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HARTZELL SERVICE BULLETIN

SERVICE BULLETIN 165E January 21, 1994
CODE: C

SUBJECT:

Inspection for Cracks in Certain Three Blade "Y" Shank Aluminum Hubs

EFFECTIVITY:

HC-( )3Y( )-( ) propellers with the model designations and serial number range listed below **AND** installed on aircraft with Lycoming (L)TIO-540* series engines; or installed on agricultural aircraft regardless of engine type.

NOTE: This Bulletin is applicable ONLY to propellers that are listed in hub model/ serial number list AND are also installed on either: any aircraft using (L)TIO-540 series engine or any agricultural aircraft (regardless of engine). Other aircraft installations, even though they use listed propeller models/ serial numbers, are not affected.

* Some aircraft applications have "IO-540" series engines with a turbocharger added by the airframe manufacturer or STC holder or other FAA approved data. The intent of the Bulletin is that all aircraft with turbocharged 540 series engines are affected even if the engine data plate says "IO".

Propeller Serial Number Range:

Basic Hub Model	Propeller Serial Number Range		
PHC-C3YF-1R( )	EE1	through	EE1461
PHC-J3YF-1R( )	FP1	through	FP37
PHC-L3YF-1R( )	FD1	through	FD7
HC-C3YF-1R( )	EC1	through	EC1020
HC-C3YK-1( )	CT1	through	CT101
HC-C3YK-1R( ) or HC-C3YR-1R( )	DY1	through	DY1897
HC-C3YK-2( ) or HC-C3YR-2( )	CK1	through	CK3510
HC-C3YK-4( ) or HC-C3YR-4( )	EL1	through	EL67
HC-E3YK-1( ) or HC-E3YR-1( )	FM1	through	FM487
HC-E3YK-2( ) or HC-E3YR-2( )	DF1	through	DF79
HC-E3YK-2A( ) or HC-E3YR-2A( )	DJ1	through	DJ7787
HC-F3YK-2( ) or HC-F3YR-2( )	DA1	through	DA1586
HC-F3YK-1( ) or HC-F3YR-1( )	DB1	through	DB137
HC-I3YK-2( ) or HC-I3YR-2( )	FS1	through	FS50

(continued)

Aircraft Models: Propellers listed on page 1 are installed on, but not limited to:

Agricultural Aircraft

Fletcher FU24-950
Cessna A188 Agwagon modified by STC SA895SO
Piper PA-36-300 Pawnee
PA-36 Pawnee modified by STC SA3952WE
Transavia Airtruk

Aircraft with (L)TIO-540* Series Engines

Cessna 310 and 320 modified by Riley STC SA2082WE
Gulfstream 700 (formerly Rockwell 700, Fuji FA-300-12)
Helio H-700
Piper PA-23-250 and PA-E23-250 (with TIO-540 only)
Piper PA-31 Navajo (with TIO-540 only)
Piper PA-31-325 Navajo C/R
Piper PA-31-350 Navajo "Chieftain"
Piper PA-31P-350 Mohave
Piper T-1020 (same as PA-31-350)
Piper PA-32(R)-301T Turbo Saratoga
Piper PA-60-600, PA-60-601, and PA-60-602 Aerostar's all modified by Machen STC (turbocharged)
Piper PA-60-700P Aerostar 700P

DISCUSSION:

Recent metallurgical information has increased concern that there may be little operational time from the time that a crack becomes detectable (at the hub exterior surface) until subsequent crack growth results in blade separation. Because of this, this revision, Bulletin 165E, imposes an even more stringent compliance requirement for certain aircraft models to require repetitive eddy current inspections at 10 hour intervals.

Hartzell recognizes that such demanding inspection requirements will cause added difficulty in meeting aircraft operational commitments. However, we believe that such requirements are necessary in order to maintain flight safety. Hartzell is, and has been, attempting to dramatically increase the production rate of replacement hubs which, when installed, will eliminate the requirements of this Bulletin.

