WRIGHT *Whirlwind* ENGINES

SERVICE BULLETINS

JANUARY, 1947

CONTENTS

WRIGHT AERONAUTICAL CORPORATION
A DIVISION OF CURTISS-WRIGHT CORPORATION
WOOD-RIDGE, NEW JERSEY, U. S. A.

FOREWORD

The Service Bulletins contained in this set are prepared by the Wright Aeronautical Corporation for the use of operators of Wright Whirlwind engines. They supplement other publications by providing the most recent information necessary to keep these publications up to date. They also provide recent information necessary for engine modernization and table of limit values, the observance of which will assist in prolonging the serviceability of the engines and improve operation.

Among the many publications issued to the operator by the Wright Aeronautical Corporation are Overhaul Manuals, Service Manuals (Instruction Books), Parts Catalogs, and Tool Catalogs.

A numerical index and an alphabetical index of the active Whirlwind service bulletins are submitted herein for convenient reference. The numerical index will be revised every two months as scheduled below, through a supplement indicating new, revised, or cancelled bulletins. Both the numerical index and the alphabetical index will be reissued as changes warrant.

January	1	July	1
March	1	September	1
May	1	November	1

NUMBERING SYSTEM

Bulletins are now numbered from No. 1 upward. Thus, the bulletins intended for this set are numbered "W-1," "W-2," etc. Prior to 1944, bulletins covering all Wright engines were published as one set and numbered in consecutive order of issuance up to No. 611. A complete set for Whirlwind engines consists, therefore, of bulletins under two numbering systems, as may be seen in the numerical index.

REVISIONS

Bulletins numbered under the former system will be reissued under the new system as revisions are published.

As bulletins of this new series are revised, they will be designated by a letter following the number of the bulletin, as "W-1A" ("A" indicating the first revision). Information of a later date supersedes and cancels all similar information that was released at a prior date.

NUMERICAL INDEX OF ACTIVE SERVICE BULLETINS

SERIES WHIRLWIND

This index indicates all the changes made in the set of Whirlwind Service Bulletins since the publication of the basic index dated January, 1947. A revised numerical index will be issued periodically, as indicated in the Foreword in the basic index, and should be used in conjunction with the alphabetical section of the Whirlwind Service Bulletin Index dated January, 1947.

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Revised September 1, 1947

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W-32	Inspection of Piston Pins
W-34	Ordering of Tools

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W-38	Carburetor Manufacturers' Bulletins
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W-64	Crankshaft, Undercutting Threaded Section on
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The following bulletins have been dropped from the Numerical Index:

No.	*Title*	*Reason*
472	Timken Rocker Arm Bearings, Mis-Matching of Rollers and Races	Obsolete
482	Oil Leakage, Standard Tachometer Drive Gear Housing	Obsolete
497	Carburetor Settings	Obsolete
499	Replacement of Whirlwind Cylinder Hold-Down Studs	Obsolete
501	Interference Between Valve Tappet Ball Socket and Guide	Obsolete
503	Reduction of Propeller Vibration and Stress	Obsolete
519	Change of Oil Pressure Marrings on Crankcase Front Section	Obsolete
529	Provision for Increased Hydro Oil Pressure	Obsolete
539	Installation of Crankcase Front Cover Spacer	Obsolete
577	Plug Type Piston Pin Retainers	Obsolete
592	Re-Design of Diffuser Section Oil Seal Ring	Obsolete

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NUMERICAL INDEX OF ACTIVE SERVICE BULLETINS

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January, 1947
Revised May, 1947
Rev. to Sept. 1, 1947

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WRIGHT AERONAUTICAL CORPORATION
A DIVISION OF CURTISS-WRIGHT CORPORATION
WOOD-RIDGE, NEW JERSEY, U.S.A.

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This index supersedes the one issued in November, 1946, and is corrected to include the changes listed below:

The following bulletin was superseded as indicated:

Old No.	New No.
W-13B	W-13C

ALPHABETICAL INDEX OF ACTIVE SERVICE BULLETINS

JANUARY, 1947

SERVICE BULLETIN NO. 482
SUBJECT: Oil Leakage, Standard Tachometer Drive Gear Housing
MODELS: Whirlwind 7 and 9 Series Engines

An investigation of reported oil leakage at the tachometer drive gear housing location of the above Whirlwinds has disclosed the following:

Oil leakage at this location is apparently caused by improper assembly of the dual tachometer drive gear and shaft assemblies. The tachometer drive gear and shaft assemblies, Part Nos. 411947 and 411948, incorporate sleeves in which are milled spiral oil grooves. During normal operation and when properly assembled, the tachometer drive gears rotate in opposite directions to each other and the spiral oil grooves are milled in such a direction that during rotation the oil is forced into the interior of the tachometer drive gear housing. However, interchanging the drive gears reverses the direction of the spiral oil grooves and tends to force the oil out of the tachometer drive gear shaft housing and results in oil leakage.

To facilitate proper assembly of the tachometer drive gears, the upper tachometer drive gear of current production Whirlwinds is marked with an ellipse. The ellipse is acid-etched on the 9/16 inch diameter shoulder near the gear end of the assembly.

It is recommended that all operators of Whirlwinds incorporating the standard tachometer drive gear assembly acid etch an ellipse on the upper drive gear to prevent improper assembly and resultant oil leakage. Etching should be done in accordance with existing instructions.

To determine the proper drive gear assembly for installation in the upper location, make the following check:

Select one of the drive gears and while facing the gear end rotate it in a counter-clockwise direction. The spiral oil groove milled in the shaft of the drive gear assembly, Part No. 411947, that should be located in the upper position, will run in toward the gear end of the assembly. If this condition is not encountered, select the remaining drive gear and repeat the check.

Etch mark and install the drive gear with the spiral oil groove running in toward the gear end in the upper position. The assembly, Part No. 411948, with the oil groove running out from the gear end, as determined from the above check, is installed in the lower position.

Service Division
Wright Aeronautical Corporation
September 11, 1941

SERVICE BULLETIN NO. 472
SUBJECT: Timken Rocker Arm Bearings, Mis-matching of Rollers and Races
MODELS: All

This bulletin applies to all engines incorporating a roller type rocker arm bearing.

Some cases of bearing rejection have been traced to mis-matched rollers and races during reassembly of rocker arm roller bearings after disassembly for inspection and cleaning.

Since the rollers and races are assembled with selective fits, it is recommended that the rollers and outer races of each side of the bearing be placed in separate cloth bags or other suitable separate containers at disassembly. These selective fits require that extreme care be taken to reassemble the sets of rollers with the same races from which they were removed.

Wright Aeronautical Corporation
(A Division of Curtiss-Wright Corporation)
Paterson, New Jersey, U.S.A.
June 30, 1941

Printed in U.S.A.

Model NA-R9 carburetors having setting number 27225, for pressure feed, or 29041, for gravity feed, used on Whirlwind R-975 E and R-975 E-1 engines should have the economizer timing adjusted to 28° throttle opening. Instructions relative to adjusting the economizer timing are given in the last paragraph of this bulletin. Stamp change letter "K" next to the setting number on the flange of carburetors having setting number 27225 and change letter "B" on carburetors having setting number 29041. Some of the early carburetors with setting number 27225 will not have this number stamped on the flange. However, they may be identified by the setting stamped on the data plate which is as follows:

Model	NA-R9	Float Level	3/4 B.P.S.
Main	#25	Econom.	#55
Idle Jet	#50	Venturi	2 7/16"
I.A.B.	#48	M.A.B.	#55

Model NA-R9A carburetors having setting number 63444 used on Whirlwind R975 E-2 and R975 E-3 engines should be modified as follows: Change the #25 main metering jet to a #26 jet. Change the #48 economizer metering jet to a #43 jet. Change the idle air bleed from a #50 to a #60 bleed and change the idle discharge orifice from a #44 to a #60-70-60-56. This will also require replacing the throttle valves with the 18° mill type. Adjust the economizer timing to 33° throttle opening. Instructions relative to adjusting the economizer timing are given in the last paragraph of this bulletin. Stamp change letter "H" next to the setting number on the flange, and change the setting on the data plate to agree with the modifications made in the economizer and main metering systems.

Model NA-R9A carburetors having setting number 64498 used on Whirlwind R975 E-2 and R975 E-3 engines should have the economizer timing adjusted to 28° throttle opening. The idle air bleed should be changed from a #50 to a #60 bleed. The idle discharge orifice should be changed from a #44 to a #60-70-60-56 and the throttle valves replaced with the 18° mill type. Instructions relative to adjusting the economizer timing are given in the last paragraph of this bulletin. Stamp change letter "D" next to the setting number on the flange.

Model NA-R9A carburetors having setting number 112166 used on Whirlwind R975 E-3 engines should have the following modifications incorporated. Change the #25 main metering jet to a #26 jet. Change the #48 economizer metering jet to a #43 jet. Adjust the economizer timing to 33° throttle opening. Instructions relative to adjusting the economizer timing are given in the last paragraph of this bulletin. Stamp change letter "A" next to the setting number on the flange and change the setting on the data plate to agree with the modifications made in the economizer and main metering systems.

It should be noted that operating fuel pressure for gravity feed carburetor settings is 1/2 lbs. per square inch plus 1.0 lbs., minus 0 lbs. When checking the fuel level of gravity feed carburetors 1 1/2 lbs. fuel pressure should be maintained and the fuel level held at 3/4 inch below parting surface.

To adjust the economizer timing proceed as follows: Check the tapered pins which locate the economizer valve actuating lever on the left end of the throttle shaft and the throttle stop lever on the right end to see that they are tight in the levers and the shaft. Back off the throttle adjusting stop screw so that the throttle valve may be completely closed. Assemble a protractor graduated in one degree units on the throttle shaft at the throttle control lever. A suitable protractor may be procured commercially and an extension should be either riveted or soldered at the axis to permit drilling a 5/16 inch diameter hole at the axis. A protractor designed for this purpose may be procured from the Bendix Products Corporation. Attach a pointer to the carburetor body. With the throttle fully closed, set the pointer to indicate zero on the protractor. The upper end of the economizer valve needle is threaded and protrudes through the cover of the carburetor body on the left of the throttle body. The threaded end of the economizer needle is provided with an adjusting nut. On Model NA-R7 and NA-R9 carburetors this nut is knurled and is locked with a cotter pin. On Model NA-R7A and NA-R9A carburetors the adjusting nut is a hex nut and is locked with a hex lock nut. Loosen the economizer valve needle adjusting nut lock nut, or remove the cotter pin if a Model NA-R7 or NA-R9 carburetor. Open the throttle until the protractor indicates the degree of throttle opening for which it is desired to set the economizer timing. Screw the economizer valve needle adjusting nut down until it contacts the valve needle actuating lever. Do not turn the nut hard enough to lift the valve needle or move the throttle, but make sure that it contacts the actuating lever. Secure the adjusting nut in position with the lock nut or cotter pin, as provided. Close the throttle and check the economizer timing. Reset if it is not correct.

SERVICE BULLETIN NO. 499
SUBJECT: Replacement of Whirlwind Cylinder Hold-Down Studs
MODELS: Whirlwind R 760 E and R 975 E Series Engines Employing Cylinder Hold-Down Studs of 7/16 Inch Diameter on the Crankcase End

This bulletin applies to all Whirlwinds using cylinder hold-down studs of 7/16 inch diameter on the crankcase end. Early Whirlwinds using cylinder hold-down studs of 3/8 inch diameter at the crankcase end are not affected by this bulletin.

Several types of cylinder hold-down studs have been supplied on the above Whirlwind models, and different methods and tools are employed for their removal and installation. Cylinder hold-down studs used in all Whirlwinds of current manufacture have ground threads and a .043 inch taper per inch on the crankcase end threads.

Whirlwind models of current manufacture employ cylinder hold-down studs having a 7/16-12 thread on the crankcase end. Part numbers and descriptions of these studs are given in Table 1 at the end of this bulletin. Instructions for replacement of these studs may be found in Section "A" of this bulletin. These studs are driven into the crankcase to obtain a stud height of .640 to .700 inches. Stud height is defined as the distance from the cylinder mounting pad to the top of the stud when driven. Extended type nuts, Part No. 124-D-116, which are drilled for lockwiring, are used with these studs. Stud holes 1 and 8 in crankcases used in Whirlwinds of current manufacture are counterbored.

The cylinder hold-down studs are numbered consecutively in a clockwise direction around the cylinder mounting pad, beginning with No. 1 as the first stud to the left of the center line of the cylinder at the front of the engine, viewed from the propeller end and looking down on the pad.

The remaining Whirlwinds affected by this bulletin formerly employed cylinder hold-down studs having a 7/16-14 straight or .0025 inch taper per inch thread on the crankcase end. Straight studs are no longer supplied for replacement. Studs having .0025 inch taper per inch may be used for replacement of straight or .0025 inch tapered studs where only a very limited number of studs require replacement and the crankcase threads are in perfect condition. However, it is recommended that the crankcases used in these engines be reworked to incorporate the new 7/16-14, .043 inch taper per inch studs. Part numbers and description of these studs are given in Table 1 at the end of this bulletin. Instructions for reworking of the crankcase and installation of the new studs may be found in Section "B" of this bulletin. These studs are driven into the crankcase to obtain a stud height of .810 to .870 inches. Plain hexagonal nuts, locked by palnuts, are used with these studs. All stud holes in crankcases used in these engines are counterbored.

In cases where the stud hole threads have become mutilated in engines using 7/16-14 studs, replacement may be possible with 7/16-14, .043 inch taper, .003 inch oversize studs. However, when necessary, 9/16-10, .043 inch taper studs or 9/16-10, .043 inch taper, .003 inch oversize studs may be procured for replacement. Part numbers and descriptions of these studs are given in

Table I at the end of this bulletin. Instructions for installation are given in Section "C" of this bulletin.

Table I of this bulletin lists the only studs currently supplied and gives the part numbers, description, stud height, stud length, location of the various studs in the cylinder pad, in cases where certain studs should be driven in specific hole locations, and part numbers of hold-down nuts to be used with each stud. Note that only one oversize stud is supplied for each of the studs listed. These studs are .003 inch oversize and are marked with a +3 on the nut end.

Careful segregation of all studs is important when these parts are stocked, since the proper selection of a stud to be used in an engine is essential. An attempt to drive into a crankcase a stud not specifically intended for use in that crankcase may cause damage to the stud hole threads which will render the crankcase unsatisfactory for use. Discard all straight studs that may be in stock, since further replacement of those studs will be made with either the .0025 or the .043 inch taper ground thread studs. The difference in amount of taper is discernible to the experienced eye but further identification can be made by the number of threads per inch.

A careful inspection of all taps must be made before using to tap stud holes, since rough edges or burrs on the tap may cause the tap to cut oversize. All taps must be tried in a test block made of the same material as the material to be cut. The tap being tested should not free itself enough to shake in the tapped hole. If such shaking is possible, that is an indication that the tap is not free of burrs. Remove burrs if necessary.

Use a torque wrench in every case in driving a new stud. Torque limits for driving cylinder hold-down studs having 3/8 inch diameter threads and 24 threads per inch on the nut end have been established in the Table of Limits, TL-45. These torque limits should under no circumstances be disregarded in obtaining the proper stud height.

Section "A" - Replacement of 7/16-12, .043 Inch Taper Studs.

Remove the old studs using stud remover, Tool No. 801490. If the stud is broken in the crankcase, drill it out using successively 1/8, 1/4, and 9/32 inch drills, Tool Nos. 84276, 84277, and 84904, and drill jig, Tool No. 84907-1, and bushings, Tool Nos. 84907-4, 84907-3, and 84907-2. Note that if the stud is broken off in a counterbored hole, it will first be necessary to drill off the entire neck of the stud using drill, Tool No. 801155, and bushing, Tool No. 84907-5. Extreme caution must be exercised while drilling through studs in blind holes, as any misalignment might result in mutilation of the threads and drilling too deep might damage the crankcase.

Most of the studs installed in holes drilled completely through the crankcase can be removed during the drilling operation. Insure that all remaining particles are removed. However, with studs in blind holes, three drilling operations are needed to leave only the threads and the tip of the stud. Some

of the threads can be picked out with long-nose pliers, while others require removing Tool No. 802150 and wrench, Tool No. 83759. The end of the stud is in the shape of a washer and can be broken by striking with a cold chisel and removed.

Tap the threads to clean up to a depth of 1-1/16 to 1-5/16 inches for stud holes 2, 3, 4, 5, 6, and 7 with finish tap, Tool No. 84898, tap holder, Tool No. 84909, and tap fixture, Tool No. 84908. Use tap, Tool No. 84899 for .003 inch oversize studs. Tap holes 1 and 8 completely through the crankcase.

Drive in the stud to the correct stud height and to the proper torque limits using stud driver, Tool No. 84432, adapter, Tool No. 84435, and torque wrench, Tool No. 84922. Check the stud height and if not within limits, remove stud. If the stud projection is too great, try another stud of the same size or retap the hole slightly deeper and drive again. If the stud projection is too small, try another stud of the same size or retap the hole for an oversize stud.

All the necessary tools for the foregoing operations are listed in Table II at the end of this bulletin.

Tool Nos. 84907-1, 84907-2, 84907-3, 84907-4, and 84907-5 are supplied in a single set under Tool No. 84907. Tool Assembly No. 802149 includes the following standard and special tools: Tool Nos. 83759, 84276, 84277, 84432, 84435, 84904, 84907, 84908, 84909, 84922, 801155, 801490, and 802150. When a complete set of tools is desired, it should be ordered under Tool No. 802149. However, when only certain special tools of this set are required, they should be ordered under their respective tool numbers. Blueprint No. 802149 is furnished with each set of tools. Tool Nos. 84898 and 84899 are furnished separately.

Section "B" - **Replacement of 7/16-14, Straight or .0025 Inch Taper Per Inch Studs With 7/16-14, .043 Inch Taper Per Inch Studs.**

Removal of the old studs is accomplished by the same procedure outlined in Section "A" using the same tools. These tools are listed in Table III at the end of this bulletin. For replacement with the .043 inch taper studs, employ fixture, Tool No. 84908, clamp, Tool No. 801012, and centering plug, Tool No. 801537-1. Locate the centering plug in the present counterbore and lock the clamp.

In counterboring, adjust stop collar, Tool No. 801815 on counterbore, Tool No. 801519, to give the desired depth, as specified on Blueprint No. 801523. Install bushing, Tool No. 801539, in the fixture and counterbore holes No. 1 and 8 on all crankcases to a depth of .875 inches. On crankcases using .0025 inch taper studs, a counterbore of .375 inches is incorporated in holes 2, 3, 4, 5, 6, and 7. Crankcases using straight studs have these six holes counterbored to a depth of .188 inches. Counterbore these six holes on all crankcases to .375 inches.

Install bushing, Tool No. 801537-2, in the fixture and ream one of holes 2, 3, 4, 5, 6, or 7, using reamer, Tool No. 801520. Check with gauge, Tool No.

801521. Install stop collar, Tool No. 801537-3 on the reamer and set stop collar with reamer seated in reamed hole. Ream all remaining holes except 1 and 8 controlling the depth with the stop collar. Remove the stop collar and ream holes 1 and 8 and check with gauge, Tool No. 801522.

Loosen fixture clamp, Tool No. 801012. For rough tapping insure to start the tap in the old threads. Use rough tap, Tool No. 801540. Adjust stop collar on tap holder, Tool No. 84909 to the following dimensions, measured from the top of the stop collar to the end of the tap in order to tap to the desired depth: 5.540 inches for holes 2, 3, 4, 5, 6, and 7, and with the wedge in the lower slot of the holder, and 6.350 inches for holes 1 and 8 with the wedge in the upper slot. Hand tap to the indicated depth. Note that the stop collar is not used for finish tapping. Install finish tap, Tool No. 801517, for standard holes or Tool No. 801518 for .003 inch oversize holes. Hand tap these holes deep enough to obtain a stud height of .81 to .87 inches when the proper torque is applied in driving the stud.

Drive in the stud to the required depth and to the correct torque limits using stud driver, Tool No. 84432, adapter, Tool No. 84435, and torque wrench, Tool No. 84922. Check the stud height and if the stud is not within the limits, remove the stud. If the stud projection is too great, try another stud of the same size or retap the hole slightly deeper. If the stud projection is too small, try another stud of the same size or retap the hole for an oversize stud.

Replacing tools for the foregoing operations are listed under Table III at the end of this bulletin.

Tool Nos. 801537-1, 801537-2, and 801537-3 are supplied in a single set under Tool No. 801537 and should be ordered as such. Tool Assembly No. 802149 includes the following standard and special tools: Tool Nos. 83759, 84276, 84904, 84277, 84432, 84435, 84907, 84908, 84909, 84922, 801155, 801490, and 802150. When a complete set of tools is desired, it should be ordered under Tool No. 802149. However, when only certain special tools of this set are required, they should be ordered under their respective tool numbers. Blueprint No. 802149 is furnished with each set of tools. All other tools are furnished separately.

Section "C" - Replacement of 7/16-14 Inch Studs With 9/16-18, .043 Inch Taper Studs.

The same procedure for removal and replacement described in Section "B" of this bulletin should be followed when installing these studs. The tools necessary for removal and replacement of these studs are listed in Table IV at the end of this bulletin. Note that drill, Tool No. 801030, stop collar, Tool No. 80153 -4 and bushing, Tool No. 801538-1 are used in an additional operation prior to counterboring. Refer to Blueprint No. 801028 for specific rework instructions.

Tool Nos. 801538-1, 801538-2, 801538-3, and 801538-4 are furnished as a single set under Tool No. 801538 and should be ordered as such. Tool Assembly

No. 801028 includes the following tools: Tool Nos. 801030, 801031, 801032, 801033, 801034, 801035, and 801036. Tool Assembly No. 802149 includes the following standard and special tools: Tool Nos. 83759, 84276, 84277, 84432, 84435, 84904, 84907, 84908, 84909, 84922, 801155, 801490, and 802150. When a complete set of tools is desired, it should be ordered under Tool No. 802149. However, when only certain special tools of this set are required, they should be ordered under their respective tool numbers. Blueprint 802149 is furnished with each set of tools. All other tools are furnished separately.

SERVICE BULLETIN NO. 499

SUBJECT: Replacement of Whirlwind Cylinder Hold-Down Studs

TABLE I

CYLINDER HOLD-DOWN STUDS USED IN WHIRLWIND ENGINES

Engine Model	Stud Part Number	Stud Length (In.)	Stud Thread Description (Crankcase End Threads)			Stud Height (Inches)		Location of Stud on Mounting Pad (Hole Nos.)	Hold-Down Nut & Method of Locking	Part Numbers of Studs Cancelled
			Diameter (Inches) / Threads per Inch	Taper (Inches per Inch)	Diameter Oversize (In.)	Min.	Max.			
R 975 E R 760 E (of current manufacture)	2118-D-1 2118-H-1 2118-D-2 2118-H-2	1.719 1.719 2.563 2.563	7/16-12 7/16-12 7/16-12 7/16-12	.043 .043 .043 .043	STD. .003 STD. .003	.640 .640 .640 .640	.700 .700 .700 .700	2,3,4,5,6,7 2,3,4,5,6,7 1,8 1,8	Lockwire 85-D-14 Nut 124-D-116	126-D-139 126-H-139 126-D-140 126-H-140
R 975 E R 760 E	126-D-141 126-H-141 126-D-142 126-H-142	2.00 2.00 2.75 2.75	7/16-14 7/16-14 7/16-14 7/16-14	.043 .043 .043 .043	STD. .003 STD. .003	.810 .810 .810 .810	.870 .870 .870 .870	2,3,4,5,6,7 2,3,4,5,6,7 1,8 1,8	Nut 124-D-54 Palnut 2000-D-3	126-D-139 126-H-139 126-D-140 126-H-140
R 975 E R 760 E	126-D-191 126-H-191 126-D-192 126-H-192	2.00 2.00 2.75 2.75	9/16-10 9/16-10 9/16-10 9/16-10	.043 .043 .043 .043	STD. .003 STD. .003	.810 .810 .810 .810	.870 .870 .870 .870	2,3,4,5,6,7 2,3,4,5,6,7 1,8 1,8	Nut 124-D-54 Palnut 2000-D-3	126-D-139 126-D-141 126-H-139 126-H-141 126-D-140 126-D-142 126-H-140 126-H-142

SERVICE BULLETIN NO. 499
SUBJECT: Replacement of Whirlwind Cylinder Hold-Down Studs

TABLE II

Removing Tools

801,490 - Whole Stud Remover
84,276 - 1/8 Inch Drill
84,277 - 1/4 Inch Drill
84,904 - 9/32 Inch Drill
801,155 - 5/16 Inch Drill
84,907 - Drill Jig, Bushings
802,150 - Removing Tool
83,759 - Wrench

Replacing Tools

84,898 - Finish Tap
84,899 - Tap (.003 inch oversize)
84,909 - Tap Holder
84,908 - Fixture
84,432 - Stud Driver
84,435 - Stud Driver Adapter
84,922 - Torque Wrench

TABLE III

Removing Tools

801,490 - Whole Stud Remover
84,276 - 1/8 Inch Drill
84,277 - 1/4 Inch Drill
84,904 - 9/32 Inch Drill
801,155 - 5/16 Inch Drill
84,907 - Drill Jig, Bushings
802,150 - Removing Tool
83,759 - Wrench

Replacing Tools

84,908 - Fixture
801,012 - Fixture Clamp
801,537 - Centering Plug, Bushings, Stop Collars
801,815 - Stop Collar
801,519 - Counterbore
801,539 - Bushing
801,520 - Reamer
801,521 - Gauge
801,522 - Gauge
801,540 - Rough Tap
84,909 - Tap Holder
801,517 - Finish Tap
801,518 - Finish Tap (.003 inch oversize)
84,432 - Stud Driver
84,435 - Stud Driver Adapter
84,922 - Torque Wrench

TABLE IV

Removing Tools

801,490 - Whole Stud Remover
84,276 - 1/8 Inch Drill
84,277 - 1/4 Inch Drill
84,904 - 9/32 Inch Drill
801,155 - 5/16 Inch Drill
84,907 - Drill Jig, Bushings
802,150 - Removing Tool
83,759 - Wrench

Replacing Tools

84,908 - Fixture
801,012 - Fixture Clamp
801,537 - Centering Plug, Stop Collars, Bushings
801,538 - Stop Collars, Bushings
801,030 - Counterbore Drill
801,031 - Counterbore
801,032 - Reamer
801,033 - Gauge
801,034 - Gauge
801,035 - Rough Tap
801,036 - Finish Tap
84,909 - Tap Holder
84,432 - Stud Driver
84,435 - Stud Driver Adapter
84,922 - Torque Wrench

SERVICE BULLETIN NO. 501
SUBJECT: Interference Between Valve Tappet Ball Socket and Guide
MODELS: Whirlwind R760E and R975E Series Engines

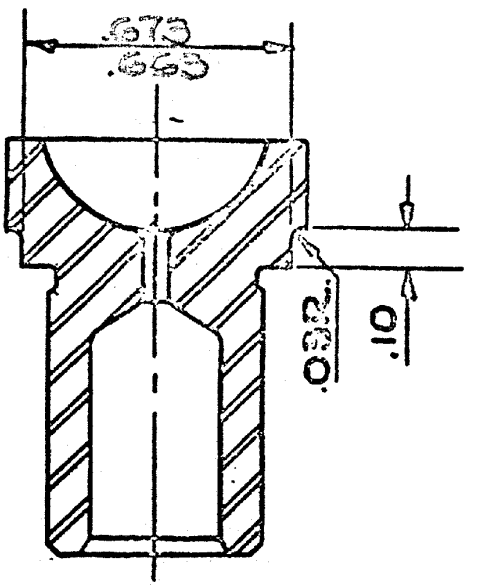
Several instances of interference between the shoulder on the valve tappet ball socket, Part No. 62728, and the tappet guide have been reported. Investigation has revealed that this condition is caused by bottoming of the valve tappet guide approximately .018 inch above the blueprint requirements, in crankcases that have been machined to the high limit of production tolerances on the outside diameter. The interference may cause mutilation of the outer ends of the tappet guides.

To overcome interference at this point, a new valve tappet ball socket, Part No. 116176, has been designed with a .10 inch wide step in the shoulder to allow sufficient clearance between this part and the tappet guide.

It is recommended that all the above model engines which have not been overhauled be inspected at once or as soon as possible for signs of this trouble. Routine overhaul inspection of older engines should have revealed previously any interference which existed between these parts. To perform this check, remove the push rod, push rod housing, and tappet guide retaining nut. The condition of the end of the tappet guide may then be checked. Whenever this trouble is experienced, it is recommended that the new socket be installed or the old socket be reworked to incorporate the change.

The rework must be accomplished by grinding because of case hardening of the socket. Chuck the socket shoulder in the grinder and check the socket body for true running. Grind the shoulder to the dimensions specified in the sketch at the end of this bulletin. Extreme care should be exercised to prevent overheating and grinding checks. Upon completion of the rework, it is recommended that a magnetic type inspection be made.

Service Division
Wright Aeronautical Corporation
(A Division of Curtiss-Wright Corporation)
January 28, 1942



REWORK OF WHIRLWIND VALVE TAPPET BALL SOCKET PART NO. 2728 TO PREVENT INTERFERENCE WITH TAPPET GUIDE.

S.B. NO. 501

SERVICE BULLETIN NO. 503
SUBJECT: Reduction of Propeller Vibration and Stress
MODELS: Whirlwind R760E Series Engines with No. 20 Spline Crankshafts
Whirlwind R975E Series Engines

THIS BULLETIN SUPERSEDES SERVICE BULLETIN NO. 503 DATED APRIL 30, 1942, DUE TO THE INCLUSION OF R975E MODEL ENGINES.

It is sometimes necessary to change the angular relation of the propeller to the crank throw to overcome excessive propeller vibration and stress. To permit the installation of the propeller at a particular angle, the blind spline must be removed from the crankshaft.

REMOVAL OF BLIND SPLINE

Install a flat head set screw, Part No. 2075-D-23, between two crankshaft splines in place of the fillister head set screw originally used. After removal of the original screw, countersink the screw hole to a .38" diameter with a 90 deg. countersink to permit proper seating of the flat head screw. Clean the shaft of all drill shavings.

CHANGING PROPELLER ANGLE

To facilitate the installation of the propeller at the desired angle on engines having the blind spline eliminated, it is recommended that the crankshaft be numbered according to the following standard reference system: Etch an "0" on the angular front face of the spline groove in which the set screw is located. Number "I" spline is adjacent to the groove marked "0" in the direction of propeller rotation. Continuing in this direction, the succeeding splines are numbered consecutively to 16.

In the following table find the angle which is closest to the angle recommended by the propeller manufacturer to give the desired timing for that installation. Note the propeller shaft splines listed after that angle in the table. Install the propeller on the shaft so that these splines are enclosed by the wide spline groove in the propeller hub.

Required Angle	Spline Numbers
0°	16 and 1
22.5°	1 and 2
45°	2 and 3
67.5°	3 and 4
90°	4 and 5
112.5°	5 and 6
135°	6 and 7
157.5°	7 and 8

Angles are measured from the centerline of No. 1 cylinder in the direction of propeller rotation when the piston in No. 1 cylinder is at top dead center.

R760E ENGINES

This bulletin is particularly applicable to R760E engines with solid

counterweights and an S.A.E. No. 20 spline crankshaft. A No. 20 spline crankshaft measures 2-3/8" across the splines. When the Hamilton Standard 2B20 propellers having 6109A or 6135A blade design are installed on these engines, it is necessary to reindex the propeller so that the blades form an angle of 90° with the crank throw, and to make certain adjustments to the propeller as specified by the propeller manufacturer's Service Bulletin No. 66, Reference 230.

When this particular propeller is used on engines with dynamic dampered crankshafts, excessive vibration may be entirely corrected by reworking the propeller as specified in the Hamilton Standard bulletin.

SERVICE BULLETIN NO. 519
SUBJECT: Change of Oil Pressure Markings on Crankcase Front Section
MODELS: Whirlwind R975E Series Engines

Some Whirlwind crankcase front sections were cast with reversed markings on the two tapped holes provided for measuring the hydro high and hydro low oil pressures. These oil pressure connections are found only on crankcase front sections which incorporate a propeller governor mounting pad.

The hydro high connection, marked "H", is located slightly to the right of the vertical center line of the engine and adjacent to the governor mounting pad. The hydro low connection, marked "L", is located several inches to the left of the vertical center line of the engine and is the connection away from the governor mounting pad. Where the markings "L" and "H" have been reversed, the "L" has been located at the hydro high connection and the "H" at the hydro low connection.

All operators of Whirlwind engines incorporating propeller governors should check to see that the hydro oil pressure connections are marked properly. If the connections have been marked incorrectly, the letters, which are of the raised type, should be removed by filing. The exposed surface should be protected by a coating of paint.

Using 1/8 inch type, stamp the proper letter directly in front of each connection boss. Although the crankcase is comparatively heavy at this point, extreme care must be exercised when stamping the letters to avoid cracking the case.

Engines on which the hydro oil connections are not identified should also be stamped in this manner.

Service Division
Wright Aeronautical Corporation
(A Division of Curtiss-Wright Corporation)
March 26, 1942

SERVICE BULLETIN NO. 529
SUBJECT: Provision for Increased Hydro Oil Pressure
MODELS: Whirlwind R760E and R975E Series Engines

Difficulty has been experienced in changing the propeller pitch on R760E and R975E engine installations which incorporate a two-position hydro oil control valve, due to insufficient hydro oil pressure. Sluggish pitch changes of the propeller when the two-position control valve is operated is evidence of insufficient hydro oil pressure.

In some engines, an external hydro oil tube has been installed. In these engines, insufficient hydro oil pressure is due to the high oil pressure backing into the normal engine oil system instead of supplying the hydro oil control valve.

In earlier engines, no external hydro oil tube was used. In these engines, insufficient pressure resulted from the drop of pressure during the passage of the oil through the engine.

In the case of engines which employ the external hydro oil tube, increased oil pressure may be obtained by plugging the oil passage between the two-position hydro valve and the propeller shaft hydro line. If the engines do not employ the external hydro oil tube, sufficient pressure may be obtained by installing the external line and plugging the oil passage.

If low pressure is evident, the rework should be done immediately. If not, the change should be made at the next overhaul.

To install this plug proceed as follows: Heat the crankcase front section to a temperature between 300°F. and 350°F. for approximately twenty minutes either in hot oil or in an oven. It is essential that the temperature of the crankcase front section does not exceed 350°F. since the strength of the metal in the crankcase may be seriously affected. Heating the front section in this manner will allow the crankcase front section sleeve to be removed easily from the propeller shaft bore. Care should be exercised in removing and in handling the sleeve since at high temperatures the metal becomes somewhat brittle. Remove the locking pin which will probably remain with the sleeve.

The oil passage to be plugged is the one towards the rear of the propeller shaft bore. Ream this passage to a diameter of .2955 - .2965 inch and to a depth of .83 inch as shown on Figure 1, using piloted reamer, Tool No. 802710. Heat the crankcase as before and insert plug, Part No. 2094-D-21, in the hole so that all edges just clear the crankshaft bore. Peen a little metal into the hole to keep the plug in place. Install the sleeve in position, aligning it with a suitable rod inserted in the locking pin holes in the sleeve and crankcase. Install a new locking pin, Part No. 13-D-31.

To install the external hydro oil line, it will be necessary to rework the lower-cylinder air deflector between cylinders, Nos. 8 and 9, in accordance with Figure 2. Insert the grommet, Part No. 2109-D-6, in the opening drilled in the air deflector. Install the deflector on the engine and insert the hydro oil tube in position through the grommet.

Remove the pipe plug from the hydro oil pressure gauge connection on the crankcase front section, and the plug from the tapped hole adjacent to No. 9 cylinder intake pipe boss on the crankcase rear section. After coating the threads with Glyptal, install an elbow, Part No. 175-D-10, in each of these locations, and align the elbow outlets with the ends of the tube, Part No. 415834. Place a piece of hose, Part No. 2058-D-43, and two hose clamps, Part No. 5040-D-1, over each end of the tube. Insert a liner, Part No. 2015-D-3, in each of the elbows and place the end of the tube over the other end of the liner. Center the hose over the tube to elbow connection and secure the hose at each end with a hose clamp. Repeat this process at the front end of the hydro oil tube.

