CATTO-CP-01

CATTO PROPELLERS

CUSTOMER OPERATIONS AND MAINTENANCE MANUAL

RECORD OF REVISION

Revision Number	Issued Date	Inserted By
R-0	Jan 1, 2013	Catto Propellers
R-1	Nov 1, 2013	Catto Propellers
R-2	Dec 17, 2013	Catto Propellers
R-3	Mar 25, 2014	Catto Propellers

LIST OF EFFECTIVE PAGES

Page Number	Revision Number	Revision Date
i	R-3	Mar 25, 2014
ii	R-3	Mar 25, 2014
iii	R-3	Mar 25, 2014
iv	R-3	Mar 25, 2014
1	R-3	Mar 25, 2014
2	R-3	Mar 25, 2014
3	R-3	Mar 25, 2014
4	R-3	Mar 25, 2014
5	R-3	Mar 25, 2014
6	R-3	Mar 25, 2014
7	R-3	Mar 25, 2014
8	R-3	Mar 25, 2014
9	R-3	Mar 25, 2014
10	R-3	Mar 25, 2014
11	R-3	Mar 25, 2014
12	R-3	Mar 25, 2014
13	R-3	Mar 25, 2014
14	R-3	Mar 25, 2014
15	R-3	Mar 25, 2014
16	R-3	Mar 25, 2014
17	R-3	Mar 25, 2014
18	R-3	Mar 25, 2014

Page Number	Revision Number	Revision Date

TABLE OF CONTENTS

1.0 INTRODUCTION

Congratulations on the purchase of a ***CATTO*** propeller. Each one is hand crafted and specifically designed for each engine and owner's flying style. The ***CATTO*** propeller is unique in its hybrid construction of wood and composite materials; deriving optimum characteristics of both materials for a superior propeller in performance, durability, smoothness, manufactured precision and quality.

1.1 General

The propeller was manufactured using only the best quality materials and with meticulous manufacturing practices. Propeller balance, accurate blade track and pitch are strictly maintained during the manufacturing process and verified before shipment from the factory.

Installation of the propeller must be carefully completed in accordance with the procedures outlined in this manual, as it has been shown that an engine must deliver its driving torque to a propeller through static friction. That is, the force that resists movement of the propeller hub on the engine flange is due to compression of the propeller's aluminum face against the flange. Therefore, it is important to apply specified torque values during propeller installation, but also important to avoid crushing the propeller. Although, the drive bushings incorporated in most flanges provide a back-up system, a load will be imposed on them only if there is movement of the propeller on the flange. The bushings and attaching bolts can carry engine driving torque loads for only a short period of time. At this point, the bolt holes and counter bores will begin to elongate and may lead to cracking of the hub and/or failure of the attaching bolts and subsequent separation of the propeller. Bushings can be purchased through Saber Manufacturing, www.sabermfg.com .

Installation of the propeller must be completed in accordance with the installation instructions and required equipment outlined in Chapter 2 of this manual.

1.2 Model Designation

Each propeller is placarded with a permanent data plate on the side of the hub which shows the propeller: Serial Number, Diameter, Pitch, Type of Aircraft the propeller is designed for, Type of Engine the propeller is designed for, Maximum Design RPM, Maximum Red Line RPM, Torque Specification, Diameter of Crush Plate Required, Date of Manufacture, and '***CATTO***' to ensure recognition that the propeller was manufactured by ***CATTO*** Propellers.

1.3 For a comprehensive listing of ***CATTO*** approved propeller and engine combinations see the most current revision of the appropriate datasheet as listed below for your propeller series.

Propeller Series	Datasheet Document No.
CT100/	CATTO-CP-07-CT100

1.4 Skills and Training – Removal and installation of a propeller is to be conducted by a certified A&P Mechanic or LSA Repairman. Major repairs or propeller overhaul are to be conducted solely by Catto Propellers.

