel pumps will have lubricating oil, conforming to grade 1065, Specification No. AN-VV-O-446, injected therein while the shaft of the engine is being rotated to insure complete coverage of the fuel pump parts with oil.

(3) The fuel line of the airplane fuel system will remain disconnected.

(4) Fuel lines will be sealed with suitable plugs or tape, conforming to Specification No. AN-T-12.

d. Rocker Boxes.

(1) Remove rocker box covers.

(2) Clean and spray interior of all rocker boxes with corrosion-preventive mixture.

(3) Replace covers and gaskets and screw down to an airtight seal.

e. Camshafts and Valve Mechanisms. - Spray as described in section II, paragraph 8.c.

f. Exhaust Ports and Manifolds. - Spray each exhaust port with corrosion-preventive mixture with the exhaust valves fully open. Spray through the exhaust outlets or through the spark plug openings.

g. Thrust Bearings.

(1) Propeller will be removed.

(2) Thrust bearing cover plates, if provided will be removed, the thrust bearing thoroughly sprayed with corrosion-preventive mixture, and the cover plate reinstalled.

h. Accessory Drives. - Cover plates will be removed, corrosion-preventive mixture applied, and the cover plates reinstalled.

i. Cylinder Bore Treatment.

(1) A minimum of 1/2 pint of the corrosion-preventive compound will be sprayed into the cylinder bores with the piston at the bottom of the stroke. Extreme care will be exercised to cover all interior surfaces.

(2) Then respray each cylinder bore without further rotation of the crankshaft. If the crankshaft is rotated, the cylinder bores will be resprayed.

(3) Install engine cylinder dehydrator plugs, conforming to Specification No. AN-4062, into the spark plug holes. The spark plug lead will be covered with protector No. AN-4060, color red. Cylinder dehydrator plugs, Specification No. AN-4064-1, and ignition cable protector, part No. 600268, color yellow, are required for V-1650 engines.

j. Seal All Engine Openings. - The distributor vents, all breathers, and all other engine openings will be sealed with tape, conforming to Specification No. AN-T-12.

k. Propeller Shaft.

(1) Spray the interior of the shaft with corrosion-preventive mixture.

(2) The exterior of the propeller shaft will be coated with a compound, conforming to Specification No. AN-C-52, type II, grade B, and then wrapped with paper, conforming to Specification No. AN-P-12, grade A, or protected by a plastic cylinder, part No. SAAD44B247-1 for shaft No. 20, -2 for shaft No. 30, -3 for shaft No. 40, -4 for shaft No. 50, and -5 for shaft No. 60.

(3) The threads of the propeller shaft will be protected with a propeller shaft nut, conforming to Specification No. AN-5012.

l. Magnetos. - Magnetos will be treated as described in section II, paragraph 8.n.

m. Application of Silica Gel.

(1) A minimum of one each 1/2-pound bags of silica gel will be placed in the exhaust outlet (s), space permitting, and in the carburetor air intake scoop.

(2) The ends thereof will be covered with moisture-impervious film, conforming to Specification No. AN-O-P-406, suitably anchored with tape. Complete sealing of manifold by placing tape, conforming to Specification No. AN-T-12, over all manifold collector joints.

n. Engine Covers. - All engines installed in aircraft will be covered with engine covers furnished with the airplane and securely fastened.

o. In liquid-cooled engines the coolant will remain in the system. As ethylene glycol is hygroscopic (will absorb and retain moisture), the following will be accomplished:

(1) When the coolant is still warm the system will be inspected and filled to avoid air spaces.

(2) Seal relief valve and other outlets with tape, conforming to Specification No. AN-T-12.

p. Inspection. - Engine cylinder and sump dehydrator plugs will be inspected weekly and changed as soon as their color indicates unsafe conditions of storage. If one-half or more of the dehydrator plugs are replaced, the dehydrator bags in the air intake and exhaust manifolds shall also be replaced. Replacement of the dehydrator plugs or bags should not be made on highly humid or rainy days.

15. ENGINES MOUNTED IN AIRCRAFT FOR DECK LOADING.

Engines installed in deck-loaded aircraft will be treated as described in section IV, paragraph 14., "Extended Storage."

a. In addition to the treatment described, the oil regulators and radiators may be sprayed with a light coat of the corrosion-preventive mixture to prevent corrosion from salt spray.

b. It is not considered necessary to spray any plated or painted portion of the engine with a corrosion-preventive compound.

16. PREPARATION OF INSTALLED ENGINES FOR SERVICE AFTER "EXTENDED STORAGE" TREATMENT.

a. Seals and Covers.

(1) Remove dehydrator plugs and silica gel bags, cover plates, tape, nipples, plugs, etc., which have been installed to close lines or other engine openings.