The parts necessary for incorporating the external hydro oil line are as follows:

Part No.	Part Name	Quantity
2109-D-6	Grommet	1
175-D-10	Elbow	2
415834	Tube	1
2058-D-43	Hose	2
5040-D-1	Clamp	4
2015-D-3	Liner	2

Wright Aeronautical Corporation
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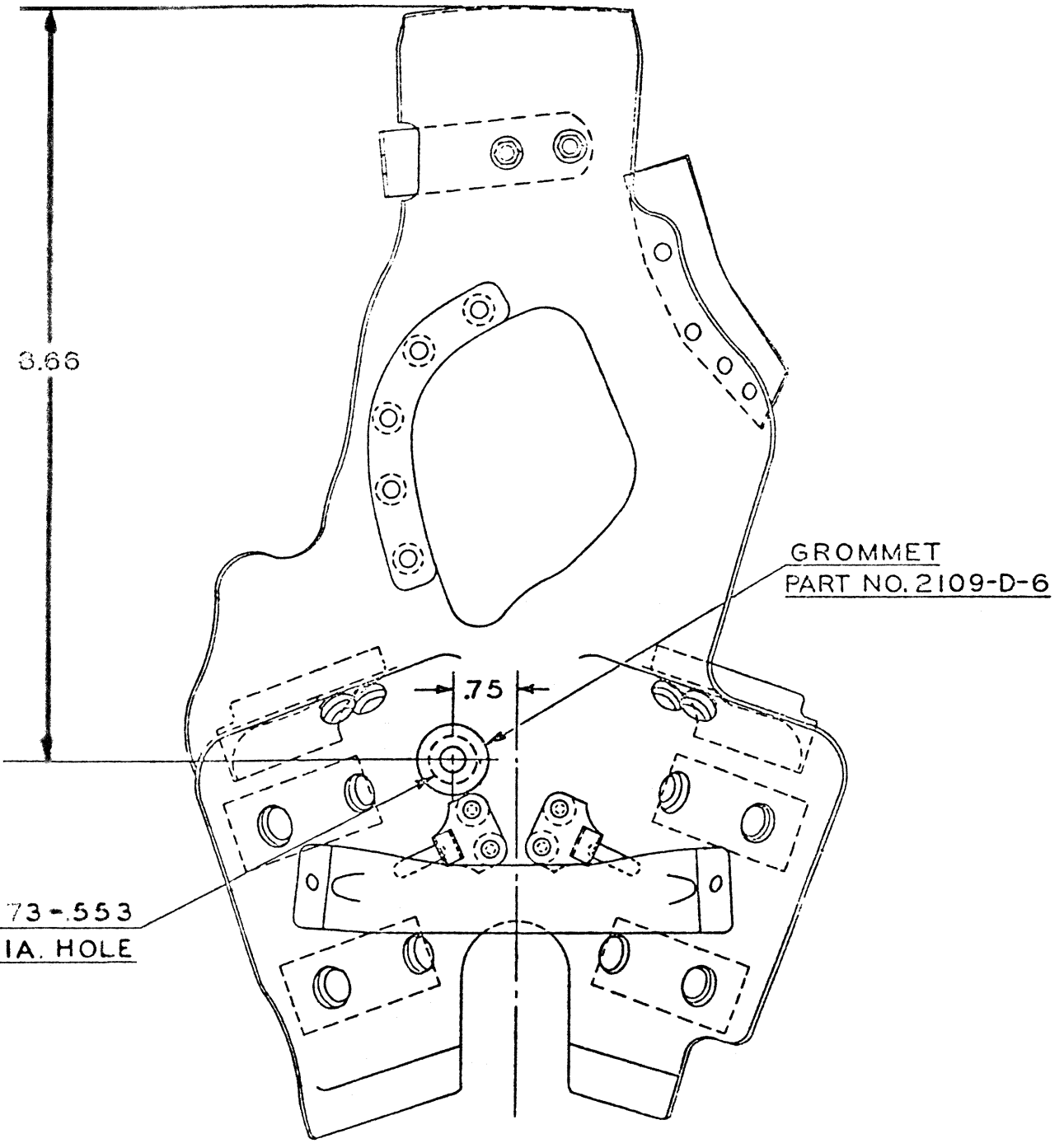
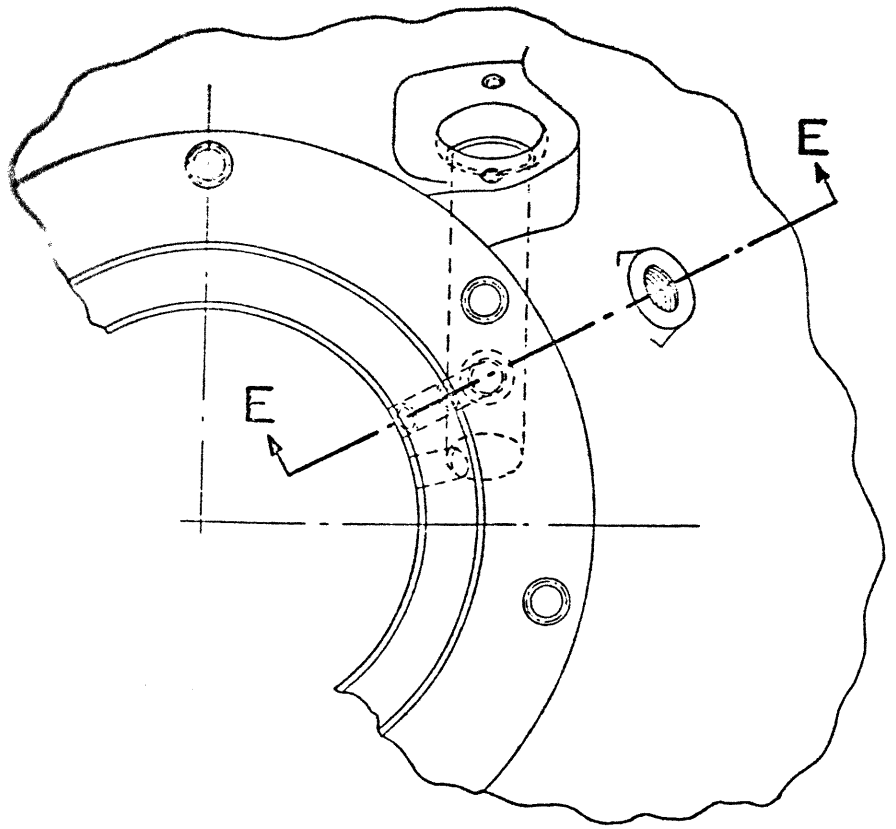
June 17, 1942



BREAK ALL SHARP CORNERS

FIG. 2

REWORK OF INTER-CYLINDER AIR DEFLECTOR
TO PROVIDE FOR EXTERNAL HYDRO OIL LINE



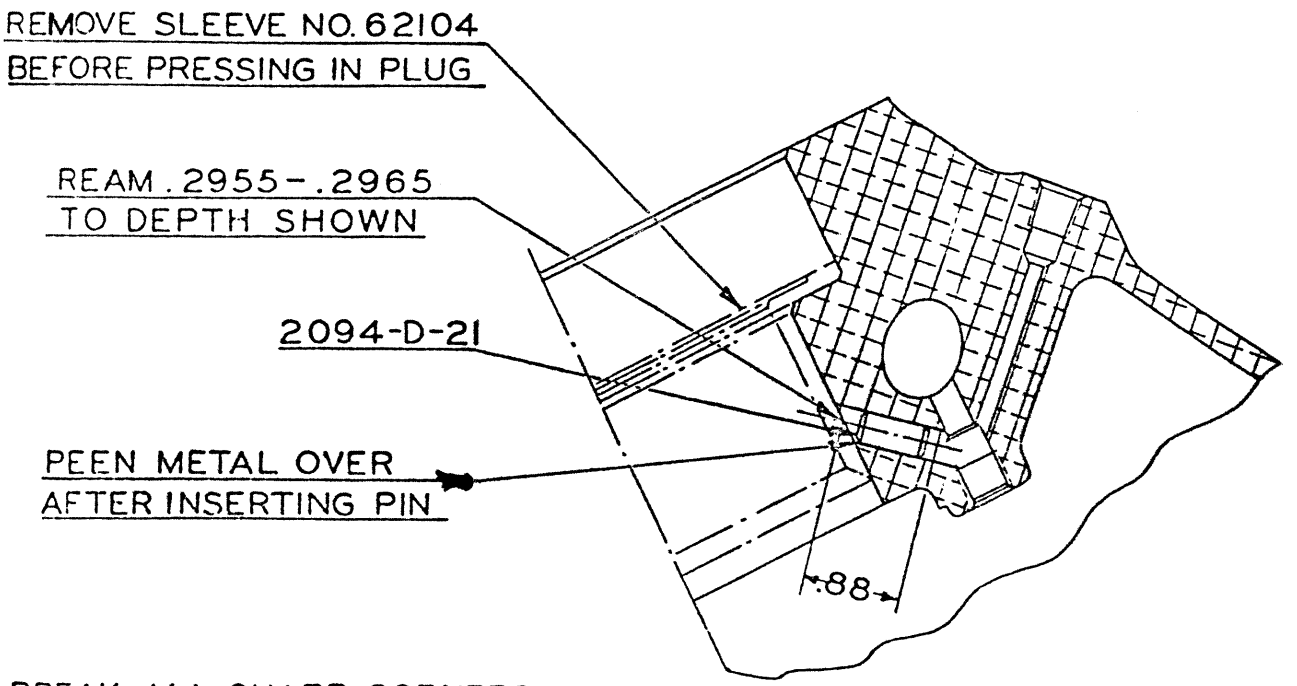


FIG. 1

REWORK OF CRANKCASE FRONT SECTION ASSEMBLY

S.B. NO. 529

SERVICE BULLETIN NO. 539
SUBJECT: Installation of Crankcase Front Cover Spacer
MODELS: Whirlwind R760E and R975E Series Engines

Whirlwind engines of current production have been provided with a steel crankcase front cover spacer, Part No. 114162, to eliminate galling between the front cover and the outer race of the thrust bearing.

A new front cover, Part No. 416337, is installed with the spacer in place of cover, Part No. 47170. The new cover and spacer together are approximately the same size and shape as the former cover alone. The .005-.007 inch tight fit between the bearing and front cover has been changed to a .002-.004 inch loose fit when the spacer is used.

It is recommended that Whirlwind operators incorporate this spacer on engines in which galling of the front cover or thrust bearing is experienced. The crankcase front cover, Part No. 47170, may be replaced or may be reworked for use with the spacer.

Rework of the front cover, which is made of aluminum, may be accomplished with an ordinary lathe operation. Reduce the width of the cover to .519-.523 inch as shown in the sketch at the end of this bulletin, removing the metal from the rear face. Reduce the outer diameter of the cover pilot flange to 4.699-4.700 inch. Provide a .040 inch radius in the corner between the two reworked surfaces. Shorten the pilot flange to .256-.258 inch and provide a .040 inch 45 degree chamfer on the outer diameter at the end of the flange. Break all sharp edges to a .003-.015 inch radius.

To measure the side clearance, the thrust bearing may be reached from the interior of the front section sub-assembly with a feeler gauge.

Wright Aeronautical Corporation
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Paterson, New Jersey, U.S.A.
August 5, 1942

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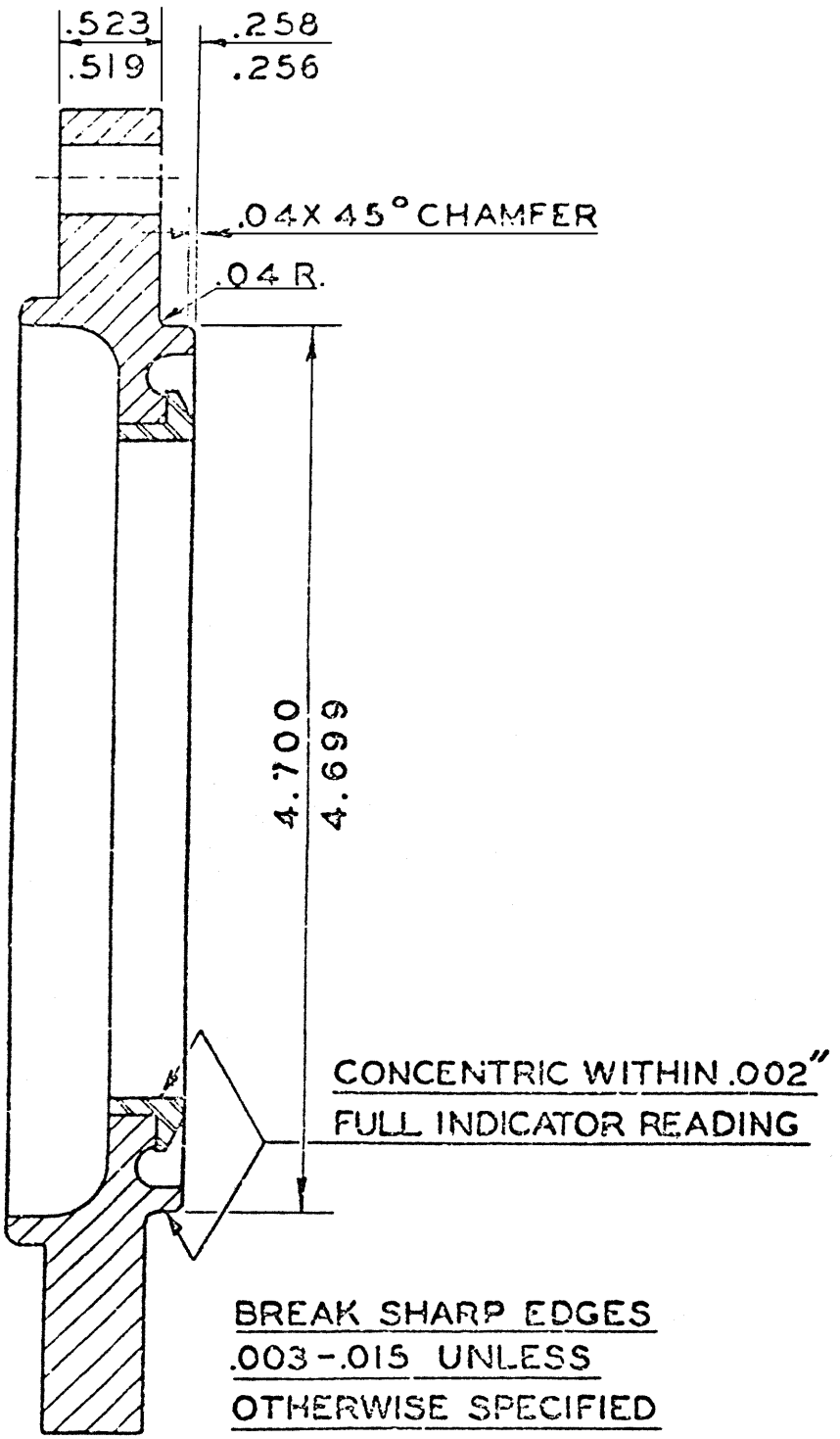


REWORK OF CRANKCASE FRONT COVER, PART NO. 47170

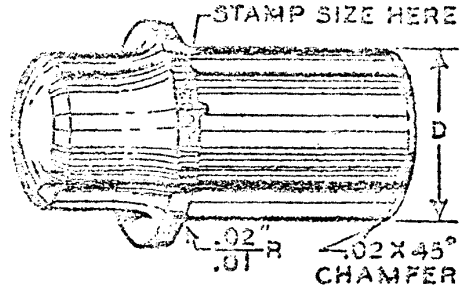
FOR USE WITH STEEL CRANKCASE FRONT COVER SPACER

PART NO. 114162

SB. NO. 539

SERVICE BULLETIN NO. 577
SUBJECT: Plug Type Piston Pin Retainers
SERIES: Whirlwind R760E and R975E

THIS BULLETIN SUPERSEDES SERVICE BULLETIN NO. 577 DATED JUNE 19, 1943, TO PERMIT REWORKING STANDARD SIZE RETAINERS TO UNDERSIZES.



Plug type piston pin retainers have been provided for Whirlwinds to replace the spring type retainer. It is recommended that the new retainers be installed at next overhaul. They may be used with all pistons.

A .002 -.004 in. loose fit is required between the retainer and the piston pin inner diameter. Two different retainers are provided to permit the installation of this type part with both the piston pin currently used and the early thin-walled pin. Measure each piston pin separately and install retainers of the proper size as noted in the following tables.

It is recommended that undersize retainers be ordered as required. Standard sizes, however, can be reworked to appropriate undersizes by turning down the "D" diameter in a lathe. The reworked surface and the inner face of the flange must be square within .002 in. full indicator reading. Stamp the retainer with the proper undersize designation as shown in the sketch.

RETAINER 117741

Use this retainer with the present piston pin No. 26823. As a .010 in. tolerance (.940 -.950 in.) had been permitted until recently on the inner diameter of this pin, undersize retainers have been provided to permit a selective fit with all pins.

Piston Pin Inner Diameter	Retainer Size	Retainer "D" Diameter	Retainer Part No.
.949 -.950 in.	Standard	.946 -.947 in.	117741
.947 -.948 in.	-.002	.944 -.945 in.	117741Y1
.945 -.946 in.	-.004	.942 -.943 in.	117741Y2
.943 -.944 in.	-.006	.940 -.941 in.	117741Y3
.941 -.942 in.	-.008	.938 -.939 in.	117741Y4
.940 in.	-.010	.936 -.937 in.	117741Y5

It may be necessary to break the edges at the inner diameter of the pin to a larger radius to avoid interference with the retainers. Before installation check fit of the piston pins and retainers at this point. Piston pins are now made with a 1/32 in. x 45° chamfer at these edges.

RETAINER 126060

Use this retainer with the early thin-walled pin No. 22037. A .036 in. tolerance (1.023 -1.034 in.) was permitted on the inner diameter of this pin. Undersize

retainers are provided for a selective fit.

Piston Pin Inner Diameter	Retainer Size	Retainer "D" Diameter	Retainer Part No.
1.033 -1.034 in.	Standard	1.030 -1.031 in.	126060
1.031 -1.032 in.	-.002	1.028 -1.029 in.	126060Y1
1.029 -1.030 in.	-.004	1.026 -1.027 in.	126060Y2
1.028 in.	-.006	1.024 -1.025 in.	126060Y3

OVERHAUL

The retainers, which are made of aluminum, must be handled very carefully. Use puller, Tool No. 803390, to remove the retainers at overhaul if they do not come out readily. Avoid scratching or marring the end that bears against the cylinder wall. Lightly polish the other surfaces to remove carbon, but do not touch this dome.

Retainers must be replaced when the worn spot on the dome exceeds 3/8 in. in diameter. Service limits on the fit with the piston pin inner diameter are .002 -.006 in.

Undersize retainers are stamped with their size for identification. To avoid measuring the piston pins at each overhaul, the size of the mating retainer may be acid etched on the ends of each pin. Pins must not be stamped or electrically etched.

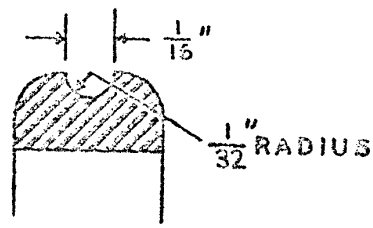
Wright Aeronautical Corporation
(A Division of Curtiss-Wright Corporation)
Paterson, New Jersey, U.S.A.
August 28, 1943

SERVICE BULLETIN NO. 592
SUBJECT: Re-design of Diffuser Section Oil Seal Ring
SERIES: Whirlwind R760E and R975E

A change has been made in the design of the oil seal packing, Part No. 2083-D-25, located at the diffuser section parting surfaces on the main pressure oil passage.

A groove has been cut in the ring to provide room for displacement of the ring material when the engine sections are assembled. With an ungrooved ring if the material more than fills the space provided for it, the excess may become wedged between the parting surfaces and may possibly crack the crankcase when the attaching bolts are tightened.

2083-D-25



CROSS SECTION
(ENLARGED)

Grooved, neoprene oil seal rings, Part No. 2083-D-25, should be installed at next overhaul. Ungrooved neoprene rings carried in stock may be reworked to the dimensions in the sketch. Set the ring on a mandrel and cut the groove with a properly trimmed grinding wheel.

Cork packing rings are no longer recommended at this location.

Wright Aeronautical Corporation
(A Division of Curtiss-Wright Corporation)
April 23, 1943

SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: PRE-OILING WHEN STARTING ENGINES

Bulletin No. W-1
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: December 24, 1943

Improved performance and extended service life of engine parts, particularly master rod bearings, may be obtained by insuring that all engines receive a sufficient quantity of oil upon starting.

To be sure that oil is immediately available, new engines, overhauled engines, or engines that have been in storage must be pre-oiled just prior to being operated. If the oil system of an aircraft has been drained, the engine must be pre-oiled before being operated. Pre-oiling, as outlined below, will provide the required supply of oil across the bearings during starting.

PRE-OILING ENGINES

1. Fill the oil tank normal full.
2. Remove the oil inlet line connection at the oil pump and drain one gallon or more of oil to insure that no air remains in the line.
3. Reinstall the oil inlet line to the oil pump.
4. Remove the oil pressure relief valve.
5. With the ignition switch off turn the crankshaft by hand or starter until sufficient oil is expelled through the oil holes to indicate that no air remains in the oil pump. Reinstall the valve.

GENERAL INSTRUCTIONS

The engine should be operated as soon as possible after pre-oiling. Start the engine in the normal manner, observing the engine oil pressure gage for indicated oil pressure. Stop the engine if the pressure does not begin to rise within five seconds and does not reach 40 pounds per square inch within ten seconds after starting.

It is recommended that an SAE 10 W oil of good quality, having a viscosity of approximately 40 at 210 deg F (99 deg C), be used in the oil pressure gage lines at all times. Keep all connections tight after the lines are filled to prevent the oil from running out. If the lines are allowed to fill up with engine oil, the oil will thicken in cold weather and give slow and incorrect pressure readings. Refill the lines whenever sluggish readings are noted.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: PROFILING CRACKED CYLINDER HEAD FINS

Bulletin No. W-2
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: December 24, 1943

Cracking of the cylinder head fins may be a result of vibration or differences in temperature. It is recommended that fins so affected be profiled to prevent the further extension of these cracks along the fins and into the dome of the cylinder. Cylinders with cracked domes must be discarded.

FIN REMOVAL LIMITS — The maximum amount of metal which may be safely removed from cylinder head fins is approximately 1 per cent of the total fin cooling area of the head, or 2 square inches, measured on one side only of the fins. Fin metal may be removed from a single fin or from several fins, provided that the total amount of metal removed does not exceed 2 square inches. This limitation is necessary because the removal of a larger amount would adversely affect the cooling of the cylinder.

PROFILING — Profiling consists of removing the cracked portion of the fin to the full depth of the fin, using for this purpose a thin burring tool or a grinding wheel that is operated on a flexible shaft. In profiling a fin, care must be exercised to prevent cutting into the dome of the head, to prevent scratching adjacent fins, and finally, to remove all sharp corners on the reworked fins. If these corners are not removed or if scratches remain in the reworked areas, other cracks may develop. Therefore, profile and blend all such areas with a minimum radius of .250 inch.

DOME INSPECTION — 1. If it is necessary to profile a fin down to the outside surface of the cylinder head dome, inspect the location to insure that the crack does not extend into the dome. This inspection is accomplished by etching the outside surface of the dome adjacent to the reworked fins by swabbing or rubbing with a 10 to 20 per cent caustic soda solution for seven to ten minutes. Swabbing or rubbing is necessary to accomplish the removal of the aluminum oxides as they are formed and to work the caustic soda into any crack that may be present.

2. After this operation is completed, swab the same area with a 35 to 65 per cent solution of nitric acid. This treatment will brighten the surface and reveal any crack that may be present. The crack will appear as a black line.

3. The presence of a crack in the surface of a dome is cause for discarding the cylinder. If no cracks are found, wash the head thoroughly with hot water to remove the etching solutions, and if the cylinder is otherwise satisfactory, it may be installed on the engine for further use.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: ENGINE **STARTING PROCEDURE**

Bulletin No. W-3A
Page 1 of 2

MODELS AFFECTED: **Whirlwind 7 and 9**

Date: October 14, 1946

This bulletin cancels Service Bulletin No. W-3 dated January 15, 1944, to provide an improved procedure.

The procedure given below should be followed in starting all the above model engines, irrespective of the type of carburetor installed.

1. Head the aircraft into the wind whenever possible.

2. Set the controls in the following positions:

Cowl Flaps	"OPEN"
Oil Cooler	"CLOSED" or "AUTOMATIC"
Carburetor Air	"COLD"
Ignition	"OFF"
Mixture	"CUT-OFF"
Propeller	"LOW PITCH" ("HIGH RPM")

3. Check for hydraulic lock by turning the propeller at least four blades. Always use the engine starter for this purpose except on installations incorporating cartridge or "shot gun" starters, in which case the propeller must be pulled through by hand in the normal direction of engine rotation. Exercise caution since two or three men exerting force on the tips of large propeller blades may cause serious damage to the engine if hydraulic lock is present. To prevent damage when using electric starters, make sure that the starter clutch setting does not exceed the recommended torque of 375±50 foot-pounds.

Never turn the propeller opposite to the engine rotation when performing this operation, as such action forces liquid into the intake pipe, whence it is apt to be drawn back into the cylinder when the engine is started. If there is any apparent high compression, remove the spark plugs from the lower cylinders and allow any liquid that has collected in the combustion chambers to drain.

The presence of any quantity of liquid in the combustion chamber is likely to cause serious damage. The Wright Aeronautical Corporation will not be responsible for damage to an engine caused by liquid or any other obstruction in the cylinders.

4. Immediately before starting, adjust the following controls as noted:

Throttle	Set for a maximum of 1200 engine rpm
Fuel Supply Cock	"ON"

5. Build up the fuel pressure with the boost pump to the normal operating limits.

6. Energize the starter for approximately 10 seconds.

7. Engage the starter and operate the primer simultaneously.

8. After the propeller has turned two revolutions, turn the ignition switch to the "BOTH" position.

9. Operate the booster ignition. If the characteristics of the engine installation make it difficult or impossible to perform the starting operation in this manner, it will be satisfactory to switch the ignition on immediately before engaging the starter.

If the engine is equipped with a cartridge type or plain inertia type starter, the procedure must be altered for starting engines in cold weather. This is necessary because of the inherent inability of such starters to provide more than several engine revolutions even in warm weather. If the weather is extremely cold or if the oil has not been diluted, it may be impossible for the starter to rotate the crankshaft more than one-half revolution. Under these conditions it is permissible to prime the engine before the crankshaft starts rotating.

Prime for two or three seconds only, then switch the ignition to the "ON" position and immediately engage the starter or fire the cartridge.

10. As the engine starts to fire, regulate the charge to obtain smooth engine operation. This may be accomplished by varying the length or frequency of the strokes on a hand priming pump, or by operating the primer switch intermittently if the airplane is equipped with a solenoid type priming system. Success in starting depends on the manner in which the primer is operated. The priming operation is affected by the primer system, the temperature, and the ability of the operator. In airplanes equipped with a solenoid, smooth starting at temperatures below 4°C (40°F) will be best obtained by engaging the starter and the primer simultaneously and holding the solenoid "ON" until the engine has been running for several seconds on the primer charge alone. These procedures will be dictated by experience to compensate for the variables mentioned above.

11. With the engine operating smoothly on the priming charge, move the mixture control to the "RICH" position. As the carburetor starts to function, it will be necessary to decrease the priming until the engine is running smoothly on the carburetor.

12. Stop the engine if the oil pressure gage does not register within ten seconds or reach 40 pounds per square inch at 1200 rpm within twenty seconds after starting.

Should the engine refuse to start within 30 seconds, let the starter cool. Move the ignition switch to "OFF" and rotate the propeller through at least four blades to insure that overpriming has not caused liquid to collect in the cylinder. Repeat the starting procedure.

Do not prime by pouring raw gasoline into the cylinders through the exhaust ports or the spark plug bushings.

Be positive that the primer shut-off valve is operating properly and that it is closed except when the pump is being operated. Depending upon the type of priming system, fuel leaking through the primer pump into the intake passages may cause liquid to collect in the lower cylinders.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: COLD WEATHER STARTING

MODELS AFFECTED: Whirlwind—All

Date: March 8, 1945

This bulletin supersedes Service Bulletin No. W-4, in order to bring the information up to date.

The major problem of cold weather operation is starting. Two basic conditions, the difficulty of vaporizing fuel and the tremendously increased lubricant viscosity at low temperatures, are fundamentally responsible for most starting troubles. Other factors, however, such as moisture or ice accumulation on the spark plug electrodes, battery power loss, and ice locking of engine accessories, will vary with location and conditions, but weigh heavily in the choice of any particular starting aid.

Regardless of the starting aids employed, standard starting procedures are recommended at all times. Moreover, experience has shown that a normal start may usually be made at temperatures above —12°C (10°F) without resorting to additional equipment and provided that careful engine handling techniques are used to prevent spark plug icing in humid areas. This temperature will be found at variance with other temperatures listed below for each contributing piece of equipment but has been found valid for the engine as a whole when all equipment is in good condition. The following paragraphs discuss those aids generally used in starting.

EXTERNAL HEAT

Many cold weather starting aids have been developed and tested, but none are so satisfactory, from the standpoint of the engine and its accessories, as applying heat externally. The use of external heat makes starting easier, eliminates need for special fuels, and precludes innumerable minor problems, because all parts of the engine and installation, not just the lubrication system, fuel system, or ignition system, operate normally from the first crank of the starter. Equipment should be available that will deliver heat continuously to the front and rear of the cylinders, rear section, battery, oil tank (unless self-sealing) and other accessories. The oil temperature must not be allowed to drop below —7°C (20°F) unless oil dilution is to supplement heating. If an oil tank of the self-sealing type is used, heat will not penetrate to the oil and oil dilution must be used. A shroud of quilted kapok, or other material, incorporating heater pipe inlets and designed to keep circulation at a minimum, is placed over the propeller dome and back, over, and around the engine cowling. The engine accessory section and carburetor are also warmed since heat aids in vaporization of fuel during and after starting.

Heating should continue until the cylinder head temperatures reach 20°C (68°F); this allows for a certain amount of cooling while preparing to start. Spark plug icing may result if the engine cools off to 0°C (32°F) before starting.

OIL DILUTION

Oil can be diluted with gasoline prior to stopping the engine, thereby reducing subsequent starting friction and preventing the oil from congealing in engine passages, lines, or tank. Dilution is recommended for use if air temperatures are 0°C (32°F) or lower providing the oil tank cannot be heated.

The values given in the following table should be used only in the absence of authenticated information, generally supplied by the airplane manufacturer and placarded in the cockpit.

1. Operate the engine at 1000 rpm maximum.
2. Maintain oil temperature below 50°C (122°F) and oil pressure within recommended limits.
3. Hold the oil dilution valve open for the time specified at each temperature condition. The conditions are:

0° to —12°C (32° to 10°F)	—3 minutes
—12° to —29°C (10° to —20°F)	—6 minutes
—29° to —46°C (—20° to —51°F)	—10 minutes

Add one minute dilution for each additional 5°C (9°F) below —46°C (—51°F).

4. During the last two minutes of the oil dilution operation, the following should be performed: On turbosupercharged engines with the regulators actuated by engine oil, dilute the oil in the regulators by moving the individual cockpit regulator control levers at least 14 complete movements from low to high boost and return.

For airplanes having hydromatic propellers, advance the propeller control until a drop of 400 rpm is observed, and return to its original position. Repeat three times. Do not depress the feathering switch.

5. Return the dilution switch to the "OFF" position and stop the engine. Diluting enables the starter to rotate the engine at a fairly high rate of speed without the necessity of preheating the oil. The gasoline evaporates gradually once the engine has started and oil temperature begins to rise.

After starting, if a highly viscous oil is indicated by an oil pressure that is too high or that fluctuates or falls off when engine rpm is increased, the dilution valve may be operated intermittently to correct this condition. Should the oil pressure drop too low, stop the engine, apply external heat and drain the system; replenish the oil supply with warm undiluted oil before attempting to start again.

AUXILIARY PRIMING SYSTEMS

If using external heat is not practicable, as in the case of water based aircraft, special priming fuels are resorted to; their use however does not eliminate the need for oil dilution. Regular aviation fuels do not sufficiently vaporize below —18°C (0°F) to provide satisfactory priming and consistent starting. If a high humidity condition is present, vaporization may be insufficient at —7°C (20°F). Numerous paraffin base, pure hydrocarbon fuels of higher volatility are available, some of which vaporize sufficiently at temperatures as low as —57°C (—70°F). Winter automotive gasoline having a Reid vapor pressure of 15 lb per sq in. (1.05 kg per sq cm) permits good starting down to approximately —29°C (—20°F). Ether, although not preferred as a priming fuel, because of toxic and low anti-knock qualities, permits successful starting to —29°C (—20°F), while pentane has been used at —34°C (—30°F).

The use of various priming systems, nozzles, and pressures has very little effect on the relative amount of fuel vaporization for starting. Any benefits derived by increasing priming pressures are probably due to the improvement of nozzle spray characteristics; even so, fuel vaporization may be reduced if fuel is injected in such quantities that it strikes the cold walls of the induction system before vaporizing.

Standard priming nozzles are satisfactory in cold weather starting when either regular fuel or special high volatile fuels are used. When improper fuel spray characteristics are suspected, the nozzle should be tested by using gasoline or water at 5 lb per sq in. (.42 kg per sq cm) pressure. A satisfactory cone spray should be obtained with no "dribbling" at a flow rate of 40 to 55 lb per hour.

To prevent spark plug electrode icing, the engine must be provided with the correct amount of priming, consequently insuring a successful start on the first attempt. The two-point priming system with discharge nozzles located in the carburetor adapter has proved most satisfactory from this standpoint and it also reduces liquid lock possibilities by introducing fuel at a location other than one where lack of vaporization or subsequent condensation would tend to fill the lower intake pipes.

A portable priming unit can be constructed with a small tank of one or two gallons capacity equipped with an electric pump. The pump outlet can be connected to the regular two-point priming system by a quick sealing coupling. Power for the electric pump is obtained by installing a cannon plug connection and a primer solenoid line. No additional controls or circuits are required on the airplane.

For temperatures from freezing to —18°C (0°F), a mixture of equal amounts of special priming fuels and standard aviation gasoline is suggested for use with minimum possibilities of vapor lock; below this temperature, a quantity of the selected priming fuel alone may be used.

Normally, the standard fuel pressure of the auxiliary priming pump will be high enough to ensure proper nozzle spray.

OIL DRAINAGE

If forced to land where cold weather starting facilities are not available, keep the engine warm by occasional run-ups or else drain the oil system immediately after shutting down and then heat the oil so that the engine may be refilled with warm oil just prior to starting. Once oil congeals within the engine, extreme difficulty will be experienced before circulation can again be obtained.

SPARK PLUG ICING

Icing inside the combustion chamber results when the temperature drops below 0°C (32°F) and any moisture, either condensed from the air or caused by combustion at an unsuccessful starting attempt, freezes. This condition effectively "shorts out" the spark plugs, preventing starting. The higher the atmospheric relative humidity, the more serious this condition becomes. It is further aggravated by the fact that the fuel-air deposits in the combustion chamber from the combustion of fuel tend to collect moisture readily.

It is essential that the first starting attempt be successful. "False starting" in which the engine fires a few times and then cuts out, can cause spark plug icing since the water products of combustion will freeze.

BATTERY HEATING

It has been proven that batteries which are kept warm at all times will more nearly approach their capacity output than batteries that are cold. Batteries are rated at an air temperature of 27°C (80°F), and the performance of a new fully charged battery decreases as the temperature decreases. This is not a straight line relationship as indicated by the table below which is calculated on a 300 ampere discharge.

Temperature	Percent Output in Relation to Capacity at 27°C (80°F)
5°C (40°F)	93
—18°C (0°F)	76
—29°C (—20°F)	55
—34°C (—30°F)	30
—37°C (—34°F)	5

Batteries, when being charged, should be in an air temperature of 5° to 27°C (41° to 80°F) since this procedure is also affected by atmospheric conditions. Most battery manufacturers specify a maximum temperature of not more than 60°C (140°F).