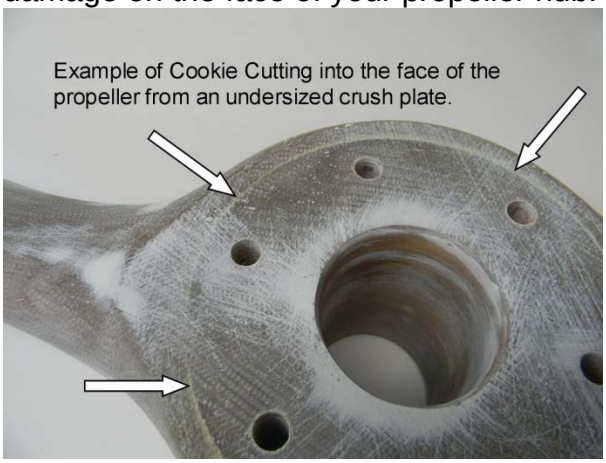
2.0 INSTALLATION INSTRUCTIONS

2.1 General

Installation of the propeller will require a crush plate, a set of attaching bolts of the proper length, current calibrated torque wrench, stainless steel safety wire 0.041" inch, safety wire pliers, de-natured alcohol, small amount of paraffin wax and in some cases a spinner assembly. (Crush plate and propeller bolts are supplied by Catto Propeller or Saber Mfg.

2.1.1 Crush Plate

2.1.1.1 A crush pate is required for the installation of the Catto Propeller to equally distribute the compression of the propeller bolt torque over the entire hub of the propeller. The correct diameter crush plate is essential for operation. A crush plate of the wrong diameter will damage the propeller. Contact Catto Propellers or Saber Manufacturing for additional information including sizing and sales. Do not use crush plates with lightening holes. Crush plates are typically 3/8", 1/2" or 5/8" thick aluminum. Never use a crush plate that is smaller in diameter than the hub, this will cause "cookie-cutter" damage on the face of your propeller hub.



2.1.2 Bolts

2.1.3 Verify the required size of bolts with the aircraft manufacturer, Catto Propellers or Saber Mfg. can help you with this. Typically the smaller engines (C-65 through O-290) will use a 3/8" diameter bolt. The O-320 can use either 3/8" or 7/16". And all 360 – 540's will run the ½" diameter bolts. As for length, you will need minimum 3 threads coming out the back of your threaded lugs. Be cautious of bolts too long as you can actually hit the engine case with a bolt that is too long. Do NOT use standard AN-6, 7 or 8 bolts for propeller bolts. They do not have adequate thread length.

2.1.4 Propeller Extensions or Spacers

Most propellers are installed on some form of an adapter, extension or spacer. There are also many that simply bolt onto the face of the starter ring gear on your engine. This is common on aircraft such as the SuperCub type aircraft. If you are running a 360 or larger engine, then an adapter is required. Most of the 360 and larger engines have short ¾" diameter engine lugs. Please see 'APPENDIX A' before installing a prop on one of these larger engines. If you are running one of the older 4" propeller extensions on your Vans RV aircraft, please update this extension with a new Saber 4". The difference is the older extensions only have a 6" diameter mounting face for your propeller. Also they do not have threaded engine lugs, they use nuts on the backside of the extension. This can be very dangerous as a standard aircraft lock nut has a much lower torque value than does a threaded propeller lug found in the newer Saber extensions.

2.1.5 Torque Wrench

2.1.5.1 Ensure that the Torque Wrench is calibrated in accordance with the manufacturer's specifications. All propellers are placarded with the appropriate torque values. All torque values are represented in Foot-Pounds (ft.*lbs., equivalently expressed as Pound-Foot or lb.*ft.).If you are running a 6" diameter propeller hub usually found on the smaller engines up to O-235, then the 3/8" bolt torque should be 25 foot pounds. On propellers with a 7" diameter hub, the torque value for the 3/8" bolt is 35 foot pounds. For 7/16" bolts 38 foot pounds and for ½" bolts 40 foot pounds.

2.2 Pre-Installation Preparation

2.2.1 Be certain that the magneto switch is OFF and that both magnetos are grounded prior to installation. Or if equipped with electronic ignition, pull the circuit breaker for the ignition.

2.2.2 Chock the aircraft wheels to prevent movement.

2.2.3 Rotate the crankshaft until #1 cylinder is TOP Dead Center (TDC). It is helpful but not necessary to remove one spark plug from each cylinder to make crank rotation and blade tracking easier during installation.

