

CANADIAN AERO MANUFACTURING
INSTRUCTIONS FOR CONTINUING AIRWORTHINESS
 All CAM643109 Series and All CAM643110 Series Starter Adapter Clutch Springs
 CI-06-03 Revision: A Issue Date: May 02, 2003 Print Date: 02/05/03 Page 1 of 5

This ICA is Transport Canada Accepted

RECORD OF REVISIONS

Revision	Effective date for new revision	Date of withdrawal of previous revision	Person making revision	Organization
A	May 2, 2003	N/A	Ron Newburg	CAM
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1. INTRODUCTION:

1.1 All CAM Clutch Springs are currently manufactured as per Canadian Aero Manufacturing PDA01-11, issue # 2 or later approved revisions.

1.2 These instructions apply to all CAM643109 Series and all CAM643110 Series Starter Adapter Clutch Springs. This ICA describes the installation and required maintenance elements. These parts are PDA approved replacements for original Teledyne Continental springs of the same application.

1.3 This document provides instruction for the disassembly, inspection, limited rework, and re-assembly of affected starter adapters. The installation of the CAM spring involves specialized repair procedures that may be beyond the scope of some repair facilities. Cylindrical Grinding, Lathe Work, NDT (MPI and LPI), Bead Blasting, and Specialized Measuring are required to complete this installation. Great care must be taken to maintain cleanliness during inspection and assembly, particularly internal oil flow passages.

1.4 The satisfactory function of the Continental Starter Adapter is very much dependent upon the dimensions and condition of these springs. Prior to installation of any of the products described herein, confirm that all of the components are within the dimensional tolerances and conditions required by both these instructions and the prevailing TCM publications.

Note: Chrome plated shaft gears are not to be used under any circumstances, as they will cause premature spring wear and give an extremely short service life.

1.5 Do not attempt the installation of the CAM clutch spring, or other maintenance on an adapter for which you do not possess adequate service information. It should be noted that some starter adapter part numbers are different simply because fittings or brackets, or stud lengths, are different to accommodate other engine or airframe systems. The internal components may be common to other starter adapters.

1.6 Geared, permanent magnet, starter motors, OEM and "after market" light weight may be used with CAM643109 Series and CAM643110 Series Starter Adapter Clutch Springs.

1.7 CAM643109 Series and CAM643110 Series Starter Adapter Clutch Springs are available in standard (new size) as well as the following size:
M15 – this spring is intended for use with Shaft Gears which have been worn or damaged by use, and have been reworked for reuse, by grinding the starter adapter main shaft gear friction drum undersize.

1.8 Distribution of this ICA is accomplished at the time of sale of a CAM Spring. This ICA is also available via the CAM website. Should there be a revision, the latest version will be available on the CAM website.

1.9 Revisions of this ICA are done by entire replacement only. All pages are at the same revision status, and are in effect as shown in the Header.

2. ELIGIBILITY:

2.1 This replacement clutch spring may be installed on Continental engines as per CAM Document CA-C-01, Rev: B-2 or later approved revision.

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3. DISASSEMBLY:

- Use aluminum soft jaws to hold the adapter in a bench vise by the shaft gear teeth.
- Remove nuts or bolts, washers and lock washers which retain the adapter lid.
- Remove lid, remove retaining ring and seal from inside the lid. Discard ring and seal.
- Using a suitable two-jaw puller, remove the bearing from main shaft gear. Discard bearing.
- Remove the shaft gear from the housing and set it aside
- Remove worm wheel with the spring attached and set it aside.
- Remove the retaining ring from the bottom of the adapter.
- Place the housing in a suitable hydraulic press so as to press out the cup bearing, part #641368, and the entire worm shaft assembly. Push out the worm shaft and worm, and set them aside. Discard bearing.
- Place the worm wheel in the vise. Bend the lock tab straight using a screwdriver.
- Using a 7/16 wrench, remove the screw from the worm wheel.
- To remove the spring, turn it 180° (as you turn the spring, pull outwards).
- Using a small screwdriver, through the hole in the worm wheel opposite the screw hole, pry the corner of the spring up, and release it from the groove. Discard the spring.
- Remove snap ring from worm shaft assembly and press bearing off of the shaft.
- Wash the housing, lid, shaft, worm wheel, shaft gear, worm shaft, worm and retaining screw invarsol, or other suitable degreaser. Use a long bristle brush to clean inside the shaft completely.
- Dry off all the parts using compressed air.
- Sand or glass bead blasting the housing, worm wheel and lid is recommended.

4. INSPECTION OF PARTS FOR RE-USE:

- Inspect the housing checking for cracks, dents, or chips, dowel holes, worn out studs or un-repairable threaded holes, make sure the three worm wheel pads are flat and smooth. Check that the retaining ring groove in the adapter housing has no chips or gaps in it.
- Inspect the housing and lid using an accepted Liquid Penetrant Inspection process
- Visually inspect the lid making sure there are no cracks. Pay special attention to the bolt holes. Check that the snap ring groove has no wear or chips, ensure that the oil groove is clean and free of obstructions.
- Inspect the worm wheel to make sure there are no cracks or chips on the teeth, and that each gear tooth surface is smooth. Measure the worm wheel drum to determine if it must be turned down to the next size.
- Inspect the shaft, paying attention to the friction drum size and the gear teeth. Make sure the gear teeth are not pitted or rusty. Check to make sure that the bearing surface is smooth. Inspect the threads, splines or keyways at the end of the shaft for wear or rust pitting.
- On the worm shaft, look for any pitting or rust. Look for any chips or dents. Polish the worm shaft in the lathe using Scotch brite.
- Inspect the shafts by Magnetic Particle Inspection as per accepted procedure. Inspect all non-ferrous parts by LPI as per accepted procedure.
- Paint or Alodine the housing and lid after inspection is complete.

