

# WOOD PROPELLERS: INSTALLATION, OPERATION, & MAINTENANCE



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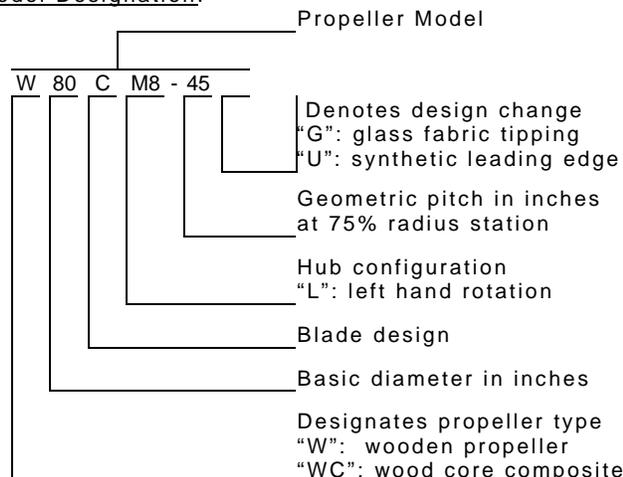
## INTEGRAL FLANGE CRANKSHAFTS

DOC#: WOOD-CF-REV-A.DOC 5-20-04

Your Sensenich wood propeller was manufactured from aircraft quality selected lumber. The laminations were bonded with high-strength waterproof resorcinol glue, and were assembled under closely controlled factory conditions. Propeller balance was strictly maintained during manufacture and verified before shipment from the factory. Assembly of Type Certificated propeller / engine / aircraft must be accomplished by personnel holding the appropriate FAA license.

Installation of the propeller must be carefully completed, as it has been shown that an engine must deliver its driving torque to a wood 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 wood surface against the flange. Therefore it is important to compress the wood to its maximum during propeller installation, but also important to avoid crushing the wood. 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.

### Model Designation:



Installation of the propeller will require a front face plate of adequate stiffness (approximately the same area and thickness as the engine flange), a set of attaching bolts of the proper length, and in some cases a spinner assembly and/or flange adapter.

Recommended wrench torques to achieve proper hub compression against standard flanges are given in **Table 1**. These torque recommendations do not consider variations of thread condition, and assumes that the threads of the bolts, nuts, or drive bushings are clean.

### PRE-INSTALLATION PREPARATION:

1. Be certain that the magneto switch is "off" and that both magnetos are grounded. Chock the aircraft wheels to prevent movement.
2. 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.
3. Clean both propeller hub faces and mounting flange. Use a clean cloth and de-natured alcohol to insure both faces are clean of grease and oil.

### INSTALLATION PROCEDURE:

Installation of the propeller requires: face plate, attaching bolts, and washers. Some installations may also require some or all of the following: spinner assembly, flange adapter, propeller-to-engine plate, lock nuts, etc.

1. Install the flange adapter, if required. Wrench torque recommendations for adapter mounting bolts are listed in **Table 3**. Lock and safety wire the bolts. NOTE: Some adapters require safety wire through the bolt heads, others incorporate safety-wired set-screws.
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. If used, place the propeller-to-engine plate on the engine flange. In some cases the propeller-to-engine plate may need to be installed before the spinner rear bulkhead.

3. Locate the propeller on the engine flange with blade number 1 (#1 stamped on front hub face) at the 10 o'clock position.
4. Place the spinner front bulkhead (if needed) and face plate on the opposite hub face and insert bolts through the assembly.
5. Using a standard ratchet, tighten all the bolts using a star pattern until the propeller and spinner assembly is snug. Ensure that the propeller attaching bolts have adequate overall length and remaining threads for final torquing.
6. Using a calibrated torque wrench, tighten the attaching bolts in small increments, moving diagonally across 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 values as specified in **Table 1**.

**TABLE 1  
WOOD PROPELLER INSTALLATION  
RECOMMENDED WRENCH TORQUES**

Size of Steel Aircraft Bolts Spec.		Recommended Wrench Torque Range*		
dia. (in)		(in-lbs)	(ft-lbs)	N-m
AN4	1/4	120 - 140	10 to 12	14 to 16
AN5	5/16	130 - 160	11 to 13	15 to 18
AN6	3/8	175 - 225	15 to 19	20 to 25
AN7	7/16	225 - 275	19 to 23	25 to 31
AN8	1/2	275 - 325	23 to 27	31 to 37

**CAUTION:** Over-tightening propeller attaching bolts will cause the wood of the hub to crush, breaking its moisture seal and slightly reducing drive-torque capacity of the installation.