2.2.4 Clean both propeller hub faces and mounting flange. Use a clean cloth and de-natured alcohol to ensure that both faces are free of particulates, dust, grease and oil. This is very important.

2.2.5 Clean the propeller bolts and threads with de-natured alcohol. Then lightly rub along the threads with paraffin wax so that the wax covers about 50% of the threads of the propeller bolt.

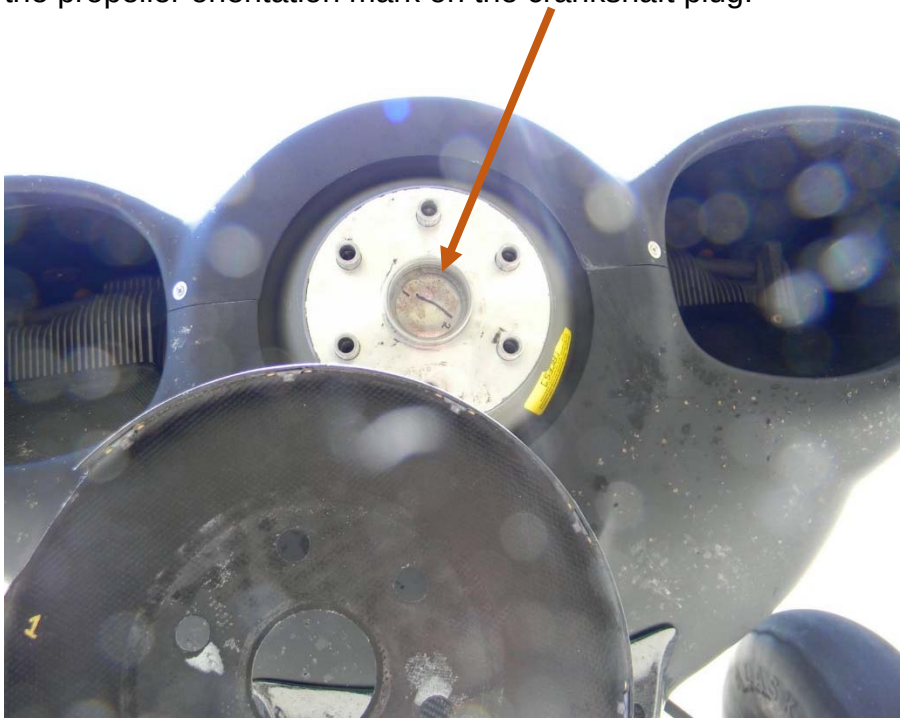
2.2.6 Never use any type of grease or oil as a lubricant on your propeller bolts.

2.2.7 Verify that the mounting face on your aircraft (this could be your engine flange, starter ring gear, propeller extension or spacer) matches the same diameter hub on your propeller and the same diameter as your crush plate being used. (Crush plate diameter is specified on the propeller label on the side of the propeller hub.)

2.3 Installation Procedures

2.3.1 Ensure that you have all required equipment, tooling and materials outlined above.

2.3.2 If a spinner is used, place the spinner rear bulkhead onto the engine flange. Orient the bulkhead so that the propeller blades will be aligned at the 10 o'clock and 4 o'clock positions as depicted on the propeller orientation mark on the crankshaft plug.



2.3.3 Install the propeller so the aluminum face of the propeller hub mates with the primary spinner bulkhead if one is used, or starter ring gear if no spinner bulkhead, or face of a propeller spacer or extension if used.

2.3.4 Ensure you have minimum 1/2” inch of lug engagement into the propeller hub face. These lugs are either 5/8” or 3/4” inch in diameter and protrude from your engine flange or propeller extension or spacer.