An alternate means of compliance is also provided with this Bulletin which can increase the repetitive inspection to initially 400 hours with 100 hour intervals thereafter; however, it also requires disassembly and rework of the propeller. This option would be of practical use only to high utilization aircraft which would have difficulty in compliance with the more stringent repetitive inspections and cannot obtain a replacement hub in the near term.

This Bulletin imposes severe repetitive inspection requirements. The more restrictive requirements are placed on aircraft models which have a history of cracked or failed hubs. Other models, such as the PA-31 (310 hp), have had no failures but are addressed in this Bulletin because of their similarity to applications which have a history. These models have a more liberal inspection requirement.

In Hartzell three blade "compact" aluminum hub propellers, cracks typically originate in the threads of a grease fitting hole on the inside of the hub. As the cracks propagate around the blade arm of the hub, their progression accelerates and results in failure of one hub half. Several incidents have continued to progress to blade separation.

WARNING: UNEXPLAINED VIBRATION OR GREASE LEAKAGE INCIDENTS, WHERE THE CONDITION INITIATED SUDDENLY, DEMAND IMMEDIATE INSPECTION FOR POSSIBLE CRACKED HUB.

COMPLIANCE:

NOTE: During 1983, a hub design change relocated the grease fitting holes near the hub parting line (see Figure 1). The earlier-design hubs are listed as affected serial numbers, however, there may be a few hubs listed that are of the later type. Any hub found to be of the current configuration does not require compliance with this Bulletin. Any hub with the old configuration requires compliance.

For all affected aircraft, if any abnormal or unexplained changes occur in propeller vibration or grease leakage, eddy current inspection per PROCEDURE 1 must be performed prior to further flight. (This issue must be made known to flight crew members as well as maintenance personnel.)

REQUIRED ACTION **for Piper PA-31-325, PA-31-350, T-1020; Aerostar PA-60-700P; and Agricultural aircraft** must be performed in accordance with either Option 1 or Option 2 below:

OPTION 1:

Within the next 10 hours of operation from the last SB 165 inspection or within 10 hours of operation from the effective date of this Bulletin, whichever occurs first, perform a combination of visual and eddy current inspection (PROCEDURE 1). Repeat inspection at intervals not to exceed 10 hours of operation.

OPTION 2:

Within the next 10 hours of operation from the last SB 165 inspection or within 10 hours of operation from the effective date of this Bulletin, whichever occurs first, disassemble the propeller, internally inspect, and rework the hub grease fitting holes per PROCEDURE 2 of this Bulletin. Repeat disassembly and internal inspection with both dye penetrant and eddy current per PROCEDURE 2 (except chamfering procedure need not be repeated) within 400 hours of operation (initially) and thereafter at intervals not to exceed 100 hours of operation.

REQUIRED ACTION **for all other affected aircraft** must be performed in accordance with either Option 1 or Option 2 below:

OPTION 1:

Within the next 50 hours of operation from the last SB 165 inspection or within 50 hours of operation from the effective date of this Bulletin, whichever occurs first, perform a combination of visual and eddy current inspection (PROCEDURE 1). Repeat inspection at intervals not to exceed 50 hours of operation.

OPTION 2:

Within the next 50 hours of operation from the last SB 165 inspection or within 50 hours of operation from the effective date of this Bulletin, whichever occurs first, disassemble the propeller, internally inspect, and rework the hub grease fitting holes per PROCEDURE 2 of this Bulletin. Repeat disassembly and internal inspection with both dye penetrant and eddy current per PROCEDURE 2 (except chamfering procedure need not be repeated) within 400 hours of operation (initially) and thereafter at intervals not to exceed 100 hours of operation.

TERMINATING ACTION:

Replacement with later style hub (post 1983) is terminating action for this Bulletin. Retirement of affected hubs on Piper PA-31-325, PA-31-350, T-1020; Aerostar PA-60-700P; and agricultural aircraft is required during propeller overhaul or by January 1, 1995, whichever occurs first. Manufacturing capabilities are limited. If later style replacement hubs are not available at the time of overhaul, to avoid aircraft grounding, it is acceptable to temporarily (for up to six months) continue operation with old style hubs.