(2) Connect fuel and oil lines, controls, etc.

b. Drain Cylinder Bores. - Before installing the spark plugs, remove any excess corrosion-preventive mixture by a hand pump or by draining.

(1) A check will be made for sticking valves by rotating the crankshaft four or five revolutions with a propeller wrench.

(2) Any valves that are found to be sticking will have the stems generously lubricated with a mixture of gasoline and lubricating oil. Continue to turn the engine over by hand until all evidence of sticking valves has been eliminated. If the mixture of gasoline and lubricating oil does not free all valves, the necessary repairs will be made before the engine is placed in service.

c. Drain Blower Section. - The blower section will be drained as described in section III, paragraph 10.g.

d. Before starting the engine after installation, one spark plug from each cylinder, if installed, will be removed and the crankshaft turned by hand at least four complete revolutions for final check to determine that there is no excess corrosion-preventive mixture in any cylinder.

e. Propeller and Propeller Shaft.

(1) Clean the propeller shaft (s) and propeller (s).

(2) Mount the propeller (s) on the propeller shaft (s).

f. Remove the Cuno Oil Strainer (Filter).

(1) The Cuno oil strainer (filter) will be removed and cleaned by washing it in a solvent such as kerosene, gasoline, or a half-and-half mixture of carbon tetrachloride and benzol. Make certain to remove all foreign material adhering to the cartridge. To facilitate cleaning rotate the cartridge while immersed in solvent. Some cartridges are built without support rods and are maintained in alignment by the piloted end of the cleaner blade rod which enters a mating hole in the filter housing. Such a cartridge, if rotated while out of its housing (as above in cleaning), must be realigned before reinstallation. Under no circumstances should a hard, edged, or pointed tool be used to scrape or pick at the cartridge.

CAUTION

AN AIR JET WILL NOT BE USED FOR CLEANING THE CARTRIDGE.

(2) Immediately after washing, lubricate the disc by immersing in clean engine oil.

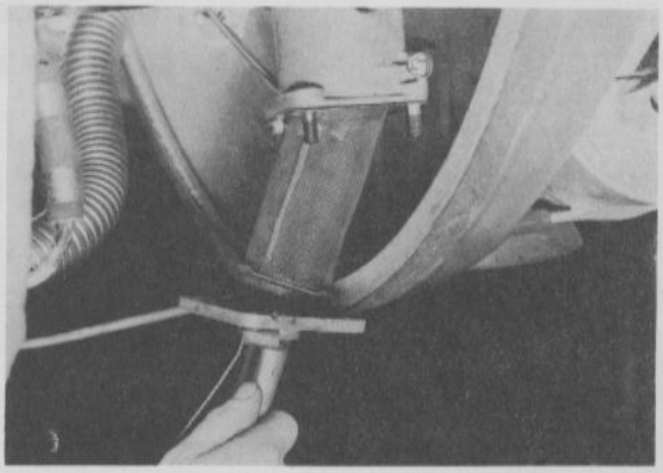


Figure 29 - Remove and Clean Oil Screens

g. Screens. - All oil screens shall be removed, cleaned in gasoline, dried, reoiled, and reinstalled.

h. Preoiling. - Prior to ground testing the engine or engines preoiling will be accomplished as described in section III, paragraph 11.

Section 5

PREPARATION OF ENGINES IN MOUNTS NOT INSTALLED IN AIRCRAFT

17. TREATED ENGINES.

Engines which are to be installed in engine mounts and which have previously been treated for storage, will in no case have the corrosion-preventive compound drained from the engine, nor the propeller shaft turned. In the event the engine has been rotated during installation in the engine mount, the cylinders will be resprayed and the crankshaft will not be rotated further.

18. ENGINES NOT TREATED.

a. Engines which have not been prepared for storage prior to installation in the engine mounts will be prepared in accordance with section IV, paragraph 13., "Temporary Storage."

b. Short storage will not be permitted.

c. Engines treated as described will not remain in engine mounts longer than 30 days. Any engine that may remain in an engine mount longer than 30 days will be prepared as a spare engine.

19. PREPARATION FOR SERVICE.

a. Engines installed in mounts will be prepared for service 48 hours or less, prior to installation in the aircraft.

b. Engines will be prepared for service as described in section IV, paragraph 13.m.

Section 6

PREPARATION OF REPAIRABLE ENGINES

20. OPERABLE ENGINES.

Repairable engines that can be operated without further damage to the engine or to any of its parts, will be treated as follows:

a. Operation on Corrosion-Preventive Mixture.

(1) Drain the lubricating oil from the engine.

(2) Refill the tanks with a sufficient quantity of the mixture to insure proper lubrication during operation.