When bringing a battery from an airplane or from storage for recharging, sudden changes in temperature should be avoided to minimize the possibility of splitting battery cases. A battery that is cold should be heated to at least 5°C (41°F) before charging to ensure maximum battery life and minimum charging time. This is applicable to a battery being charged on a bench, in a hangar, or by the generator on the engine while in flight.

ACCESSORY FREEZING

Trouble has been experienced below —18°C (0°F) with frozen engine mounted accessories resulting in sheared accessory shafts when the engine is started. The vacuum pump in particular has been subject to this condition since the moisture condensed from the air during operation freezes after the engine has been shut down. Other accessories experience a similar trouble from lack of lubrication at starting. Since this lubrication is provided by engine oil through metering passages, normal oil dilution does not appreciably relieve this condition.

WARM-UP

It may be necessary, after the engine has started, to use carburetor air heat to prevent subsequent engine cutting out. This will occur when the carburetor intake air is at a low enough temperature to reduce fuel vaporization below the amount needed to maintain engine operation. Heat should be used as necessary to maintain a carburetor air temperature of not less than —18°C (0°F).

The entire engine warm-up should be conducted according to existing recommendations. In the case of a diluted engine the airplane may be flown at once if the oil pressure remains constant and a temperature rise is indicated by the oil temperature gage. The length of time it takes to evaporate the fuel varies for each installation, therefore the warm-up period will depend solely on the operator's judgment. Cowl flaps must be full open during all ground operations.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: CYLINDER HOLD-DOWN STUDS—LOCATION OF

Bulletin No. W-5
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: February 23, 1944

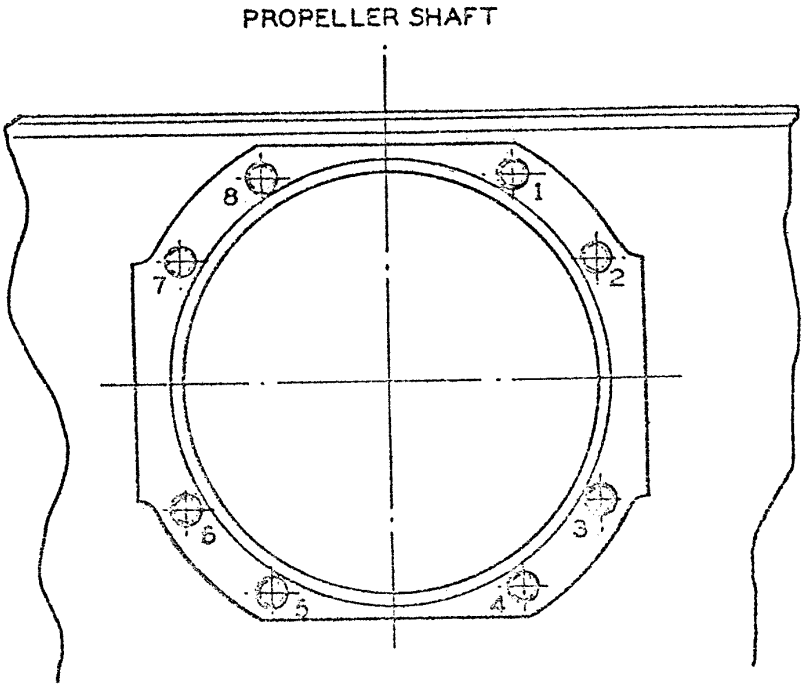
This bulletin supersedes all previously published material on this subject.

It is the purpose of this bulletin to establish a uniform method for identifying stud locations on the cylinder mounting pads of subject engines.

Cylinder hold-down studs are numbered in a clockwise direction, facing the cylinder mounting pads, with the propeller shaft end of the engine facing up. Number one stud is the first at the top and to the right of the vertical center line of the mounting pad when the propeller shaft is pointing up. Refer to the sketch.

The number of the pad is the same as the number of the cylinder mounted on it.

The number of each stud hole in the cylinder mounting flange will be the same as the number of the corresponding stud location on the cylinder mounting pad.



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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: IDENTIFICATION AND INSPECTION OF STEEL PARTS TREATED TO ELIMINATE CHAFING

Bulletin No. W-6
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: March 7, 1944

This bulletin supersedes Service Bulletin No. 596, dated May 26, 1943.

To eliminate chafing at steel to steel contact locations in all engines, the affected parts are often given a metallic or chemical treatment. The two methods of treatment are:

1. Plating the part with either silver, copper, tin, chrome or lead. This treatment results in a surface discoloration that resembles the color of the metal used in the plating.

2. Treating the surface of the part with chemicals. This treatment results in the surface having a dull, black, satin-like appearance.

These changes in appearance have caused the treated pieces to be mistaken for used or unfinished parts, and attempts have been made to polish them. Do not polish these parts.

NOTE

Chemically treated parts that are magnetized by passing electrical current through them must be polished at the point of contact with the electrodes as this type of finish acts as a partial insulator to electric current.

PRECAUTIONS Certain precautions must be taken when subjecting treated parts to a magnetic type inspection. Due to the discolored surface of the parts, a black medium will not give the desired result. Use a red oxide powder as a medium to obtain clearly visible patterns. Parts that can be magnetized circularly on a bar must not be polished, regardless of the type of treatment they have received.

WRIGHT AERONAUTICAL CORPORATION
A Division of Curtiss-Wright Corporation
PATERSON, NEW JERSEY, U. S. A.

SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: TOP DEAD CENTER INDICATOR TOOL No. 80932

Bulletin No. W-7
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

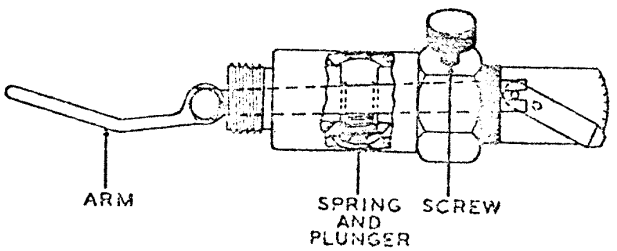
Date: March 3, 1944

This bulletin supersedes Service Bulletin No. 591, dated April 26, 1943.

The top dead center indicator, Tool No. 80932, must be assembled correctly to prevent breakage of the arm and to permit correct readings to be obtained. It is recommended that this tool be checked for proper assembly.

Disassemble the tool by removing the arm, loosening the screw, and taking the body from the shell. Remove the spring and plunger from the body. Install the spring in the plunger and reassemble the tool. Be careful that the plunger and spring assembly and the arm are installed exactly as shown in the sketch.

Adjust the angle setting of the arm to conform with the particular piston cylinder assembly being checked.



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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

SUBJECT: PISTON AND RING ASSEMBLY—MODIFICATION OF

Bulletin No. W-8B
Page 1 of 4

MODELS AFFECTED: Whirlwind R-760E and R-975E

Date: August 7, 1945

This bulletin supersedes Service Bulletin No. W-8A dated June 3, 1944, to include the R-760E series engines and to specify a new piston ring for piston ring groove No. 1.

GENERAL

Piston, part No. 114333, is being installed in all R-760E and R-975E engines. This piston incorporates 12 oil drain holes in the No. 5 ring groove and employs a new chrome faced piston ring, part No. 130799, in the No. 1 ring groove. See figure 1. Rings, part No. 112213, 66239, 67159, and 67160, are used in ring grooves No. 2, 3, 4, and 5 respectively. This arrangement greatly improves oil control which in turn insures longer service from the piston and the piston rings.

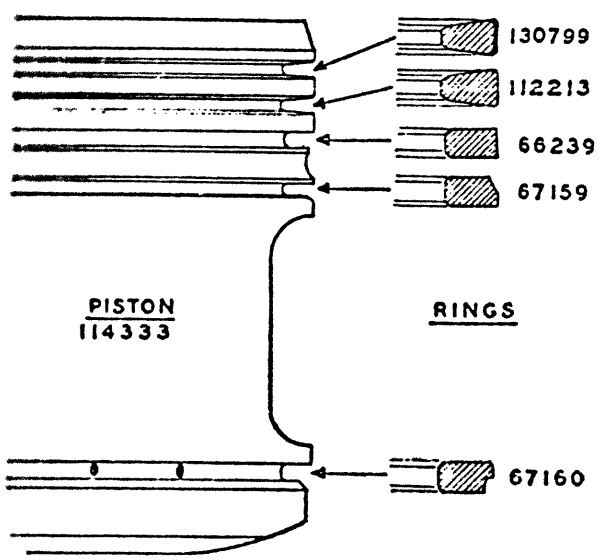

Figure 1

Piston, part No. 112214, formerly installed in these engines, incorporated oil drain holes in ring groove No. 4 and in the land between grooves No. 3 and 4. Ring, part No. 112213, was installed in ring grooves No. 1 and 2 and ring, part No. 66239, was installed in grooves No. 3, 4, and 5.

Piston, part No. 112214, may be reworked in accordance with instructions contained herein and used satisfactorily with the ring set up shown in figure 1.

REWORK

1. Remove the piston rings from the piston, part No. 112214.

2. Ream and plug the drain holes located in groove No. 4 and in the land between grooves No. 3 and 4 as follows:

(a) Place the piston on a vee block on a drill press table as shown in figure 2. Insert a No. 00 taper pin reamer in the drill chuck and ream the first hole until the large end of pin, part No. 75D9, when inserted, will project approximately .050 inch above the bottom of the land, as shown in View "A." Set the stop of the drill spindle for the proper reaming fit. Ream the remaining holes on the land.

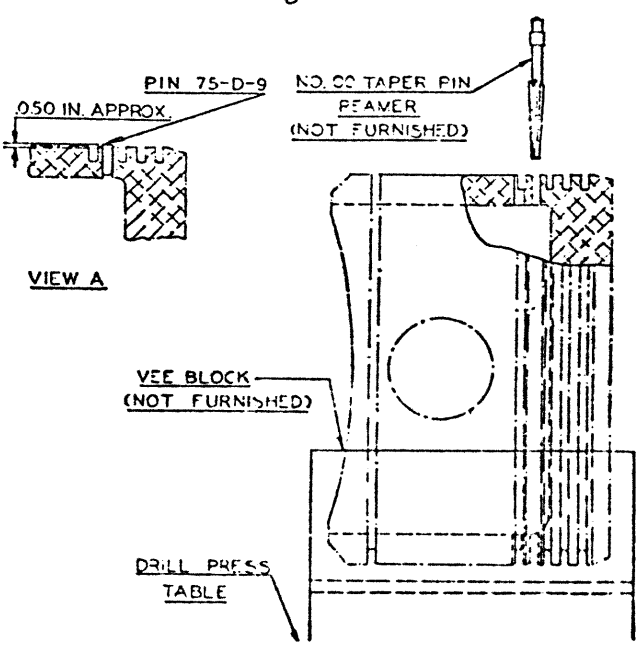

Figure 2

(b) Place the piston on a vee block as shown in figure 3, with the block shimmed to approximately 2 degrees. Insert a No. 0 taper pin reamer in the drill chuck and ream the first hole in groove No. 1 until the large end of pin, part No. 69D5, when inserted, will project approximately .050 inch above the bot-

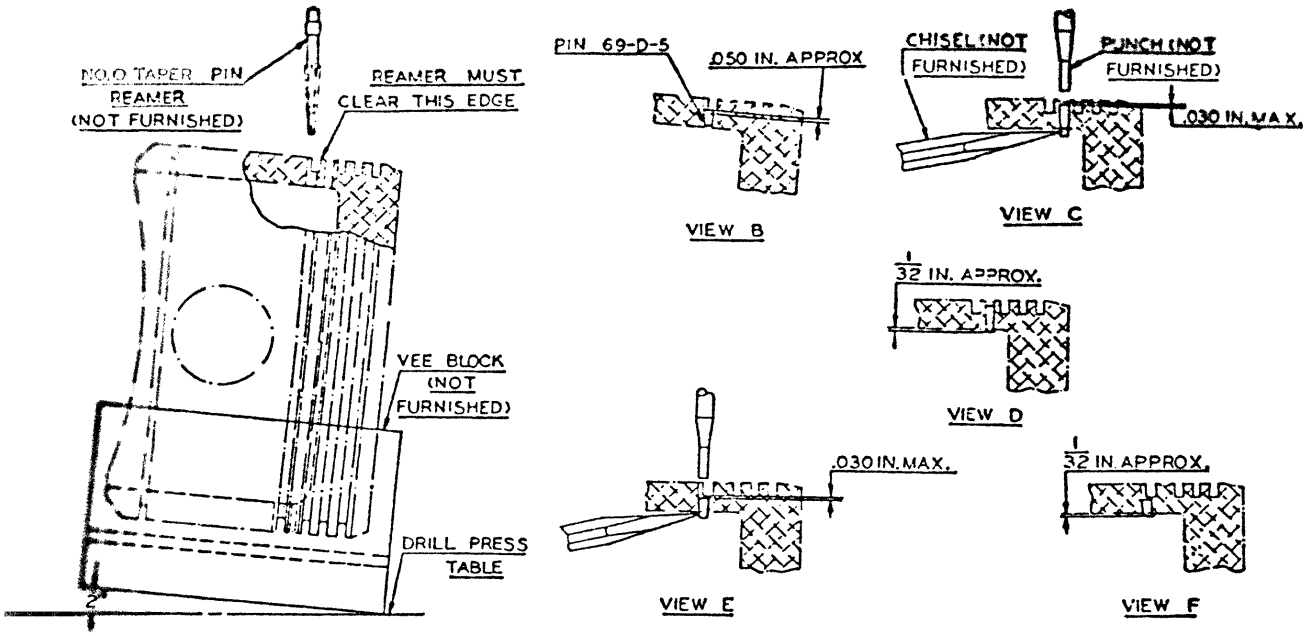

Figure 3

tom of the groove, as shown in View "B." Set the stop on the drill spindle for the proper reaming fit. Ream the remaining holes in groove No. 4.

(c) Drive the pins in the reamed holes in the land to the dimensions shown in View "C." Cut off the pins inside of the pistons, to the dimensions shown in View "D," using a dull edge chisel in order to peen one side of the pin for retaining the latter in the piston. Install the pins in groove No. 4 using the same procedure. See Views "E" and "F."

3. Drill the new vent holes in the No. 5 ring groove as follows:

(a) Insert plug, tool No. 804498-2, in the piston pin hole, and slip drill jig, tool No. 804498, over the lower end of the piston and locate the blind hole in the jig with the pin in the plug. Insert the shank of a No. 45 (.082 inch diameter) drill through one of the drill bushings and into the lower groove of the pistons. Engage the pilot end of the four screws in this groove using care so that the screws are not forced against the piston. Remove the drill. Place the jig on a vee block. Drill 12 holes through using a No. 45 (.082 inch diameter) drill. Remove the burrs. See figure 4.

4. Machine a relief on the skirt of the piston as follows:

(a) Clamp the fixture, tool No. 804497, to the lathe plate. Indicate at "A" to run true within .001 inch full indicator reading. Place the piston on the fixture and insert a dummy pin, tool No. 804497-4, through the piston and the draw rod and tighten the nut on the draw rod lightly. Locate the piston radially on the fixture using pin, tool No. 804497-2, and locator, tool No. 804497-3, as shown in figure 5. Clamp the piston to the fixture securely by tightening the draw rod nut. Cut the relief to the dimensions shown. Repeat this operation on the opposite side of the pistons. Break all sharp corners. See figure 5.

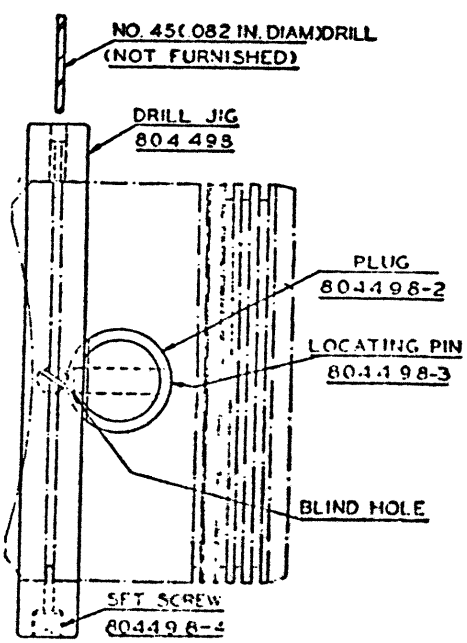

Figure 4

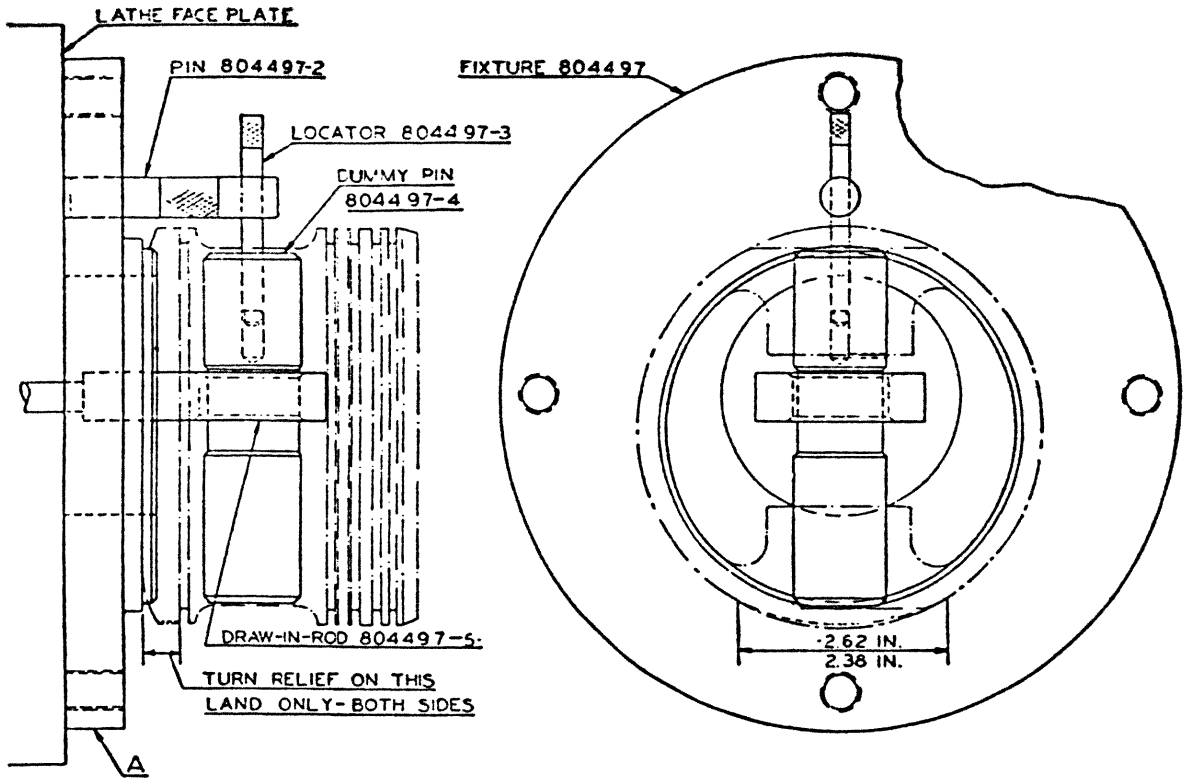

Figure 5

5. Machine a chamfer on the bottom ring groove as follows:

(a) Clamp the fixture, tool No. 804497, to the lathe face plate, indicating surface "A" to run true within .001 inch full indicator reading. Clamp the piston to the fixture using the dummy piston pin and draw-in rod as shown. Cut chamfer to the dimensions shown. Break all sharp corners. See figure 6.

6. Restamp the piston part number.

(a) Deface the old part number, 112214, with a blunt end punch. Using a metal stamp with 1/8 inch numerals, stamp part No. 114333 on the dome, confining the stamping to the same section of the dome and between 3/8 and 1 inch from the edge of the piston.

(b) Polish the stamping lightly with crocus cloth to remove raised edges.

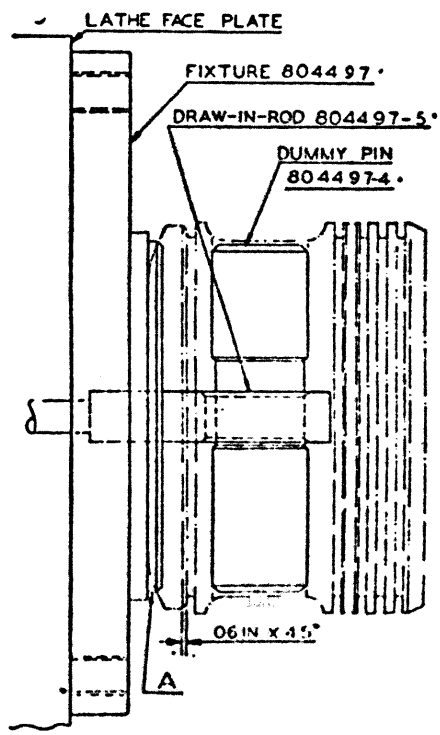

Figure 6

TOOLS REQUIRED

Tool	*Name*
(Not Furnished)	Reamer, No. 0
(Not Furnished)	Reamer, No. 00
801497	Lathe, Fixture
801498	Drill, Jig
	Drill, No. 45 (.082 inch diameter)
(Not Furnished)	Vee Block

PARTS REQUIRED

Part No.	Quantity Per Piston	Name
130799	1	Ring, Groove No. 1
112213	1	Ring, Groove No. 2
66239	1	Ring, Groove No. 3
67159	1	Ring, Groove No. 4
67160	1	Ring, Groove No. 5
69D5	14	Pin, Special Taper, No. 0 by .250 inch
75D9	16	Pin, Special Taper, No. 00 by .375 inch

WRIGHT AERONAUTICAL CORPORATION
A DIVISION OF CURTISS-WRIGHT CORPORATION
PATERSON, NEW JERSEY, U.S.A.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: INDICATOR EXTENSION ARM FOR MEASURING PROPELLER SHAFT RUN-OUT

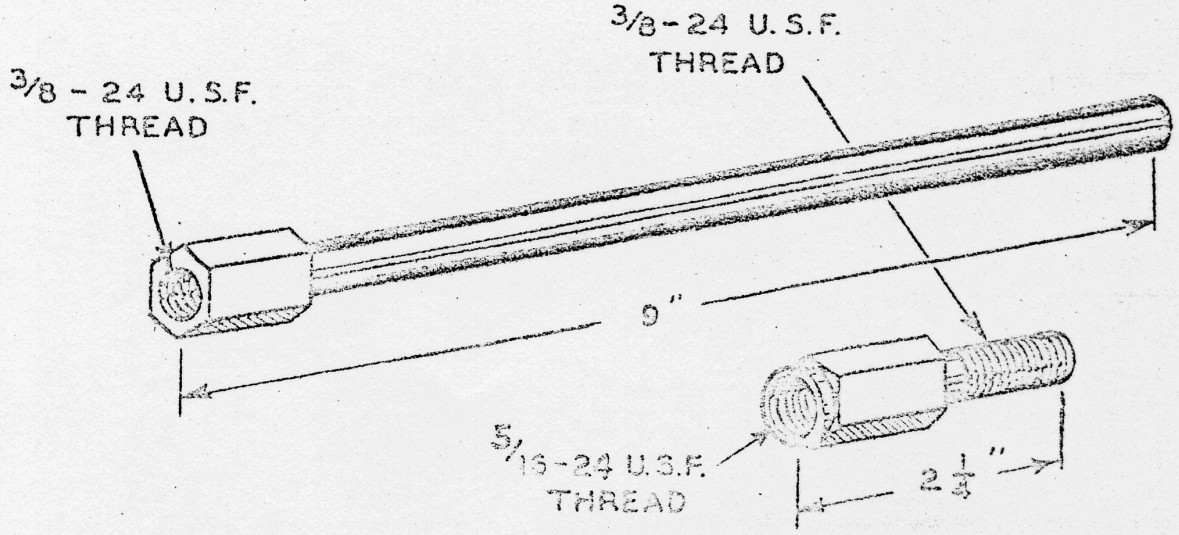
MODELS AFFECTED—Whirlwind—All

Bulletin No. W-9
Page 1 of 1
Date: May 2, 1944

This bulletin supersedes Service Bulletin No. 598, dated May 31, 1943.

Measurement of propeller shaft run-out on an engine installed in an aircraft may be done quite simply by the use of a dial indicator and an extension arm similar to that illustrated. The tool is constructed to a 9-inch length with internal threading at one end and a 3/8 inch shank. Attachment of the tool to the engine is made by removing one of the crankcase front cover nuts and installing the arm on the stud threads.

An adapter, also illustrated, may be constructed to accommodate the tool when used on engines incorporating 5/16-inch studs at the crankcase front cover location.



DIAL INDICATOR HOLDER

ADAPTER

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: CLEANING SPARK PLUG INSERT THREADS

Bulletin No. W-10
Page 1 of 1
Date: May 24, 1944

MODELS AFFECTED: Whirlwind—All

The use of the tool described below will simplify the removal of hard-baked deposits which accumulate in the spark plug insert threads during normal engine operation. This procedure will not require the removal of the cylinder to clean the insert, as the danger of damage to the engine from metallic chips falling into the cylinder will be eliminated.

CONSTRUCTION OF TOOL 1. Select a rejected spark plug which has good threads.

2. Mill four 1/16-inch slots in the threads as illustrated. Extend these slots up to the shell shoulder. See figure 1. Mill the slot deep enough to provide adequate clearance for any material which might accumulate when the plug is used as a tool.

3. With a fine three-cornered file, dress the threads next to the slots to remove any rough edges that might result from the milling operation.

USE OF TOOL Insert the plug, which is now similar to a tap, into the spark plug insert as far as it will go. One passage should remove any foreign material without increasing the depth of the insert threads. Do not use grease of any kind during this operation. Do not install a spark plug gasket.

Note

If spark plug insert distortion is experienced, it will be necessary to use a spark plug insert tap to true up the threads. Use this tap in accordance with current instructions, and apply a generous amount of heavy grease during the operation so that the amount of material which might fall into the cylinder is held to a minimum. After the operation is completed, carefully remove the grease.

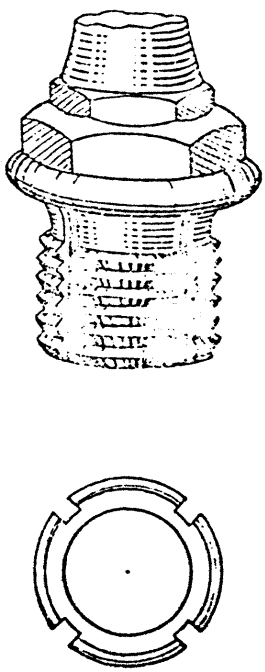

Figure 1

TOOLS REQUIRED FOR TAPPING OPERATION

Tool No.	Name
81355	Tap

PARTS REQUIRED A rejected spark plug with good shell threads.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: CYLINDER HOLD-DOWN STUDS, REPLACEMENT OF

Bulletin No. W-11
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: June 17, 1944

When it is necessary to replace a cylinder hold-down stud because of failure during operation, it is recommended that the remainder of the studs on the cylinder pad be replaced at the same time.

It has been found that the failure of one stud overstresses the remainder, thus making them unsafe for further use.

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A Division of Curtiss-Wright Corporation
PATERSON, NEW JERSEY, U. S. A.

SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: TABLE OF LIMITS

Bulletin No. W-12E
Page 1 of 10

MODELS AFFECTED: Whirlwind—All

Date: July 5, 1944
Revised: September 1946

This bulletin supersedes Bulletin No. W-12D, dated May 20, 1946, to incorporate the latest changes in the Tables of Limits.

The Table of Limits, Numbers 13 and 79, contained in this bulletin provide the most recent, recommended maximum and minimum service clearances and shall be considered to supersede all previously issued instructions.

In order to determine a particular clearance, it is first advisable to find the exact location of the fit on the cross-sectional drawing of the Limits and Lubrication Chart. The arrow directed to the clearance will indicate the reference number to be used. The number of the Table of Limits in which both the reference number and the clearance figures appear is also clearly indicated on the chart. When consulting the Table of Limits, the letter "L" will indicate a loose fit, while the letter "T" will indicate those fits which are tight, or which are less than a line to line fit.

Revised pages to the Table of Limits will be issued periodically and, when received, they should be inserted in place of the pages which they supersede. Each revised page will be dated and the letter "R" will precede reference numbers for revised fits and the letter "N" will be used in the same location to advise of additional or new fits. Charts may be kept up to date by simply drawing an arrow on the chart to indicate each new reference number added to the Table of Limits. Reference numbers missing from the orderly sequence of reference numbers in the Table of Limits have been cancelled and should be so indicated by deleting the corresponding numbers on the charts.

The date of issuance of the most recent Limits and Lubrication Charts is shown below. Copies of these charts may be obtained upon request.

Whirlwind Limits and Lubrication Charts

Chart No.	*T. L. No.*	*Chart Name*	*Part No.*	*Latest Revision*
1	79	Section Through Accessory Drives—R-760E, R-975E	853560	January, 1944
2	13 and 79	Longitudinal Section—R-760E, R-975E	853559	January, 1944

Table of Limits No. 13

WHIRLWIND R-975E ENGINES

GUN SYNCHRONIZER

The reference numbers listed are found on Limits and Lubrication Chart No. 2.

Reference No.	Chart No.	Description	Inches Minimum	Inches Maximum
106	2	Synchronizer Housing and Plunger ..... Dia.	.0005L	.005L
107	2	Synchronizer Cam and Roller with Plunger Locked in Position ...	.002L	.010L
108	2	Synchronizer Roller and Plunger ..... Side Clearance	.002L	.012L
109	2	Synchronizer Roller and Shaft ..... Dia.	.001L	.004L
110	2	Synchronizer Shaft Bearing and Housing ..... Dia.	.000	.003L
111	2	Synchronizer Shaft Bearing Cage and Housing ..... Dia.	.000	.003L
112	2	Synchronizer Shaft Bearing and Cage ..... Dia.	.000	.003L
113	2	Synchronizer Drive Gear Shaft and Synchronizer Drive Shaft Gear ..... Backlash	.004	.025
114	2	Synchronizer Shaft and Bearing ..... Dia.	.0006T	.002L
115	2	Synchronizer Shaft Bearing Cage and Housing ..... Dia.	.001T	.003L
116	2	Synchronizer Drive Gear and Accessory Drive Shaft Bevel Gear ..... Backlash	.004	.025
117	2	Synchronizer Cam Shaft and Housing ..... Dia.	.001L	.008L
500	2	Ball Bearing Retainer Nut ..... Tightening Torque Threads must be lubricated with oil.	375 in.-lb	400 in.-lb

Table of Limits No. 79

WHIRLWIND R-760E AND R-975E ENGINE BASIC

LONGITUDINAL SECTION AND SECTION THROUGH ACCESSORY DRIVES

The reference numbers listed are found on Limits and Lubrication Charts No. 1 and 2

Reference No.	Chart No.	Description			Inches Minimum	Inches Maximum
1	1	Rocker Roller Hub and Pin		Dia.	.001T	.002L
2	1	Rocker Roller Hub and Roller		Dia.	.0015L	.020L
3	1	Rocker Roller Hub and Rocker Arm Select to obtain .000-.001 inch tight fit before riveting.		Side Clearance	Rivet Tight	
4	1	Rocker Roller and Rocker Arm		Side Clearance	.0095L	.050L
5	1	Rocker Box and Rocker Bearing Before clamping.		Side Clearance	.004L	.020L
6	1	Rocker Bearing Bore and Rocker Bolt		Dia.	.000	.004L
7	1	Rocker Bearing Outside Diameter and Rocker Arm		Dia.	.000	.0017T
8	1	Rocker Bolt and Cylinder Head		Dia.	.0005L	.005L
		VALVE SPRING LOAD				
		Spring	Wire Dia. in.	At Height in.		
9	1	Outer	.175	1.380	49.32 lb	.....
10	1	Interm	.135	1.380	30.07 lb	.....
11	1	Inner	.112	1.340	20.91 lb	.....
12	1	Valve Guide and Intake Valve		Center Dia.	.0025L	.006L
		Large diameter valve stem.		End Dia.	.0025L	.008L
12A	1	Valve Guide and Intake Valve		Center Dia.	.0025L	.008L
		Small diameter valve stem.		End Dia.	.0025L	.010L
13	1	Valve Guide and Exhaust Valve		Center Dia.	.005L	.010L
		Large diameter valve stem.		End Dia.	.005L	.013L
13A	1	Valve Guide and Exhaust Valve		Center Dia.	.005L	.012L
		Small diameter valve stem.		End Dia.	.005L	.015L
14	1	Intake Valve Guide and Cylinder Head Shrink fit.		Dia.	.0008T	.0023T
15	1	Exhaust Valve Guide and Cylinder Head Shrink fit.		Dia.	.002T	.0035T
16	1	Exhaust Valve Seat and Cylinder Head Shrink fit.		Dia.	.011T	.015T
17	1	Intake Valve Seat and Cylinder Head Shrink fit.		Dia.	.011T	.015T
18	1	Cam Hub Bearing Spacer Select spacer to align cam with valve tappet rollers.				
19	1	Valve Tappet Ball Socket Spring Wire Diameter .051 in. Load at 2.18 in.			7.74 lb	.....
20	1	Valve Tappet Guide and Valve Tappet Select tappet to obtain this fit.		Dia.	.001L	.003L
21	1	Valve Tappet Guide and Crankcase		Dia.	.0005T	.002T
22	1	Valve Tappet Roller and Roller Pin		Dia.	.003L	.007L
23	1	Piston and Piston Pin		Dia.	.0005T	.003L
24	1	Piston Groove No. 1 (Top) and Ring		Side Clearance	.0075L	.010L
24A	1	Piston Groove No. 1 (Top) and Ring (Wedge) Side clearance of wedge rings must be measured in four equally spaced places and is obtained when wedge ring OD is flush with the piston thrust faces at the short diameter.		Side Clearance	.002L	.006L

Reference No.	Chart No.	Description	Inches Minimum	Inches Maximum
25	1	Piston Groove No. 2 and Ring ..... Side Clearance	.006L	.0035L
25A	1	Piston Groove No. 2 and Ring (Wedge) ..... Side Clearance Side clearance of wedge rings must be measured in four equally spaced places and is obtained when wedge ring OD is flush with the piston thrust faces at the skirt diameter.	.002L	.006L
26	1	Piston Groove No. 3 and Ring ..... Side Clearance	.0045L	.007L
27	1	Piston Groove No. 4 and Ring (Scraper Ring) ..... Side Clearance	.0045L	.007L
27A	1	Piston Groove No. 4 and Ring (Uniflow Piston) ..... Side Clearance	.009L	.012L
		(Oil Control Ring) ..... Side Clearance	.0045L	.0075L
28	1	Piston Groove No. 5 and Ring ..... Side Clearance	.0045L	.007L
29	1	Piston and Cylinder—Center of Skirt ..... Dia.	.023L	.041L
29A	1	Piston Wear—Center of Skirt ..... Dia.	.....	.004
30	1	Piston Pin Bushing and Master and Articulated Rods (Split Bushing) ..... Dia.	.0045T	.0065T
30A	1	Piston Pin Bushing and Master and Articulated Rods (Solid Bushing) ..... Dia.	.001T	.005T
31	1	Piston Pin and Bushing ..... Dia. Bushing bores in either end of connecting rod must be parallel in all planes within .015 inch in 6 inches when checked on standard fixture.	.0015L	.005L
32	1	Master Rod End Clearance on Crankpin	.013L	.050L
33	1	Crankpin Bearing and Master Rod ..... Dia. Shrink fit.	.001T	.003T
34	1	Crankpin Bearing and Crankpin ..... Dia. Select at assembly. Bushing bores in either end of connecting rod must be parallel in all planes within .015 inch in 6 inches when checked on standard fixture.	.0025L	.006L
34A	1	Crankpin Bearing and Crankpin ..... Dia. **Select at assembly. Bushing bores in either end of connecting rod must be parallel in all planes within .015 inch in 6 inches when checked on standard fixture. For R-760E series engines only.**	.003L	.0065L
34B	1	Crankpin Bearing and Crankpin ..... Dia. Select at assembly. Bushing bores in either end of connecting rod must be parallel in all planes within .015 inch in 6 inches when checked on standard fixture. For R-975-7 engines only.	.0035L	.006L
35	1	Knuckle Pin and Master Rod ..... Dia.	.000	.0015T
36	1	Knuckle Pin Bushing and Master Rod ..... Side Clearance	.006L	.030L
37	1	Knuckle Pin Bushing and Articulated Rod ..... Dia. Split bushing.	.0045T	.0065T
37A	1	Knuckle Pin Bushing and Articulated Rod ..... Dia. Solid bushing.	1T	.005T
38	1	Knuckle Pin Bushing and Knuckle Pin ..... Dia. Bushing bores in either end of connecting rod must be parallel in all planes within .015 inch in 6 inches when checked on standard fixture.	.0015L	.005L
39	1	Main Bearing Support and Crankcase Front Section ..... Dia.	.003T	.005L
40	1	Main Front Bearing Support and Bearing Ring ..... Dia.	.003T	.006T
41	1	Main Front Bearing and Bearing Ring ..... Dia.	.0002T	.006L
42	1	Main Front Bearing and Crankshaft ..... Dia.	.0002T	.0013T