NOTE: To encourage operators to replace hubs, special reduced pricing has been established for replacement hubs and/or propeller assemblies. Old style hubs removed from service are to be retired rather than used on other applications not affected by this Bulletin. (See retirement procedures, Service Instruction 114A.)

PROCEDURE 1:

The following procedure may be accomplished by either a certificated aircraft mechanic or propeller repair station personnel with experience and training in eddy current inspection.

1. Remove spinner dome and, as necessary, engine cowling to expose propeller hub. Remove rubber caps from grease fittings.

2. In a majority of cases, traces of grease coming from a crack have been the means of crack discovery. Make a visual inspection for traces of grease prior to cleaning. Then, if present, remove any paint, grease or other matter which may hinder visual examination.

   NOTE: If paint removal is required, chemical stripper must be used carefully to prevent it from accumulating in the cavity between the hub and blade. Paint removal from the entire hub is not required, an area within approximately two inches of each grease fitting is adequate. Before returning to service, the exposed area of the aluminum hub must have either an anodized surface or be protected with approved chemical film treatment such as Alodine. Also, the area which has had paint removed should remain unpainted to allow future inspection (approved deviation from Hartzell Service Instruction 144G).

   NOTE: The Aeroshell #6 grease used in propellers is mildly fluorescent. Although not a requirement, inspection using a black light (as is used with dye penetrant inspection) was found to be a useful aid in performing in performing visual inspections.

CAUTION: A VISUAL INSPECTION IS, IN ITSELF, NO LONGER CONSIDERED ADEQUATE. AN EDDY CURRENT INSPECTION MUST ALSO BE PERFORMED.

3. Use 10X magnifying glass and light source to perform careful visual inspection of the hub for hairline cracks in the general vicinity of blade retention bearings, but primarily inspect the grease fitting areas as shown in Figure 1. Perform inspections with grease fittings installed.

   NOTE: Typically, cracks begin at the grease fitting and propagate perpendicular to blade around the blade arm barrel. Cracks may initiate on either hub half from any of the six (6) grease fittings.

4. Perform external eddy current inspection:

   a. Tools Required:

      1) Magnaflux ED-520 or ED-530; or HALEC Mk II eddy current instrument (with instruction manual) are recommended. Other eddy current instruments capable of operating within a frequency range of 50 KHZ to 250 KHZ are acceptable.

         NOTE: Hartzell has tested and can recommend Magnaflux ED-520, ED-530 and HALEC Mk II eddy current equipment. Other manufacturers of eddy current devices are capable of providing suitable results. Use of other types of eddy current equipment is acceptable to Hartzell if approved by local airworthiness authorities (FAA or foreign equivalent).

2) Eddy Current Probe - A small diameter "pencil" type, shielded eddy current probe is required. Also, some aircraft models may require use of an eddy current probe with a 90 degree angle in order to inspect the fitting hole on the aft side of the hub (between hub and spinner bulkhead). Recommended probe - 1/8 inch diameter, 90 degree probe with 1/2 inch drop, 6 inches long, shielded (Absolute - 200 KHZ).

NOTES: 1) An unshielded probe is not recommended due to possible background noise.
2) The probe is used on a shot peened surface. To prevent premature wear of the probe element, the element end may be covered with 0.003 inch thick teflon tape.

3) Calibration/Reference Standard - 1-1/4 inch by 3 inch aluminum block 5/16 inch thick with 0.008, 0.020, and 0.040 inch deep reference notches that are 0.003 to 0.005 inch wide.