5. INSTALLATION:

5.1 Grinding Friction Drum of Shaft Gear and turning Worm Wheel:

5.1.1 Installation of the standard spring cannot be accomplished if the friction drum area of the shaft gear is worn below 1.948" diameter on the large end or 1.9365" on the small diameter. If it is

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found that the friction drum area of the shaft gear is worn below 1.948", or if there is an excessive taper, it may be possible to install an M15 clutch spring.

5.1.2 Installation of the M15 spring will require that the friction drum area of the shaft gear be ground down to obtain a final preferred diameter of 1.935", with an absolute minimum diameter of 1.933" on the large diameter and 1.923", with an absolute minimum diameter of 1.922" on the small diameter. The newly ground corner of the friction drum must be chamfered at a 45° angle to prevent worm wheel damage, and the surface finish must be 32 micro-inches or smoother. Wire wheel the threads of the shaft, and polish it using Scotch Brite.

5.2 Turning worm wheel:

5.2.1 Lathe cut the proper taper on the worm wheel if the dimensions are lower than the standard sizes of 1.938 to 1.937" on the small diameter and 1.960 to 1.955" on the large diameter. M15 sizes are as follows:

Large diameter from 1.945 to 1.940" and the small diameter from 1.923 to 1.922".

5.3 Installation of New Spring and Assembly of Starter Adapter:

5.3.1 Installation of the CAM Clutch Spring is to be accomplished as described below:

- Apply white lithium grease to the drum of the worm wheel and the inside of the spring. Turn and push the spring onto the worm wheel until it sits in the groove at the base of the worm wheel.
- Ensure that the notch in the spring lines up with the screw hole.
- Place the lock tab part #MS9276-10 over the screw hole and then insert and tighten the screw, the torque to be applied is 25-35 inch pounds.
- Place the shaft vertically in the vise and apply white lithium grease to the friction drum and slide the worm wheel and spring onto the shaft, it will be a snug fit.
- Place some white lithium grease in the center of bearing part #641368. Using a long handled drift, tap the bearing into the adapter.
- Put white lithium grease on the three worm wheel pads inside the adapter housing.
- Slide the bearing part# CAM13041 onto the worm shaft and put the new snap ring part#MS16626-3078 on. Put white lithium grease on the worm and slide the entire worm assembly into the adapter housing.
- Put the retaining ring# CAM502287 into the retaining ring groove.
- Slide the shaft with the worm wheel attached into the housing and let the worm wheel sit on the pads inside the housing.
- Place a plain washer and a lock washer on the lid bolts or nuts and tighten them into place.
- Torque the bolts to manufacturer's specifications.
- Check the function of the adapter as follows: Using a large screwdriver turn the worm shaft counter clockwise and push the housing away from you to make sure it does not slip.

6. CONTINUING AIRWORTHINESS INSTRUCTIONS:

6.1 The continuing airworthiness of the clutch spring, and the starting system as a whole, is unchanged from the original instructions included in the TCM publications for the Continental Engines. Once properly installed, the CAM spring will function in exactly the same way as the original Continental product. All maintenance functions required by Continental must be carried out accordingly.

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6.2 Service or overhaul the starter motor every four years, as required by the TCM service manual, **OR** when installing an overhauled or repaired starter adapter.

6.3 The clutch spring and starter adapter may be damaged during use, as a result of any of the following:

- Faulty Magneto components, or timing, which can cause a kickback on starting very cold engines.
- Starter adapter oil passages may become clogged due to infrequent oil changes and sludge build-up.
- Overall engine maintenance and proper lubrication are very important for the best possible Spring life.
- Prolonged engagement of the starter when the drive appears to be slipping.

7. TROUBLESHOOTING:

The starter adapter can be presumed not to be operating properly if engagement of the starter, and a properly operating motor, does not result in the prompt and continuous rotation of the propeller.

Observation	Possible cause	Recommended action
When the starter is engaged, no effect is observed.	Electrical circuit failure.	Safely operate starter while listening for starter motor. If no starter sound is heard, determine reason for electrical problem
Starter motor can be heard while engaged, but propeller does not turn	Drive broken or slipping moderately	Remove and inspect starter adapter, and repair as required as per this ICA
Propeller turns non-continuously while starter engaged	Starter adapter slipping, probably due to worn spring or shaft gear	Remove and inspect starter adapter, and repair as required as per this ICA
Propeller turns very slowly or non-continuously while starter engaged	Discharged battery and / or very cold engine	Discontinue start attempt. Charge battery and / or preheat engine as required
Accessory driven by starter adapter, is no longer being driven	Failed drive inside starter adapter	Confirm that the drive failure is not in the accessory. If the starter adapter internal drive is suspected. Do not operate engine. Remove and inspect starter adapter, and repair as required as per this ICA

Note: Any questions regarding the spring should be addressed to Canadian Aero Manufacturing, 2648 Ego Side road, Orillia, Ontario, Canada L3V 6H3; Tel # (705) 326 1368. Residents of USA may call (800) 565 4268.

The preceding constitutes the entire ICA for Canadian Aero Manufacturing Springs.

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