Reference No.	Chart No.	Description	Inches Minimum	Inches Maximum
43	1	Allowable Run-Out of Crankshaft at Center Bearing When Supported at Thrust and Rear Main Bearings	.004 Maximum Full Indicator Reading	
44	1	Thrust Bearing and Front Section ..... Dia.	.0002L	.004L
45	1	Thrust Bearing and Crankshaft ..... Dia.	.0002T	.0009L
46	1	Thrust Bearing and Front Cover Clamp Shim	.005T	.007T
47	1	Allowable Run-Out of Crankshaft at Thrust Bearing Journal When Supported at Front and Rear Main Bearings	.004 Maximum Full Indicator Reading	
48	1	Crankcase Front Cover and Crankcase Front Cover Sleeve ..... Dia.	.003T	.006T
49	1	Main Bearing Support and Crankcase Main Section ..... Dia.	.002T	.006L
50	1	Propeller Shaft Thrust Bearing Nut and Oil Seal Ring ..... Side Clearance	.002L	.028L
51	1	Thrust Bearing ..... Play Between inner and outer races measured on an axis parallel to crankshaft.	.....	.020
52	1	Crankshaft Front and Crankshaft Rear ..... Dia. Before tightening screw.	.001T	.005L
53	1	Crankshaft Rear End Plug and Crankshaft ..... Dia.	.000	.002T
54	1	Crankshaft Rear Gear Hub and Crankshaft Gear ..... Dia.	.001L	.005L
55	1	Crankshaft Rear Gear Hub and Crankshaft Gear ..... Side Clearance	.001L	.008L
56	1	Crankshaft Rear Spring Wire Diameter .125 in. Load at .713 in. Height	181 lb	.....
57	1	Crankshaft Rear Bearing and Rear Crankshaft ..... Dia.	.002L	.0045L
58	1	Crankshaft Rear Bearing and Crankcase Main Section ..... Dia. Shrink fit.	.002T	.004T
59	1	Rear Crankshaft and Counterweight Pin Bushing ..... Dia.	.001T	.0025T
60	1	Rear Crankshaft and Counterweight ..... Side Clearance	.006L	.015L
61	1	Rear Counterweight and Stop	.041L	.060L
62	1	Rear Counterweight and Bushing ..... Dia.	.0015T	.003T
63	1	Starter Drive Gear Bushing and Diffuser Section ..... Dia.	.001T	.003T
64	1	Starter Drive Gear and Bushing ..... Dia.	.001L	.008L
65	1	Starter Shaft Bushing and Shaft ..... Dia.	.001L	.008L
66	1	Starter Shaft Bushing and Rear Section ..... Dia.	.001T	.003T
67	1	Starter Shaft ..... End Clearance	.013L	.050L
68	1	Starter Drive and Crankshaft Gear ..... Backlash	.008	.025
69	2	Oil Check Valve Spring Wire Dia. .036 in. Load at 1.440 in. Height	1.575 lb	.....
70	2	Oil Suction Strainer Spring Wire Dia. .063 in. Load at 3.125 in. Height	6 lb	.....
71	2	Vacuum Pump Drive Shaft and Vacuum Pump Drive Gear ..... Backlash	.004	.025
72	2	Oil Pump Idler Shaft and Oil Pressure Pump Body ..... Dia.	.001L	.0025L
73	2	Oil Pump Idler Shaft and Pump Spacer ..... Dia.	.002L	.0035L
74	2	Reverse-Type Generator Idler Pinion and Bracket ..... Dia.	.001L	.008L
75	2	Reverse-Type Generator Idler Gear and Pinion ..... Backlash	.004	.050
76	2	Oil Pressure Relief Valve Body and Oil Pump Body ..... Dia.	.000	.005L
77	2	Oil Check Valve Body and Crankcase Rear Section ..... Dia.	.001T	.001L

Reference No.	Chart No.	Description	Inches Minimum	Inches Maximum
78	2	Oil Pressure Relief Valve Spring Wire Dia. .048 in. Load at 1.250 in. Height	4.95 lb	.....
79	2	Oil Pump Drive Shaft and Oil Pump Idler Shaft ..... Backlash	.004	.025
80	2	Oil Pressure Pump Body and Oil Pump Idler Shaft ..... End Clearance	.002L	.005L
81	2	Oil Pump Body and Oil Pump Idler Shaft ..... Dia.	.001L	.0025L
82	2	Oil Pump Body and Pump Gear ..... Dia.	.005L	.009L
83	2	Oil Pressure Pump Body and Oil Pump Idler Shaft ..... Dia.	.004L	.010L
84	2	Oil Pump Body and Oil Pump Idler Gear ..... Dia.	.004L	.010L
85	2	Oil Pump Body and Oil Pump Drive Shaft ..... Dia.	.001L	.0025L
86	2	Oil Pump Body and Vacuum Pump Drive Shaft Bushing ..... Dia.	.001T	.003T
87	2	Oil Pump Idler Gear and Body ..... End Clearance	.002L	.005L
88	2	Oil Pump Drive Shaft and Oil Pressure Pump Body ..... Dia.	.001L	.0025L
89	2	Oil Pump Drive Gear and Oil Pressure Pump Body ..... Dia.	.001L	.008L
90	2	Oil Pump Drive Shaft and Oil Pump Gear Spacer ..... Dia.	.002L	.0035L
91	2	Oil Pump Shaft Gear and Oil Pressure Pump Body ..... Dia.	.004L	.010L
92	2	Oil Pump Gear and Oil Pump Idler Gear ..... Backlash Total permissible backlash in finished pump.	.....	.025
93	2	Oil Pump Bushing and Vacuum Pump Drive Shaft ..... Dia.	.001L	.008L
94	1	Impeller Shaft Rear Ball Bearing ..... Side Clearance Do not use to set impeller shaft.	.005L	.....
95	1	Impeller Shaft Ball Bearing and Impeller Shaft ..... Dia.	.0001L	.....
96	1	Impeller Shaft Bearing Support and Bearing ..... Dia.	.0005L	.0013L
97	1	Impeller Shaft Rear Bearing and Cage ..... Dia.	.0005L	.0013L
98	1	Impeller Oil Seal Ring ..... Side Clearance	.006L	.011L
99	1	Impeller Oil Seal Ring ..... Gap	.003	.010
100	1	Impeller and Shaft	Impeller must be a tight fit on splines	
101	1	Impeller Shaft Nut Lock and Nut ..... Side Clearance	.003L	.006L
102	1	Impeller Shaft Nut Lock and Nut ..... End Clearance	.000	.004L
103	1	Impeller and Supercharger Housing (Front) ..... Side Clearance	.022L	.027L
104	1	Impeller and Supercharger Housing (Rear) ..... Side Clearance	.018L	.072L
105	1	Impeller Drive Gear Bearing and Support	Clamp Tight	
106	1	Impeller Drive Gear Pinion and Bearing ..... Side Clearance	.008L	.025L
107	1	Supercharger Intermediate Gear and Bushing ..... Dia.	.001T	.003T
108	1	Impeller Drive Gear Hub Bearing and Impeller Drive Gear Bushing ..... Dia.	.003L	.006L
109	1	Impeller Shaft Gear and Drive Gear ..... Backlash	.002	.010
110	1	Impeller Drive Pinion and Crankshaft Gear ..... Backlash	.010	.025
111	1	Cam Drive Pinion Spring Wire Dia. .062 in. Load at 1.375 in. Height	8 lb	.....
112	1	Cam, Cam Hub and Attaching Screw ..... Dia.	.000	.002T
113	1	Cam Hub and Cam Bearing ..... Dia.	.0015T	.0045T
114	1	Cam Hub Support and Cam Bearing ..... Dia.	.003L	.008L
115	1	Cam Hub ..... Side Clearance	.007L	.025L
116	1	Cam and Cam Drive Pinion ..... Backlash	.006	.025
117	2	Accessory Drive Shaft and Bushing ..... Dia.	.001L	.008L
118	1	Hydro-Control Valve Adapter and Crankcase ..... Dia.	.002L	.006L
119	2	Accessory Drive Idler and Starter and Accessory Drive Gears ..... Backlash	.004	.025
120	1	Accessory Drive Idler Gear ..... Side Clearance	.011L	.050L

TABLE OF LIMITS No. 79

Reference No.	Chart No.	Description	Inches Minimum	Inches Maximum
121	1	Accessory Drive Idler Gear Bushing and Diffuser Section ..Dia.	.001T	.003T
122	1	Accessory Drive Idler Gear and Bushing .....Dia.	.001L	.008L
123	2	Accessory Drive Shaft Bushing and Crankcase Rear Section..Dia.	.000	.002L
124	2	Accessory Drive Shaft and Rear Bushing ..... Dia.	.001L	.008L
125	2	Accessory Drive Shaft Rear Bushing and Crankcase Rear Section .....Dia.	.001T	.003T
126	2	Accessory Drive Shaft and Bushings ..... Side Clearance	.012L	.050L
127	2	Accessory Drive Shaft Bevel Gear and Tachometer and Fuel Pump Drive Shaft ..... Backlash	.004	.025
128	2	Tachometer Drive Gear and Sleeve and Tachometer Shaft Bushing ..... Dia.	.001L	.008L
129	2	Tachometer and Fuel Pump Drive Shaft and Fuel Pump Drive Gear..... Dia.	.000	.002L
130	2	Tachometer and Fuel Pump Drive Shaft and Tachometer and Fuel Pump Drive Shaft Adapter.....Dia.	.001L	.008L
131	2	Tachometer and Fuel Pump Drive Shaft Adapter ..... Side Clearance	.006L	.020L
132	2	Tachometer Driving Gear and Drive Shaft Gear.....Backlash	.004	.025
133	2	Tachometer Driving Gear and Sleeve.....Dia.	.0035T	.0015L
134	2	Tachometer Drive Gear and Housing ..... Side Clearance	.003L	.050L
135	2	Rear Crankcase and Tachometer and Fuel Pump Drive Shaft Adapter ..... Large Dia.	.001L	.005L
136	2	Fuel Pump Adapter Bushing and Fuel Pump Gear..... Dia.	.001L	.005L
137	2	Rear Crankcase and Tachometer and Fuel Pump Drive Shaft Adapter ..... Small Dia.	.000	.002L
138	2	Crankcase Rear Section and Packing Retainer Ring..... Dia.	.001T	.005T
139	2	Fuel Pump Drive Gear and Tachometer and Fuel Pump Drive Shaft ..... Backlash	.004	.025
140	2	Fuel Pump Adapter and Bushing ..... Dia.	.001T	.003T
141	2	Drive Shaft Bushing and Diffuser Section ..... Dia.	.001T	.003T
142	1	Governor Drive Adapter and Crankcase .....Dia.	.000	.004L
143	1	Governor Drive Bevel Gear Bushing and Adapter ..... Dia.	.0015T	.0035T
144	1	Governor Drive Bevel Gear and Bushing ..... Dia.	.001L	.005L
145	1	Governor Drive Intermediate Bevel Gear and Governor Drive Bevel Gear..... Backlash	.004	.025
146	2	Reverse-Type Generator Gear and Support .....Dia.	.006L	.010L
147	2	Reverse-Type Generator Gear and Bracket ..... Dia.	.002L	.008L
148	1	Crankshaft (Front) Gear Oil Seal Ring ..... Gap	.008	.013
149	1	Crankshaft (Front) Gear and Governor Drive Intermediate Spur Gear .....Backlash	.004	.025
150	1	Governor Drive Intermediate Bevel Gear and Bushing.... Dia.	.001L	.005L
151	1	Governor Drive Intermediate Bevel Gear and Bushing and Bracket ..... Dia.	.0015T	.0035T
152	2	Tachometer Driving and Drive Shaft Gear.....Backlash	.004	.025
153	2	Tachometer Drive Shaft and Bushing .....Dia.	.0025L	.008L
154	2	Tachometer Housing and Bushing .....Dia.	.0005T	.0025T
155	2	Tachometer Drive Shaft .....Side Clearance	.008L	.040L
156	2	Tachometer Drive Shaft and Bushing .....Dia.	.001L	.008L
157	2	Tachometer Drive Shaft Cover and Bushing..... Dia.	.0035T	.0055T
158	2	Tachometer Drive Packing Gland Spring Wire Dia. .095 in. Load at .591 in. Height	16 lb	.....

Reference No.	Chart No.	Description	Inches Minimum	Inches Maximum
159	2	Tachometer Drive Shaft and Gland ..... Dia.	.009L	.020L
160	2	Generator Idler Gear and Starter Gear ..... Backlash	.004	.020
161	2	Generator Idler Gear Bushings and Shaft ..... Dia.	.001L	.008L
162	2	Generator Idler Gear and Bushings ..... Dia.	.0005T	.0035T
163	2	Generator Idler Gear ..... Side Clearance	.003L	.050L
164	2	Generator Drive Gear Support and Bushing ..... Dia.	.0015T	.0035T
165	2	Generator Drive Gear and Generator Drive Support Bushing ..... Dia.	.0025L	.008L
166	2	Generator Drive Gear and Generator Drive Support ..... Side Clearance	.006L	.020L
167	2	Tachometer Drive Shaft and Housing ..... Dia.	.006L	.016L
168	2	Tachometer Drive Shaft ..... Side Clearance	.005L	.035L
169	2	Tachometer Shaft Spiral Gear ..... Backlash	.004	.025
170	2	Tachometer Drive Sleeve and Bushing ..... Dia.	.0005T	.0025T
171	2	Tachometer Drive Shaft and Bushing ..... Dia.	.001L	.0065L
172	2	Generator Drive Gear Support and Rear Crankcase ..... Dia.	.001T	.003L
173	2	Generator Idler Gear Shaft Bushing and Rear Crankcase ..... Dia.	.001T	.003T
174	2	Generator Idler Gear Shaft and Rear Crankcase ..... Dia.	.000	.003L
175	2	Generator Idler Gear Shaft and Bushing ..... Dia.	.000	.003L
176	2	Generator Idler Gear and Starter Shaft Gear ..... Backlash	.004	.025
177	1	Crankshaft Constant Speed Governor Drive Gear and Oil Seal Ring ..... Side Clearance	.001L	.006L
178	1	Hydro-Control Propeller Operating Valve and Hydro-Control Valve Adapter ..... Dia.	.0005L	.0037L
179	1	Crankcase Sleeve and Crankcase Front Section ..... Dia.	.001T	.0035T
180	1	Crankshaft Constant Speed Governor Drive Gear and Crankcase Front Section Sleeve ..... Dia.	.017L	.034L
181	1	Crankshaft Constant Speed Governor Drive Gear and Crankshaft ..... Dia.	.0005L	.003L
182	2	Generator Idler Gear and Bushing ..... Dia.	.0005T	.0035T
183	1	Spline ..... Side Clearance **Movement of propeller hub on crankshaft measured at 15 inch radius from center of crankshaft.**	.....	.040
184	1	Propeller Thrust Bearing Nut Oil Seal Ring ..... Gap	.000	.002
185	1	Allowable Run-Out of Crankshaft between Threads and Splines at Forward End When Supported at Front and Rear Main Bearings	.012 Maximum Full Indicator Reading	
186	1	Oil Sump Strainer Spring Wire Dia. .094 in. Load at 1 in. Height	1.45 lb	.....
187	2	Gear and Accessory Drive Shaft Spline	.001L	.008L
188	2	Gear and Accessory Drive Shaft ..... Dia.	.001L	.005L
189	2	Gear and Tachometer and Fuel Pump Drive Adapter ..... Dia.	.0015L	.008L
190	2	Gear and Accessory Drive Shaft Adapter and Bushing ..... Dia.	.0005L	.008L
191	2	Tachometer and Fuel Pump Drive Cover and Bushing ..... Dia.	.0005L	.0025L
192	2	Accessory Drive Shaft and Vacuum Drive Bevel Gear Backlash	.004	.025
193	2	Gear and Vacuum Pump Drive Shaft ..... Spline	.001L	.012L
194	2	Vacuum Pump Drive Shaft and Fuel Pump Drive Gear ..... Backlash	.004	.025
195	2	Fuel Pump Adapter and Bushing ..... Dia.	.0025T	.0045T

TABLE OF LIMITS No. 79

Reference No.	Chart No.	Description	Inches Minimum	Inches Maximum
196	1	Piston Rings ..... Gap	.032	.....
197	2	Fuel Pump Drive Gear and Bushing ..... Dia.	.002L	.006L
198	2	Vacuum Pump Adapter and Bushing ..... Dia.	.0035T	.0055T
199	2	Vacuum Pump Drive Shaft and Bushing ..... Dia.	.001L	.005L
200	2	Gear and Vacuum Pump Drive Shaft ..... Dia.	.001L	.006L
201	2	Accessory Drive Housing and Bushing ..... Dia.	.0015T	.0035T
202	2	Vacuum Pump Drive Shaft Gear and Bushing ..... Dia.	.001L	.008L
203	2	Vacuum Pump Drive Shaft ..... Side Clearance	.008L	.040L
204	2	Governor Drive Gear and Vacuum Pump Drive Shaft ... Backlash	.004	.025
205	2	Governor Drive Gear and Bushing ..... Dia.	.002L	.008L
206	2	Governor Adapter and Bushing ..... Dia.	.0015T	.0035T
207	1	Crank Cheek Cap Screw ..... Stretch Use .625 inch diameter ball at head end when measuring.	.004	.005
208	1	Knuckle Pin Locks—Select to Obtain a Light Tapping Fit When Assembled between Knuckle Pins		
209	1	Thrust Bearing and Crankcase Front Cover Spacer ..... Side Clearance	.001L	.004L
210	1	Cylinder Barrel Bore ..... Taper	.....	.010
211	1	Cylinder Barrel Bore ..... Out-of-Round	.....	.005
212	1	Crankshaft Adapter and Oil Seal Ring ..... Side Clearance Apply to 7 ring adapters.	.001L	.015L
213	1	Crankshaft Adapter Oil Seal Ring ..... Gap	.008	.013
214	1	Hydro-Control Propeller Operating Valve and Crankcase Front Section ..... Dia.	.0005L	.004L
215	2	Valve Tappet Guide and Valve Tappet (External Lubrication) ..... Dia.	.0002L	.003L
216	1	Impeller Drive Gear Pinion and Bushing ..... Dia.	.001T	.003T
217	1	Impeller Drive Pinion Bearing Ring and Pinion ..... Dia.	.0025T	.0045T
218	1	Impeller Drive Pinion and Clutch Band and Dog (Slot) ..... Side Clearance	.000	.020L
219	1	Impeller Drive Ring Gear and Clutch Assembly Total Clearance	.000	.020L
220	1	Starter Drive Gear Bushing and Rear Section ..... Dia.	.000	.002L
221	1	Governor Drive Bracket and Crankcase ..... Dia.	.000	.004L
222	1	Starter Shaft (With Riveted Starter Drive Gear) .. End Clearance	.009L	.050L
223	1	Crankshaft Adapter and Oil Seal Ring ..... Side Clearance Apply to 3 ring adapters.	.0035L	.030L
224	1	Crankshaft Adapter and Crankcase Front Section Sleeve ... Dia.	.035L	.050L
225	1	Crankshaft Adapter and Crankshaft ..... Dia.	.0025L	.005L
226	1	Crankshaft Adapter Oil Seal Ring ..... Gap	.000	.015
227	1	Propeller Thrust Bearing Nut and Front Cover Sleeve ..... Dia.	.0215L	.0485L
228	2	Tachometer Drive Shaft and Gland ..... Dia.	.010L	.020L
229	2	Tachometer Drive Shaft and Housing ..... Dia.	.006L	.016L
230	1	Crankshaft ..... Length Front crank cheek front face to shoulder on rear crank cheek.	6.498	6.502
231	1	Piston Pin Plug and Piston Pin ..... Dia.	.002L	.006L
232	1	Valve Clearance ..... If this clearance aligns oil hole in adjusting screw with split in rocker arm, turn screw in direction to increase valve clearance until hole is closed off .009 inch or until .017 inch valve clearance is obtained, whichever occurs first In no case must .017 inch clearance be exceeded.	.010	.....
233	1	Piston Pin Plug and Cylinder Bore ..... Total Side Clearance	.031L	.061L

Reference No.	Chart No.	Description	Inches Minimum	Inches Maximum
500	1	Intake Pipe Flange to Cylinder Head Attaching Bolt ..... Tightening Torque	125 in.-lb	150 in.-lb
501	1	Valve Clearance Adjusting Screw Lockscrew (Tapered Head) ..... Tightening Torque	135 in.-lb	150 in.-lb

WRIGHT AERONAUTICAL CORPORATION
A DIVISION OF CURTISS-WRIGHT CORPORATION
WOOD-RIDGE, NEW JERSEY, U.S.A.

Table of Limits No. 45

ALL MODELS

TIGHTENING TORQUE VALUES

Note: Special cases and exceptions to TL-45 are listed in other Tables of Limits.

STANDARD STUDS, BOLTS, SCREWS AND CAP SCREWS

NAME	*Size of Thread*	*Minimum Diameter of Thread Root or Neck (Inches)*	*Minimum Rockwell Hardness*	*Tightening Nut, Screw, or Cap Screw TORQUE VALUES*	
				Minimum In.-Lb.	*Maximum In.-Lb.*
Button Head Screws	10-32	.1467	B-50	20	25
	12-24	.1585	B-50	25	30
Bolts, Screws, Cap Screws	10-32	.1467	C-19	35	40
	12-24	.1585	C-19	45	50
Standard Plain and Elastic Stop Nuts and Undrilled Cap Screw Heads	1/4-28	.180	C-26	80	85
	5/16-24	.229	C-26	160	175
	3/8-24	.285	C-26	225	250
	7/16-20	.331	C-26	350	375
	1/2-20	.387	C-26	550	600
	9/16-18	.436	C-26	825	875
	5/8-18	.493	C-26	1125	1200
Standard Slotted Nuts and Drilled Cap Screw Heads	1/4-28	.180	C-26	70	95
	5/16-24	.229	C-26	145	200
	3/8-24	.285	C-26	200	285
	7/16-20	.331	C-26	315	425
	1/2-20	.387	C-26	500	700
	9/16-18	.436	C-26	750	1000
	5/8-18	.493	C-26	1000	1375

STANDARD PRACTICES FOR SPECIAL APPLICATIONS

Cylinder Hold-Down Stud	3/8-24	.313	C-32	325	450
Cylinder Hold-Down Stud Nut				350	375
Cylinder Hold-Down Stud	7/16-20	.331	C-32	400	550
Cylinder Hold-Down Stud Nut				425	450
Cylinder Hold-Down Cap Screw	7/16-20	.330	C-26	500	525
Rocker Hub Bolt	7/16-20	.371	C-32	250	325
	15/32-20	.400	C-19	250	325
	9/16-18	.488	C-26	300	375
Spark Plug	18mm			300	360
Water Injection Discharge Valve	9/16-18			200	210
Water Injection Discharge Valve	3/4-16			130	170
Water Injection Tube Gland Nut	7/16-20			105	145
Water Injection Tube Gland Nut	5/8-18			160	200
Spark Plug Insert	1.000-14			1200	1400
Fuel Injection Nozzle Insert	5/8-18			400	450
Exhaust Flange Lock Nut	5/16-24			90	100
Fuel Injection Nozzle	7/16-20			275	300
Fuel Injection Nozzle Adjusting Plug	7/16-20			275	300

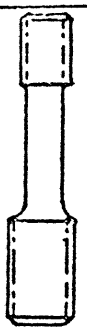
TORQUE VALUES FOR DRIVING STUDS

STEPPED STUDS

TYPES X AND Y ARE DRIVEN FROM NUT END

TYPE Z IS DRIVEN FROM FLAT ON STUD END

TYPE X



TYPE Y

TYPE Z

	STUD SIZE Nut End	STUD SIZE Stud End	TORQUE VALUE In.-Lb	TORQUE VALUE In.-Lb	TORQUE VALUE In.-Lb
Hand Driven	.250-28	.313-18	50-100	50-70	50-110
	.313-24	.375-16	100-210	100-150	100-240
	.375-24	.438-14	175-390	175-275	175-435
	.438-20	.500-13	250-600	250-425	250-670
	.500-20	.563-12	400-980	400-700	400-1110
	.563-18	.625-11	600-1360	600-975	600-1570
	.625-18	.688-11	900-1950	900-1400	900-2130
Machine Driven	.250-28	.313-18	50-100	50-80	50-125
	.313-24	.375-16	100-235	100-170	100-330
	.375-24	.438-14	175-460	175-325	175-510
	.438-20	.500-13	250-730	250-520	250-820
	.500-20	.563-12	400-1130	400-810	400-1290
	.563-18	.625-11	600-1620	600-1150	600-1790
	.625-18	.688-11	900-2320	900-1670	900-2540

STRAIGHT STUDS

TYPES X AND Y ARE DRIVEN FROM NUT END

TYPE Z IS DRIVEN FROM FLAT ON STUD END

TYPE X

TYPE Y

TYPE Z

	STUD SIZE Nut End	STUD SIZE Stud End	TORQUE VALUE In.-Lb	TORQUE VALUE In.-Lb	TORQUE VALUE In.-Lb
Hand Driven	.250-28	.250-20	50-70	50-60	50-70
	.313-24	.313-18	100-150	100-130	100-150
	.375-24	.375-16	175-275	175-230	175-2 5
	.438-20	.438-14	250-425	250-370	250-425
	.500-20	.500-13	400-700	400-500	400-700
	.563-18	.563-12	600-975	500-690	600-975
	.625-18	.625-11	900-1400	700-1010	900-1400
Machine Driven	.250-28	.250-20	50-90	50-65	50-90
	.313-24	.313-18	100-200	100-135	100-200
	.375-24	.375-16	175-350	175-250	175-350
	.438-20	.438-14	250-560	250-400	250-560
	.500-20	.500-13	400-880	400 630	400-880
	.563-18	.563-12	600-1290	500 920	600 1290
	.625-18	.625-11	900 1790	700 1290	900 1790

SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: APPROVED SPARK PLUGS

Bulletin No. W-13D
Page 1 of 1

MODELS AFFECTED: Whirlwind—R760E and R975E

Date: February 17, 1947

This bulletin supersedes Service Bulletin No. W-13C, dated December 2, 1946 in recognition of changes in the list of approved spark plugs.

The procedure outlined below is currently being followed in determining the acceptability of new or improved spark plugs for use in Whirlwind engines.

1. The vendor must submit spark plugs to the Wright Aeronautical Corporation who will apply to the Civil Aeronautics Administration for approval of the plugs after sufficient engine test stand experience has shown that approval is warranted.

2. Upon receiving Civil Aeronautics Administration approval and upon request by the spark plug manufacturer, the Wright Aeronautical Corporation will notify all domestic operators that the new plug has been approved for limited use to accumulate service operating experience. The Wright Aeronautical Corporation will then notify the spark plug manufacturer that these plugs may be released to domestic operators for this purpose.

3. Service experience operation must be conducted with a total of between 1,000 and 2,000 plugs of which no more than 500 plugs may be used by any one airline.

4. All spark plugs to be service tested must be routed through the Service Division of the Wright Aeronautical Corporation for inspection, after which they will be forwarded to the operator.

5. A report of operation experience must be forwarded to the Wright Aeronautical Corporation on forms which will be provided, together with a sufficient quantity of parts to permit accurate analysis. Subsequent to the accumulation of operating experience and the analysis of the results as obtained by operators participating in the project, the Wright Aeronautical Corporation will grant or deny final approval of the plugs for general use.

All spark plugs currently approved for use in these engines are included in the following list. The order of listing is not intended to represent a recommendation for any particular spark plug mentioned.

The approval of any of these spark plugs for use in a particular engine is limited only by installation requirements—the necessary reach of the plug and the size and type of ignition wiring harness attachment.

Part No.	Wrench Size	Spark Plug	Reach	Type	Terminal Connection Thread Size
28044	11/16	B.G. 3B2	Short	Unshielded	Clamp Fastened
27818	11/16	B.G. 4B2	Short	Unshielded	Clamp Fastened
29624	11/16	B.G. 3B2S	Short	Shielded	9/16-27
29263	11/16	B.G. 4B2S	Short	Shielded	9/16-27
63185	1	B.G. 314GS	Short	Shielded	9/16-27
64174	1	B.G. 298GS	Long	Shielded	9/16-27
111556	1	B.G. LS 298	Long	Shielded	5/8-24
117597	1	B.G. LS 298A	Long	Shielded	5/8-24
112895	7/8	B.G. LS 465	Long	Shielded	5/8-24
117596	7/8	B.G. LS 465A	Long	Shielded	5/8-24
118602	7/8	Champion C35S	Long	Shielded	5/8-24
130170	7/8	Champion RC35S	Long	Shielded	5/8-24
132278	7/8	Champion C26S	Short	Shielded	5/8-24
133108	7/8	Champion R37S	Long	Shielded	5/8-24
132680	7/8	B.G. RB19R	Long	Shielded	5/8-24

* Use short reach where inserts in cylinder have 1/2 inch thread depth.
Use long reach where thread depth is 13/16 inch.

REFERENCE INFORMATION:
R-760E, R-975E may require either long or short reach, shielded or unshielded plugs.

WRIGHT AERONAUTICAL CORPORATION
A DIVISION OF CURTISS WRIGHT CORPORATION
WOOD-RIDGE, NEW JERSEY, U.S.A.

PRINTED IN U.S.A.

SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: CHROME PLATING FOR SALVAGE

MODELS AFFECTED: Whirlwind—All

Date: September 8, 1944

Wear on engine steel parts often causes rejection of the part due to the fact that established clearances cannot be met although the part is otherwise in satisfactory condition. Some of these parts may be reconditioned for further use by chrome plating. This procedure is only necessary where oversize and undersize mating parts are not available.

The sketches included in this bulletin are intended to designate the location and amount of chrome plating permissible to salvage worn parts. The heavy lines and the number adjacent indicate the surface to which chrome plate may be applied and the maximum permissible finished thickness of the chrome plating on that surface. This information applies only to those parts which bear the part number listed. Parts which are chrome plated on a carburized surface shall be required to pass magnetic inspection for cracks after chrome plating and finishing.

NOTE

Most chrome plating processes are patented and permission to use them must be obtained from the licensor. As the work must be conducted under carefully controlled expert supervision, it is recommended by the Civil Aeronautics Administration that the plating operations be accomplished by the Wright Aeronautical Corporation or a Certificated Repair Station in accordance with Wright Aeronautical Corporation specifications.

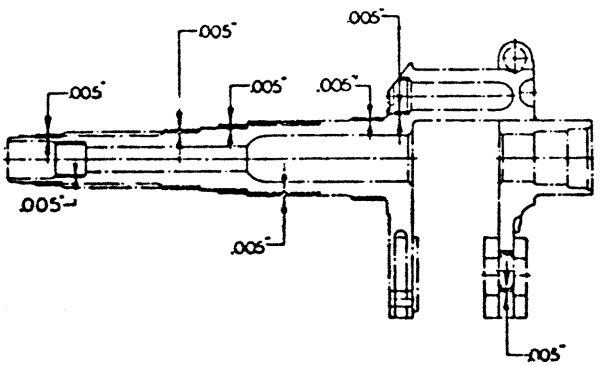


Figure 1
Crankshaft Machining and Balancing Assembly
Parts No. 47773, 48171, 49344, 411235, 411236, 411895, 413107, 413747, 414502, 414585, 415381, 417422

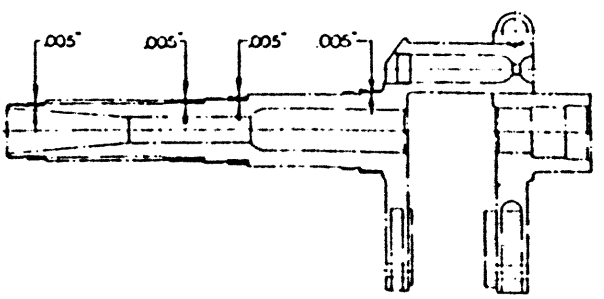


Figure 2
Crankshaft Machining and Balancing Assembly
Parts No. 40222, 44044, 44336, 44510, 44529, 44768, 44867, 44939, 45883, 46208, 46466, 47747, 48188, 48939, 415523

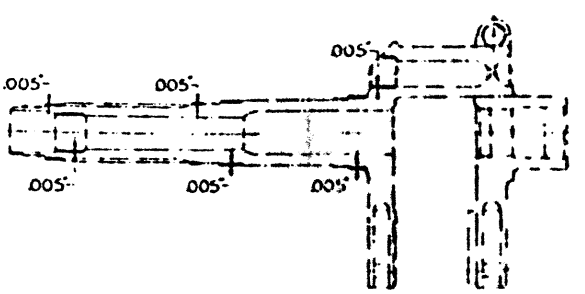


Figure 3
Crankshaft Machining and Balancing Assembly
Parts No. 414547, 414586, 414588, 414711, 414824

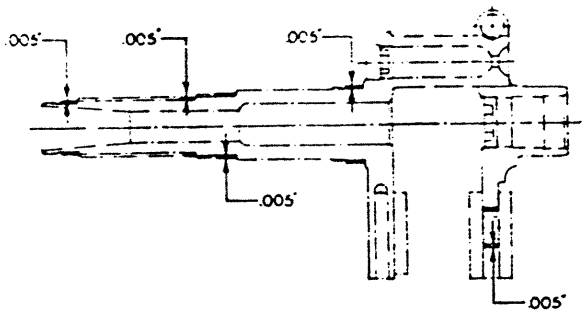


Figure 4
Crankshaft Machining and Balancing Assembly
Parts No. 47221, 48084, 48814, 48908

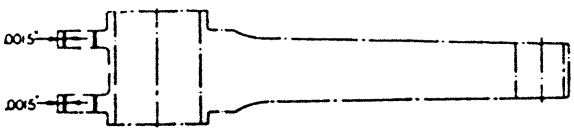
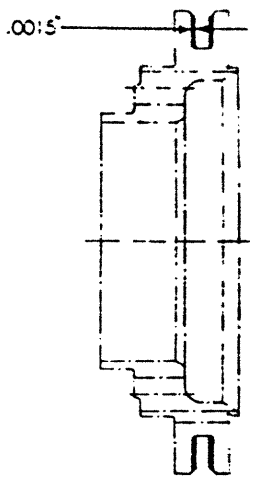


Figure 5
Master Connecting Rod
Parts No. 22134, 67357



Crankshaft
Gear Hub
Parts No.
28504, 67900

Figure 6

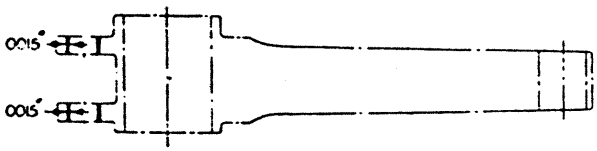


Figure 8

Master Connecting Rod
Parts No.
21942, 67358, 117911

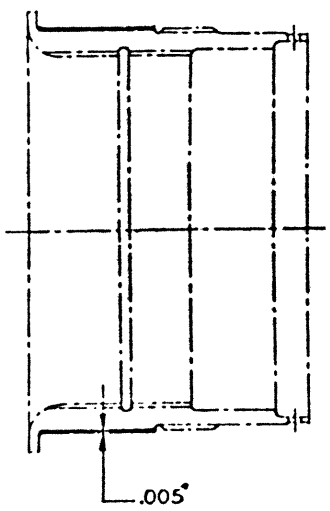


Figure 7
Crankshaft Rear Bearing
Parts No. 25088, 64836

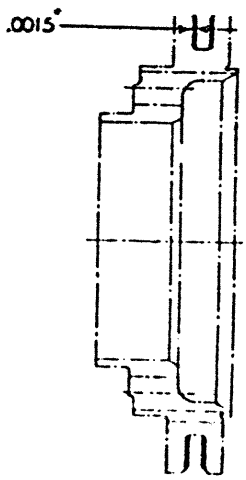


Figure 9
Crankshaft Gear Hub
Parts No. 28008, 28013, 60047

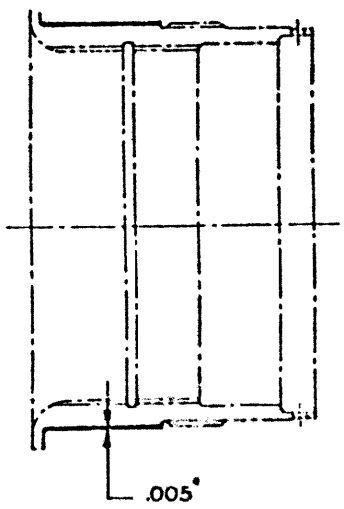


Figure 10
Crankshaft Rear Bearing
Parts No. 25088, 64836

WRIGHT AERONAUTICAL CORPORATION
A Division of Curtiss-Wright Corporation
PATERSON, NEW JERSEY, U. S. A.

SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: ACID ETCHING PARTS—INSTRUCTIONS FOR

MODELS AFFECTED: Whirlwind—All

Bulletin No. W-15A
Page 1 of 1
Date: April 21, 1945

This bulletin supersedes Service Bulletin No. W-15, dated September 9, 1944, in order to include additional information.

GENERAL PRECAUTIONS

This information will establish a procedure for acid etching parts for identification purposes. If the etching is accomplished in a careless manner there is the possibility of a corrosive action being set up where the part has been stamped. Before attempting to etch or to stamp good usable parts, it is recommended that some rejected parts be stamped for practice purposes.

Acid etching equipment must be handled and stored carefully as acid fumes easily contaminate parts in their vicinity. When in use, keep the acid and rubber stamp as far from the neutralizer and swabs as possible. When the equipment is not in use, keep the acid well covered and isolated from any parts.

To prevent possible corrosive action, do not touch the area being etched. To prevent injury, keep the hands from direct contact with the acid.

PROCEDURE

1. Clean the part at the location to be etched.

Parts coated with engine oil or low viscosity slushing compound require only that the area to be stamped be wiped clean, as the remaining film of oil protects the surface of the work from rust and corrosion, also the film of oil is thin enough to permit the etching acid on the rubber stamp to penetrate.

Make certain that the correct acid is used for etching. Use etching fluid corresponding to Wright Aeronautical Corporation Specification No. 300 (Part No. 87940) when etching steel parts. Use etching fluid corresponding to Wright Aeronautical Corporation Specification No. 301 (Part No. 850335) when etching bronze or nitralloy parts.

2. Press the rubber stamp to the acid pad. To assure that more acid than necessary does not remain on the part, blot the stamp on a clean white blotter or cloth before applying it to part.

3. Apply the stamp firmly to the surface to be etched.

4. Remove the stamp. Let the acid remain on the part for at least 30 seconds.

5. Apply a cotton swab containing a neutralizing agent to the area. Press down with a blotting motion and then lift the swab carefully from the surface. Do not smear or rub with the swab.

Make certain that all acid is positively neutralized.

As the neutralizing agent consists of water and oil, it is not necessary that it be removed because the water will evaporate and leave a film of oil as a protective covering.

6. After the etching is completed, coat each part with a suitable corrosion preventive.

Replace the stamp when necessary.

SPECIAL EQUIPMENT REQUIRED

1. Blue acid conforming to Wright Aeronautical Corporation Specification 300 (Part No. 87940, supplied in one pint bottles) to be used when etching all steel parts.

2. Green acid conforming to Wright Aeronautical Corporation Specification 301 (Part No. 850335, supplied in one pint bottles) to be used when etching all bronze and nitralloy parts.

The colors are an additional safeguard against an incorrect choice of acids.

3. Neutralizer conforming to Wright Aeronautical Corporation Specification 62.

A neutralizer may be made by mixing one part of any soluble cutting oil or grinding oil to three parts of water. The volume of neutralizer mixed should be about three times the amount needed. This will assure enough excess solution to neutralize any acid carried into the container by the swab.

Make certain that the neutralizer is always alkaline. Use red litmus paper to test the solution. If the paper turns blue when it is placed in the neutralizer, the solution is alkaline. If the paper remains red under the same conditions the solution must be discarded.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: PREPARATION OF ENGINES FOR STORAGE OR SHIPMENT

Bulletin No. W-16A
Page 1 of 5

MODELS AFFECTED: Whirlwind R760E and R975E

Date: February 17, 1947

This bulletin supersedes Service Bulletin No. W-16 dated September 14, 1944 in order to standardize procedures.

Protect all engines which are to remain idle, to be stored, or to be shipped, in accordance with the instructions contained in specification AN-E-11 or specification AMS 2570A, which is included in this bulletin and reprinted with the permission of the copyright owner.

AERONAUTICAL MATERIAL SPECIFICATION
SOCIETY OF AUTOMOTIVE ENGINEERS, INC.
29 WEST 39TH STREET
NEW YORK CITY

AMS 2570A
Issued 6-1-42
Revised 11-1-45

PRESERVATION OF ENGINES

1. PURPOSE

To provide a procedure for preparing reciprocating aircraft engines to resist corrosion during shipment and storage.

2. MATERIAL AND EQUIPMENT

The latest revision of the following specifications and standards shall be applicable:

AMS 3070—Oil, Corrosion-Preventive (Carburetor Slushing)
AMS 3072—Compound, Corrosion Preventive (Aircraft Engine)
AMS 3075—Compound, Corrosion Preventive (Parts and Equipment)
AMS 3160—Solvent, Petroleum
AMS 3420—Agent, Dehydrating
AMS 3535—Moisture Vapor Resistant Sheet
AMS 3540—Wrapper—Greaseproof
AMS 3542—Wrapper—Greaseproof Paper (Laminated)
AMS 3610—Plastic Film—Transparent, Moisture-Resistant
AS 6—Enclosure, Storage and Shipping
AS 7—Plug, Cylinder Dehydrator
AS 8—Plug, Crankcase Dehydrator
AS 9—Protector and Cable Attachment
AS 10—Indicator, Humidity—Large
AS 11—Equipment, Spray
AS 160—Collar—Propeller Shaft, Shipping
AS 172—Nut Propeller Shaft, Shipping
AS 173—Cap Propeller Shaft, Shipping
AS 338—Shipping Containers, Aircraft Engines and Components
AS 347—Indicator Humidity Medium
ARP 197—Preservation and Packaging of Aircraft Engine Parts

3. SLUSHING PROCEDURE

It is recommended that the sequence of operations specified in this section be followed in all essential details and for best results should be accomplished within 48 hours, except as otherwise specified.

(a) **Crankcase Sections.** The engine shall be securely mounted in its normal running position. In this position the engine shall be driven from an external source of power or operated under its own power at a crankshaft speed of not less than 500 rpm. While running at this speed the engine lubricating system shall feed from a reservoir of preservative oil, AMS 3072. During this operation the oil shall be maintained within the temperature limits of 215-260°F. If because of peculiarities of individual installations it may not be practical to retain the temperature at or above the low limit without exceeding the high limit, then the high limit (260°F) shall be the controlling temperature. The engine shall be operated for a minimum 15 minutes under the above conditions.

(b) **Cylinder Bores.** The above procedure shall be supplemented by spraying the cylinder bores with preservative oil, AMS 3072, by one of the following methods:

(1) **Aspirating.** Within the last two minutes of the above specified slushing run, while the engine is turning over, the preservative oil, AMS 3072, under pressure, shall be aspirated through the induction system. The quantity of compound to be used to insure adequate coverage, and the procedure, should be determined for each individual engine model. The

engine shall be shut down immediately after this operation.

(2) Gun Spraying. As an alternate procedure the cylinder bores may be preserved by the following procedure. At the end of the engine run using the preservative oil as a lubricant, the fuel supply shall be cut off and the engine speed accelerated at the time the ignition is switched off. Within two hours from the shut down time each cylinder of the engine shall be sprayed with preservative oil, AMS 3072, through a spark plug hole with the piston at the bottom of stroke. This operation may be done on cylinders in firing order. Twenty-five millileters of oil is considered adequate for each cylinder provided application is conducted in a manner to ensure complete coverage. (See AS 11 for recommended equipment.)

(c) Oil and Coolant Drainage. Preferably while the engine is still warm from the procedure specified in paragraph 3(a) excess oil shall be drained from the engine crankcase, filter or screen chambers, and/or sump(s). Screens or filters shall be removed, cleaned, slushed with preservative oil, AMS 3072, and replaced. The coolant shall be drained from liquid cooled engines and the coolant chambers dried. All drain plugs shall be replaced and safetied.

(d) Cam and Rocker Boxes. Within three hours after the procedure specified in paragraph 3(a), all valve mechanism such as cam shafts, rockers, springs, washers, valve stems and interior of housings and rocker boxes shall be thoroughly coated with preservative oil, AMS 3072. This preservative oil shall be applied preferably by spraying using pressure gun equipment. Covers which have been removed to accomplish this operation shall be cleaned and reinstalled.

(e) Exhaust Ports. The exhaust ports shall be sprayed directly with preservative oil, AMS 3072, so as to coat thoroughly the opened exhaust valves as well as the port walls. Seal the exhaust ports with oil and moisture-resistant covers or gasketed plates. Where an exhaust manifold is supplied on the engine prior to shipment see instructions contained in paragraph 4(d).

(f) Accessory Drives. The ends of accessory drives for which oil seals are provided shall be thoroughly coated with preservative oil, AMS 3072. Covers or cover plates with gaskets shall be installed over all accessory drives.

(g) Cylinder Bore Preservation. Before the engine has been prepared for final packing the cylinders shall be sprayed again in the manner described in paragraph 3(b)(2). The propeller shaft shall then be turned at least six revolutions and the cylinders resprayed without moving the pistons. The cylinders shall then be thoroughly drained of excess compound through the spark plug holes. Sufficient time shall elapse for sufficient draining to ensure against the danger of subsequent hydraulic damage to cylinders and moving parts. The use of a suction gun to facilitate removal of this drained compound is recommended. After this operation a temporary tag shall be tied to the propeller shaft with the warning note "DO NOT TURN PROPELLER SHAFT."

(h) Cleaning. Where necessary the external surfaces of the engine may be cleaned with petroleum solvent, AMS 3160 or equivalent.

4. DEHYDRATING PROCEDURE

(a) Cylinder Dehydrators. Cylinder dehydrator plugs, conforming to AS 7, shall be installed in each spark plug opening and tightened to the torque recommended in AS 7 for the applicable plug size. The moisture seal shall not be removed from the end of the dehydrator plug until immediately before the plug is installed.

(b) Crankcase Dehydrators. All openings to the interior of the engine such as breathers and oil connectors shall be plugged or suitably sealed with oil and moisture resistant closures. The oil sump plug or closure(s) of other selected opening(s) shall be removed and replaced with a crankcase dehydrator plug of suitable size. The dehydrator plug shall be tightened to the torque specified for applicable plug size listed in AS 8. The removed plugs and or closures shall be attached to engine together with suitable instructions for removing dehydrator and reinstalling permanent plugs or covers. The quantity of crankcase dehydrators shall be installed according to the following schedule:

Engine Weight Pounds	*Weight of Desiccant Grams Minimum*	*Minimum No. of Plugs AS 8*
Up to 500	20	1
500 to 1000	40	1 or 2
1000 + to 2000	60	2
2000 + to 3000	60	2
3000 + to 4000	80	3

The moisture seals shall not be removed from the ends of dehydrators until immediately before plugs are installed.

(c) Induction Port Dehydrators. Dehydrating agent, contained in a sift-proof bag, as specified by AMS 3120 shall be installed at the entrance to the air induction system to the engine according to the following schedule:

Cylinder Displacement per Engine Cubic Inches	Desiccant Quantity, AMS 3420—Grade E Ounces Minimum
Up to 1000	4 oz.
1000+ to 2000	8 oz.
2000+ to 3000	12 oz.
3000+ to 4000	16 oz.
4000+	16 oz. +4 oz./1000 cu. in. or fraction thereof.

The above quantities may be interpolated to more exact amounts for actual "cylinder displacement." Where openings in small engines are not of sufficient size to accommodate the above specified amounts of desiccant a bag of dehydrating agent as large as practicable shall be used. Where the carburetor is shipped installed in its operating location the desiccant shall be placed at the induction entrance of the carburetor. A conspicuous warning tag or notice shall be provided to indicate presence of the dehydrating agent and need for removal prior to engine operation. Handling of the desiccant shall be held to a minimum and shall always be installed in the engine immediately after removal from its closed shipping container. The intake manifold or carburetor opening shall then be immediately sealed with a gasketed cover or plate securely fastened in place. It is desirable to have the bags containing dehydrating agent installed in such a manner that they will be removed with the cover or observed when cover is removed.

(d) Exhaust Manifold. When an exhaust manifold is shipped attached to the engine, a one-half pound bag of dehydrating agent, AMS 3420, Grade E, shall be installed in the opening(s) of the collector ring or rings and the opening(s) closed with an oil and moisture resistant diaphragm(s) or sealing cover(s). A conspicuous warning tag indicating the presence of the dehydrating material shall be fastened adjacent to the opening. The dehydrating agent shall be installed directly from its closed shipping container.

(e) Propeller Shaft Breather. Where a propeller shaft breather is provided with sufficient space a one-quarter pound bag of dehydrating agent, AMS 3420, Grade E, shall be located inside the propeller shaft thread protector cap with provision for its removal with the cap. The bag of dehydrating agent shall not be removed from its closed shipping container until immediately before installation.

5. PACKING PROCEDURE

All ends of locking wire shall be bent inward or covered with tape to prevent rupture of engine envelope. All loose ends of pipes, ignition leads, etc., shall be secured in place to prevent chafing of engine envelope. The spark plug leads may be supported in shipment by fastening the terminal protector, AS 9, to the end of each cylinder dehydrator plug. Remove warning tag from end of propeller shaft having warning note "DO NOT TURN PROPELLER SHAFT."

(a) Engine Envelope. An envelope incorporating, in general, the requirements of AS 6 shall be fitted to the shipping case saddle, anchor plate or to the engine, whichever is more convenient. Holes for the anchor belts shall be punched and the belts inserted to hold envelope in position. The shipping case saddle or anchor plate together with envelope shall then be fitted to the engine taking care not to tear the envelope. The engine and envelope with attaching components shall be then secured to the shipping container. This procedure may be varied at the discretion of the shipper, provided the anchor plate or saddle is removable with the engine.

(b) Shipping Container. The engine shipping container shall conform to the requirements of AS 338 where applicable.

(c) Dehydrating Agent. Bags of dehydrating agent, AMS 3420, Grade E, shall be uniformly distributed around the engine at the rate of one pound per cylinder for engines up to and including 14 cylinders. For engines with more than 14 cylinders the recommended minimum of 14 pounds shall be supplemented by the addition of dehydrating agent at the rate of at least one pound per each additional two cylinders. Not less than a half pound per pound weight of paper, etc., shall be added to provide for dehydration of the dunnage within the shipping envelope. The dehydrator bags shall not be removed from closed shipping container until immediately before attachment to the engine.

(d) Humidity Indicator. A humidity indicator, AS 10 or AS 347, shall be secured to the engine opposite the inspection port in the shipping container in a manner to be readily observed from outside the encased engine by lifting the inspection port cover.

(e) Creped paper, canvas, or other suitable covering shall be placed around the periphery of radial engines and other locations as required to prevent damage to the shipping envelope which might result from chafing on projections. For in-line engines the covering shall be placed so as to provide maximum protection.

(f) Propeller Shaft. Exterior surfaces of the propeller shaft shall be coated thoroughly with preservative oil, AMS 3072, or preservative compound, AMS 3075. A thread protector cap, AS 173, shall be installed, and the splines covered with greaseproof paper, AMS 3540 or AMS 3542. Any surface of the propeller shaft exterior to the engine envelope must be coated with preservative compound, AMS 3075.

(g) Propeller Shaft. (Alternate Method) When it is contemplated that the engine will be handled while in storage with the aid of a lifting eye applied to the end of the propeller shaft a hole shall be care-

fully cut to the inside diameter of the large gaskets provided near the open end of the shipping envelope. Shipping parts AS 160, AS 172, and AS 173 shall be applied in proper sequence as explained in AS 6. The propeller shaft splines shall be coated and wrapped as detailed in paragraph 5(f). With this arrangement for shipping an additional band of greaseproof paper, AMS 3540 or AMS 3542 shall be applied to the cone seat and shall be of sufficient width to extend to the top of the gasket area. This will provide insulation from contact corrosion between the envelope material and the propeller shaft. The threads, cone seat, and inside of the propeller shaft shall be thoroughly coated with corrosion-preventive compound, AMS 3075, before shipping parts are installed. A second application of corrosion-preventive compound to the threads after installation of nut and before installation of thread protector cap is recommended.

(h) Envelope Sealing. The engine shipping envelope shall be heat sealed (using a temperature within the range specified on the envelope identification panel) as soon as practicable after attaching dehydrator bags as specified in paragraph 5(c). In so doing, the envelope shall be unfolded and the open edges brought together and sealed under heat and pressure so as to provide a continuous moisture-proof seam. Excess air within the envelope shall be removed by the use of a suitable exhaust fan to assist in folding the envelope around the engine, but not to an extent which will cause damage to the envelope.

(i) After the sealing operation the excess material of the envelope shall be folded around the engine and secured with tape in a manner to provide a minimum size package. The envelope should be so arranged as to permit unobstructed visibility of the humidity indicator.

(j) Closure of Shipping Container. The engine container sides and/or cover shall be assembled over the envelope enclosed engine in such a manner as not to rupture the envelope. The humidity indicator contained within shall be carefully examined through inspection port in the side of the container for suitable alignment and visibility. The inspection port cover shall be closed and sealed and the container secured for shipment.

(k) Marking. In addition to dispatching information which may be special for each consignment the shipping container shall be marked as specified in AS 338.

6. ACCESSORIES

Preservative oil, AMS [illegible], may be used for the preservation of accessories except carburetors, and other units which contain elements such as synthetic rubber diaphragms which may be damaged by this compound. Unless the recommendations of the accessories manufacturers are otherwise, these "excepted" accessories shall be preserved with oil conforming to AMS 3070.

(a) Carburetor Slushing. The carburetor shall be emptied of all residual gasoline and shall be filled with oil, AMS 3070. Interior surfaces shall be thoroughly slushed in accordance with manufacturers' instructions. Care shall be exercised not to damage moving parts such as needle valves or float (where provided). When flushing a pressure-type carburetor the oil pressure applied to fuel chambers or passages shall not exceed eight pounds per square inch. Under no circumstances shall the regulator air chambers, air passages, and/or automatic mixture control be flushed with oil; these must be kept dry at all times. Drain excess oil from all fuel passages and replace plugs or cover plates. When the carburetor is shipped attached to the engine lock the throttle plates in the open position.

(b) Carburetor Packing. When the carburetor is shipped disassembled from the engine the throttle plates shall be locked in a position which will prevent damage during shipment. For this method of shipment the carburetor shall be sealed within a moisture-resistant enclosure fabricated of material conforming to either AMS 3610 or AMS 3535. The enclosure shall contain dehydrating agent, AMS 3420, Grade E, in quantity as calculated by the following formula:

$$\text{Pounds of dehydrating agent} = \frac{A}{10} + \frac{D}{2}$$

A = Area in square feet of the moisture-resistant enclosure.

D = Weight of Hygroscopic dunnage in pounds.

The minimum quantity of dehydrating agent shall be one-half pound. The dehydrator bags shall not be removed from their closed shipping container until immediately before applying to the carburetor. A humidity indicator conforming to AS 347 shall be fastened to carburetor in a conspicuous location before enclosure is sealed.

(c) All accessories and auxiliaries to be shipped with the engine shall be packed in accordance with ARP 197.

7. MAINTENANCE

(Inspection and re-preservation will not be the responsibility of the engine manufacturer after engines have been shipped from the engine manufacturer's plant.)

(a) Inspection of Engines in Storage. Engines shall be inspected periodically, preferably monthly, to ascertain the relative humidity prevailing within the engine envelope. If the relative humidity is above 20% the atmosphere contains sufficient moisture to cause corrosion. The humidity indicator, secured to the engine opposite the inspection port of the shipping case, affords a convenient means of approximating the relative humidity. By matching the color of the indicator dehydrating agent with the color scale printed on the front of the Humidity Indicator, AS 10 or AS 347, an inspector may quickly determine if an engine must be re-preserved. The indicating agent used in the humidity indicator is deep blue in color when dry, but fades to a lighter shade of blue or pink, depending on the degree of moisture absorbed.

(b) Re-preservation of Engines During Storage. When moisture within the engine envelope has increased to an unsafe amount, as shown by the Humidity Indicator, AS 10 or AS 347, the engine envelope shall be opened by cutting off the seal and the engine re-preserved by replacing all old dehydrating agent with freshly activated dehydrating agent, and installing a new Humidity Indicator. Likewise, the dehydrator plugs which have a color matching an unsafe shade on the color scale of the Humidity Indicator shall be replaced. As soon as this is accomplished, the engine envelope shall be re-sealed.

NOTE

The dehydrator bags shall not be removed from their moisture resistant containers, nor the moisture seals removed from dehydrator plugs until immediately before application to the engine.

(c) Re-Sealing and Repairing Damaged Engine Envelopes. An engine envelope shall be re-sealed, using an iron heated to the temperature recommended on the envelope identification panel. Ruptured envelopes may be repaired by heat-sealing a patch of the envelope material over the opening or by sealing the open edges of a straight tear.

NOTE

SIMILAR SPECIFICATION

Army-Navy Aeronautical AN-E-11 is listed for information only and shall not be construed as an acceptable alternate unless all requirements of this AMS are met.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: INSTALLATION OF SPLIT TYPE INNER RACE THRUST BEARING

Bulletin No. W-17A
Page 1 of 1

MODELS AFFECTED: Whirlwind R760E and R975E

Date: August 19, 1946

This bulletin supersedes Service Bulletin No. W-17, dated October 2, 1944, to provide additional information.

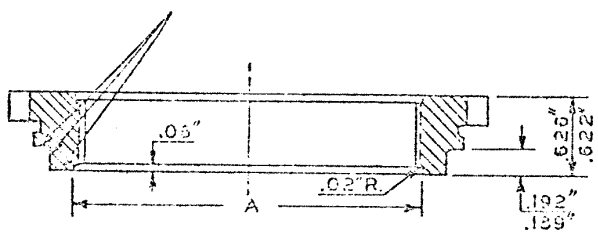
Thrust bearing, part No. 21D101, currently supplied to replace the thrust bearing, part No. 21D68, in the above engine models except as indicated below, differs from the earlier type in that it has a smaller inside diameter, a puller flange on the propeller end, and a split inner race. Its tighter fit reduces movement of the inner race on the crankshaft and decreases end float of the crankshaft. The puller flange which acts as an oil slinger ring eliminates the need for an additional slinger and permits easier removal of the bearing. In addition, the bearing life is increased.

When replacing the thrust bearing in service engines, install bearing, part No. 21D101, except as noted below. If bearing, part No. 21D68, was used, it will be necessary to discard the oil slinger and to either use a new thrust nut, part No. 120889 for number 20 spline crankshafts and part No. 117908 for No. 30 spline crankshafts, or rework the old nut as indicated by the illustration.

Exception—Thrust bearing, part No. 21D101, cannot be used on R760E and R975E engines incorporating a crankcase front section with a 6.313 inch diameter front cover bolt circle because of interference with the thin type crankcase front cover, part No. 21554. Bearing, part No. 21D68, must be retained in this assembly along with the oil slinger ring and thrust nut being used.

SPECIAL TOOLS REQUIRED

Tool No. (Bearing, Part No. 21D68)	*Tool No. (Bearing, Part No. 21D101)*	*Name*
82932	82932	Wrench, propeller shaft (20 spline) thrust bearing nut lug
82934	82934	Wrench, propeller shaft (30 spline) thrust bearing nut lug
.....	805055	Puller, front crankshaft thrust bearing inner race spacer and gear removing
.....	805056	Adapter, puller
.....	805057	Adapter, puller
.....	803151	Clamp, crankshaft thrust bearing nut oil seal ring installing
802198	.....	Puller, crankcase front section removing



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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: TIMING SERRATIONS—INCREASED DIAMETER OF

Bulletin No. W-18
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: September 4, 1944

This bulletin supercedes Service Bulletin No. 425 dated December 3, 1942, to revise the parts list and change the title.

Early production engines provided a one inch diameter meshing surface of the timing serrations on the starter drive gear and cam drive pinions. Engines of more recent production incorporate a modified starter drive gear and cam drive pinion which increases the meshing surface of the timing serrations to a two inch diameter. This was done to assure more positive engagement of these serrations. It is recommended that service engines that do not incorporate this change have the following parts replaced: starter shaft, starter shaft bolt, starter shaft bolt nut, starter drive gear and cam drive pinion, and cotter pin. The incorporation of a pin having a .116 inch diameter provides a stronger lock for the nut, but, before this size pin can be installed, the starter shaft bolt nut must be reworked.

REWORK Rework the nut in the following manner:

1. Redrill the cotter pin holes in the starter shaft bolt nut with a .125 inch drill.

2. Chamfer the holes at 45 degrees to a .15 inch diameter.

3. Remove the burrs from the nut threads by running a standard ½-20 USF tap through the nut.

PARTS REQUIRED

Quantity R760E	Quantity R975E	Part No.	Part Name
1	1	65693	Starter Shaft
	1	48728	*Starter Drive Gear and Cam Drive Pinion
1		49463	*Starter Drive Gear and Cam Drive Pinion
1	1	65694	Starter Shaft Bolt
1	1	124D87	Starter Shaft Bolt Nut
1	1	59D1	Cotter Pin

*Detail parts of the starter drive gear and cam drive pinion will not be supplied separately. These parts must be kept clamped together until assembled to prevent mismatching, and to avoid mutilation of the serrations.

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A Division of Curtiss-Wright Corporation
PATERSON, NEW JERSEY, U. S. A.

SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: ENGINE DRIVEN ROCKER BOX LUBRICATOR—
OPERATION OF

Bulletin No. W-19
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: February 14, 1945

This bulletin reinstates Service Bulletin No. 281, dated December 17, 1936, since the information is still applicable.

The purpose of this Service Bulletin is to supply information regarding the installation and proper adjustment of the engine driven rocker box lubricator with which some engines are equipped.

The lubricator may be installed to operate satisfactorily in either direction of rotation. If rotation is in the direction indicated by the arrow and 1-1 stamped on the flange of the mounting pad, the housing cover should be installed so that the numbers 1 on the cover and body will index. If, however, rotation is in the opposite direction to that indicated by the arrow, then the housing cover should be installed so that the number 2 indexes with 2 on the housing.

The lubricator should be adjusted to secure an oil flow of from one-quarter to one-half pint per hour at rated engine speed. If a test rig is not available, the flow may be measured with the lubricator on the engine. With the engine thoroughly warmed up, remove the discharge line so that the oil from the lubricator flows into a small graduated measure. Run the engine at rated speed for ten minutes and note the amount of oil collected. Multiplying the amount by six will give the flow per hour. The rate of flow may be changed by loosening the adjusting screw and altering the position of the adjusting washer with respect to the scale stamped on the cover. Movement of the washer so that its reference line indexes with higher numbers on the scale will increase the rate of oil flow. It should be noted, however, that the numbers on the scale do not denote any specific flow in terms of pints or pounds per hour.

When installing or removing the lubricator tubes, two wrenches should be used on the fittings in order to prevent twisting and damaging the rubber tubing. Some free movement in the fitting which attaches the tube to the rocker hub bolt is permissible since there is a conical seat at the connection which seals the passage.

To ensure an adequate supply of lubricant the rocker boxes should be filled with engine oil whenever the rocker box covers are removed.

WRIGHT AERONAUTICAL CORPORATION
A Division of Curtiss-Wright Corporation
PATERSON, NEW JERSEY, U. S. A.

SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: BLOCK TESTING OF OVERHAULED ENGINES

MODELS AFFECTED: Whirlwind—All

Date: February 8, 1945

This bulletin cancels and supersedes Service Bulletin No. 590 dated April 21, 1943 in order to bring the information up to date.

The information contained in this Service Bulletin is intended to establish standard run-in specifications and various operating limits for overhauled engines.

RUN-IN FOLLOWING TOP OVERHAUL No run-in is necessary on engines which have undergone top overhaul; that is, the restoration of valves, pistons, piston rings and cylinders to service limits. Ground running to check the installation of the engine in an aircraft should be held to a minimum. Any "slow" time that is desired should be obtained in flight, since prolonged ground running of engines installed in aircraft may result in excessive cylinder barrel temperatures, thus causing piston ring feathering and allied troubles.

RUN-IN FOLLOWING MAJOR OVERHAUL In order to test the operating characteristics of engines which have undergone a major overhaul, test stand equipment should be provided from which the necessary readings of temperatures, pressures, fuel and oil flows and engine speeds may be taken. Specifications and detail drawings of this equipment may be procured from Wright Aeronautical Corporation.

A sufficient number of properly calibrated test propellers should be maintained to compensate for variations in climatic conditions. The test propeller used during the run-in should provide, within plus or minus two percent, a normal rated manifold pressure at a speed within plus or minus two percent of normal rated RPM. Since values of manifold pressure are taken from propeller load curves, the run-in may be conducted using values of engine speed for the criterion of power output. At rated and take-off powers, manifold pressure and engine speed must both agree with the specified values.

The use of standard or cut-down flight propellers in place of test propellers is not approved unless such propellers are provided with cuffs or fans to provide satisfactory cylinder barrel cooling.

Tests should be conducted with fuel of the grade specified for normal operation of the engines, and the carburetor mixture control should at all times be set at the "Full Rich" position.

During block test operation, the use of power and fuel flow curves is not considered necessary for the determination either of brake horsepower or of brake specific fuel consumption. Since the brake horsepower values computed from the curves are found from MAP and RPM readings, the attainment of the proper manifold pressure and speed may be regarded as the criterion of engine performance, while carburetor acceptance should be based on the flow bench test, and the BSFC may then be calculated, if desired, as a secondary check.

Run-ins in accordance with the following schedule are recommended for all engines after major overhaul.

Item No.	*Duration in Minutes*	*Operation*	*% of Normal Rated Speed*	*Approx. % of Normal Rated Power*	*Approx. % of Normal Rated MAP*
1	5	Start and Warm-Up	45	...	...
2	5	Endurance	58	[illegible]	[illegible]
3	10	Endurance	68	30	60
4	10	Endurance	74	40	65
5	45	Endurance	84	60	75
6	60	Endurance	95	85	90
7	30	Endurance	100	100	100
8	Idle for 2 minutes; accelerate to take-off RPM and MAP for 1 minute.				

During operation under Item 5 of the schedule, a magneto check should be conducted. Loss of engine speed while operating on one magneto must not exceed 75 RPM.

When operating under Item 8, it will occasionally be necessary to install another test propeller in order to obtain RPM and MAP within plus or minus two percent of take-off values.

The following table presents various engine operating limits during block test operation of overhauled engines.

Engine Model	Main Oil Pressure PSI	Minimum Nose Oil Pressure PSI	Maximum Oil Consumption at Normal Rated Power, Qts/Hr	Maximum Cylinder Head Temperatures—°C at % of Normal Rated Power			Maximum Oil Flow at Normal Rated RPM—Lbs/Min.
				0–70	70–100	Take-off	
R760E2	60-80	25	2	205	232	260	15
R975E3	60-80	25	3	205	232	260	20

Oil flow readings should be taken at 185°F (85°C) oil-in temperature.

WRIGHT AERONAUTICAL CORPORATION
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PATERSON, NEW JERSEY, U. S. A.

SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: STARTER DRIVE GEAR BUSHING.
REMOVAL AND INSTALLATION OF

MODELS AFFECTED: Whirlwind—All

Date: November 4, 1944

This bulletin supersedes all instructions previously issued on removal and replacement of starter drive gear bushings.

The purpose of this bulletin is to present the most recently established procedure for removal and installation of the starter drive gear bushing.

PROCEDURE

1. With a standard .120 inch punch, drive the lock pin from the diffuser section and starter drive gear bushing. See figure 1.

2. Place the diffuser section on the collar, Tool No. 800556-2, and insert a plug, Tool No. 800556-1, into the bushing. Press out the bushing with an arbor press contacting the plug. See figure 2.

3. Plug all oil passages and channels with beeswax or paraffin.

4. Chamfer and face the starter bushing hole to the dimensions shown in figure 3. Use cutter, Tool No. 800557.

5. Dewax the diffuser section by heating it in a 135°C (275°F) oil bath for 20 minutes. Blow out the holes with hot 49°C (120°F) kerosene at approximately 20 pounds per square inch pressure.

Allow the section to cool before proceeding with the operation.

6. Place the diffuser section on the collar, Tool No. 800556-2 and install a bushing, Part No. 111975, pressing it into place with a plug, Tool No. 800556-1 and arbor press as shown in figure 4. Hold the force on the bushing for a few minutes until it settles in place.

CAUTION

Assemble the bushing so that the oil hole in the bushing is more than 45 degrees away from the pin hole in the diffuser section. See end view, figure 5.

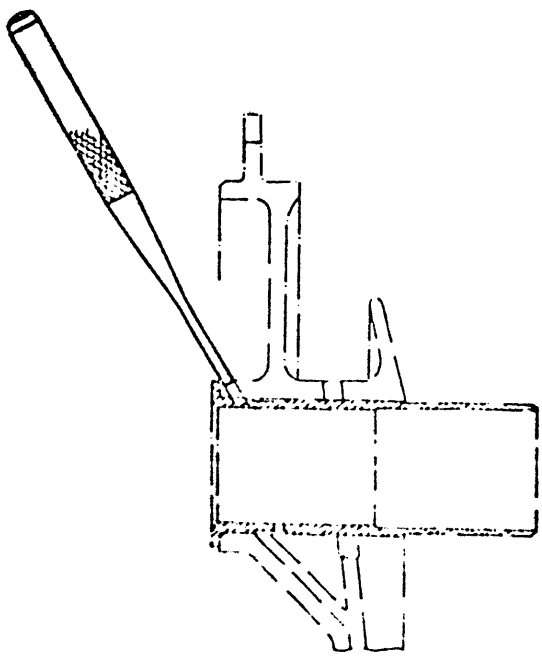

Figure 1

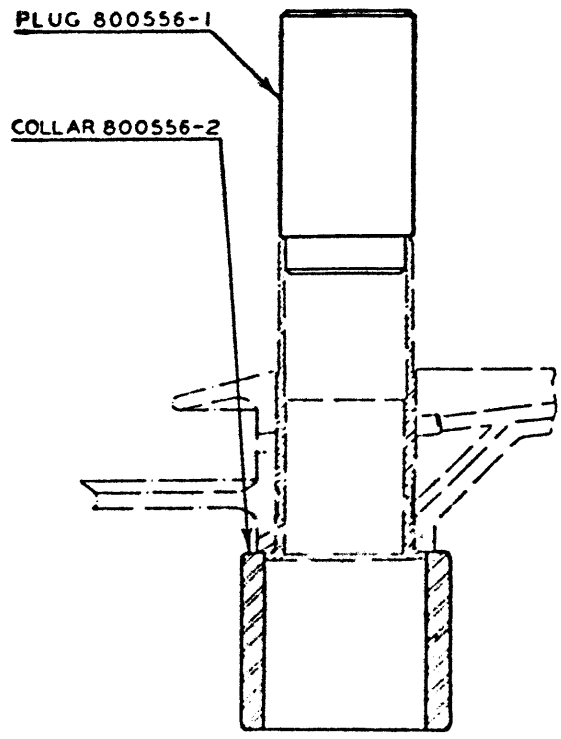

Figure 2

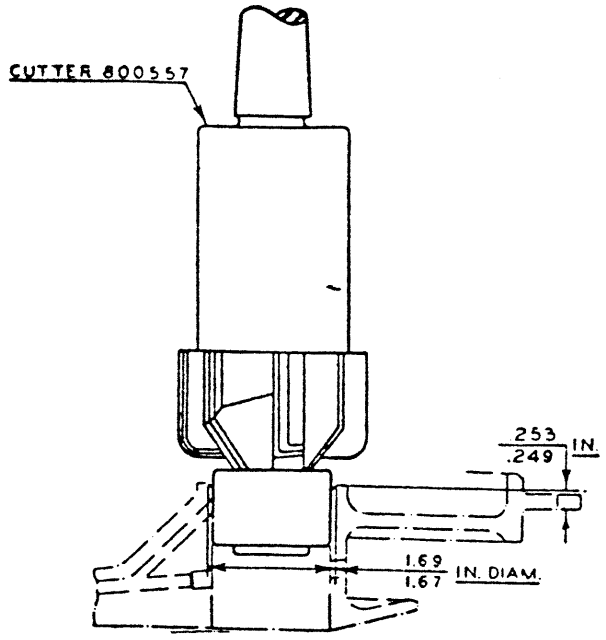

Figure 3

Check with a .0015 inch feeler gage between the bushing flange and the housing. When the bushing is properly installed, the feeler gage will not enter at any point. When the feeler gage does enter at any point, apply additional force to correct this condition.