Sources of eddy current probes and reference standards:

Company	Probe P/N	Reference Standard P/N
Centurion NDT, Inc. (formerly Magnaflux Electronic Products) 707 Remington Rd. Suite 9 Schaumberg, Illinois 60173	223695MP	207066
NDT Products Engineering 7056 South 220th Kent, Washington, 98032	MP905-60P	SRS0824A
NDT Equipment & Supply, Inc. 10728 S. Pipeline, Suite D Hurst, Texas 76053	NDT 905-60	TB-AL

CAUTION: EFFECTIVE EDDY CURRENT TESTING REQUIRES EXPERIENCED, WELL-TRAINED PERSONNEL WHO ARE FAMILIAR WITH PROPER PROCEDURES FOR INSTRUMENT CALIBRATION AND USAGE OF THE EQUIPMENT.

b. Calibration Procedure:

1) Calibrate/balance the eddy current instrument in accordance with the instrument manufacturer's procedures.

2) Check eddy current instrument lift off settings by placing a 0.003 inch lift off shim or smooth piece of transparent tape on an area of the reference standard away from any reference notches. Place the probe on the shim or tape and slide the probe off to the bare metal. The meter deflection must be in accordance with the eddy current instrument manufacturer's calibration/balance procedures.

3) Place the eddy current probe on the aluminum reference standard and slide probe over 0.020 inch notch and note meter deflection or phase shift. The eddy current gain/sensitivity control must be adjusted to display a 150 microampere deflection minimum on the Magnaflux ED 520/530; 50% deflection on the Hocking Locator UH and UH-B; and a 50% amplitude signal on phase analysis instruments.

c. Scanning and indexing criteria:

1) Place eddy current probe on hub, positioned against the grease fitting and note the instrument readings and adjust balance or zero controls to bring needle on meter, if required. The active area of the probe must remain nearly perpendicular to the surface during all calibration and scanning procedures.

2) Scan probe gradually around each of the six grease fittings on the propeller hub. See Figure 1, scan probe in a manner to cross typical crack indications (rather than scanning in strokes that may be parallel to typical crack indications). The center of the probe tip must pass within 1/4 inch of the grease fittings and outward from the fitting as far as practical (up to 2 inches). The initial scanning around the grease fitting should consist of a circle with the probe as close to the grease fitting hole as possible. Perform subsequent scans of concentric circles around the grease fitting with no more than 1/10 inch spacing between circles.

NOTE: If a large or blunt eddy current probe is used, removal of grease fittings may be required in order to pass the center of the probe tip within 1/4 inch of the edge of the grease fitting hole.

d. Evaluation:

1) Any rapid eddy current indication that exceeds 150 microampere deflection on a ED 520/530; 50% deflection on a Hocking Locator; or 50% amplitude signal on a phase analysis eddy current instrument must be evaluated further.

2) All hubs with suspect indications are to be sent to the Hartzell Product Support Department for further evaluation.

5. If no cracks are found, re-install rubber caps on grease fittings, re-install spinner dome and make logbook entry indicating compliance.

6. If there are any indications of a crack, hub replacement (by an approved propeller repair station) must be accomplished prior to further flight.

ALTERNATIVE METHOD for external Eddy Current Inspection (Option 1 only):

Step 4 in PROCEDURE 1 calls for eddy current inspection method. Localized application "on aircraft" of fluorescent dye penetrant is acceptable in lieu of eddy current if accomplished in strict accordance with procedures provided in Hartzell Standard Practices Manual 202A (visible dye method is not authorized). An initial (one-time) pre-penetrant etching treatment is required. Etching is considered an IMPORTANT step in making a tight crack detectable with fluorescent dye penetrant, ref. Hartzell Manual 202A, p. 309, para. 6. Careful, localized application of caustic/ nitric solutions are acceptable, but also grease fittings would have to be removed afterward for cleaning to prevent accumulation of solutions in the threads.

PROCEDURE 2:

The following procedure must be accomplished by a propeller repair station.