2.3.5 Place the spinner front bulkhead (if needed) and crush plate on the opposite hub face and insert the bolts through the assembly.
** A front bulkhead is recommended to be installed. If your spinner does not currently have the front bulkhead, they are available for purchase through Catto Propellers as well as other suppliers.**

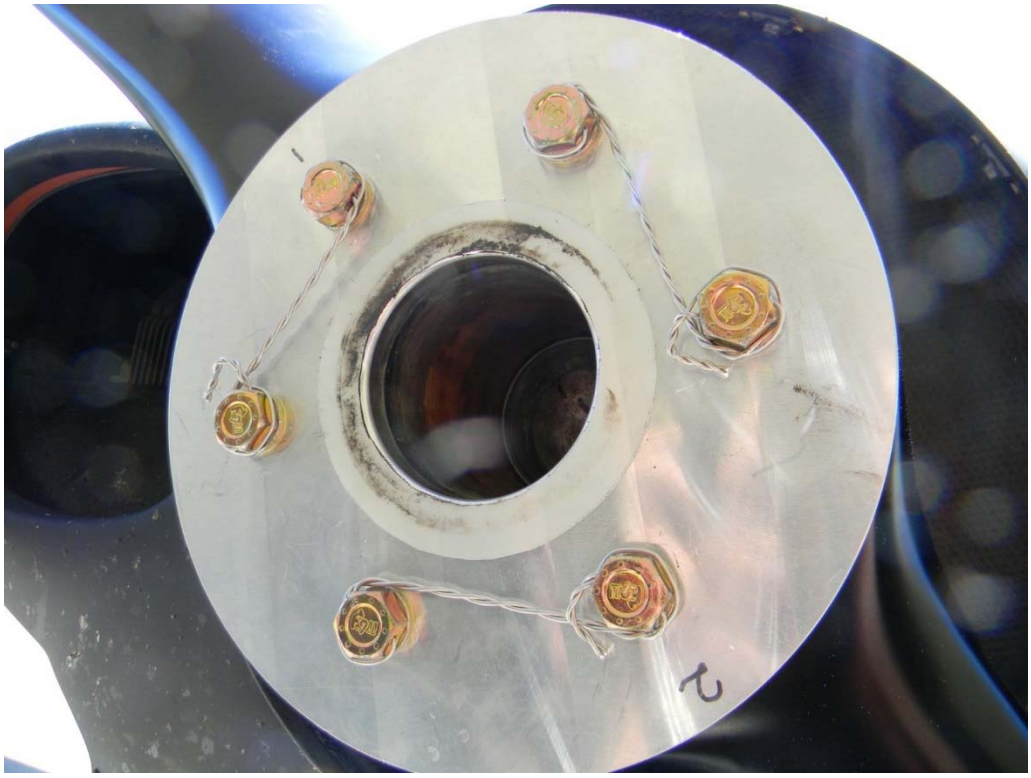
2.3.6 Using the standard ratchet, tighten all the bolts using a star pattern until the propeller and spinner assembly are snug. Ensure that the propeller bolts have adequate overall length (minimum 3 threads out the back). Verify that the propeller bolt threads do not “bottom out” onto the threaded engine or extension lugs. Verify thread length does not interfere with the engine case or impede movement of the propeller with surrounding components.

2.3.7 Using a current calibrated torque wrench, tighten the attaching bolts in small increments, 3 to 5 pounds at a time, moving diagonally along the bolt circle. It is good practice to check blade track frequently while tightening the bolts. Take care to tighten bolts on opposite sides of the blade centerline evenly so that blade-to-blade conformity of angles is maintained. **Torque all bolts to the recommended torque as described in this manual and on the propeller data label.** *Caution: Over-torqueing the propeller attaching bolts will cause the hub to crush!* It is important to note that the torque recommendation does not consider variations of thread condition, and assumes that the threads of the bolts, nuts or drive bushings are clean. Never use lubricant on the bolt threads, use of paraffin wax is acceptable.

2.3.8 Check track of the blade tips by rotating the tips past some fixed object on the floor. The tips must track within 1/8” inch of each other when the installation is complete. Blade track can be checked

3 to 5 inched from each tip and down the trailing edge on the back (or flat side) of the propeller.

2.3.9 Install stainless steel safety wire 0.041inch in accordance with the double twist method of standard safety wire practices for aircraft as outlined in the current version of FAA AC 43.13-1B. (http://www.faa.gov/regulations_policies/advisory_circulars/index.cfm)



2.3.10 If a spinner is used, place the spinner dome over the propeller and align the screw holes in the spinner dome and bulkhead flange(s). Install spinner screws per spinner installation instructions.