7. Plug all oil passages or channels with beeswax or paraffin.

8. Clamp the jig, Tool No. 800558, in the bushing and set the assembly at a 45 degree angle as shown in figure 5.

9. Install the drill bushing, Tool No. 800558-2, in the jig and drill through the bushing with drill, Tool No. 800559.

10. Replace the drill bushing with the reamer bushing, Tool No. 800558-3, and ream out the hole with reamer, Tool No. 83794.

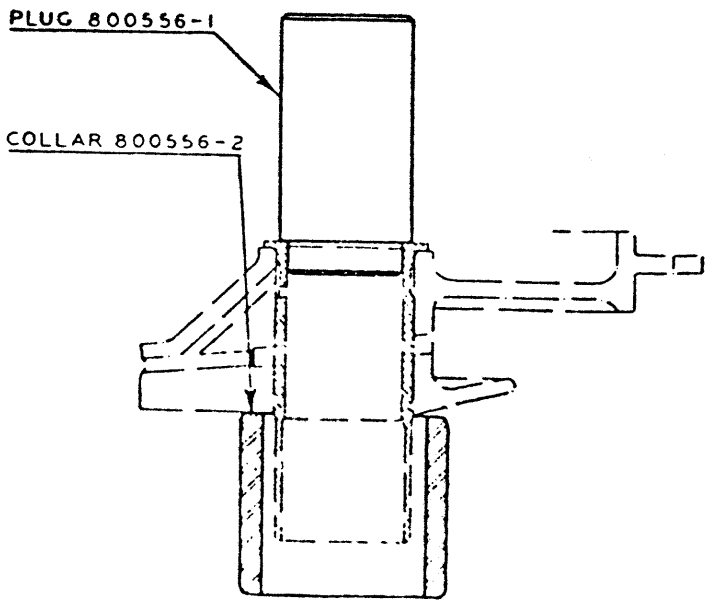

Figure 4

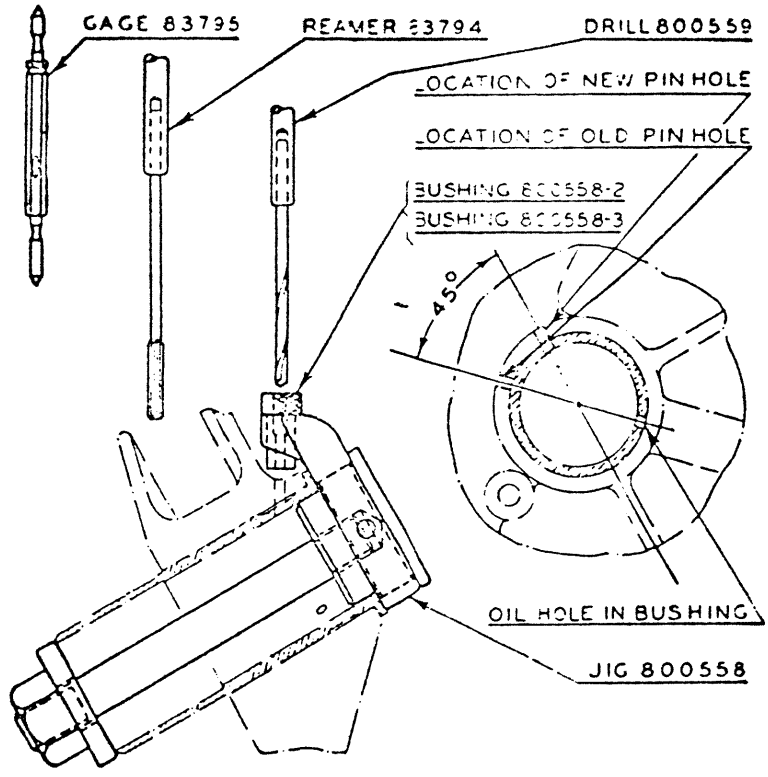

Figure 5

Check the finished hole with the plug gage, Tool No. 83795.

11. With a standard .120 inch punch, drive a new lock pin, Part No. 13D42, into the hole so that it extends to within .01 to .03 inch of the inner diameter of the bushing. Peen metal over the outer end of the pin. See figure 6.

12. Assemble the diffuser section to the crankcase rear section.

13. Insert the reamer pilot bushing, Tool No. 83043-2, in the crankcase bushing and ream out the starter shaft bushing with reamer, Tool No. 83043-1. See figure 7.

Check the inside diameter of the bushing with the plug gage, Tool No. 800579.

14. Dewax the diffuser section as described in step 5.

PARTS REQUIRED PER ENGINE

Quantity	Part No.	Name
1	111975	Starter drive gear bushing
1	13D42	Lock pin

SPECIAL TOOLS REQUIRED

Tool No.	Name
800556-2	Collar
800556-1	Plug
800557	Cutter

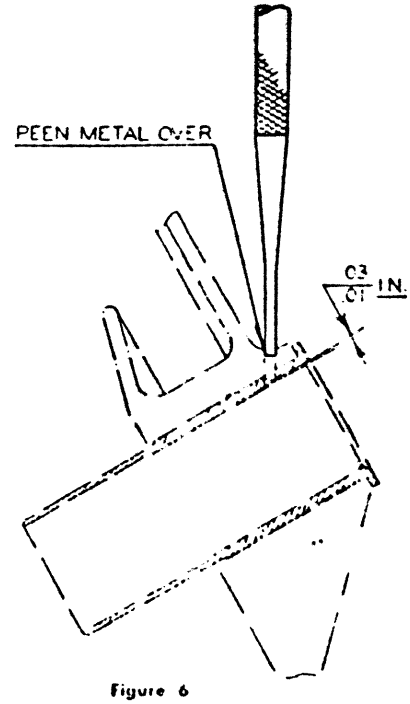

Figure 6

SPECIAL TOOLS REQUIRED

Tool No.	Name	Tool No.	Name
800558	Jig	83795	Gage
800558-2	Bushing, drill	83043-2	Bushing, Pilot reamer
800559	Drill	83043-1	Reamer
800558-3	Bushing, reamer	800579	Gage
83794	Reamer		

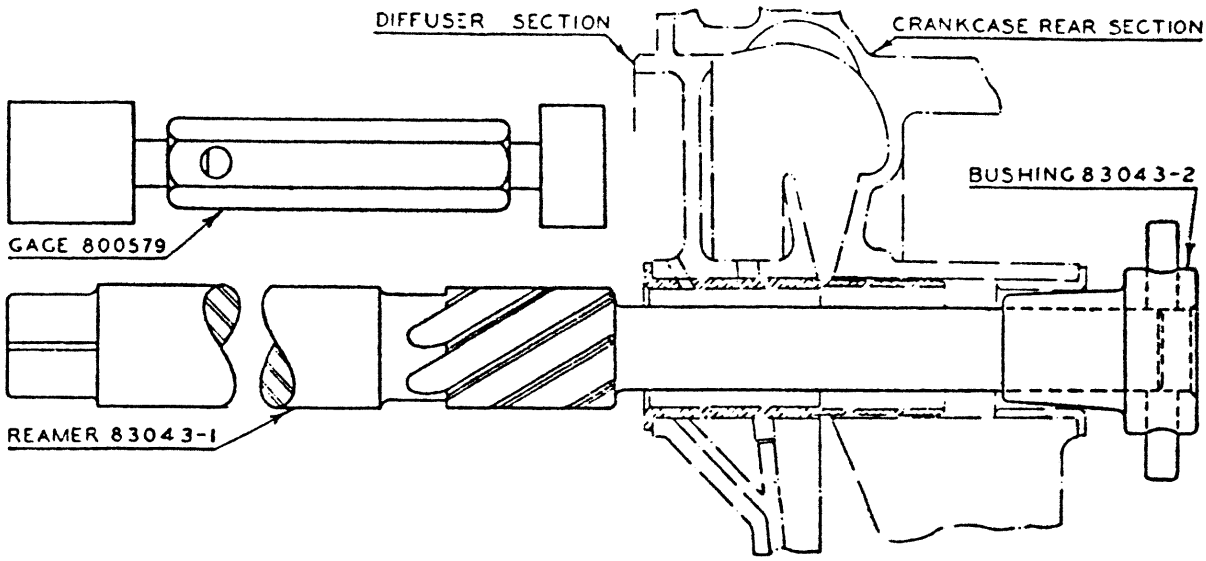

Figure 7

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: EXCESSIVE ENGINE VIBRATION—PREVENTION OF

MODELS AFFECTED: Whirlwind—All

Date: December 27, 1944

This bulletin supersedes Service Bulletin No. W-22, dated November 7, 1944 to correct the information contained therein.

Occasional cases have been found of excessive-engine vibration caused by mismatching of parts by weight while assembling after overhaul. Since there is a possibility of such occurrences, it is the purpose of this bulletin to give weight combinations which will help the customer to eliminate or correct this condition.

The first chart lists the weight combinations which will, when assembled, effect a balanced engine. For example: a crankshaft requiring a master weight of 26.70 pounds, to be assembled in an R-760 engine, must be assembled with pistons weighing 2.20-2.24 pounds each, piston pins weighing .378 pounds each, articulating rods weighing 1.74 pounds each, and a master rod weighing 7.92 pounds. This chart gives the possible variance in piston weights. The weight of a piston is stamped on the piston head.

The second chart gives the permissible variation of weights of the piston pins, the articulating rods and the master rod. The articulating rod weight represents the articulating rod assembled with bushings. The master rod weight represents the master rod with its bushing and bearing installed. These parts are not marked with their weight, but must be weighed by the operator.

CAUTION

These charts are a guide against which an assembly may be checked in order to assure balance. They must be used for that purpose only.

CHART No. 1

Crankshaft Master Weight	Engine	Piston lbs	Piston Pin lbs	Articulating Rod lbs	Master Rod lbs
26.70	R-760	2.20-2.24	.378	1.74	7.92
26.82	R-760	2.20-2.24	.378	1.74	7.92
27.33	R-760	2.42-2.46	.378	1.74	7.92
28.49	R-760	2.33-2.37	.516	1.74	7.92
28.80	R-760	2.42-2.46	.516	1.74	7.92
28.90	R-760	2.42-2.46	.516	1.74	7.92
29.64	R-760	2.38-2.42	.516	1.82	8.86
29.92	R-760	2.33-2.37	.516	1.82	8.86
30.00	R-760	2.33-2.37	.516	1.82	8.86
30.82	R-760	2.67-2.71	.516	1.82	8.86
30.87	R-760	2.67-2.71	.516	1.82	8.86
31.10	R-760	2.72-2.76	.516	1.82	8.86
32.55	R-975	2.20-2.24	.378	1.74	7.92
33.15	R-975	2.20-2.24	.516	1.74	7.92
34.24	R-975	2.33-2.37	.516	1.74	7.92
34.87	R-975	2.33-2.37	.516	1.74	8.20
35.07	R-975	2.38-2.42	.516	1.74	8.20
35.19	R-975	2.38-2.42	.516	1.74	8.20
35.32	R-975	2.38-2.42	.516	1.74	8.20
36.21	R-975	2.33-2.37	.516	1.82	8.64
36.38	R-975	2.33-2.37	.516	1.82	8.64
37.62	R-975	2.67-2.71	.516	1.82	8.64
37.90	R-975	2.72-2.76	.516	1.82	8.64

CHART No. 2

WEIGHT IN POUNDS

Part	Nominal	Minimum	Maximum
Master Rod	7.92	7.855	7.985
Master Rod	8.20	8.18	8.22
Master Rod	8.64	8.575	8.705
Master Rod	8.86	8.795	8.925
Articulating Rod	1.74	1.705	1.775
Articulating Rod	1.82	1.79	1.85
Piston Pin	.378	.371	.385
Piston Pin	.516	.506	.526

There are two possibilities for interchangeability, both of which are listed in the first chart. Any required number of the pistons mentioned below may be used interchangeably:

1. Pistons weighing 2.33-2.37 pounds used on the R-760 or R-975 engines may be used interchangeably with pistons weighing 2.38-2.42 pounds listed for use on the same model engine. The variance of weights between the pistons concerned is too small to affect the engine balance.

2. Similarly, pistons weighing 2.67-2.71 pounds are interchangeable with pistons weighing 2.72-2.76 pounds provided they are both designed for use on the same model engine.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: PROPELLER SHAFT THRUST BEARING NUT—LIMITS FOR REWORKING

Bulletin No. W-23
Page 1 of 1

MODELS AFFECTED: Whirlwinds—All

Date: November 14, 1944

During overhaul inspect the front face of the propeller shaft thrust bearing nut for possible galling. If such a condition exists, correct it by grinding sufficient material from the affected area to clean up the surface. If necessary, material may be removed from the front face of the nut to permit installation of the propeller retaining nut lock ring. In either case the maximum amount of material which may be removed is .015 inch in order that the hardened case is not completely ground off.

To prevent removal of too much material at subsequent overhauls, reworked nuts should be identified by acid- or electric-etching on the outer circumference of the nut the total amount which has been removed from the front face.

Rework all surfaces so that they are parallel, flat, square, and true as applicable within .002 inch full indicator reading.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: REPLACEMENT OF IGNITION WIRE FERRULES WITH WASHERS

MODELS AFFECTED: Whirlwind—All

Bulletin No. W-24A
Page 1 of 1
Date: January 20, 1945

This bulletin supersedes Service Bulletin No. W-24, dated November 21, 1944 in order to present additional information.

To lessen the possibility of flashover at altitude the distance between the magneto end of the ignition cables and the nearest ground has been increased by replacing the ferrules assembled at this location with a flat washer. When flashover at altitude is suspected in service engines, replace all ferrules with washers.

PROCEDURE (1) Remove sufficient insulation from the magneto end of an ignition cable to expose one-half inch of wire.

(2) Insert and draw the wire through the hole in the center of the washer. See figure 1.

(3) Fan out the ends of the wire and bend the strands back through the slots in the sides of the washer.

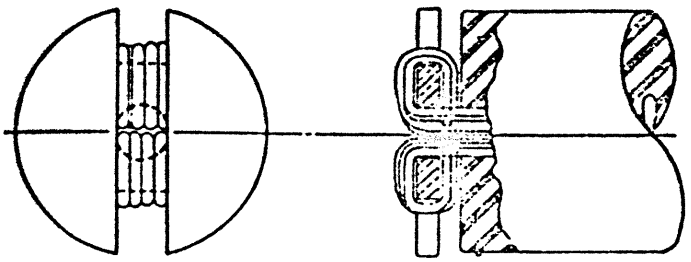
(4) Secure the strands of wire between the washer and the cable as shown in figure 1. Perform this operation with special pliers or any suitable tool.

TOOLS REQUIRED

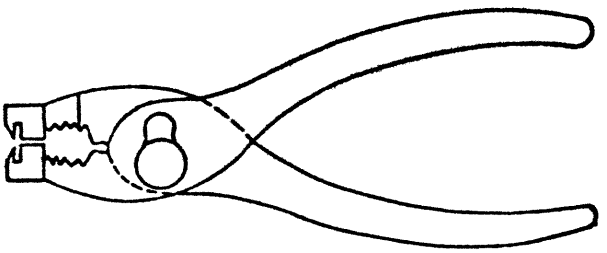
Tool No.	Tool Name
803828 or any suitable tool	Pliers (See figure 2)

PARTS REQUIRED

Quantity	Part No.	Name
As required	118995*	Washer



Cable with Washer Installed (enlarged)
Figure 1



Tool No. 803828
Figure 2

A complete set of washers each of which is stamped with the number corresponding to its magneto terminal block location, is furnished under Part No. 853990. If this is desired, one of Part No. 118995 is also required for the booster ignition lead.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: COUNTERWEIGHT STOP—REWORK TO PERMIT INSTALLATION OF LARGER COUNTERWEIGHT PINS

Bulletin No. W-25A
Page 1 of 1

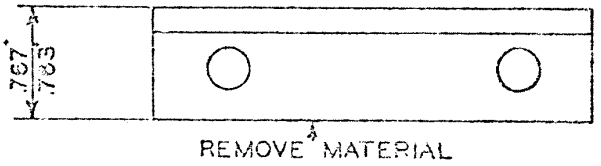
MODELS AFFECTED: Whirlwind R-975

Date: December 27, 1944

This bulletin supersedes Service Bulletin No. W-25, dated November 27, 1944 in order to incorporate additional information.

Early engines incorporated crankshafts in which the crankpin bore was concentric with the crankpin. These crankshafts use small rear counterweight pins (.874-.876 diameter). More recent models used crankshafts in which the crankpin bore was eccentric to the crankpin. These shafts require large rear counterweight pins (.889-.891 diameter). This situation requires that the operator keep a supply of both large and small counterweight pins on hand for replacement purposes. The necessity for maintaining a stock of both part numbers may be obviated if when assembling concentric crankpin bore engines during overhaul, the rear crankshaft counterweight stop, Part No. 62984, is replaced with stop, Part No. 112038. This will permit the larger pins, now required for eccentric crankpin bore engines only, to be installed on all engines.

REWORK If it is preferred, counterweight stops, Part No. 62984, provided they are otherwise satisfactory, may be reworked by removing material from the lower edge of the stop to the dimensions shown in the sketch. When performing the rework make certain that the surfaces are kept parallel, flat, square, and true to each other within .002 inch full indicator reading. After the rework is accomplished obliterate the old part number and stamp the part 112038.



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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: PREVENTION OF EXCESSIVE WEAR OF THE ACCESSORY DRIVE SHAFT SPLINES

Bulletin No. W-26
Page 1 of 1

MODELS AFFECTED Whirlwind—All

Date: November 27, 1944

This bulletin supersedes Bulletin No. 424 dated September 12, 1940.

In some cases corrosion and wear of the accessory drive splines have been experienced. This difficulty is apparently due to a lack of sufficient lubrication at this location. In order to prevent excessive wear caused by the condition, it is recommended that a soft felt plug saturated with engine oil be inserted in the bottom of the spline hole of the accessory drive shaft prior to the installation of the mating accessory.

Make the felt plug circular, of a diameter equal to the inside diameter of the accessory drive shaft bore, and thick enough so that the space remaining in the drive shaft b re after the accessory is installed will be entirely filled.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: UNAUTHORIZED CHANGES IN CARBURETOR SETTINGS

Bulletin No. W-27
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: December 6, 1944

This bulletin supersedes Service Bulletin No. 443 dated December 31, 1940, so that it may be included in the new numbering system.

The Wright Aeronautical Corporation continually conducts extensive laboratory and dynamometer tests in order to determine the carburetor settings required for the various models of Wright aircraft engines. A strict adherence to these settings will aid in obtaining optimum performance and increased service life of these engines. When experiments at the factory indicate that a change in carburetor setting is desirable, operators will be notified. Only changes recommended by the Wright Aeronautical Corporation will be considered authorized changes in carburetor settings.

The Wright Aeronautical Corporation will not be responsible for damage to an engine or for malfunctioning of an engine which may be traced to an unauthorized change of a carburetor setting.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: CLEANING OF MASTER RODS

Bulletin No. W-28
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: December 6, 1944

This bulletin supersedes Service Bulletin No. 445 dated January 27, 1941, so that it may be included in the new numbering system.

Investigation has indicated that certain types of cleaning solutions currently used for cleaning engine parts have a tendency to remove lead from the surface of copper-lead master rod bearings. For this reason it is recommended that the bore of the master rod bearing be protected from the solution while the rod is being cleaned.

PROCEDURE (1) Wipe the master rod bearing clean. Use a clean, lintless rag soaked in unleaded fuel. Do not polish, burnish, or attempt to clean bearings by any other means.

(2) Put suitable plugs in the oil holes in the bearing and install protectors, Tool No. 800924, on the master rod at the ends of the bearing. This will prevent the cleaning solution from coming in contact with the bearing.

(3) Degrease and clean the master rod thoroughly by immersing it in a bath of cleaning solution.

(4) After the rod is clean, remove it from the solution, rinse it in hot water, and then in Varsol. This is necessary to assure the complete removal of the cleaning solution.

(5) Remove the rod from the Varsol, remove the protectors and plugs, and rinse the master rod in hot water.

(6) Remove the master rod from the hot water and dry it in a suitable manner.

(7) After the rod is completely dry, coat it with a corrosion preventive conforming to Aeronautical Material Specification No. 3075.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: VALVE CLEARANCE ADJUSTING SCREW TAPERED-HEAD LOCK SCREW

Bulletin No. W-29A
Page 1 of 1

MODELS AFFECTED: Whirlwind 7 and 9

Date: January 10, 1945

This bulletin supersedes Service Bulletin No. W-29, dated December 15, 1944 to include new information.

To eliminate the possibility of overstressing or insufficiently tightening the valve clearance adjusting screw tapered-head lock screw, the following tightening procedure is recommended:

1. Adjust the valve clearance in the usual manner to the proper value.

2. Tighten the lock screw until the adjusting screw is lightly locked. Test by feel with the standard adjusting screw screwdriver.

3. Mark a convenient point of the hex head of the lock screw with a non-permanent marking and make a corresponding indexing mark on the rocker arm. See figure 1.

4. Tighten the lock screw further by rotating the lock screw 120 degrees as closely as can be approximated using the marks as a guide. See figure 2. The points of the hex are 60 degrees apart.

The correct torque and stretch of the adjusting screw lock screw will thereby be obtained.

Engines not incorporating the tapered-head lock screw may be modified to include this screw, which requires no lock washer, by performing the following rework.

PROCEDURE

Before installing the new screw, cut a taper in the screw hole in the rocker arm:

1. Install the rocker arm in a fixture, tool No. 801415.

2. Countersink the screw hole to the dimensions shown in the figure 3. For this purpose use a countersink, tool No. 801416.

3. Check the operation with a flush pin gage, tool No. 801417.

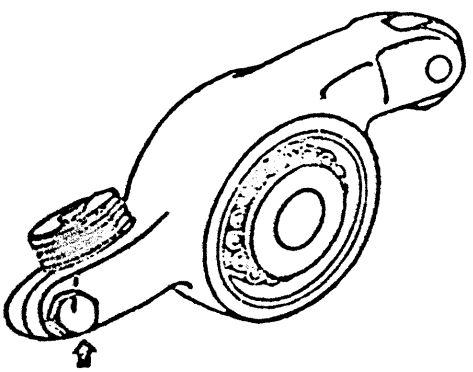

Figure 1

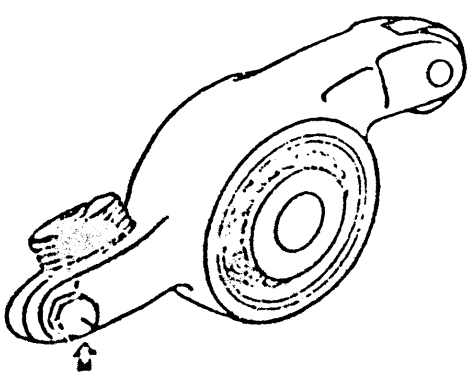

Figure 2

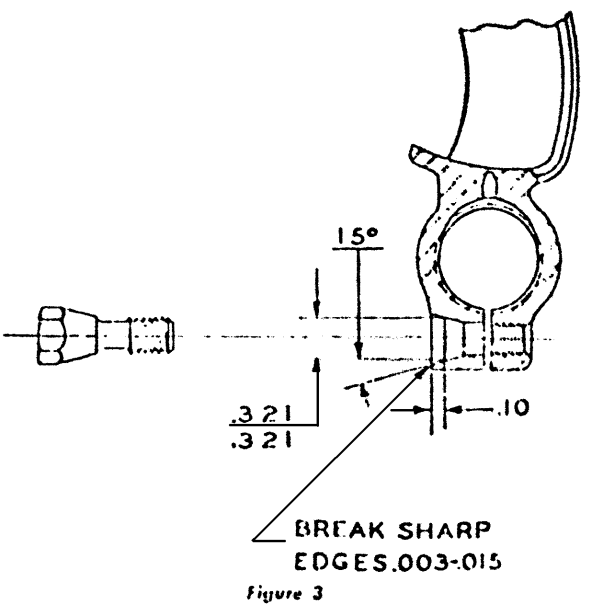

Figure 3

WRIGHT AERONAUTICAL CORPORATION
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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: PISTON RINGS AND CYLINDER BARRELS—
PRE-LUBRICATION OF

Bulletin No. W-30
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: December 27, 1944

This bulletin supersedes Service Bulletin No. 580, dated February 23, 1943 so that it may be included in the new numbering system.

It is recommended that castor oil be applied during assembly in place of engine oil as a pre-lubricant for pistons, rings, and cylinder barrels. Engine oil tends to drain away before the engine is ready for operation, leaving the rings and cylinder walls without lubrication when the engine is first started until the regular oil supply becomes available. Castor oil will adhere to the parts much more effectively. It will not be wiped away as easily by the rings when the crankshaft is turned during subsequent assembly operations, and it will not be washed away by gasoline when the engine is primed.

Before installing the cylinder, coat the side walls of the piston assembly, particularly the rings and lands, and also the lower 3 or 4 inches of the cylinder barrel. Avoid the use of too much oil as any surplus draining into the combustion chamber may cause fouling of the spark plugs.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: PROTECTION OF CYLINDER IDENTIFICATION NUMBERS

Bulletin No. W-31
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: December 30, 1944

This bulletin supersedes Service Bulletin No. 523, dated April 10, 1942 so that it may be included in the new numbering system.

Cylinders on which the identification number has become obliterated have occasionally been received at the factory for reconditioning. It is apparent that these numbers, which are stamped on a pad on the intake rocker box, were effaced when sand blasting the cylinder head.

It is recommended that this pad be protected by a covering of several thicknesses of masking tape or similar material during sand blasting operations.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: INSPECTION OF PISTON PINS

Bulletin No. W-32
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: December 30, 1944

This bulletin supersedes Service Bulletin No. 515, dated March 17, 1942 so that it may be included in the new numbering system.

Cracks in the inner surface of a piston pin may result in progressive fatigue failure of the part if it is installed in an engine.

During overhaul, after the outer surface of a pin has been magnetically inspected, it is recommended that the pin be redipped and that the inner surface be carefully inspected. Use a dental mirror for this inspection.

If the inspection indicates a questionable surface condition, remove the pin from service and if practicable, return it to the Wright Aeronautical Corporation, Paterson, New Jersey, for further inspection.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: ORDERING OF TOOLS

Bulletin No. W-34
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: December 30, 1944

This bulletin supersedes Service Bulletin No. 532, dated June 17, 1942 so that it may be included in the new numbering system.

Tool orders are occasionally received which list detail tool numbers. A tool consisting of several individual parts should be requested as a unit without reference to detail numbers.

To cite an example, an overhaul manual or service bulletin may describe a rework operation requiring the use of Tools No. 800000-1, 800000-2, 800000-3, and 800000-4. When these tools are requested, the order should list only Tool No. 800000. Parts of a tool, such as Tool No. 800000-2, will not be furnished separately.

Publications incorporate these detail numbers in rework instructions solely to aid in the complete description of each of the several steps of an operation.

In some cases reference is made to a set of tools comprising details having different basic tool numbers, that is, the details are not identified by dash numbers. The tool number of the set of tools is given for ordering purposes, and the tool numbers comprising the set are listed. These tools may be ordered separately since some of them may already be in the possession of the operator.

Because of the present demands on the tool industry, some delay may be experienced in procuring rework tools. However, the necessary drawings for fabricating tools, except for vendors' proprietary items, may be procured from the Wright Aeronautical Corporation in cases of emergency.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: ELASTIC STOP NUTS

Bulletin No. W-35A
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: March 7, 1945

This bulletin supersedes Service Bulletin No. W-35, dated January 18, 1945, in order to present additional information.

When using Elastic Stop Nuts, observance of the following recommendations is required:

1. Wright Aeronautical Corporation 2087D and 4040D series Elastic Stop Nuts are the only type that have been approved for use by Wright Aeronautical Corporation.

2. One full thread of the bolt, stud, or cap screw must protrude beyond the end of the fiber insert to insure proper locking. When this can not be accomplished either a thinner washer or some other type of nut must be used.

3. After repeated use, Elastic Stop Nuts tend to lose their locking effectiveness. Nuts which thread on the bolt so easily as to indicate that the self-locking feature is less than full strength must be replaced with satisfactory nuts. Re-use of an Elastic Stop Nut should be governed by the minimum torque required to turn the nut on a bolt, stud, or cap screw before it takes up its normal tightening action. This minimum torque for determining the gripping power of the fiber inserts is tabulated below for fine thread nuts:

Size	*Torque In. Lbs. Minimum*
10–32	0.95
1/4–28	1.8
5/16–24	3.2
3/8–24	5.2
7/16–20	7.4
1/2–20	10.3
9/16–18	13.5
5/8–18	18.0
3/4–16	27.5

4. Elastic Stop Nuts are subject to the following limitations of usage.

They will not be used:

a. On internal engine parts, or where nuts could enter the engine if they became loose.

b. On loose studs, such as fuel pump and tachometer housing attaching studs.

c. On cylinder hold-down studs.

d. When the maximum operating temperature of the stud is over 121°C (250°F).

e. When the threads of the stud are in such condition that tearing of the fiber insert may result. The presence of drilled locking holes in the stud does not prevent the use of Elastic Stop Nuts unless their fiber inserts might be damaged by burrs or rough edges around the locking holes. This condition can be corrected by polishing or filing as necessary.

5. The tightening torque values given for conventional nuts are applicable to Elastic Stop Nuts.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: IGNITION MANIFOLD DRAIN HOLES—PROVISION OF

Bulletin No. W-36
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

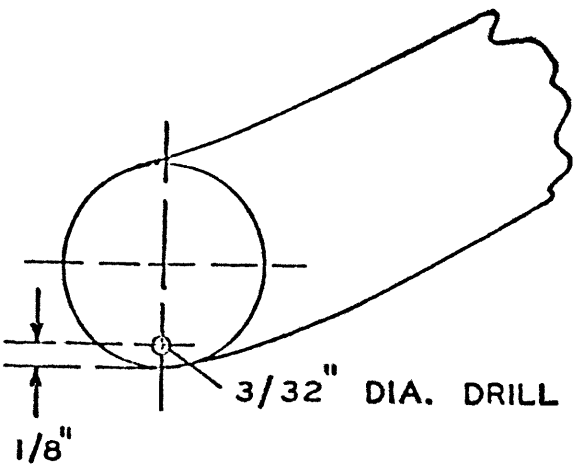
Date: February 2, 1945

This bulletin supersedes Service Bulletin No. 525 dated April 30, 1942, to correct the information contained therein.

On engines of recent production, ignition manifolds which are neither pressurized nor plastic filled are provided with a 3/32 inch drain hole in each end plate. This hole is located 1/8 inch from the bottom of the plate on its vertical center line and provides drainage for moisture resulting from condensation. To avoid possible moisture damage to the wiring, it is recommended that all ignition manifolds which are not plastic filled or pressurized be provided with similar drain holes.

PROCEDURE Center punch the end plate at the drain hole location, see sketch. Install a stop collar about 1/8 inch from the tip of a No. 42 drill and drill through the end plate at the point marked by the center punch. The stop collar, installed on the drill, prevents the drill from extending too far into the manifold and causing damage to the wires. When drilling, hold the drill at a 90 degree angle to the end plate. Drill the opposite end plate in a similar manner.

This rework can be performed at any time whether the harness is on or off the engine. If the harness is on the engine, use either a spanner or a strap wrench to loosen the ignition manifold coupling nut. Loosen the brackets which secure one section of the manifold ring to the engine. The end of this section can then be swung out so that the drill can be held at the required 90 degree angle. After performing the rework on this section of the manifold ring, tighten the brackets which secure it to the engine. Repeat this procedure in reworking the other manifold end plate. Secure the manifold coupling nut by drawing it up as tightly as possible without deforming the manifold ring. Tighten the screws holding the manifold brackets to the crankcase front section using the torque value shown in the Table of Limits.



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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: CLEANING OF ENGINE PARTS

MODELS AFFECTED: Whirlwind—All

Date: February 16, 1945

This bulletin supersedes Service Bulletin No. 437, dated November 26, 1940, to correct and add to the information contained therein.

CLASSIFICATION OF METHODS

Cleaning methods may be classified under two general headings—chemical cleaning, and mechanical cleaning. Chemical cleaning depends upon various emulsification, reaction, or dissolution principles while mechanical cleaning includes all operations that accomplish the physical removal of foreign matter through the use of abrasives, brushes, or cutting tools. Usually a combination of both methods will be necessary to clean a given part satisfactorily.

CHEMICAL CLEANING

Chemical cleaning, preceding mechanical cleaning, is employed to wash away oil and grease, and to remove or soften hard deposits of foreign material.

Primary Washing—Primary washing should be accomplished with Varsol, or a similar solvent conforming to Aeronautical Material Specification No. 3160, in a ventilated spray booth equipped with a pressure gun. In many cases it is possible to use Varsol salvaged from more critical cleaning operations further along the overhaul sequence.

1. If the engine is exceptionally dirty, wash the exterior before overhaul disassembly.

2. After disassembly, wash the individual parts to prevent unnecessary contamination and weakening of the degreasing and carbon softening compounds used in subsequent cleaning operations.

Vapor Degreasers—Vapor degreasers utilize the condensation principle. Vapors, rising from a tank of trichloroethylene heated to 86°C (188°F), condense on the cooler engine parts suspended over the tank and provide an effective degreasing and paint stripping action. This action ceases when the parts reach the temperature of the vapors. A special tank, designed for trichloroethylene degreasing, is necessary and adequate shop ventilation must be provided to protect personnel. Trichloroethylene is not effective on dirt or carbon but is a very satisfactory agent for removing preservative compounds.

1. Suspend the parts over the tank until they are degreased or until the parts reach the temperature of the vapors and the degreasing action ceases.

2. If further degreasing action is needed, cool the parts and again suspend them in the degreaser.

3. Allow the parts to drain thoroughly before removing them from the unit.

General Cleaning and Carbon Softening—Commercial cleaning agents such as Gunk 70 or Gerlach 77, have been found satisfactory when used in a tank heated to 60°C (140°F) with steam coils. Lower temperatures prolong the cleaning period, while higher temperatures result in uneconomical evaporation.

1. Immerse steel parts in the cleaning tank for two to three hours.

2. Limit the immersion period of aluminum or magnesium parts to 20 to 30 minutes.

3. Immerse all parts completely to prevent slight lines of corrosion at the point where parts project above the surface of the cleaning fluid.

MECHANICAL CLEANING

Mechanical cleaning, following the degreasing and carbon softening procedures, has a twofold purpose. First, it removes carbon deposits and discolorations that did not respond to chemical cleaning. Second, the surfaces of the parts are restored to their original clean and polished condition. Whatever the means of mechanical cleaning used, wash away all traces of dirt and cleaning materials with a Varsol spray or rinse before the parts are assembled.

Gritblasting—During gritblasting operation, adequate protection must be provided for running or mating surfaces such as piston skirts, cylinder barrel interiors, valve stems, and rocker box cover pads. Studs and threaded areas should never be gritblasted.