1. Disassemble propeller per Manual 117D (or subsequent revision).
2. Perform eddy current inspection of the hub in the area of the grease fitting holes, both internally and externally, in accordance with PROCEDURE 1 in this Bulletin. If there are any indications of a crack, hub replacement must be accomplished prior to further flight.
3. Using a 6 fluted, 45^{o} chamfering tool (Hartzell part number 57BST5845), cut a chamfer to 0.429 to 0.500 inch diameter on the inside of the hub at each grease fitting location. Using the same tool, also cut a chamfer 0.304 to 0.357 inch diameter on the external side of each grease fitting hole. See Figure 2.
   a. Chamfering may be performed with a hand-held variable speed drill. Vary the RPM and force on the drill to minimize tool chatter. Testing on a scrap hub is recommended prior to performing this operation.
   b. Check diameter of chamfer using a dial caliper. Hub retirement is required if chamfer exceeds maximum diameter.
4. Polish any sharp edges created by the chamfering tool with 320 grit (or finer) emery cloth or sandpaper.
5. Perform dye penetrant inspection of the hub per Manual 202A. This includes etching of the surface prior to penetrant inspection. Since a complete overhaul is not required for compliance with this Bulletin, localized etching and penetrant inspection in the area of the grease fitting holes is permissible.
6. Provide corrosion preventative treatment, either anodize or chemical conversion coating, in accordance with Manual 202A.
7. Reassemble propeller per Manual 117D.
8. Using a metal impression stamp, stamp the letter "E" as a suffix to the propeller assembly serial number on each half of the hub.
9. Make a logbook entry to indicate compliance with this portion of Bulletin 165E and that "Option 2" Compliance criteria is applicable to this hub.

