



Technical portions are FAA-approved.

SUBJECT: S539800 STARTER ADAPTER CLUTCH SPRINGS and STARTER MOTORS

PURPOSE: To provide owners and operators with Instructions for Continued Airworthiness and Installation Instructions for S539800 clutch springs, to improve service life of starter adapters, and to provide inspection criteria for applicable starter motors.

COMPLIANCE: When installing S539800 clutch springs at repair or overhaul of TCM starter adapters and whenever applicable starter motors are overhauled, repaired or replaced.

MODELS

AFFECTED: S539800 clutch springs are eligible for installation on all TCM right-hand rotating, direct-drive engines employing old style starter adapters identified by a steel sleeve in the housing (*except early O-470-A and -B models still equipped with early starter adapter having a 2-tooth worm gear on the input shaft*) as follows:

O-300-D. IO-346-A. IO-360-A,AB,C,CB,D,DB,ES,G,GB,H,HB,J,JB,K,KB.
TSIO-360-A,AB,B,BB,C,CB,D,DB,E,EB,F,FB,GB,H,HB,JB,KB,LB,MB,NB,PB,RB,SB.
O-470-A,B,E,G,J,K,L,M,P,R,S,U. IO-470-C,D,E,F,G,H,J,K,L,M,N,P, R,S,U,V,VO.
TSIO-470-B,C,D. IO-520-A,B,BA,BB,C,CB,D,E,F,J,K,L,M,MB.
TSIO-520-AF,B,BB,BE,C,CE,D,DB,E,EB,G,H,J,JB,K,KB,L,LB,M,N,NB,P,R,T,UB,VB,WB.
IO-550-A,B,C,D,E,F,G,L,N,P,R. IOF-550-B,C,N,P,R. TSIO-550-A,B,C,E,G.
TSIOL-550-A,B,C.

SUPERSEDURE: This document supersedes Aircraft Specialties Services, Inc. documents 1101-1, "S539800 Spring Installation Instructions", rev. 2 dated 05/23/2006; and 1101-2, "Continuing Airworthiness Instruction for Clutch Spring Part Number S539800" (all sizes), rev. 1 dated 04/25/2006.

Part 1. Background

Aircraft Specialties Services, Inc. manufactures starter adapter clutch spring P/N S539800 as a direct replacement part for TCM spring part numbers 539800 and 654565. S539800 springs are manufactured in both STD (standard) size and M015 (.015" undersize on the ID) under authority of FAA Part Manufacturer Approval (FAA-PMA) PQ829SW. Aircraft Specialties Services also manufactures two additional undersizes, M030 and M040 (.030" and .040" undersize on the ID, respectively) under the authority of Supplemental Type Certificate SE09846SC.

NOTE: *More than 15 years ago TCM began replacing many old style starter adapters with a design that does not require a steel sleeve in the housing. These new style (also known as "sleeveless" or "smooth-drum") starter adapters require a different design shaftgear and clutch spring. S539800 springs cannot be used in new style TCM sleeveless starter adapters. However, when properly assembled and operated, old style starter adapters are just as reliable as new style starter adapters. Old style starter adapters are still the only type that can be used on TCM 346, 520 and 550-cubic-inch engines having the "permold" design crankcase.*

Through extensive research and testing, Aircraft Specialties Services, Inc. has determined that two key parameters greatly affect performance and service life of TCM old style starter adapter assemblies using the S539800 clutch springs. These parameters are:

- Dimensional limits for the shaftgear, clutch spring and sleeve.
- Drag of the starter motor armature or output shaft.

These parameters apply regardless of whether the shaftgear and spring are standard size or one of the approved undersizes. Aircraft Specialties Services strongly recommends that the information below be adhered to whenever original design starter adapters are repaired or overhauled and reassembled.

Part 2. Starter Adapter Dimensional Limits

2.1 Replace Starter Adapter Clutch Spring As Required.

Starter adapter clutch springs must be replaced whenever slippage occurs during starting and whenever the shaftgear and worm wheel are reworked to a new undersize. Since the spring is flexible and localized wear of the spring ID is very difficult to measure without specialized fixtures and measuring equipment, Aircraft Specialties Services recommends replacing the clutch spring whenever the starter adapter is disassembled and reassembled for any reason.

2.2 Maintain New Part Limits for the Sleeve ID.

New limits for the sleeve ID are 2.338”-2.343”. This diameter is measured at the extreme front (inner) end of the sleeve ID. If ID exceeds 2.343”, the sleeve must be replaced. Replacement is not easily accomplished and may damage the starter adapter housing without proper tooling and procedures. Aircraft Specialties Services has the expertise to perform this service.

2.3 Maintain Proper OD of the Shaftgear Drum (knurl) and Worm Wheel (brass gear).

Starter adapter shaftgears must be thoroughly cleaned and inspected for cracks using fluorescent magnetic particle testing and part processing by the wet continuous method in accordance with an FAA-approved process specification. Critical areas are roots of gear teeth, keyslots and changes of cross-section. Inspect shaftgear teeth and worm wheel teeth for wear, damage and raised edges per applicable TCM overhaul manuals. Repair or replace as required.