(3) Fuel conforming to service requirements may be used if grade 65 fuel is not available.

(4) Engines will be operated at idling speeds for at least 15 minutes using the corrosion-preventive mixture as a lubricant.

(5) Drain the mixture from the engine and the oil tank while the engine is still warm.

(6) Drain the coolant from liquid-cooled engines.

b. Rocker Boxes.

(1) Remove rocker box covers.

(2) Clean and spray each rocker box with corrosion-preventive mixture.

(3) Replace covers and gaskets and screw down to an airtight seal.

c. Exhaust Ports and Manifolds. - Spray each exhaust port with corrosion-preventive mixture with exhaust valve fully open. Spray through the exhaust outlets or through the spark plug holes. The individual exhaust ports will be sealed by closing with gasketed oil - and moisture-resistant plates, or by using red plastic inserts, part No. 43A21578, for R-1830 engines, yellow, part No. 43A21579, for R-2800 engines, and black, part No. 43A22439, for R-2000 engines.

d. Accessory Drive. - The cover plates will be removed, corrosion-preventive mixture applied, and the cover plates reinstalled.

e. Thrust Bearings.

(1) Propeller will be removed.

(2) Thrust bearing propeller plates, if provided, will be removed. The thrust bearing will be thoroughly sprayed with corrosion-preventive mixture and the cover plate reinstalled.

f. Carburetor. - Carburetor will be treated as described in section II, paragraph 8.g.

g. Carburetor Adapter. - Carburetor adapter will be treated as described in section II, paragraph 8.h.

h. Oil Intake and Outlet. - The oil intake and outlet will be sealed with locally manufactured oil- and moisture-resistant blank caps or tape conforming to Specification No. AN-T-12.

i. Breather. - All breather openings will be adequately sealed against moisture as described in section II, paragraph 8.k.

j. Crankcase. - The oil sump plug will be removed and replaced by crankcase dehydrator plug, conforming to Specification No. AN-4061, which will be screwed to a tight seal. Crankcase dehydrator AN-4061-1 for engines designed by Lycoming, Kinner, Continental, and V-1650. Crankcase dehydrator AN-4061-2 for engines designed by Wright and Pratt & Whitney. Crankcase dehydrator AN-4061-3 for V-1710, Jacobs and Franklin engines. Replaced plug will be attached to the sump.

k. Magnetos. - All external openings in the magnetos will be sealed with tape conforming to Specification No. AN-T-12. The cam breaker mechanism will be generously coated with oil, grade 1100, Specification No. AN-VV-O-446.

l. Propeller Shaft.

(1) The propeller shaft will be cleaned thoroughly. Other external surfaces of the engine need not be cleaned.

(2) Spray the interior of the propeller shaft with corrosion-preventive mixture.

(3) The exterior of the propeller shaft will be coated with a compound conforming to Specification No. AN-C-52, type II, grade B. Following this, the propeller shaft shall be wrapped in paper, conforming to Specification No. AN-P-12, grade A, or protected by plastic cylinders, part No. SAAD44B247-1 for shaft No. 20, -2 for shaft No. 30, -3 for shaft No. 40, -4 for shaft No. 50, -5 for shaft No. 60. The threads of the propeller shaft will be protected with a propeller shaft nut conforming to Specification No. AN-5012.

m. Cylinder Bores.

(1) A minimum of 1/2 pint of the corrosion-preventive mixture will be sprayed into the cylinder bores with the piston at the bottom of the stroke. Extreme care will be exercised to spray all portions of the cylinder interior.

(2) Respray each cylinder bore without further rotation of the crankshaft.

(3) Install cylinder bore dehydrator plugs conforming to Specification No. AN-4062, into the spark plug holes. Attach ignition cable protector, color red, Specification No. AN-4060. Cylinder dehydrator plugs, Specification No. AN-4064-1, and ignition cable protector, color yellow, part No. 600268, are required for V-1650 engines.

n. Other Engine Openings. - All other openings in the engine will be sealed with tape, conforming to Specification No. AN-T-12, or other suitable moisture-proof seals.

o. Packing Procedure. - The silica gel and the engine envelope will be applied as described in section II, paragraph 9.

21. INOPERABLE ENGINES.

Engines which may not be operated or which cannot have the crankshaft turned will be treated as far as practicable, as specified in paragraph 20. of this section. Care will be exercised to spray all possible interior surfaces as the engine will be without the protection of run-out on the corrosion-preventive mixture.

Section 7

INSPECTION, REPREPARATION AND STORAGE

22. INSPECTION.

a. Engines Sealed in Engine Envelopes.

(1) Humidity indicator cards attached to engines in engine envelopes will be inspected twice each month for the first 6 weeks following preparation, and monthly thereafter, to determine the color of the silica gel contained therein.