2.3.11 Check bolt torque after first 2 to 3 hours of operation and then again at 10 to 15 hours. After that, it is mandatory to recheck the bolt torque every 50 hours or 6 months, whichever comes first.

3.0 TORQUE INFORMATION, MAINTENANCE AND INSPECTION PROCEDURES

3.1 Maintaining proper bolt torque is the most important maintenance item for a propeller. Loss of proper bolt torque will result in the decrease or loss of hub compression and thus the loss of drive friction between the propeller mounting hub face and the engine. At this point the engine power pulses are transferred only by the engine lugs and attaching bolts. This will begin to elongate the bolt holes in the propeller. *This can eventually cause elongation in the hub and/or failure of the attaching bolts and possible separation of the propeller from the aircraft.*

It is important to comply with the following torque, maintenance and inspection schedules.

3.2 Torque Inspection Procedures

3.2.1 Ensure that the magneto switch is off, and that both magnetos are grounded and or electronic ignition circuit breakers are pulled. Remove the spinner dome, if applicable, remove safety wire.

3.2.2 With a current calibrated torque wrench, set your torque wrench 5 pounds under the rated torque setting. Check bolt torque by applying the torque in a tightening direction. With the torque setting set 5 pounds under the desired rating, if the wrench does not "click" and the bolt turns, then you know the bolt torque has reduced substantially. If the wrench "clicks" before the bolt turns then your torque value has held within a safe margin. Bring the bolts up to the rated torque value. *DO NOT OVERTORQUE YOUR PROPELLER BOLTS.*

3.2.3 If the propeller bolt torque has come off more than 5 pounds, i.e., the bolts turn when torque wrench is set to 5lbs less than the torque value, then remove propeller in accordance with the instructions for removal of propeller and inspect the propeller as outlined in this manual. If the propeller passes inspections, or had a torque value within 5 lbs. of installation value then re-install and re-torque the propeller in accordance with the procedures outlined in this manual.

3.2.4 If the torque is at the installation value then no further action is necessary, continue with the installation procedures as outlined in Chapter 2.

3.3 Torque Inspection Intervals

3.3.1 Check bolt torque after first 2 to 3 hours of operation and then again at 10 to 15 hours. After that it is mandatory to recheck the bolt torque every 50 hours or 6 months, whichever comes first.

3.3.2 After the first 2 to 3 hours, recheck bolt torque in accordance with 3.2 Torque Inspection Procedure.

3.3.3 After the first 10 to 15 hours, recheck bolt torque in accordance with 3.2 Torque Inspection Procedure

3.3.4 After the first 50hours or 6 months of installation, recheck bolt torque in accordance with 3.2 Torque Inspection Procedure.
If there are any significant changes in environmental conditions (+/- 40^{o}F in temperature, and +/- 50% relative humidity consistent with changing environmental seasons) the propeller bolt torque must be rechecked.

3.4 Hub Inspection Procedures

3.4.1 Ensure that the magneto switch is off, and that both magnetos are grounded and or electronic ignition circuit breakers are pulled. Remove the spinner dome, if applicable.

3.4.2 Remove safety wire on the propeller mounting bolts. Loosen and remove bolts, crush plate, and front spinner bulkhead (if

applicable). Remove propeller from flange. A slight rocking may be necessary to remove the propeller, use caution when removing so as not to damage or bend any of the connection faces on the flange or on the aluminum side of the propeller hub.

3.4.3 Clean both propeller hub faces with de-natured alcohol.

3.4.4 Inspect propeller hub face for any galling of the aluminum, cracks or elongation of the bolt holes.

3.4.4.1 Galling of the aluminum plate generally occurs concurrently with an elongation of the bolts or bolt holes. *If ANY bolt-hole elongation is more than .010" inch then the propeller must be returned to **CATTO** for a closer inspection and the attaching bolts must be replaced.*

3.4.5 Inspect the spinner rear bulkhead and engine flange for fretting. If the fretting is severe and cannot be dressed out with emery cloth and re-anodized (for aluminum parts only) then the parts must be replaced. Clean the flange faces for re-installation.