1. Use only enough air pressure to clean the parts satisfactorily.

2. Gritblast cylinder heads, piston interior surfaces, and valve heads with Alundum 80-90 grit.

Grain Blasting—Blasting with cracked wheat offers an alternate method for cleaning piston ring grooves. If dampness prevents satisfactory blasting, it is recommended that a small steam coil be installed within the wheat hopper.

Machine Cleaning—This type of cleaning is used only for piston ring grooves and must be performed with utmost care. The tool must be accurately shaped and so handled as to avoid any gouging or damage

to the ring lands, the grooves, or the slight radius at the bottom of the groove.

1. Chuck the piston in a lathe.

2. Use a well supported tool to remove all carbon accumulations from the ring grooves. Do not remove any metal.

Wire Brush Cleaning—Brush wheels should be used for polishing and to remove engine varnish or carbon from parts that cannot be grit-blasted.

1. Protect cylinder barrel or other running surfaces from contact with wire brushes.

2. Use a special narrow wire brush to remove carbon from the inner groove of the cylinder barrel to cylinder head joint.

3. Never use a wire brush in such a manner as to leave marks on the surface of the part.

4. Use a ten inch Tampico fiber brush wheel in conjunction with 3M polishing compound for general polishing.

Polishing—Use crocus cloth and Varsol for fine polishing.

Cloth Wiping—This is the only cleaning recommended for master rod bearings which must be protected with plugs or covers to prevent damage from chemical or mechanical cleaning agents.

1. Wipe the bearing gently with a clean soft cloth and Varsol.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: CARBURETOR MANUFACTURERS' BULLETINS

Bulletin No. W-38
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: February 23, 1945

This bulletin supersedes Service Bulletin No. 569, dated December 30, 1942 so that it may be included in the new numbering system.

It is recommended that Service Bulletins and instructions of the various carburetor manufacturers be followed as closely as possible in the servicing of their respective products. These bulletins are issued in coordination with the Wright Aeronautical Corporation and bear Wright approval before they are released.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: PISTONS—STAMPING FOR IDENTIFICATION

Bulletin No. W-39
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: February 26, 1945

This bulletin supersedes Service Bulletin No. 561, dated December 2, 1942, so that it may be included in the new numbering system.

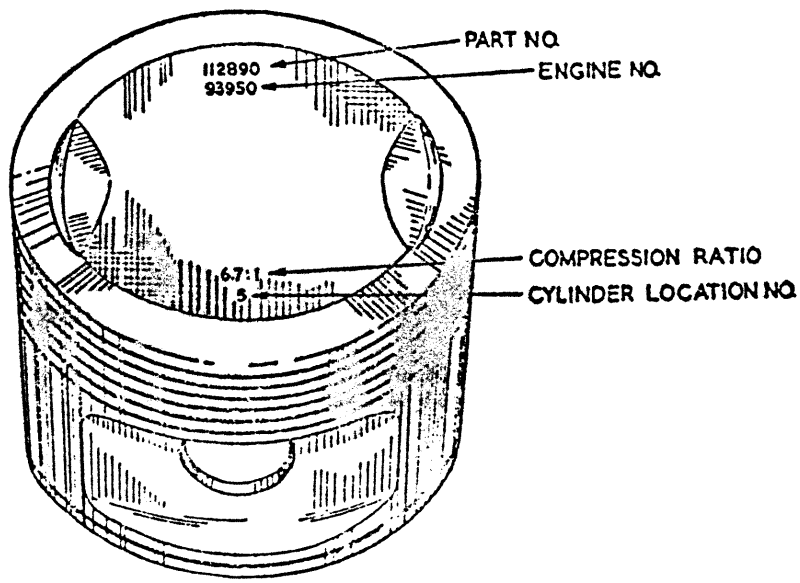
GENERAL

Part numbers, engine numbers, and cylinder location numbers stamped on piston domes may become illegible after repeated cleaning of pistons which have been in service for more than one overhaul period. Unnecessary stamping must be avoided, but data which is required should be restamped in accordance with instructions given herein. When it is necessary, the compression ratio may be stamped on the piston dome as shown in the sketch. The weight of a piston is no longer stamped on the piston dome although this was a practice prior to 1939.

PROCEDURE

Locate the numbers about 1/2 inch from the outer edge of the piston, midway between the valve recesses. Use a metal stamp with 1/8 inch numbers. Impress the numbers on the dome just deep enough to be legible. Stamp the data facing the front of the piston, in the order shown in the sketch included in this bulletin. Do not stamp identification numbers on either of the piston pin bosses or in the center of the piston dome.

Clean piston domes carefully so that a minimum of restamping is necessary.



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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: VALVE GUIDES—CHANGES IN INSTALLATION OF

MODELS AFFECTED: Whirlwind—All

Date: March 5, 1945

It is the purpose of this bulletin to revise the temperature to which a cylinder is heated when installing valve guides, and to establish new limits for checking the seating of valve seat inserts.

Valve guides will be removed and installed in accordance with existing instructions except that cylinders will be heated in an oven or with a torch to 232° to 260°C (450° to 500°F) for the installation operation. When using a torch, keep rotating the cylinder while applying the heat and keep a constant temperature check with a pyrometer fastened to either of the top spring seats. When the pyrometer registers a temperature approaching that required, direct the flame through the valve port and rocker box to apply localized heat to the guide boss.

Immediately after installing a new valve guide, check the seating of the intake and exhaust valve seat inserts. A seat insert that has dropped to the maximum allowed will permit a .002 inch feeler gage to fit snugly at any one location. A seat insert that has dropped to .015 inch must be tapped into place after the cylinder is heated to 260°C (500°F). If the insert has dropped more than .015 inch, install a new insert in accordance with existing instruction.

When a new valve seat insert is to be installed, heat the cylinder for 60 minutes in a 316°C (600° F) oven.

When it is necessary to install both a valve guide and a valve seat insert, heat the cylinder for 60 minutes in a 316°C (600°F) oven.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: TESTING OF SPARK PLUGS

Bulletin No. W-41
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: March 7, 1945

This bulletin supersedes Service Bulletin No. 384, dated September 22, 1939, so that it may be included in the new numbering system.

Booster magnetos or spark coils should not be used for the bomb testing, core testing, or other electrical testing of mica insulated spark plugs. Booster magnetos will not provide sufficient voltage for continuous sparking at the pressures desired for bomb testing. Spark coils will not give a reliable indication of spark plug condition, and may cause damage to the mica insulation.

It is recommended that an aircraft magneto that is in good condition be used for testing spark plugs. The magneto should be driven at a speed which will provide approximately 1,000 sparks per minute.

When a magneto is used for testing, all magneto distributor block terminal leads not in use for the test should be connected to one spark gap. This will discharge the potential built up in these leads and will eliminate the possibility of damage to the magneto.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: VALVE TAPPET AND GUIDE—RECONDITIONING AND INSPECTION OF

Bulletin No. W-42
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: March 24, 1945

This bulletin supersedes Service Bulletin No. 520, dated May 26, 1943, so that it may be included in the new numbering system.

During inspection and reconditioning of valve tappets and guides, care should be used to avoid conditions that may result in seizure between the two parts.

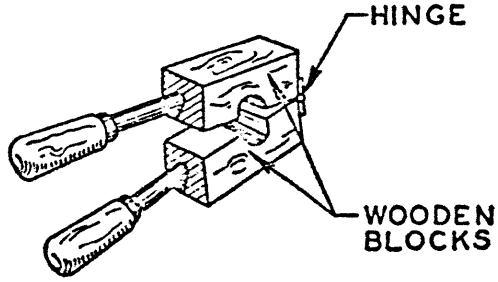
Inspect the tappets and guides for cracks and for scoring on the mating surfaces. Scored or scratched parts that cannot be cleaned up by light polishing, should be scrapped. Aloxite No. 320 polishing cloth and H41 fine finishing compound, or their equivalents, are recommended as suitable polishing material. These materials may be obtained from the Carborundum Corporation, Niagara Falls, New York.

A draw bar or similar device for holding the tappet in a lathe is recommended for polishing the tappets. Make a hand polishing tool similar to that shown in figure 1. Line this cylindrical inner surface of the tool with polishing cloth and clamp the tool around the tappets as it is rotated in the lathe. The inside diameter of tappet guides may be polished by mounting a suitable plug in a lathe chuck. Provide a slot in the plug in which to anchor the polishing cloth. After polishing insure that all sharp edges around the roller slot of both tappet and guide are broken.

Do not stone either the tappet or guide to remove scratches or scores. Small flats or irregularities thus formed may cause a seizure of the tappet in the guide.

The outside diameter of the tappet and the inside diameter of the tappet guide should be measured with a telescope gage and a micrometer caliper. When taking these measurements on the tappets check the outside diameter at three different locations rotating the part 90 degrees. Record these measurements. A tappet which is found to be .0005 out-of-round must be replaced.

Consult the Table of Limits for the proper operating clearances for these parts.



TAPPET
POLISHING TOOL

Figure 2

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: INTAKE VALVES—INSPECTION OF

MODELS AFFECTED: Whirlwind—All

Date: April 13, 1945

This bulletin supersedes Service Bulletin No. 381, dated October 6, 1939, so that it may be included in the new numbering system.

It is recommended that all intake valves be given a magnetic type inspection before they are installed in an engine. Perform this operation as instructed by the equipment manufacturer.

Recheck the valve for minute cracks. Carefully examine the entire surface. Use a binocular microscope at ten diameters for this purpose. If cracks, no matter how small, are present discard the valve.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: CARBURETOR FLOW BENCH LIMIT—DEVIATION IN

MODELS AFFECTED: Whirlwind—All

Date: April 30, 1945

GENERAL

Current flow bench limits on all carburetors allow a two percent plus or minus variation. This tolerance is used by the carburetor manufacturer and Wright Aeronautical Corporation in air box testing all carburetors. This close limit is desirable and in most instances can be maintained, but because of deviations occasionally encountered in the field by overhaul shops and repair stations this bulletin is issued to present a comprehensive explanation.

It is occasionally discovered that overhaul and repair depots which are doing an entirely satisfactory job of overhauling, repairing, and flow testing are not able to get all carburetors to stay within the plus or minus two percent flow bench limits at all points. Other cases have been reported from time to time in which an operator will flow bench test a new or repaired carburetor just received from the carburetor manufacturer or WAC, where it had been air box tested. The flow bench calibration of such a carburetor is not always found to be entirely within the established limits, which may cause the operator to wonder about the validity of the air box test.

REASONS FOR DEVIATION

The discrepancy lies in the fact that the original calibration of the carburetor was not necessarily in the middle of the allowable limits. The flows may have been on the rich side at some points and on the lean side at others. When an attempt is made to hold the carburetor strictly within limits on a flow bench run, the cumulative correlation errors introduced by minor differences between the air box and the flow bench enter the picture and make it impossible to maintain the desired limits of accuracy. This may occur even if all equipment is in the proper mechanical condition and all work has been properly performed. These errors may be brought about by differences in the flow meter calibration, in the gasoline used and/or differences in the adjustment of the carburetor.

The above factors make it possible for a properly calibrated carburetor to show slight deviations when run on a flow bench although such occurrences are not frequent.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: VALVE TAPPET GUIDE AND ROLLERS—
IDENTIFICATION AND MATCHING OF

MODELS AFFECTED: Whirlwind—All

Date: April 10, 1945

This bulletin supersedes Service Bulletin No. 538 dated July 24, 1942, in order to bring the information given therein up to date.

GENERAL

When valve tappets, guides, and rollers are assembled, every precaution should be taken to insure that they are properly mated and installed in the correct model engine. Failure to assemble and install these parts correctly may result in an engine failure caused by insufficient lubrication for the valve operating mechanism.

A reference list of parts is included in this bulletin which will help to identify the correct parts for any given engine.

Engine Model	SUBJECT PART: Tappet Part No.	SUBJECT PART: Guide Part No.	SUBJECT PART: Roller Part No.	Used In Cylinder No.	MAY BE USED WITH: Tappet Part No.	MAY BE USED WITH: Guide Part No.	MAY BE USED WITH: Roller Part No.	Identification of Subject Part
R760E R975E	66950			Int. and Exh. 1, 2, 3, 8, 9		66044	116447	3.66 inches long, 1-.093 inch hole 1.04 inch from top.
				Int. and Exh. 4, 5, 6, 7		29297		
	41770*			All		29297	116447	Ball socket integral with tappet 3.97 inches long.
		66044		Int. and Exh. 1, 2, 3, 8, 9	66950		116447	3.54 inches long, 2-.125 inch holes .484 inch from outside flange
		29297*		Int. and Exh. 4, 5, 6, 7	66950		116447	3.53 inches long. No oil holes Inside diameter .6873-.6883 inch (.6873-.6878 inch after shrinking into crankcase)
		29297*		All	41770*		116447	3.53 inches long. No oil holes Inside diameter .6873-.6883 inch (.6873-.6878 inch after shrinking into crankcase)
			116447	All	66950 41770*	66044 29297*		1.25 inch outside diameter .377 inch inside diameter .236 inch width.

* Used on engines with external rocker arm lubrication.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: PROCEDURE IN DETERMINING THE ACCEPTABILITY OF NEWLY DEVELOPED AND IMPROVED OILS

Bulletin No. W-46A
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: July 10, 1945

This bulletin supersedes Service Bulletin No. W-46 dated April 30, 1945, to correct and add to the information contained therein.

The procedure outlined below is currently being followed in determining the acceptability of new or improved oils which do not conform to Specification No. AN-VV-O-446a and the latest edition of Wright Aeronautical Specification No. 5815. Lubricating oils which meet the requirements of Specification No. AN-VV-O-446a and the latest edition of Wright Aeronautical Specification No. 5815 are now considered acceptable for use in all Wright engines without preliminary acceptance tests. This change in procedure is a departure from the full scale engine testing of oils which was previously carried on at Wright Aeronautical Corporation. An outline of the acceptance procedure follows:

1. An oil company developing a new or improved oil must make application for the Civil Aeronautics Administration to determine the air-worthiness of an oil and arrange with Civil Aeronautics Administration for the flight test.

2. The Civil Aeronautics Administration will notify the manager of the Technical Data Division of Wright Aeronautical Corporation that the oil is considered air-worthy.

3. The refiner is to notify Wright Aeronautical Corporation of plans for flight service tests. Flight tests must be conducted in at least two engines operating for a period not less than the minimum period of operation between overhauls currently approved by the Civil Aeronautics Administration. Flight tests on any aircraft engines of comparable power will be considered as a satisfactory basis for acceptance or non-acceptance of the oil.

4. During the period of the service test, the refiner should supply Wright Aeronautical Corporation data relative to the progress of the test and submit used oil analyses obtained during the period of the subject test.

5. Upon completion of the test, a Wright Aeronautical Corporation representative will participate in an inspection of the engine in cooperation with representatives of the refiner, airline, and the Civil Aeronautics Administration. Based upon the results of this inspection and upon the review of the data submitted on the oil, a letter of acceptability or non-acceptability will be forwarded to the oil company by Wright Aeronautical Corporation.

6. In the future, no list of approved or acceptable oils will be published. Since the oils which appeared on the previously published approved list have already demonstrated their acceptability, they will be considered acceptable. However, the Wright Aeronautical Corporation assumes no obligation for any brand of oil which may be considered acceptable.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: ASSEMBLIES, SERVICE—SALVAGING OF

MODELS AFFECTED: Whirlwind—All

Date: May 5, 1945

It is occasionally necessary to make detailed part substitutions in assemblies which have been sent back to Wright Aeronautical Corporation for repair. These substitutions are made on assemblies which have been superseded and are out of production resulting in unavailability of parts required in the assembly. Such substitution results in salvaging many useful assemblies which otherwise would have to be scrapped.

Whenever substitutions are considered, odd detail parts are studied carefully in view of the requirements of the assembly. The detail chosen must be satisfactory in every respect.

Before an assembly containing an odd detail part leaves the factory, it is stamped with an assembly number which was compiled to facilitate recording of the rework done on the assembly. The original assembly number is always used. Incorporated with it are a letter signifying a rework on the assembly and additional numbers referring to the authorization of the substitution. The customer, at any time subsequent to the change in an assembly, must use this newly stamped assembly number whenever referring to the assembly, since it will be through this number that the manufacturer can tell its exact status.

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S E R V I C E B U L L E T I N

WRIGHT AERONAUTICAL CORPORATION

TITLE: PREPARATION OF ENGINES FOR OPERATION AFTER STORAGE

Bulletin No. W-48
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: May 17, 1945

This bulletin supersedes Service Bulletin No. 572 dated September 24, 1943, so that it may be included in the new numbering system.

All engines which have been slushed for storage or shipment must be prepared for service as described in this bulletin. The removal of the corrosion preventive must be delayed until it is certain that the engine is to be immediately operated. The entire aircraft oil system should be thoroughly cleaned before the engine is installed. Engines stored or shipped in shipping boxes must be removed from the pliofilm envelope, lifted from the box, and installed in the aircraft. Engines stored or shipped in an aircraft must have the engine cover removed.

Current preparations for storage employ adequate lubricants as corrosion preventives, Aeronautical Material Specifications No. 3070 and 3072. These compounds may be sufficiently removed from the engine by draining.

PROCEDURE

Lubricating Compound

Treat engines which have been slushed with compounds conforming to Aeronautical Material Specifications No. 3070 and 3072 in the following manner:

1. Remove all the dehydrator plugs and bags from in and around the cylinders and the sump.
2. Install the spark plugs.
3. Remove all the moisture resistant seals from the exhaust ports and the vents.
4. Remove, clean, inspect, and reinstall the oil filter and the magnetic sump plug.
5. Reinstall all engine parts which have been removed.
6. Before installing, treat the accessories as recommended by their manufacturers.
7. Pre-oil and start the engine in accordance with current instructions.
8. Operate the engine for 15 minutes at 1000 to 1200 rpm. Remove and inspect the oil filter and the magnetic sump plug for foreign material. Drain the oil from the sump and reinstall the oil filter and the magnetic sump plug. Then add enough fresh oil to replenish the oil supply before further operation.

Non-Lubricating Compound

Former instructions for preparation for storage recommended the use of non-lubricating compounds, Wright Aeronautical Corporation Specifications No. 5840 and 5841, which have a tendency to congeal when cool. Treat engines which have been slushed with these compounds in the following manner:

1. Remove by scraping as much corrosion preventive as possible. Pay particular attention to the removal of the compound from the combustion chambers and intake pipes.
2. Flush all passages with hot oil.
3. After all the non-lubricating compound has been removed, pre-oil and start the engine in accordance with current instructions.
4. Run the engine for 15 minutes at 1000 to 1200 rpm and drain the oil from the entire system.
5. Inspect and reinstall the oil filter and magnetic sump plug.
6. Refill the system with new oil before further operation.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: INSTALLATION OF MISCELLANEOUS CLIPS AND BRACKETS UNDER CYLINDER HOLD-DOWN NUTS—AVOIDANCE OF

MODELS AFFECTED: Whirlwind—All

Date: June 1, 1945

This bulletin supersedes Service Bulletin No. 441, dated April 30, 1940, in order that it may be included in the new numbering system.

It has been the practice of some aircraft manufacturers in some instances in the past to install clips, clamps, supports and other miscellaneous parts under cylinder hold-down nuts.

This practice should be discontinued. The only parts that can with safety be installed under cylinder hold-down nuts are those provided with the engine.

Proper tightening of cylinder hold-down nuts is of the utmost importance. The Wright Aeronautical Corporation has established limits of torque to be used when tightening these parts. The use of extraneous attaching parts under cylinder hold-down nuts may change the normal nut seating condition to such an extent that, although the specified torque be observed with the torque wrench when tightening these parts, actually an abnormal tightening condition may be obtained. Loosening or improper pre-stressing of nuts or uneven loading on the cylinder flange may result from this condition.

The Wright Aeronautical Corporation will not be responsible for failure of an engine or of engine parts as a result of the attaching of extraneous parts under cylinder hold-down nuts other than those provided with the engine.

It is suggested that the following alternate attaching points be employed for parts which may have previously been attached under cylinder hold-down nuts. Approved points of attachment for such parts as propeller de-icing fluid line support clips and propeller governor control line support brackets are crankcase front section attaching studs, and supercharger rear housing attaching studs.

Should some problem arise in connection with the installation of these parts and the operator is unable to find a solution, the Service Division of the Wright Aeronautical Corporation will analyze the problem and suggest a solution for that specific installation upon request.

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S E R V I C E B U L L E T I N

WRIGHT AERONAUTICAL CORPORATION

TITLE: STARTER SHAFT OIL SEAL AND RETAINER—
REPLACEMENT OF

Bulletin No. W-50
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: June 8, 1945

This bulletin supersedes Service Bulletin No. 502 dated January 28, 1942, so that it may be included in the new numbering system.

GENERAL

A new duprene oil seal, part No. 2083D30, has been designed to replace the cork seal, part No. 23480, which, in a few instances, has caused leakage of oil into the diffuser section. This leakage was the result of a permanent set taken by the cork after a few hours of engine operation.

At next overhaul, install the new oil seal, part No. 2083D30. This cannot be done, however, without replacing the retainer, part No. 23484, with part No. 114732. If it is desired, part No. 23484 may be reworked to the dimensions of part No. 114732 and installed satisfactorily with the new oil seal.

REWORK:

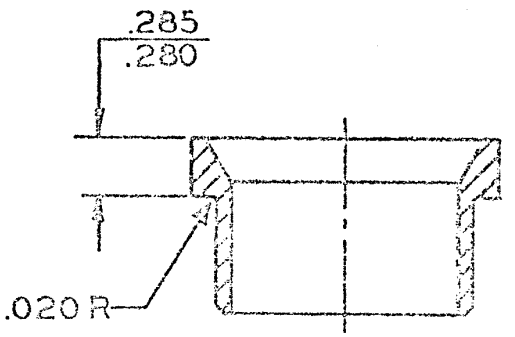
Shorten the flange of part No. 23484 to the dimensions given. See figure 1.

1. Chuck the flange in a lathe.

2. Check run-out with dial indicator. A maximum of .010 inch is permissible.

3. Remove the necessary amount of material from the flange face and maintain the radius specified.

4. Break all sharp edges, and give the part a careful visual inspection when finished.



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S E R V I C E B U L L E T I N

WRIGHT AERONAUTICAL CORPORATION

TITLE: OIL SEAL, CRANKSHAFT, 8-RING TYPE—
INSTALLATION OF

Bulletin No. W-51
Page 1 of 1

MODELS AFFECTED: Whirlwind R760E and R975E Series Engines which employ 2-Position Hydro-Controllable Pitch Propeller Operating Parts in Governor Drive Type Crankcase Front Section

Date: June 15, 1945

This bulletin supersedes Service Bulletin No. 407, dated May 14, 1940, so that it may be included in the new numbering system.

GENERAL

Some of the above models of Whirlwind engines employing 2-position hydro-controllable pitch propeller operating parts in a propeller governor drive type crankcase front section were originally provided with a crankshaft oil seal having seven rings. One ring of this seal partially obstructs one set of oil distributing holes in the crankcase front section sleeve. In engines where trouble caused by this condition has been experienced, it is recommended that the 7-ring type crankshaft oil seal be replaced with an 8-ring type seal at next overhaul.

Part Name	Part No.	Quantity Per Engine	
		Install	Remove
Adapter, Crankshaft	65271		1
Gear, Crankshaft Propeller Governor Drive	64332	1	
Key, Crankshaft Propeller Governor Drive Gear	7-D-17	1	
Ring, Crankshaft Oil Seal	5015-D-6	8	7

The crankshaft propeller governor drive gear, Part No. 64332, is designed for use in propeller governor drive type crankcase front sections employing either a propeller governor or a 2-position hydro-control. When a propeller governor is used, the crankshaft gear drives the propeller governor drive intermediate gear.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: SLOT-HEADED PLUGS—REMOVAL OF

Bulletin No. W-52
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: June 15, 1945

Some difficulty has been experienced in removing slot-headed plugs because the standard tapered shank screwdriver is not adapted for this purpose.

The tapered shank screwdriver may slip and mutilate the plug. When this happens it will be necessary to employ other means to accomplish the removal. Any standard commercial plug remover of proper size is suitable for this operation.

For satisfactory removal of these subject plugs hollow grind the shank of any suitable tapered shank screwdriver as shown in the drawing. This will enable the blade of the screwdriver to grip the bottom of the plug slot, reducing the possibility of slippage when torque is applied.

Rework

Any standard tapered shank screwdriver of suitable size and thickness may be reworked by hollow grinding the shank as shown in the drawing.

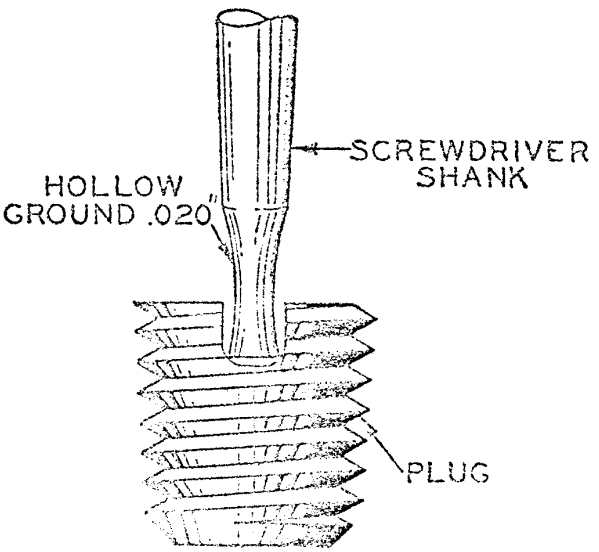

Figure 1

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: TRANSFER OF ENGINES FROM SURPLUS STOCK TO LICENSED OPERATION

Bulletin No. W-53
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: June 30, 1945

With the transfer of engines from surplus stock to licensed operation the desirability of incorporating certain design changes recently released is becoming apparent.

In order to insure the most satisfactory operation of these engines, Wright Aeronautical Corporation feels that certain requirements should be met before they are placed in licensed operation. It is recommended that any engines which may be procured from surplus stock for use in licensed aircraft be subjected to a complete overhaul including overhaul of the accessories. The overhaul is recommended for new and used engines and should be performed by a factory approved overhaul shop. Experience has proven this to be necessary as assurance that the internal parts of the engine are in good condition and also to ensure that they are not affected by corrosion which has a tendency to develop during long periods of inactivity in spite of precautionary preservation measures that may have been taken.

It is further recommended that certain parts which are of latest design be incorporated in these engines during this overhaul. A detailed list of these items is available for the various engine models and can be obtained upon request.

It is therefore recommended that operators who procure any of these engines consult the Wright Aeronautical Corporation for recommendations applicable to the specific engines involved.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: METHOD OF SELECTING OVERSIZE WEDGE-TYPE PISTON RINGS

MODELS AFFECTED: Whirlwind—All

Date: July 19, 1945

This bulletin supersedes Service Bulletin No. 418, dated August 9, 1943, in order to include revised piston ring side clearances.

The correct piston ring to be used during assembly is identified through the use of special ring gages. The purpose of this bulletin is to describe the construction of these gages and the method of using them.

Examine all gages now in use to ensure that the width of the ring segment and the oversize indicated on the gage correspond to the values given in the table. This is necessary in order to conform to the latest recommendation on piston ring side clearance.

GAGE CONSTRUCTION

Select the oversize rings listed below. Cut a section that bears no oversize markings from each ring and construct a gage to the dimensions shown in figure 1. Drill two holes in the ring section with a No. 55 drill and solder a 16-gage wire to the ring section for a handle. Fold a piece of metal around the handle as shown in order that each tool may be identified.

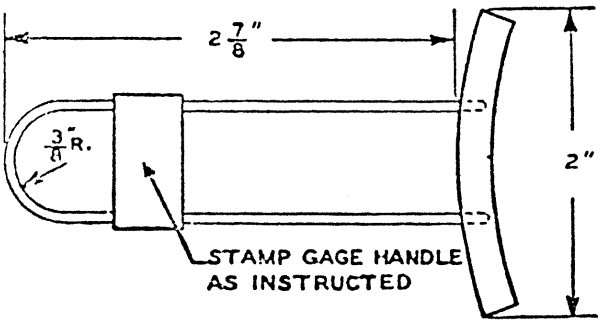

Figure 1

PISTON RING

Part No.	*Oversize*	*Ring Width ±.0003 In.*	*Stamp Gage Handle*
112213Y2	+.004 in. width	.124 in.	Use std ring
112213Y3	+.006 in. width	.126 in.	Use +.002 in. ring
112213Y4	+.008 in. width	.128 in.	Use +.004 in. ring
112213Y5	+.010 in. width	.130 in.	Use +.006 in. ring
112213Y20	+.010 in. width +.015 in. OD	.132 in.	Use +.008 in. ring

It is important that the section of piston rings used as gages be of the exact width mentioned in the tables. This measurement is taken at the widest portion of the ring.

The size of the ring used in making the gage indicates the size of the groove and not the oversize of ring to be selected. Be guided in selecting the ring by the information stamped on the handle of the gage.

PROCEDURE

Select a gage that fits flush or nearly flush with the land and check the width of the No. 1 groove at locations directly under the valve recesses in the head of the piston. Then check at the two additional points 90 degrees from these positions. If the width of the groove varies more than .002 inch, if the gage bottoms in the groove and rocks perpendicularly to it, or if the groove side faces are not parallel to the outer edge of the gage when visually inspected, remachine the groove. Refer to the Service Bulletin on remachining instructions.

If the groove is in good condition or if it has been remachined, select the largest size gage that will fit tightly in the piston groove without projecting beyond the lands, and install the appropriate ring to fit the designated groove. The ring gage will indicate the correct oversize width ring.

If the .008 inch oversize ring gage is a loose fit when flush with the lands as mentioned above and the

groove is not beyond service limits when checked with a snap gage, tool No. 802263, use a .010 inch oversize width ring.

Follow the procedure outlined above and inspect and measure all the grooves that accommodate wedge-shaped rings. *The outer surface of a ring correctly fitted to the groove fits below the lands and does not protrude beyond them.*

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: PRE-FLIGHT IGNITION CHECK

Bulletin No. W-55
Page 1 of 1

MODELS AFFECTED: Whirlwind—All

Date: July 23, 1945

GENERAL

The ignition system should be checked to insure proper functioning, prior to take-off, as described below.

PROCEDURE

Throttle and Propeller Governor Adjustment—With the mixture control in the full "RICH" position and the governor control in the full "INCREASE RPM" position, adjust the throttle to give 28 to 30 inch Hg manifold pressure. DO NOT EXCEED 30 inch Hg manifold pressure.

CHECK FOR RPM DROP

Note the rpm as the engine operates with the ignition switch in the "BOTH" position. Then, without changing the throttle setting, operate the engine with the switch in the "LEFT" position just long enough to note the rpm drop (a matter of seconds). Return the ignition switch to the "BOTH" position to permit the engine speed to stabilize. Repeat this procedure for the "RIGHT" position. This check should be made in as short a time as practicable and should not extend over 15 seconds. Atmospheric conditions will influence the readings obtained; however, a drop of 75 rpm or less is considered normal providing no engine roughness is encountered.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: SERVICE LIMITS FOR ANTI-FRICTION BEARINGS

MODELS AFFECTED: Whirlwind 7 and 9

Date: May 20, 1947

This bulletin supersedes Service Bulletin No. W-56, dated April 5, 1946, to include additional information.

The purpose of this bulletin is to establish general limits which may be used for inspection of anti-friction bearing surface conditions during engine overhaul. While it is impossible to establish definite limits of acceptability on these parts, the illustrations and descriptions are guides to help the inspector.

Limits specified herein for ball or roller paths also apply to balls and rollers. Superficial pitting not exceeding ⅛ inch in length across the track is acceptable on three rollers. Superficial pitting, on three balls, not exceeding ⅛ inch in any direction is acceptable.

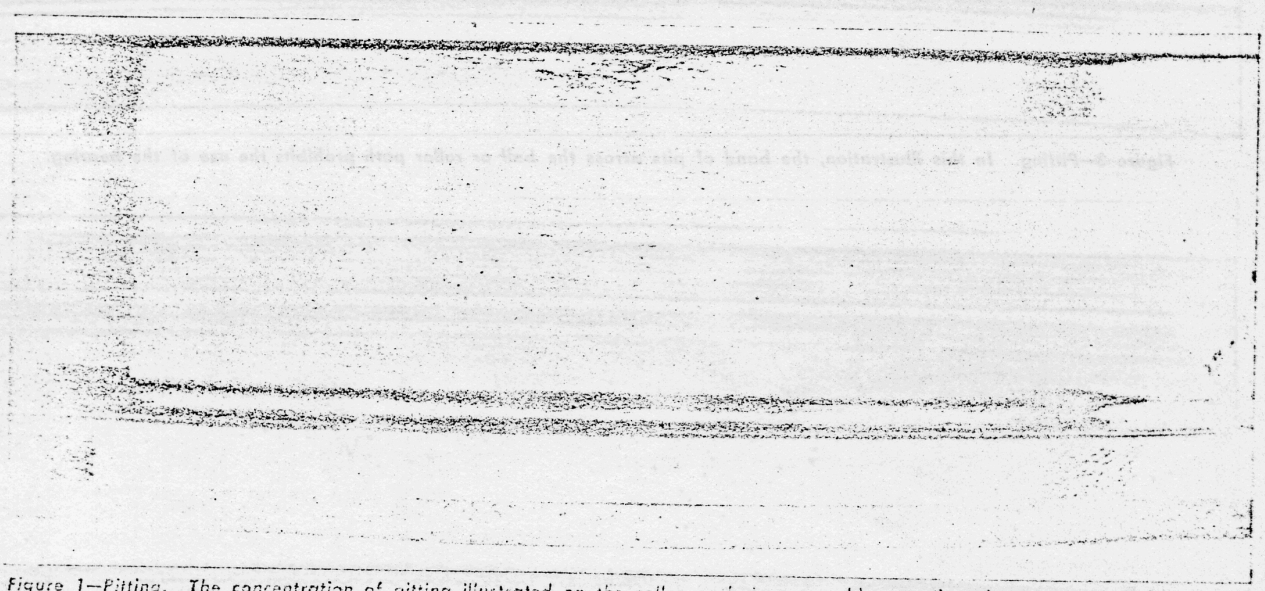

Figure 1—Pitting. The concentration of pitting illustrated on the roller path is acceptable on all surfaces, provided the pits are small in relation to the width of the bearing path.

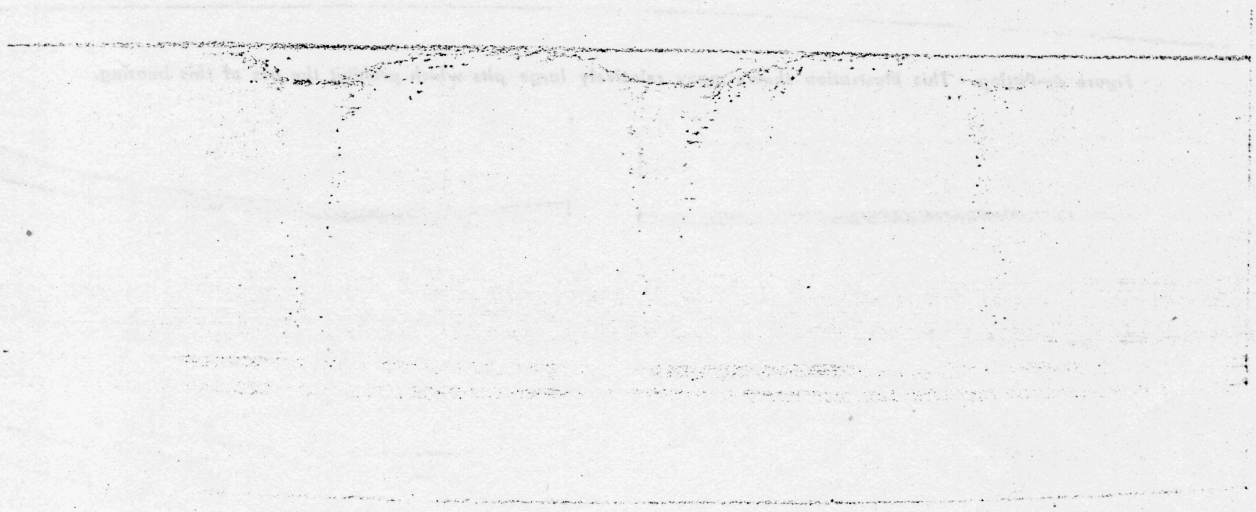

Figure 2—Pitting. The illustration shows lines of closely spaced pits and some harmless stains across the roller path. Because of the lines of pits, this bearing should not be used. Staining as a discoloration only has no effect on bearing performance and can generally be cleaned up by using crocus cloth or equivalent.