(2) A record of the inspection, by date, will be made on a card attached to the exterior of the engine box.

(3) Engines stored in a building will have the inspection door easily accessible for inspection and free to open. The bolted plate-type inspection door will remain open until shipment of the engine.

b. Engines Not Sealed in Engine Envelopes. - Inspection of the engine cylinder and sump dehydrator plugs will be made weekly to determine the color of the silica gel therein.

23. REPREPARATION.

a. Procedure to be used if the dehydrator plugs and the humidity indicator are pink (30 percent relative humidity or over) indicating unsafe conditions of storage, is as follows:

(1) Remove the engine box top.

(2) Cut the engine envelope along its top edge close to the engine seal.

(3) Carefully roll the engine bag down from the engine.

CAUTION

To avoid tearing the engine envelope it is desirable to have the plastic film envelope at a temperature of 21.1°C (70°F) or higher for a short period of time prior to and during subsequent handling.

(4) Without rotating the crankshaft, remove the dehydrator plugs and inspect the interior of each cylinder bore with an inspector's light for evidence of rust. Removal of the cylinder will be accomplished if any trace of rust is observed.

(5) The cylinder bores will be resprayed through the spark plug openings without rotating the crankshaft if any portion of the interior of the cylinder bore is observed to be not covered with a corrosion-preventive mixture, if the crankshaft is rotated, or if a cylinder is removed.

(6) Engine cylinder and crankcase dehydrator plugs will be replaced with new dehydrator plugs.

(7) Replace the silica gel bags and the indicator chart with new bags and chart.

(8) Sealing of Engine Envelope.

(a) Bring the engine envelope back over the engine.

(b) Heat seal all but a small opening of the envelope with plastic film sealing iron, Specification No. AN-40399.

(c) Collapse the envelope about the engine, or remove the excess air by means of a vacuum.

(d) Complete sealing the envelope.

(9) Replace Engine Box Cover. - Extreme care will be exercised in lowering the engine box over the engine to avoid rupture of the engine envelope.

b. Procedure to be used if the humidity indicator chart only has changed color and all of the dehydrator plugs indicate safe conditions of storage.

(1) Remove the engine box top.

(2) Cut the engine envelope along the top edge close to the seal.

(3) Carefully roll the engine bag down from the engine.

(4) Replace the silica gel bags and the indicator chart with new bags and a new chart.

(5) Inspect engine envelope for holes.

(6) Seal the engine envelope as directed in paragraph 23.a.(8) of this section.

24. STORAGE.

a. Aircraft engines prepared for storage in engine boxes will be stored in suitable shelters whenever warehouse space can be made available.

b. If warehouse space is not available and it is necessary to store engines in engine boxes out-of-doors, the engine boxes will be covered with a two-ply roofing paper across the top and down the sides. Wooden strips (battens) will be used to anchor the roofing paper and prevent it from tearing. Engine boxes containing engines will be placed on blocks to avoid direct contact with the ground.

25. PREPARATION OF ENGINE FOR SHIPMENT.

a. Shipment by Rail, Steamship, or Truck. - All engines shipped by rail, steamship, or truck will be shipped in the engine case supplied by the manufacturer or suitable reproduction thereof. The engine will remain in the engine envelope. An inspection of the humidity indicator chart will be made prior to shipment and repreparation accomplished if necessary.

b. Shipment by Air. - All engines to be shipped by air transport will be shipped on air transport cradles. Such shipment will necessitate the removal of the engine envelope and the silica gel bags at the point of shipment. The engine will then be installed on the air transport cradles. Immediately upon receipt at its destination, silica gel bags will be installed and the engine will be placed in an engine envelope. On all air shipments a suitable engine envelope will be included. The only exception to this requirement will be engines which will be placed in service within 7 days after arrival at the point of destination. In this case the sump and cylinder bore dehydrator plugs shall be inspected daily and be replaced at any time when they indicate the relative humidity to be above 20 percent by comparison with the humidity indicator, Specification No. AN-7511.

Section 8

SPECIAL INSTRUCTIONS AND PRECAUTIONS

26. ENGINE ENVELOPES.

a. The plastic film engine envelopes lose some of their flexibility at low temperatures and are more susceptible to rupture. The pliability of the envelope will return if it is placed in a room heated to a temperature of 70°F (21°C) or higher.

b. The engine envelope is made of a fairly tenacious material, however, if reasonable care is not exercised, the envelope will be easily torn. If the envelope should be torn, it may be repaired by the application of heat along the gathered edges of the tear, using plastic film sealing iron, AAF Specification No. 40399.

c. The engine envelope is designed for re-use several times. When removed from the engine, the envelope will be cleaned and returned to stock, if serviceable. If torn beyond repair, envelope will be cleaned and salvaged as follows:

(1) Salvage Procedure. - All unserviceable plastic film (Pliofilm) and nonrepairable engine envelopes will be salvaged. Pliofilm will be shipped, no accountability, to the AAF Storage Depot at Mogadore, Ohio.