4.0 REMOVAL PROCEDURES

4.1 If the propeller was installed with a spinner, the spinner dome and screws must be removed.

4.2 Cut and remove all safety wire.

4.3 Using a standard ratchet wrench, loosen all bolts gently one by one, releasing torque in small intervals in a star pattern and then remove bolts one by one, carefully supporting the propeller so the weight is not supported by the bolts.

4.4 Remove bolt, propeller and crush plate.

5.0 OPERATION LIMITATIONS

5.1 The maximum continuous design RPM and the maximum operating RPM, or Red Line rpm can be found be referencing the most current revision of the appropriate datasheet for your series propeller as listed below.

Propeller Series	Datasheet
CT100/	CATTO-CP-07-CT100

6.0 LIFE LIMITATIONS

6.1 Nickel Leading Edge – The propeller shall be returned to either ***CATTO*** Propellers or an approved service agent for inspection after 500 hours of operation or five years, whichever comes first. The nickel leading edge is to be inspected in accordance with ***CATTO's*** Operations and Repair Manual, with dye penetrant to check for any cracks, fractures or subsequent fatigue in the metal. If the nickel leading edge has shown evidence of any cracks or fractures the propeller must be returned to ***CATTO*** for replacement.

6.2 While the propeller core and composites themselves have no life limit; the propeller will be inspected while the propeller is in for nickel leading edge inspection, in accordance with ***CATTO's*** Operations and Repair Manual to ensure the return to service of a high quality propeller.

7.0 MANUFACTURER'S RECOMMENDATIONS

7.1 Always inspect the overall propeller condition during each preflight.
7.2 Using the butt end of a screwdriver, tap the Nickel Leading Edges for change in sound, higher pitch vs. lower pitch. The pitch sounds should be constant.
7.3 Inspect and check propeller attaching bolt torque at least every 50 hours according to the Torque Procedures outlined in this manual. More frequent inspection may be necessary when climatic changes are extreme, such as change of season.
7.4 When the propeller is not in use, place the propeller in a horizontal position and if it is exposed to the weather, cover it with a waterproof cover.
7.5 Do not use the propeller as a tow-bar to move your aircraft.
7.6 Protect your propeller from moisture and UV exposure by waxing with an automotive type paste wax at least once a year.
7.7 Touch up cuts, nicks, scratches no deeper than 1/32" inch or 3" inch in length with any sandable epoxy paste such as JB Weld. Return the propeller to ***CATTO*** for areas with signs of fatigue or damage in the composites or nickel leading edge, or nicks, scratches or cuts greater than 1/32" inch deep or 3" inch in length.
7.8 Assume that your propeller is un-airworthy after any kind of impact. Contact ***CATTO*** to determine the extent of damage.
7.9 Any major repairs or alterations must be completed by ***CATTO*** or one of its recognized repair stations.
7.10 Never repaint your propeller for any reason. This will cause the propeller to go out of balance and can cause major vibrational damage to your airframe.
7.11 If your propeller shows any of the following damage, it should be removed from service:
    7.11.1 Cracks in hub bore or bolt holes.
    7.11.2 Visually Bubbled or Separated surface lamination
    7.11.3 Oversize or elongated hub bore or bolt holes.
    7.11.4 If there is any major visual damage due to impact.
    7.11.5 Obvious damage or wear beyond economical repair.

8.0 TROUBLESHOOTING STATIC AND FLIGHT RPM

The following are a list of possible reasons why there are inaccurate static and flight RPM readings which can affect the performance of your propeller. *NOTE: EACH PROPELLER IS BUILT ACCORDING TO ENGINE SPECIFICATIONS PROVIDED*

BY THE CUSTOMER. IT IS IMPORTANT TO VERIFY AIRCRAFT AND ENGINE CONFIGURATION IN ORDER TO ENSURE OPTIMUM PROPELLER EFFICIENCY.

8.1 Verify the accuracy of mechanical tachometers with a digital or optical hand held tachometer (View-Thru or Prop-Tach are acceptable types of digital tachometers or local service and repair facilities can assist in verifying tachometer).