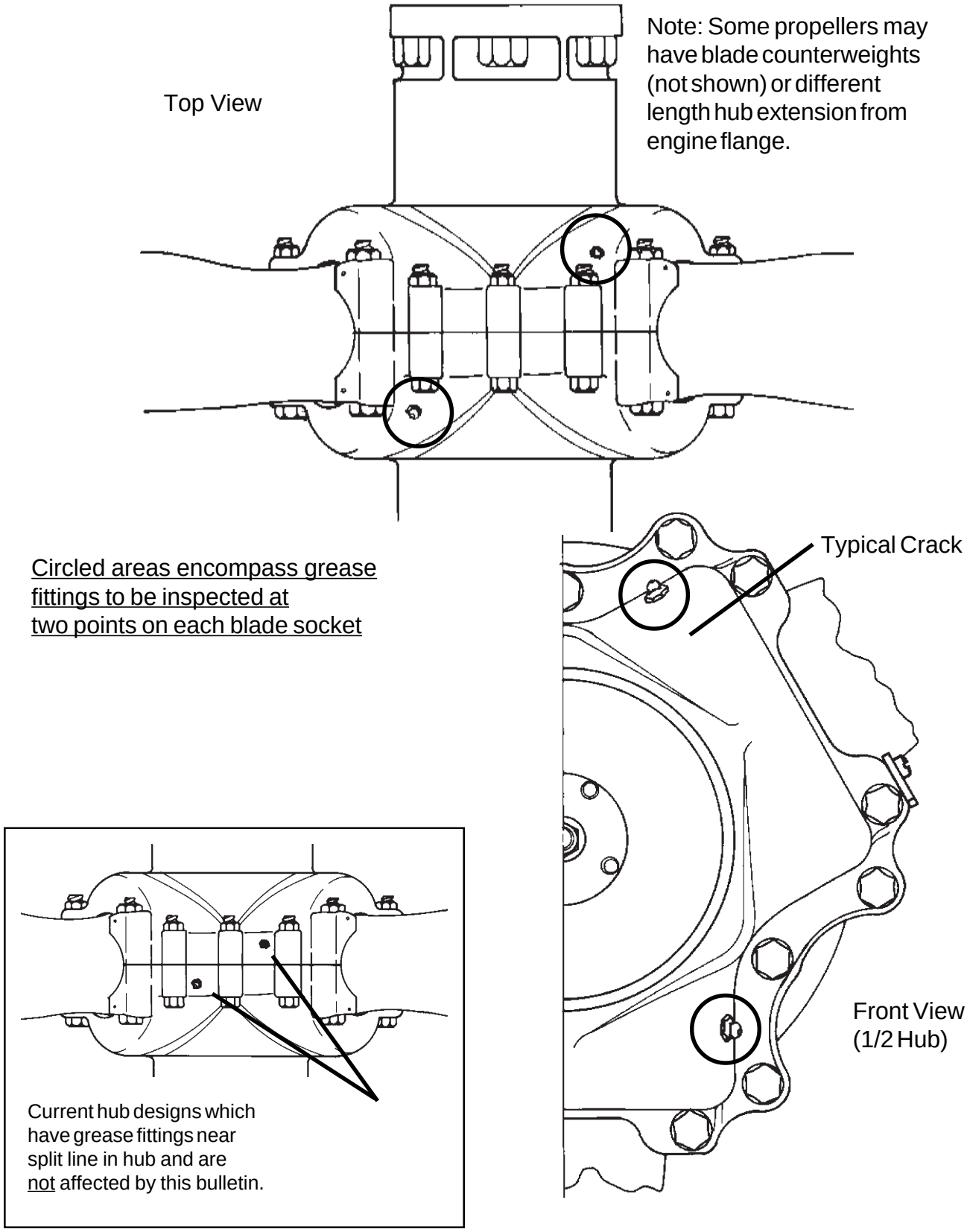

Figure 1. Hub Grease Fittings

PUBLICATIONS AFFECTED:

This Bulletin replaces Service Bulletin 165D dated August 6, 1993. This bulletin is now considered part of Hartzell Manuals 113B and 117D.

APPROVAL:

Federal Aviation Administration (FAA) approval has been obtained on technical data in this publication that affects type design. This revision has been coordinated with the manager of the Chicago Aircraft Certification Office 2300 E. Devon Ave. Des Plaines, Illinois 60018 and is approved as an alternate means of compliance with Airworthiness Directive AD 93-16-14.

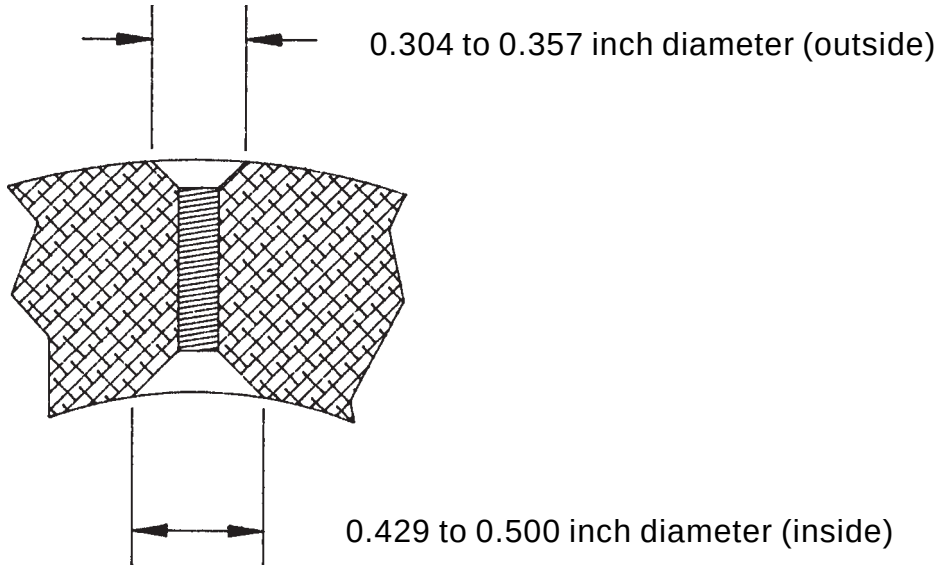

Figure 2. Hub Rework