(2) Pliofilm shipments may be combined with scrap rubber shipments, but if shipped separately, the shipments will be in lots of not less than 100 pounds, baled and shipped by the cheapest method possible.

27. SILICA GEL.

Silica gel in bags will not be re-used. It may not be used after prolonged exposure to the air and cannot be reactivated successfully. Spent silica gel will be forwarded to salvage in accordance with current directives.

IMPORTANT

IN ALL INSTANCES, THE SILICA GEL, EITHER BAGS OR DEHYDRATOR PLUGS, MUST NOT BE REMOVED FROM THE MOISTUREPROOF SHIPPING CONTAINER UNTIL IMMEDIATELY BEFORE APPLICATION TO THE ENGINE AND SEALING OF ENVELOPE.

28. HUMIDITY INDICATOR.

a. A "blue" color indicates safe condition of storage. A "pink" color indicates unsafe conditions of storage and requires immediate repreparation.

b. The humidity indicator, conforming to Specification No. AN-7511, will be located in such a position on the engine that it can readily be seen when the inspection door is open.

c. In all instances the humidity indicator must not be removed from the moistureproof shipping container until immediately before application to the engine and sealing of the envelope.

29. ENGINE CYLINDER AND SUMP DEHYDRATOR PLUGS.

a. All dehydrator plugs will not be re-used or reactivated. At no time will a "pink" plug be inserted in an opening. Used plugs will be sent to salvage in accordance with current directives.

b. Cylinder and sump dehydrator plugs contain the same color indication as does the humidity indicator. The lower dehydration plugs will frequently become filled with the oil corrosion-preventive mixture. This mixture does not impair the action of the dehydrator plugs as they will continue to absorb any water that may be present in the oil. Since the mixture discolors the interior of the lower dehydrator plugs, the upper plug will be used as the indicator for both.

c. Dehydrator plugs, both cylinder bore and sump, will be sealed in their respective positions by application of pressure applied by means of a suitable tool. Should the plug be broken during the seating operation it will be necessary to remove, by disassembly of the engine, any of the silica gel that may have fallen into the cylinder bore.

Care must be exercised to avoid applying excessive pressure.

30. MIXTURE.

a. The mixture specified in this Technical Order is a blend of one part corrosion-preventive compound, conforming to Specification No. AN-VV-C-576, in three parts of aircraft engine lubricating oil, conforming to Specification No. AN-VV-O-446.

CAUTION

The corrosion-preventive compound will never be used unless mixed with lubricating oil in the specified ratio.

b. The grade of lubricating oil required for the mixture in the lubricating system for shut-down operation of installed engines will vary with the air temperature taken at the ground as specified below:

GRADE OIL	AIR TEMPERATURE AT GROUND
1120	40°F (4°C) and above
1100	20° to 80°F (-7° to 27°C)
1080	50°F (10°C) and below

c. In a test cell shut-down procedure grade 1120 lubricating oil will be used at all times in preparing the mixture.

d. The mixture for spraying will consist of the same ratio of one part of corrosion-preventive compound mixed with three parts of lubricating oil, Specification No. AN-VV-O-446. Grade 1120, 1100, 1080, or 1065 may be used. The grade used should give a desirable free spray and yet be sufficiently thick to remain on the part.

Section 9

MATERIALS, PARTS, AND EQUIPMENT

31. MATERIALS AND PARTS.

a. Materials and parts will be requisitioned in sufficient quantities to meet anticipated requirements. If materials are not available to prepare aircraft engines for storage, notify Headquarters, Air Service Command, Patterson Field, Fairfield, Ohio, Attention: Supply Division, within 24 hours of the existing requirements. If no reply is received after an additional lapse of 24 hours, a second notification will be sent to Headquarters, Air Service Command, Maintenance Division, Patterson Field, Fairfield, Ohio, Attention: Engine Section.

b. The following materials and parts are required to accomplish this Technical Order:

QUANTITY	AN AERONAUTICAL SPECIFICATION NO. AND/OR PART NO.	NOMENCLATURE	CLASS	SOURCE
14 per engine	43A21578	Plug - Exhaust pipe, red (for R-1830 engines)	02-H	AF Stock
18 per engine	43A21579	Plug - Exhaust pipe, yellow (for R-2800 engines)	02-H	AF Stock
14 per engine	43A22439	Plug - Exhaust pipe, black (for R-2000 engines)	02-H	AF Stock
2 per engine	Stock No. 0255-600269	Adapter - Cylinder head valve compartment dehydrator (for V-1650 engines)	02-J	AF Stock
1 per engine	Stock No. 0255-601707	Adapter - Crankcase dehydrator (for V-1650 engines)	02-J	AF Stock
1 per spark plug	Stock No. 0255-600268	Protector - Cable, ignition yellow (for V-1650 engines)	02-J	AF Stock
1 per engine	AN5012-20 (for snaft No. 20)	Cap - Propeller shaft thread	03-J	AF Stock
1 per engine	AN5012-30 (for shaft No. 30)	Cap - Propeller shaft thread	03-J	AF Stock
1 per engine	AN5012-40 (for shaft No. 40)	Cap - Propeller shaft thread	03-J	AF Stock
1 per engine	AN5012-50 (for shaft No. 50)	Cap - Propeller shaft thread	03-J	AF Stock
1 per engine	AN5012-60 (for shaft No. 60)	Cap - Propeller shaft thread	03-J	AF Stock
1 per engine	SAAD 44B247-1	Protector - Propeller shaft, plastic (for shaft No. 20)	03-J	SAASC
1 per engine	SAAD 44B247-2	Protector - Propeller shaft, plastic (for shaft No. 30)	03-J	SAASC
1 per engine	SAAD 44B247-3	Protector - Propeller shaft, plastic (for shaft No. 40)	03-J	SAASC
1 per engine	SAAD 44B247-4	Protector - Propeller shaft, plastic (for shaft No. 50)	03-J	SAASC
1 per engine	SAAD 44B247-5	Protector - Propeller shaft, plastic (for shaft No. 60)	03-J	SAASC
2 per cylinder	AN-4062	Plug - Dehydrator, engine cylinder	04-A	AF Stock
2 per cylinder	AN-4064-1	Plug - Dehydrator, engine cylinder (for V-1650 engines only)	04-A	AF Stock

QUANTITY	AN AERONAUTICAL SPECIFICATION NO. AND/OR PART NO.	NOMENCLATURE	CLASS	SOURCE
1 per engine	AN-4061-1	Plug - Dehydrator, crankcase (for engines designed by Lycoming, Kinner, Continental & Packard V-1650) 1-inch diameter 20 N.S. threads per inch	04-A	AF Stock
1 per engine	AN-4061-2	Plug - Dehydrator, crankcase (for engines designed by Wright and Pratt & Whitney) 1-inch diameter 18 S. threads per inch	04-A	AF Stock
As req	AN-4061-3	Plug - Dehydrator, crankcase (used on Allison V-1710* engines, Jacobs & Franklin) 3/4-inch N.P.T. (*) To be installed on left side of accessory gear housing, top of reduction gear housing, and front housing openings.	04-A	AF Stock
As req	AN-4061-4	Plug - Dehydrator, crankcase (used in breather openings of engines designed by Wright, Pratt & Whitney & Jacobs) 1-3/8 inch diameter 12 threads per inch	04-A	AF Stock
1 per spark plug	AN-4060	Protector - Cable, ignition, red	04-A	AF Stock
1 per engine	43A21101	Adapter - Crankcase dehydrator (for R-1340 engines) NOTE: To be installed in the 1-3/4 inch opening on the sump; will receive dehydrator plug, part No. AN-4061-2.	04-A	AF Stock
As req	AN-O-P-406	Plastic Film - Transparent, moisture-impervious	04-B	AF Stock
1 per carburetor	AAF Specification No. 17018	Envelope - Carburetor protector open end 30-inch depth 30-inch or open end 45-inch depth 45-inch	04-B	AF Stock
1 per engine	AN-E-1 P/N AN-4066-1	Envelope - Engine protector (for R-440 & R-540 engines)	04-B	AF Stock
1 per engine	AN-E-1 P/N AN-4067-1	Envelope - Engine protector (for L-440 engines)	04-B	AF Stock
1 per engine	AN-E-1 P/N AN-4068-1	Envelope - Engine protector (for V-770 engines)	04-B	AF Stock
1 per engine	AN-E-1 P/N AN-4069-1	Envelope - Engine protector (for R-670 & R-680 engines)	04-B	AF Stock
1 per engine	AN-E-1 P/N AN-4070-1	Envelope - Engine protector (for R-760 & R-755 engines)	04-B	AF Stock
1 per engine	AN-E-1 P/N AN-4071-1	Envelope - Engine protector (for R-975, R-985, & R-1340 engines)	04-B	AF Stock
1 per engine	AN-E-1 P/N AN-4072-1	Envelope - Engine protector (for R-1820 & R-1830 engines)	04-B	AF Stock
1 per engine	AN-E-1 P/N AN-4073-1	Envelope - Engine protector (for R-2600 & R-2800 engines)	04-B	AF Stock
1 per engine	AN-E-1 P/N AN-4074-1	Envelope - Engine protector (for V-1650-1 & V-1710 engines)	04-B	AF Stock
1 per engine	AN-E-1 P/N AN-4075-1	Envelope - Engine protector (for R-3350 engines)	04-B	AF Stock
1 per engine	AN-7511	Indicator - Humidity	05-B	AF Stock
As req	AN-VV-0-446	Oil - Lubricating, aircraft	06-A	AF Stock
As req	AN-VV-F-756 or AN-F-22	Fuel - Aircraft engine, grade 65	06-A	AF Stock
As req	AN-C-52 (Supersedes U.S. Army Specification No. 2-82)	Compound - Exterior surfaces corrosion-preventive, type II, grade B	06-B	AF Stock