- Aircraft Specialties Services recommends that all starter adapter shaftgear and worm wheel drums be within new part limits at overhaul. See Figures 1-3 below. If machining and grinding are required, Aircraft Specialties Services can provide these services.
- Permissible wear on the shaftgear drum shall not exceed .0015” for either diameter or taper in order to be considered serviceable. Serviceable limits may be observed for mid-TBO reassembly only. If wear exceeds serviceable limits, grind the shaftgear to the next allowable undersize, or replace. See Figure 1.
- Worm wheel drums must be machined to the same undersize as the starter adapter shaftgear. See Figure 2 or Figure 3 below. Either machining configuration is permissible. All earlier worm wheels having three steps (Fig. 2) may be reworked to the current configuration of two diameters joined by a taper (Fig. 3).
- Identify shaftgears and worm wheels reworked to undersize by vibro-peening the undersize (M015, M030 or M040) adjacent to the part number per Figures 1-3. Keep vibro-peening clearly legible but as shallow as possible. Lightly vibro-peen an “X” over previous undersize markings. Identify three-step worm wheels reworked per Figure 3 details by adding the suffix “-1” to the part number.

Part 3. Starter Motor Armature Resistance MUST NOT EXCEED 5 in/lbs TORQUE.

For all old style starter adapters it is imperative that the starter adapter input shaft unwind at least one full revolution after engine start so that the clutch spring may fully release. In order for this to occur, spring forces inside the starter adapter must be able to overcome the resistance to rotation (drag) of the starter motor armature or output shaft. If the torque required to rotate the armature of the starter motor exceeds five (5) in/lbs, the clutch spring will not fully release. The rotating shaftgear will then be forced to run with an interference fit inside the clutch spring during engine operation. Through extensive testing, Aircraft Specialties Services, Inc. has demonstrated conclusively that nearly all wear of the shaftgear and clutch spring occurs as a result of this condition which considerably shortens starter adapter life and may cause metal contamination of the engine.

Aircraft Specialties Services, Inc. therefore strongly recommends that the following precautions be observed before installing any starter motor on an old style starter adapter:

- Measure the torque required to rotate the starter armature or output shaft. This value must not exceed 5 in/lbs. If torque exceeds 5 in/lbs, repair or replace starter motor. It must be possible to easily rotate the armature shaft when the drive tang is grasped with the thumb and index finger.
- Determine that the starter armature or output shaft has end clearance. For direct drive starters this should not be less than .005" nor more than .050". Repair or replace as required. For lightweight reduction gear starters this will be the internal bearing clearance and not generally adjustable.
- The starter mounting flange must mate properly with the starter adapter flange. If the starter does not fully and easily seat against the starter adapter, it may indicate excessive length of the armature shaft or a concentricity problem. Either of these conditions could cause excessive drag on the armature shaft when the starter mounting nuts are tightened. Investigate thoroughly, and repair or replace components as required.

Aircraft Specialties Services, Inc. continues to evaluate starter motors as they are introduced into the general aviation market. For questions or recommendations regarding acceptable starter motors, please call Aircraft Specialties Services, Inc. at 800-826-9252 or 918-836-6872; or contact us via e-mail at aircraft@fullnet.net.

NOTE: Installation of a different type of starter motor may affect aircraft weight and balance data!

Part 4. Installation and Reassembly, Instructions for Continued Airworthiness, and STC Data

4.1 Installation and Reassembly

Install S539800 clutch spring, and reassemble the starter adapter in accordance with the current Teledyne Continental Motors engine overhaul manual and any applicable service bulletins and/or FAA Airworthiness Directives. Be certain to use all new gaskets, seals, lock tabs and lock washers. Pay particular attention to lubrication requirements for all parts and recommended fastener torque values.

4.2 Instructions for Continued Airworthiness

Once installed, S539800 clutch spring does not change the operation or continued airworthiness requirements of the engine and starting system. Therefore, no new Instructions for Continued Airworthiness are required. All maintenance and inspection items required by Teledyne Continental Motors engine overhaul manuals and maintenance manuals and by Aircraft Specialties Services, Inc. (ref. Parts 2 and 3 and Figures 1-3 of this service bulletin) are applicable.

SERVICE BULLETIN

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4.3 STC Information and Document List

S539800M030 and S539800M040 clutch springs are produced under the authority of FAA Supplemental Type Certificate SE09846SC. Pertinent documents for these STC items are listed below:

DOCUMENT	TITLE	REVISION and DATE OF APPROVAL
Drawing 1101	S539800M030 & M040 Starter Adapter Spring	Rev. 2, dated 09/14/2007; FAA-approved 10/19/2007
Service Bulletin S-2008-01	S539800 Starter Adapter Clutch Springs and Starter Motors	Rev. 0, dated 01/03/2008; technical portions FAA-approved 01/10/2008

Part 5. Troubleshooting

Starter adapter clutch spring life is also dependent on proper lubrication and the level of aircraft and engine maintenance. If premature wear or failure of the clutch spring occurs, inspect the engine and aircraft for the following conditions and correct as required:

- Blocked oil passage at the shaftgear pilot bearing bore in the engine crankcase
- Starter motors having excessive armature resistance and/or misalignment. See Part 3 above.
- Improperly connected magneto P-leads
- Improper magneto-to-engine timing that could result in kickback during starting
- Crossed ignition leads or carbon tracked magneto distributor blocks that could result in crossfiring and kickback during starting
- Defective magneto impulse couplings, starting vibrators or ignition switches that could result in kickback during starting
- Defective ignition/starter switches and/or starter relays that could cause the starter motor to run after engine start

WARNING!

Always use extreme caution around the aircraft propeller when performing engine maintenance! Whenever possible, disconnect the upper spark plug leads and remove the upper spark plugs before turning the aircraft propeller by hand, when checking magneto timing, or when repairing or inspecting the starting and ignition systems. Re-install and properly torque spark plugs and ignition leads after maintenance, and check all systems for proper operation. Document all maintenance and inspections in the aircraft or engine maintenance records, as applicable.

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