8.1.1 During verification of the tachometer, try both of the following:

8.1.1.1 Try to lean the engine. A small amount of leaning should increase static RPM. If the engine quits after a small amount of leaning, then the engine is too lean. If excessive leaning is required, then the engine is running too rich.

8.2 Verify that the internal timing of the engine is correct.

8.2.1 Incorrect timing can cause serious performance problems, such as low Static RPM but correct Flight RPM.

8.2.1.1 Remove upper plug from cylinder #1.

8.2.1.2 Remove rocker from cylinder #2.

8.2.1.3 Rotate crankshaft until cylinder #1 is Top Dead Center.

8.2.1.4 Looking at cylinder #2 rocker arms, rotate the propeller back and forth. You should see one valve opening and the other closed when you rotate in one direction and the opposite value open when the propeller is rotated the other way. This is the overlap area.

8.2.1.5 If the propeller has to be rotated more than 20 degrees to either side of TDC then the timing gears are one (1) tooth out of time. This must be corrected prior to any further diagnostics being performed.

8.2.2 For EXPERIMENTAL AIRCRAFT**,** it's very important to verify the following additional checks:

8.2.2.1 Ensure that the throttle is connected properly, i.e. does the throttle valve open fully when the throttle is in the full or wide open throttle position.

8.2.2.2 Ensure that the induction system is functioning properly, i.e. is the carb heat closing properly (don't want inadvertent heating of the induction air because this causes power loss) or are there any blockages in the induction system.

8.2.2.3 Is the engine fitted with the proper carburetor and or fuel pump? Each installation requires a certain carburetor and fuel pump and settings based on induction system, exhaust, etc. Have the customer check with the Kit manufacturer (1st) and Engine Manufacturer (2nd) to verify proper components.

9.0 MASS MOMENT OF INERTIA

9.1 The propeller mass moment of inertia can be found be referencing the most current revision of the appropriate datasheet for your series propeller as listed below.

Propeller Series	Datasheet
CT100/	CATTO-CP-07-CT100

Feel free to contact CATTO propellers if you have any additional questions, comments, requests or concerns.

Catto Propellers 12370 Airport Rd. Jackson, CA 95642 USA +1 (209) 754-3553

APPENDIX A

Important information about installation of CATTO propellers on -360, -375, -390 and -540 Engines.

An adapter kit is required to safely install a CATTO propeller on any of the engines listed above. The reason is these engines are typically set up for the installation of a metal fixed pitch or metal Constant Speed propeller, not for wood or composite propellers.

The ¾" diameter lugs that protrude from the engine propeller flange are very short. These drive lugs will not protrude into the propeller enough to safely transfer the power pulses and HP to the propeller.

The flange on the propeller is 7" in diameter and thus needs to be mounted onto a 7" diameter flange on the engine. This is done through one of the adapter kits available. There are three possible adapters you may use, the ETP kit, 1" spacer kit, or propeller extension.

The ETP Kit consists of a set of new longer ¾" diameter engine lugs. A 7" diameter x ¼" thick aluminum plate is placed over the lugs before the propeller is bolted on. This now gives you the 7" diameter mounting face you need along with proper lug engagement into the propeller. On the outer face of the propeller is the 3/8" or ½" thick x 7" diameter crush plate. Also, included in the kit is your new propeller bolts.

The 1” spacer kit is a very simple installation and easily snaps on the face of the starter ring gear of the engine. The new face on the 1” spacer kit has the longer ¾” lugs and is 7” in diameter to match the 7” diameter face of the propeller. The kit also includes either a 3/8” or ½” thick crush plate and new longer propeller bolts.

Propeller extensions are available from 2” to 8” in length. All of the extensions will have the longer ¾” lugs on the mounting face and are 7” in diameter. These extensions are first bolted onto the face of your starter ring gear with a set of 6 bolts. The torque value used is higher than that of the propeller as this is a metallic installation. Once the extension is bolted onto the engine, the propeller can be installed with the 3/8” or ½” thick x 7” diameter crush plate located on the face of the propeller. The six propeller bolts are then torqued to the recommended torque value. All of the above installation kits are available from Catto Propellers or direct from Saber Manufacturing at 817-326-6293. www.sabermfg.com