QUANTITY	AN AERONAUTICAL SPECIFICATION NO. AND/OR PART NO.	NOMENCLATURE	CLASS	SOURCE
As req	AN-VV-C-576	Compound - Corrosion-preventive aircraft engine	06-B	AF Stock
As req	AN-T-12	Tape - Adhesive moistureproof red - 2 inches wide	21	AF Stock
As req	AN-T-12	Tape - Adhesive moistureproof red - 6 inches wide	21	AF Stock
As req	AN-D-6	Silica Gel - Dehydrating agent (activated) type V	24	AF Stock
As req	AN-P-12	Paper - Greaseproof, wrapping, red, uncreped, grade A	25B	AF Stock
As req	AN-P-12	Paper - Creped, greaseproof, wrapping 24-inch width, 230-lb. weight NOTE: For use as a protective covering around rocker boxes and over in-line engines to prevent tearing of the plastic envelope.	25B	AF Stock

c. The following material and parts will be disposed of as indicated:

AN AERONAUTICAL SPECIFICATION NO. AND/OR PART NO.	NOMENCLATURE	DISPOSITION
AN-D-6	Silica Gel - Dehydrating agent type V (unserviceable)	AAF Regulation 65-43
AN-O-P-406	Plastic Film - Transparent, moisture-impervious (serviceable or unserviceable)	AF Stock
AN-4060	Protector - Cable, ignition, red	AF Stock
Stock No. 0255-600268	Protector - Cable, ignition, yellow	AF Stock
AN-4061	Plug - Dehydrator, crankcase (unserviceable)	AAF Regulation 65-43
AN-4062	Plug - Dehydrator, engine cylinder (unserviceable)	AAF Regulation 65-43
AN-4064-1	Plug - Dehydrator, engine cylinder (unserviceable)	AAF Regulation 65-43
AN-5012	Cap - Propeller shaft thread	AF Stock
AN-7511	Indicator - Humidity (unserviceable)	AAF Regulation 65-43
AN-E-1	Envelope - Engine protector (serviceable or unserviceable)	AF Stock
AAF Specification No. 17018	Envelope - Carburetor protector (serviceable or unserviceable)	AF Stock
AN-T-12	Tape - Adhesive, moistureproof (unserviceable)	AAF Regulation 65-43
AN-P-12	Paper - Greaseproof, wrapping, red, uncreped, grade A (unserviceable)	AAF Regulation 65-43
AN-P-12	Paper - Creped, greaseproof wrapping, used around rocker boxes and over in-line engines. (unserviceable) NOTE: Paper will be returned to stock and re-used if considered to be in a serviceable condition.	AAF Regulation 65-43
AN-VV-0-446	Oil - Lubricating, aircraft (unserviceable oil, with or without corrosion-preventive compound)	AF Stock
43A21578	Plug - Exhaust pipe, red	AF Stock
43A21579	Plug - Exhaust pipe, yellow	AF Stock
43A22439	Plug - Exhaust pipe, black	AF Stock
43A21101	Adapter - Crankcase, dehydrator	AF Stock
Stock No. 0255-600269	Adapter - Cylinder head valve compartment dehydrator	AF Stock
Stock No. 0255-601707	Adapter - Crankcase dehydrator	AF Stock
SAAD 44B247	Protector - Propeller shaft, plastic	AF Stock

32. EQUIPMENT.

a. Equipment to be obtained from AF Stock includes the following:

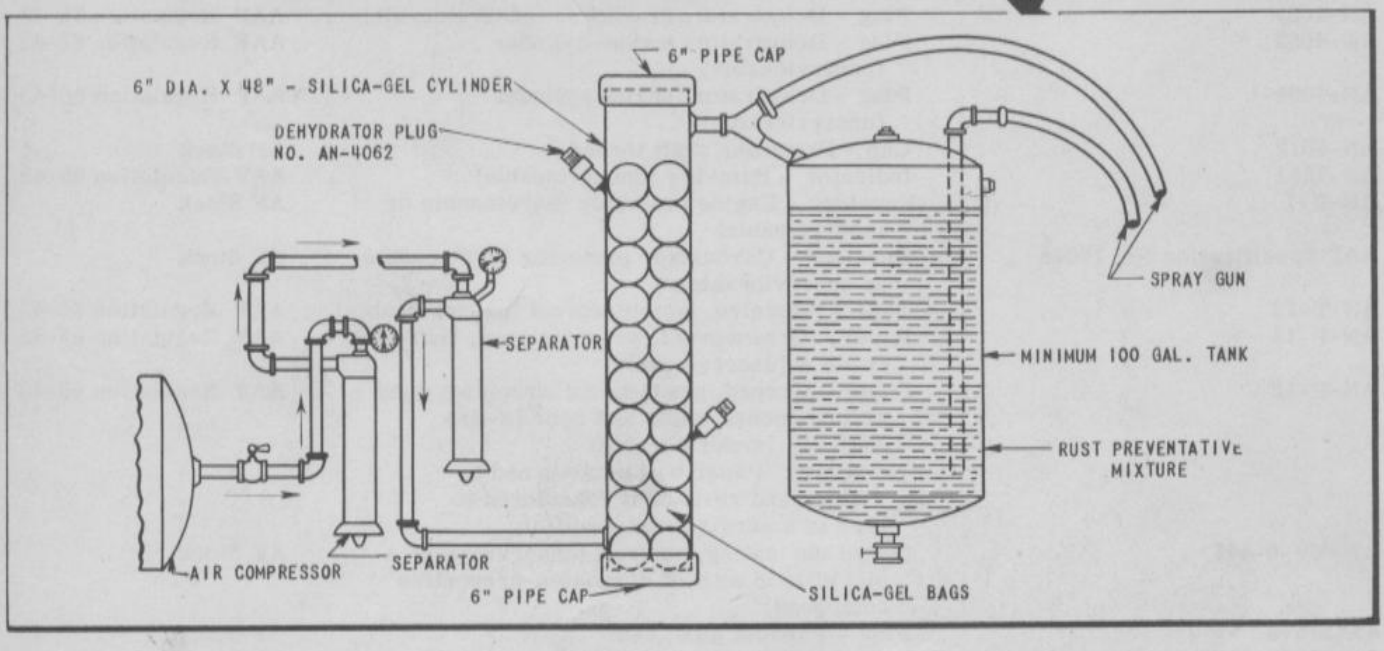
QUANTITY	STOCK NO.	NOMENCLATURE	CLASS	SOURCE
1	8042-AAF-275450	Iron - Sealing, plastic film AAF Specification No. 40399	18	AF Stock
1	7900-402740	Gun - Oil spray AC Specification No. 50127	17-B	AF Stock

b. Auxiliary Oil Tank. - Each test stand will be equipped with an auxiliary oil tank for operating the engine on the corrosion-preventive mixture during the 15 minutes clear fuel run. The capacity of the oil tanks will be sufficient to permit the use of 10 gallons of the mixture per 1000 engine horsepower (A 2000 horsepower engine will require a 20-gallon tank.) The tank will be equipped with a means for maintaining the mixture outlet temperature at 104.4°C to 121.1°C (220°F to 250°F) and will have adequate breather to permit the escape of accumulated water vapor.

c. Auxiliary Tank for Aspiration. - Each test stand will be equipped with an auxiliary oil tank with a minimum of 1-gallon capacity to enable aspiration into the impeller section of the engine and preliminary treatment of the cylinder bores. This tank will be equipped with suitable air pressure on the oil side to insure injection of the mixture. A needle valve may be used in the air line to permit adjustment of the air pressure.

d. Dry, Compressed Air. - Dry, compressed air must be used for blowing out coolant systems and coolant liquid, and in all spraying operations called for in this Technical Order. Dry, compressed air may be obtained by inserting at least one, and preferably two, water traps in the compressed air line between the compressor and the point of application. In series with these water traps, between the water traps and the point of application, the compressed air should be passed through a dehydrating tower, fabricated from standard 6- to 8-inch inside diameter pipe, 4 to 5 feet in length and filled with bags of silica gel conforming to Specification No. AN-D-6, type V. A dehydrator plug will be inserted in the outlet line from this dehydrating tower to indicate when the silica gel should be replaced. The dehydrator equipment is illustrated by figure 30.

Figure 30 - Dehydrator Equipment



By Command of General ARNOLD:

WALTER H. FRANK,
Major General, U. S. A.,
Commanding General, Air Service Command.