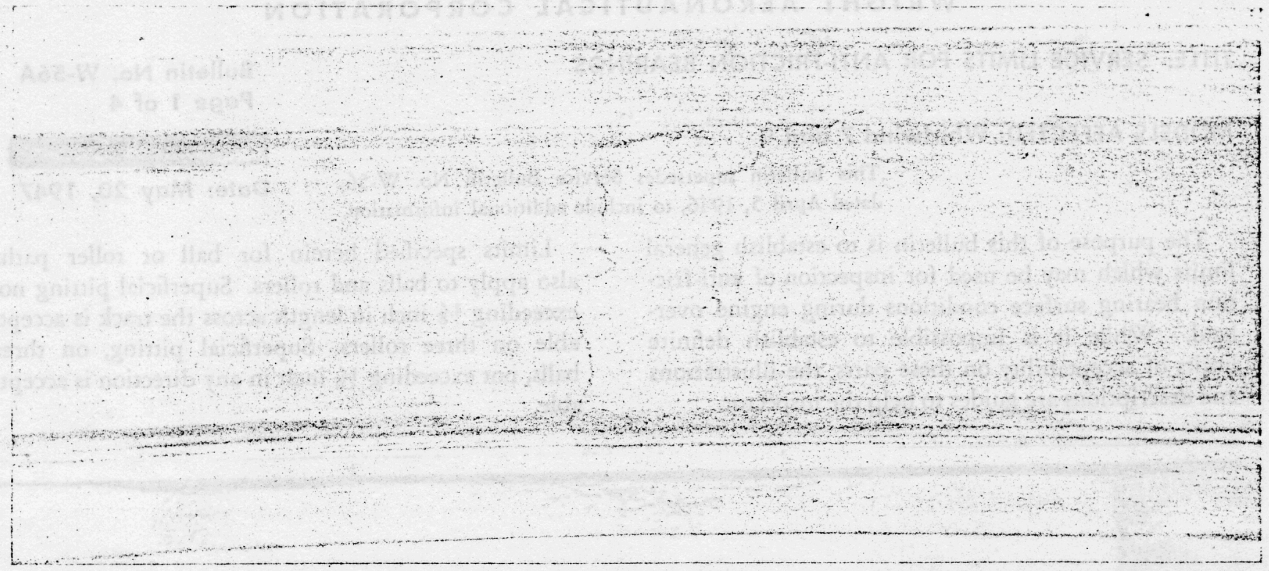

Figure 3—Pitting. In this illustration, the band of pits across the ball or roller path prohibits the use of the bearing.

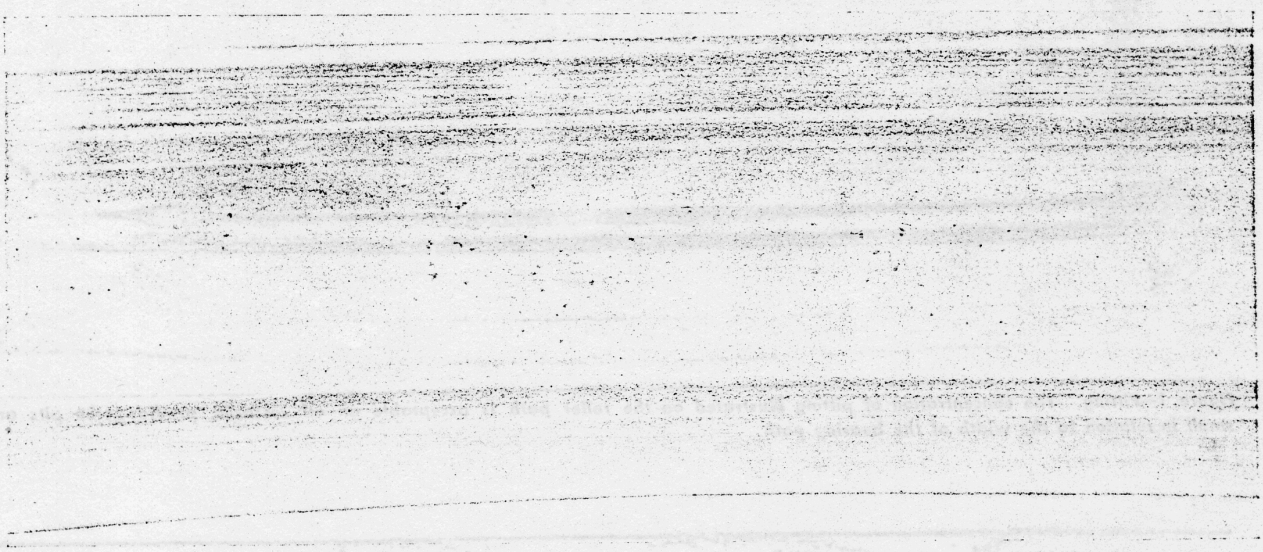

Figure 4—Pitting. This illustration shows many relatively large pits which prohibit the use of this bearing.

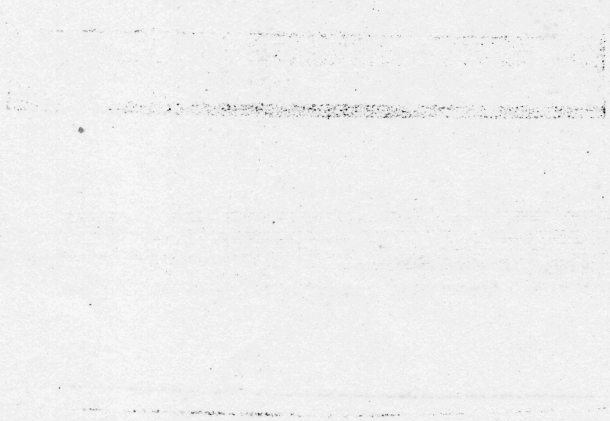

Figure 5—Pitting. Two such concentrated pitted areas within the area shown by the illustration shall be considered the limit of acceptability on ball or roller paths. On all other surfaces four such areas shall be considered the limit of acceptability. Pits no larger than shown but dispersed shall be acceptable on any surface.

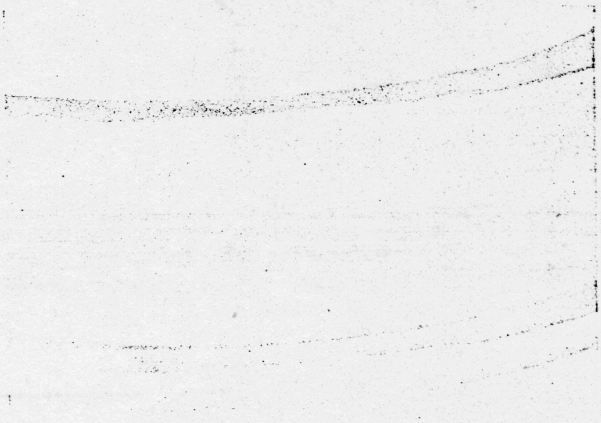

Figure 6—Pitting. One area equivalent to or larger as shown by this illustration shall be the limit of acceptability on ball or roller paths. Acceptable as shown on all other surfaces.

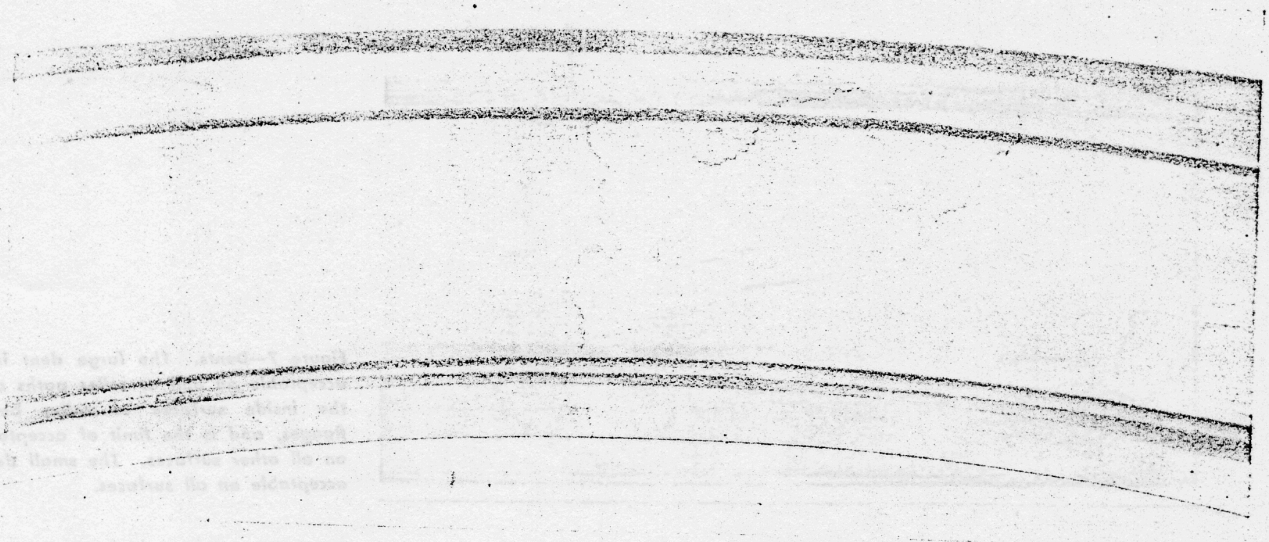

Figure 10—Manufacturing Flaws. A race having magnetic or visual indications due to non-metallic inclusions as illustrated shall be rejected if the length of any one indication on the roller path or ball groove exceeds 1/8" or if the sum of the lengths of all indications exceeds 3/8"; or, if the length of any indication on any other surface of the race exceeds 3/8" or if the sum of the lengths of all indications exceeds 1". If more indications than one are present they must be separated by at least 1".

Figure 11—Spalling. The illustration shows bearing race exhibiting spalling in its early stages. Spalling in any stage prohibits the continued use of the bearing.

Figure 7—Dents. The large dent is not acceptable on ball or roller paths or on the inside surfaces of roller bearing flanges, and is the limit of acceptability on all other surfaces. The small dent is acceptable on all surfaces.

Figure 8—Dents. Acceptable as a limit with regard to size and concentration on balls, rollers, and ball or roller paths. These dents are caused by metallic particles passing through the bearing.

Figure 9—Polishing Marks. Two scratches twice as long as shown, within the area illustrated, shall be the limit of acceptability on ball or roller paths or on inside faces of roller bearing flanges. Four marks twice as long as shown shall be the limit of acceptability on all other surfaces.

SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: SPARK PLUGS, INSTALLATION RECOMMENDATIONS

Bulletin No. W-57
Page 1 of 1

MODELS AFFECTED: Whirlwind 760E and 975E

Date: May 7, 1946

Service Bulletin No. 351 which was previously cancelled is hereby reinstated so that these instructions will be available to new operators.

The thickness of solid copper spark plug gaskets and washer type spark plug thermocouples should be within .068 inch minimum and .095 inch maximum. A thinner gasket or thermocouple washer will allow the spark plug to be screwed too far into the cylinder thereby exposing the bottom threads to the gases in the combustion chamber. This will result in overheating of the plug, which may cause detonation, and will make spark plug removal more difficult by allowing carbon to accumulate on the exposed threads.

The Wright Aeronautical Corporation does not recommend the use of copper-asbestos spark plug gaskets.

Spark plugs shipped from the factory with new or overhauled engines are protected from corrosion with a preservative compound. Before these plugs are tested or installed in an engine it is recommended that they be washed with a good grade of clear gasoline. The plugs should then be dried thoroughly before installation. The use of compressed air for this purpose should be avoided due to the moisture in the air.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: FUEL, USE OF CORRECT OCTANE

Bulletin No. W-58
Page 1 of 1

MODELS AFFECTED: Whirlwind 7 and 9

Date: May 17, 1946

Engines should usually operate on the grade of fuel specified in the engine specification and on the engine data plate. However, if fuel of the recommended octane rating is not available, it is permissible to use a fuel of higher octane. Under no circumstance should a fuel of lower octane rating be used.

Since higher octane fuels are aromatic to a greater degree and since aromatics have a detrimental effect on rubber and artificial rubber components of a fuel system, caution should be exercised in the use of higher octane fuels than specified until the fuel system has been determined suitable for use with aromatic fuels.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: VALVE TAPPET GUIDE—REWORK OF SLOT

Bulletin No. W-59
Page 1 of 1

MODELS AFFECTED: Whirlwind 7 and 9

Date: May 29, 1946

Service Bulletin No. 547 which was previously cancelled is hereby reinstated so that the rework recommended herein may be incorporated in surplus military engines converted to commercial use, if such rework has not already been accomplished.

To prevent valve tappet seizures, the blend between the roller slot and the inside diameter of the valve tappet guide has been increased to a .030 inch radius. It is recommended that guides which do not incorporate this change be reworked during the next overhaul as described below. Check for sharp edges both visually and by running the fingers over the reworked portions of the guide. The surfaces must be perfectly blended and have no sharp edges.

PROCEDURE

1. Use a 3/8 inch ball type abrasive wheel (Norton 38120 or similar) in a small high speed hand grinder, and with the abrasive wheel inserted in the roller slots, as illustrated in figure 1, break the sharp inside edges of each valve tappet guide slot.

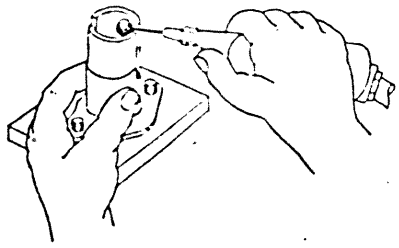

Figure 1

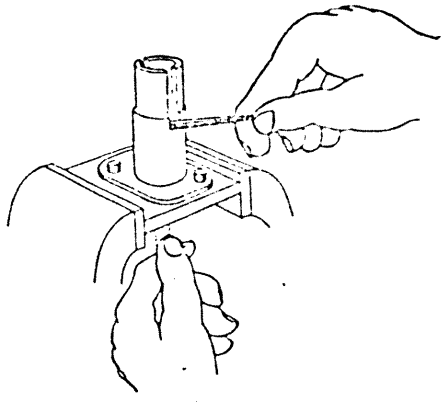

Figure 2

2. When a guide incorporating a flat at the blind end of the slot is being reworked, it will be necessary to break the edge of the flat and the adjacent radius with a strip of No. 240 abrasive cloth used as shown in figure 2.

3. Blend and smooth the surfaces reworked above into the tappet guide bore and slot by using a folded strip of No. 320 abrasive cloth held in a slotted arbor and bent back to create a "butterfly" or pointed grinding surface. The arbor is driven by a high speed hand grinder and used as shown in figure 3. To prevent the valve tappet bore from being damaged by the abrasive cloth during this operation, a soft metal shield should be constructed with an opening approximately 1/16 inch larger than that of the slot being reworked and inserted in the tappet guide bore. Care should be taken in inserting and removing the shield to avoid scratching the guide bore.

4. Polish the inner surfaces of the tappet guide with crocus cloth mounted on a split arbor driven by a high speed lathe as shown in figure 4.

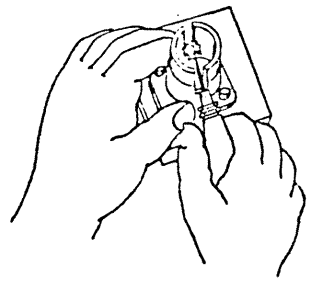

Figure 3

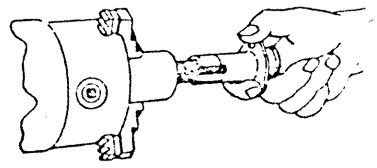

Figure 4

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: RECONDITIONING OF PISTON RING GROOVES

Bulletin No. W-60
Page 1 of 2

MODELS AFFECTED: Whirlwind—R760E and R975E

Date: June 5, 1946

This bulletin supersedes Service Bulletin No. 375, dated September 27, 1943, to incorporate up-to-date information.

GENERAL

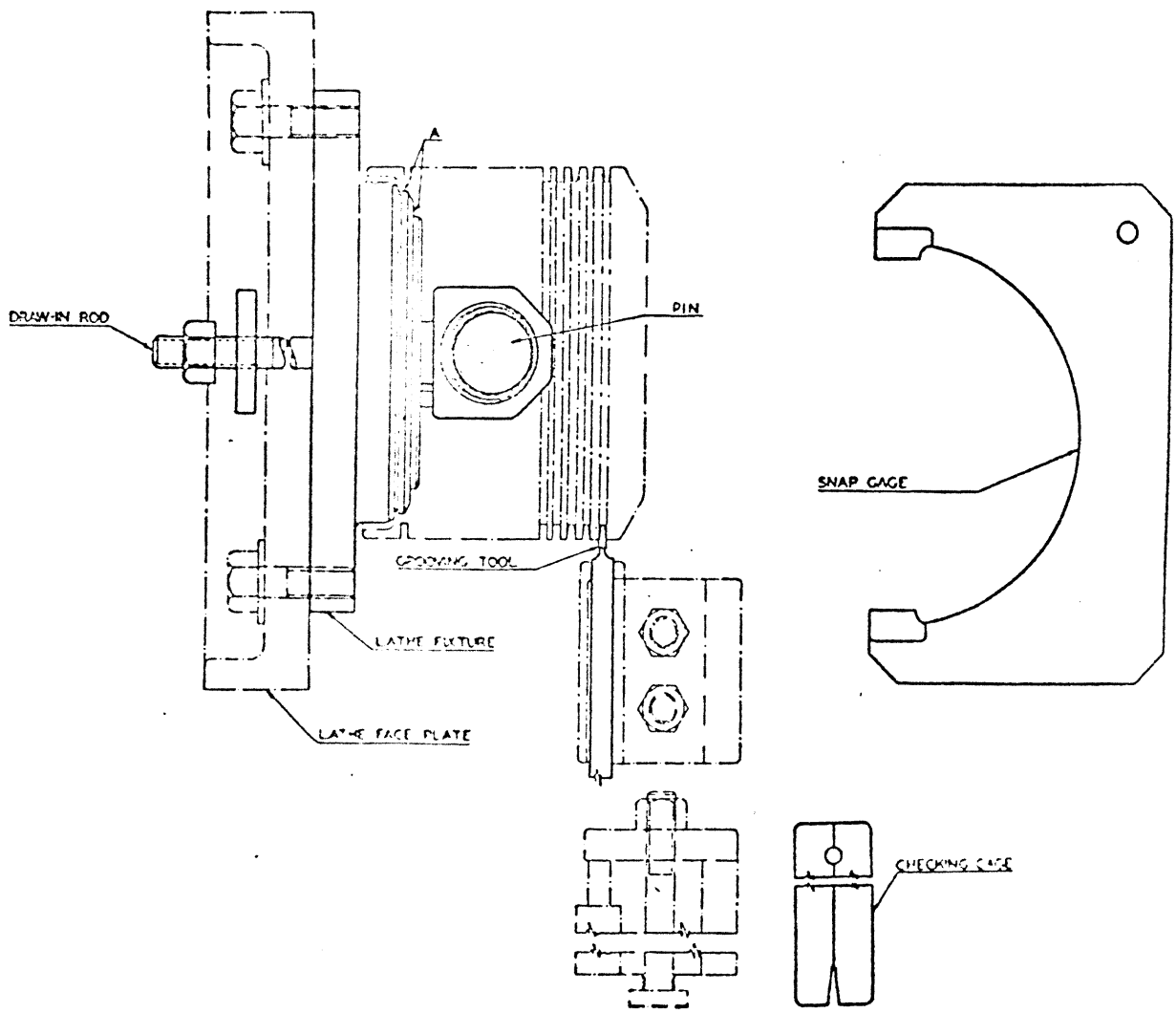
Service reports indicate that considerable difficulty exists in the field in reconditioning piston ring grooves, particularly those which are wedge shaped. It is the purpose of this bulletin to establish new reconditioning procedures to alleviate the existing difficulty, thereby increasing the life of both piston and piston rings.

Ring grooves are numbered in consecutive order starting with the groove nearest the dome of the piston as number 1.

During reconditioning, the depth of a ring groove, both wedge and rectangular shape, must never be increased. After reconditioning, a smooth fillet must be formed between the sides and bottom of a groove regardless of its shape.

Special Tools Required

Name	Tool No.
Lathe Fixture	801830
Limit Gage	802263
Grooving Tool	801097
Grooving Tool Checking Gage	803720



WEDGE SHAPED GROOVES

Clean used pistons by a carbon-solvent bath followed by soft grit blasting and by remachining the sides of wedge shaped grooves to the extent necessary to obtain smooth, flat, and true surfaces. Prior to machining, however, a limit gage should be used on the grooves. If the gage passes through the groove, the piston must be replaced.

Clamp the fixture on the lathe face plate, indicating surfaces "A" to run true within .002 inch full indicator reading. The compound rest must be parallel to the lathe fixture as illustrated. Use parallel blocks to elevate the point of the grooving tool to dead center. Use suitable blocks, clamp, and two bolts as shown, to insure tight clamping along the greater length of the tool. Clamp the tool lightly. Place the gage flat against the fixture and, engaging the tool cutting edges accurately, clamp the tool securely. Insert the draw-in rod through the fixture of the lathe face plate. Place the piston on the fixture and insert the correct dummy pin through the piston pin hole and the eye of the draw-in rod. Clamp the piston into the fixture by tightening the nut at the end of the draw-in rod.

Indicate the outside diameter on the ring land between the second and third grooves from the top and also one side of the bottom groove below the piston pin hole to run true within .001 inch full indicator reading. If necessary, use shims between the piston and fixture.

Arrange the spindle speed for 125 to 200 rpm. Use a suitable cutting oil. Centralize the tool in the top ring groove and advance the tool toward the bottom of the groove as close as possible without touching it. At this point, set the micrometer on the cross feed at zero. This establishes the maximum depth. Move the carriage so that the tool touches the right-hand side of the groove. Back the tool out of the groove and move the carriage approximately .001 inch to the right, using the micrometer carriage stop. Advance the tool into the groove until the zero cross feed is reached. Repeat this operation until the side of the ring groove is cleaned up.

Leave the tool set to its maximum depth. Clean up the opposite side of the groove in the same manner, maintaining the same maximum depth of the grooving tool. After the groove has been cleaned up, check with the correct maximum limit gage. If the gage passes through the groove, the piston is no longer suitable for service use. However, if the gage does not pass through the ring groove, proceed to recondition, if necessary, the second and third groove from the top, checking each with the maximum limit gage.

The grooving tool is to be ground only on the top and not on the sides. Use the checking gage to insure the correct angle on the tool.

RECTANGULAR SHAPED GROOVES

If side clearance limits are exceeded when a .010 inch oversize ring is installed in a rectangular groove, the piston must be replaced.

Rectangular grooves may be machined with standard commercial cutting tools equipped to provide a .030 inch radius at the fillet. Hold the piston in the lathe fixture as described for pistons with wedge shaped grooves.

The final step is to break all sharp corners lightly before the piston is removed from the lathe.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: IDLE MIXTURE SETTING—
ADJUSTMENT OF

Bulletin No. W-61
Page 1 of 1

MODELS AFFECTED: Whirlwind 7 and 9

Date: July 11, 1945

Service Bulletin No. 536 which was previously cancelled is hereby reinstated and changed to present an improved procedure for idle mixture adjustment.

The carburetor idle mixture setting should be adjusted after each engine or carburetor change, whenever changes in airport altitude or atmospheric conditions require it, or whenever poor idling characteristics indicate the need of mixture adjustment.

Adjustment of Idle Mixture Setting:

Adjust the idle mixture setting in the following manner after a thorough warm-up.

1. With the mixture control in the "RICH" position, adjust the carburetor throttle stop so that the engine idles at 400 rpm. Speeds up to 600 rpm are permissible but 400 rpm is preferred to give a more sensitive adjustment.

2. Set the idle mixture adjustment to give maximum speed or lowest manifold pressure at this setting.

3. Readjust the throttle stop to gain the original rpm setting and again set the idle mixture adjustment to give maximum speed or lowest manifold pressure.

4. Reset the carburetor throttle stop to give the minimum idle speed desired.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: CYLINDERS—TESTING FOR CRACKS OR LEAKS IN

Bulletin No. W-62
Page 1 of 1

MODELS AFFECTED: Whirlwind 7 and 9

Date: July 19, 1946

The hydraulic testing and air testing of cylinders at overhaul is no longer recommended in checking cylinder heads for cracks or leaks. Testing of this nature is performed at the factory during manufacture, thereby precluding the need for further testing at overhaul.

All checking of cylinder heads for cracking should be performed by careful visual inspection. If indications exist which to the eye seem doubtful, light acid etching may be employed.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: SPACER, CRANKSHAFT FRONT MAIN BEARING—TIN PLATING OF

Bulletin No. W-63
Page 1 of 1

MODELS AFFECTED: Whirlwind R760E and 975E

Date: July 19, 1946

This bulletin supersedes Service Bulletin No. 453, dated February 26, 1941, to include it in the new numbering system and to incorporate additional information.

It is the purpose of this bulletin to provide instructions for tin plating of crankshaft front main bearing spacers from which the tin plating is worn. Plate only spacers which are in good condition or which may be reconditioned by light polishing.

Tin Plating Instructions

1. Remove all carbon using a carbon removing cleaner or by polishing with pumice.
2. Degrease using Permachlor or a similar commercial solvent.
3. Electric-clean with a standard electric-cleaner using the spacer as the anode. This will also remove any tin which was on the part previously.
4. Rinse in clean hot water.
5. Rinse in clean cold water.
6. Dip in a cold muriatic solution, 15 percent by volume, until all tarnish is removed.
7. Rinse in clean cold water twice.
8. Tin plate in an alkaline stannate bath using 9 to 1.1 amperes current per spacer. Use 4 to 6 volts and allow the spacer to remain in the bath for approximately one-half hour. The exact time required to plate to .0003 to .0005 inch must be determined by trial.
9. Rinse in clean cold water.
10. Rinse in clean hot water.
11. Dry in a clean air blast.

The alkaline stannate solution must be 63° to 79°C (145° to 175°F) and is composed as follows:

Sodium Stannate	13 ounces
Caustic Soda	1.25 ounces
Sodium Acetate	2 ounces
Hydrogen Peroxide (100 percent volume)	1/16 fluid ounce
Water	To make one gallon

It is recommended that the alkaline stannate solution be procured from a chemical supply company and its strength be maintained in accordance with their instructions.

If tin plating equipment is not available, the spacer may be returned to Wright Aeronautical Corporation for plating, or a new front main bearing spacer which has been tin plated may be procured for replacement.

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: CRANKSHAFT—UNDERCUTTING THREADED SECTIONS ON

Bulletin No. W-64
Page 1 of 1

MODELS AFFECTED: Whirlwind—R760E and R975E

Date: October 22, 1946

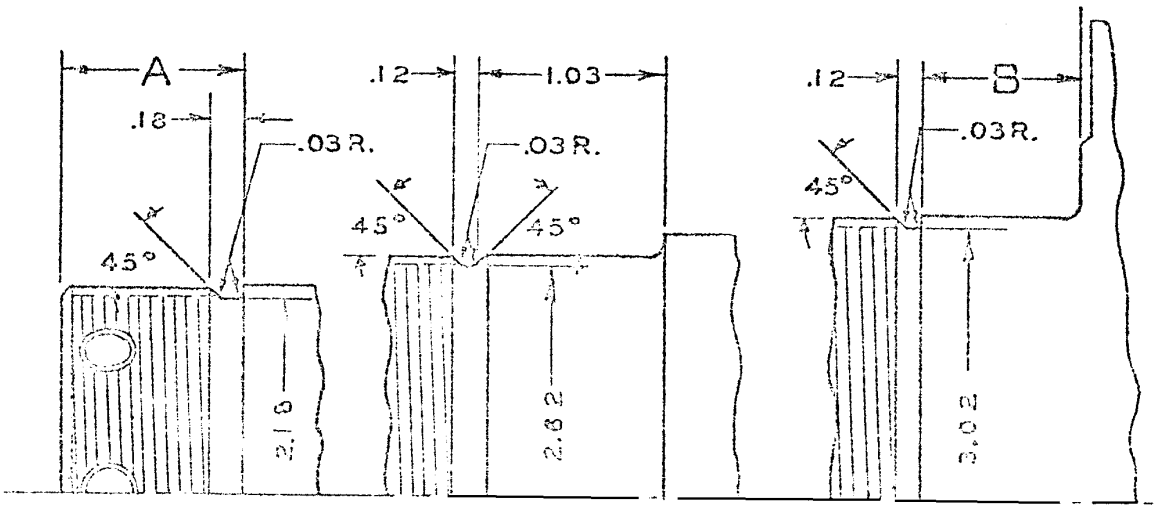
This bulletin supersedes Service Bulletin No. 544, dated September 30, 1942, in order that it may be included in the new numbering system.

GENERAL.

To avoid excessive stress concentrations at the sharp corners on the last threads, undercuts are machined behind all threaded sections of crankshafts.

Crankshafts not provided with these undercuts should be reworked as shown in the sketch. Rework may be accomplished in a lathe. Cut the grooves only deep enough to remove incomplete threads. Do not cut beyond the diameter specified. Polish to remove all tool marks and subject the part to a magnetic inspection.

Crankshaft Part No.	A	B
22179	.875	....
23439	.875	.88
63027	1.000	.88
64565	1.500	.88
66943	1.000	.88
68612	1.000	.906
112016	1.500	.88
112130	1.500	.88
112363	1.000	.88



PROPELLER NUT THREADS

THRUST BEARING NUT THREADS

FRONT MAIN BEARING LOCK NUT THREADS

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SERVICE BULLETIN

WRIGHT AERONAUTICAL CORPORATION

TITLE: DEFLECTORS, CYLINDER HEAD AIR—
CUSHIONED MOUNTING FOR

Bulletin No. W-65
Page 1 of 1

MODELS AFFECTED: Whirlwind—R760E and R975E

Date: October 22, 1946

This bulletin supersedes Service Bulletin No. 533, dated October 22, 1942, to include it in the new numbering system.

On the above engines, cylinder head air deflector brackets are now attached to the cylinder head with neoprene grommet mountings.

To effect this change:

1. Replace the present bracket with the bracket assembly sketched in figure 1. Attach the brackets to the deflector with three 1/8 inch rivets, part No. 66D19, and washers, part No. 27D130.

2. To provide clearance for the new bracket, profile the first cooling fin below the attaching screw boss on the exhaust side as shown in figure 2. Break and blend all sharp edges.

3. Install the deflector on the cylinder head, using screw, part No. 35D7, which is .938 inch overall length, in place of the present screw, part No. 35D13, which is .781 inch overall length. Lockwire securely. No washer is used with the new screw.

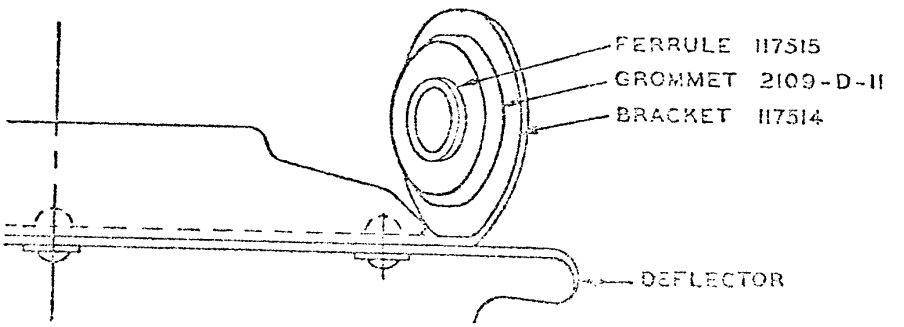

Figure 1

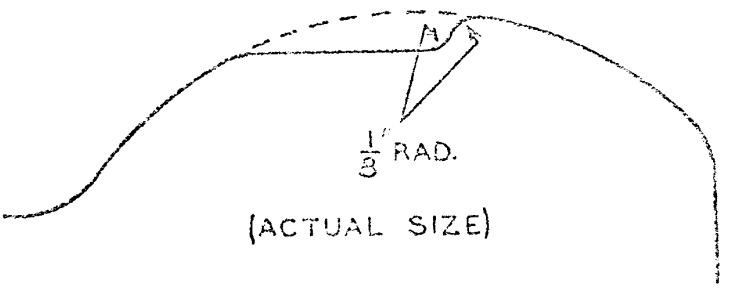

Figure 2

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S E R V I C E B U L L E T I N

WRIGHT AERONAUTICAL CORPORATION

TITLE: SPARK PLUG APPROVAL PROCEDURE

Bulletin No. W-65

MODELS AFFECTED: Whirlwind R760E and R975E

Date: May 15, 1943

GENERAL

It is considered desirable to have the engine manufacturer approve all spark plugs prior to general use in his engines. This applies not only to newly designed plugs, but also to previously approved plugs in which major changes have been made.

So that the engine manufacturer may lend full cooperation in supplying his approval, he has established a course of action believed to be acceptable to all concerned. The procedure, currently in effect, is outlined in this bulletin.

CONDITIONS

Engine manufacturer's approval of a spark plug must be obtained prior to the release of any publicity concerning the plug.

The number of plugs to be submitted for service testing, the model engines in which the plugs are to operate and the necessary operating time to complete a service test must be determined by the engine manufacturer. After service test, the engine manufacturer reserves the right to destructively examine ten per cent of all plugs tested.

Approval of a plug does not constitute a guarantee of the plug's performance, and the engine manufacturer will not be responsible for engine malfunctioning or failure due to the use of a plug. Approval of a plug may be withdrawn, in whole or in part, at any time, when in the engine manufacturer's opinion, the plug is not performing as it should.

The engine manufacturer also reserves the right to determine when changes in a previously approved plug warrant a revaluation of its performance.

NEWLY DESIGNED PLUGS

A newly designed plug is submitted to the engine manufacturer for preliminary study prior to contacting any other party. If it is considered to be potentially satisfactory, he requests permission from the Civil Aeronautics Authority to subject the plug to a service test.

When Civil Aeronautics Authority's permission has been granted, the engine manufacturer notifies the spark plug manufacturer that the plug may be released to Commercial Airlines for limited service operation.

NOTE

A minimum of 250 spark plugs must be supplied to any one operator and the total number of plugs released must not exceed 2000.

Before accepting plugs for service testing the operator should contact the engine manufacturer to learn whether or not he has agreed to a test and in what model engine the test should be conducted. The engine manufacturer promptly supplies this information and, if the plug is to be tried, furnishes the operator with forms on which he may report the results of his experience.

While a trial plug is being tested by an operator, the engine manufacturer's Service Representatives follow its progress. At the first regular plug change, they obtain

one average set of plugs for examination by the Wright Aeronautical Corporation.

Meanwhile, operation of the remaining plugs continues, up to approximately 500 hours. At each regular plug change, one representative set of plugs is returned to the engine manufacturer.

At the conclusion of the test, the entire group of plugs is returned to the engine manufacturer, accompanied by the operator's reports on the plug's performance.

After a complete analysis of all obtainable information, the Wright Aeronautical Corporation either approves or rejects the use of the plug in its engines. If approval is given, the plug may be immediately used in any engines of equal or lower specific power rating as compared to the engine in which the test was conducted. If approval is witheld, the spark plug manufacturer, if he so desires, makes any recommended changes and resubmits the plug for approval. In this event, the plug may or may not be approved without further service testing. When further service testing is required, the entire procedure as outlined above is followed.

CHANGES IN APPROVED PLUGS

If a previously approved spark plug is to be altered in any way, the contemplated change is discussed with the engine manufacturer at the earliest possible time, and, in any event, before co-ordinating the change with anyone else. When the change is of a minor nature, it is immediately approved. However, when it is felt the change may have an unevaluated effect upon the plug, the engine manufacturer withdraws his approval until satisfactory results are obtained through service testing. In this case, the plug is submitted to the same procedure followed in obtaining approval for a newly designed plug.

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