**\*NOTE REGARDING SELF LOCKING NUTS:** For self locking nuts only, add nut drag torque to the torque values above.

7. Check track of the blade tips by rotating the tips past some fixed object on the floor. The tips must track within 1/8" of each other when the installation is completed.
8. Install safety wire. It is good practice to wire the attaching bolts in pairs (not a continuous wire), twisting the wire between bolt heads.
9. 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.

10. Check bolt torque after first flight and after the initial 25 flight hours. Refer to the Bolt Torque Check Procedure.

**PROPELLER MAINTENANCE (BOLT TORQUE):**

Maintaining proper bolt torque is the most important maintenance item for a wooden 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 or spool drive flange. At this point the torque is transferred only by the engine flange drive bushings and attaching bolts, which will begin to elongate the bolt holes and counterbores in the rear face of the wooden propeller. **This can eventually cause cracking in the hub and/or failure of the attaching bolts and possible separation of the propeller from the aircraft.**

The main factor that leads to the loss of propeller bolt torque is the variation of the wood hub thickness. The hub thickness will vary with (a) wood moisture content changes and (b) temperature changes. Even though your propeller has been sealed and/ or painted, changes in wood moisture content will occur which can significantly change the thickness of the hub. A one percent (1%) change in the moisture content of a propeller (increase / decrease) will cause a 0.010" change in hub thickness. As the required compression for a typical 65 HP wood propeller is 0.021", almost half of the required hub compression has now been lost. Moisture content changes are not immediate and can span several weeks or months, depending on many factors such as temperature, humidity, and operating schedules. Operating temperature changes have similar effects but are not as severe.

For the above reasons, it is important to follow the maintenance schedule below:

1. **After First Flight** – After the first flight, recheck the bolt torque. Refer to Bolt Torque Check Procedure and **Table 2**.
2. **After First 25 Hours** – After the first 25 hours, recheck the propeller bolt torque. Refer to Bolt Torque Check Procedure and **Table 2**.
3. **Every 50 Hours** – After the first 25 hour recheck, it is **Mandatory** that the propeller bolt torque be rechecked every 50 hours. Refer to Bolt Torque Check Procedure and **Table 2**.
4. **Environment Changes** - Should the operating environment change significantly in temperature and/or humidity for a long period of time, the propeller bolt torque must be rechecked.

## BOLT TORQUE CHECK PROCEDURE:

1. Be certain that magneto switch is off, and that both magnetos are grounded. Remove the spinner dome, if applicable. Remove safety wire on propeller mounting bolts.
2. With a calibrated torque wrench, check bolt torque by applying the torque in a tightening direction until the bolt begins to turn. Torque check values and required actions are given in **Table 2**.

**IMPORTANT!** Improper torque values will be obtained by measuring the breaking torque in a loosening direction. The torque should be checked in a tightening direction and adjusted as needed.

**TABLE 2.  
BOLT TORQUE CHECK VALUES / ACTIONS**

Bolt Size	Actual Torque*	Required Action
AN4 ¼" bolts	Below 80 (in-lbs) 7 (ft-lbs) 9 (N-m)	<b>Remove Propeller</b> Inspect hub for damage (see <b>Propeller Hub Inspections</b> section)
	Between 80-120 (in-lbs)	<b>Adjust torque, see Table 1.</b>
	Between 120-140 (in-lbs)	<b>No further action required</b>
	Above 140 (in-lbs)	<b>Loosen Bolts, re-torque see Table 1</b>
AN5 5/16" bolts	Below 87 (in-lbs) 7 (ft-lbs) 10 (N-m)	<b>Remove Propeller</b> Inspect hub for damage (see <b>Propeller Hub Inspections</b> section)
	Between 87-130 (in-lbs)	<b>Adjust torque, see Table 1.</b>
	Between 130-160 (in-lbs)	<b>No further action required</b>
	Above 160 (in-lbs)	<b>Loosen Bolts, re-torque see Table 1</b>
AN6 3/8" bolts	Below 117 (in-lbs) 10 (ft-lbs) 13 (N-m)	<b>Remove Propeller</b> Inspect hub for damage (see <b>Propeller Hub Inspections</b> section)
	Between 117-175 (in-lbs)	<b>Adjust torque, see Table 1.</b>
	Between 175-225 (in-lbs)	<b>No further action required</b>
	Above 225 (in-lbs)	<b>Loosen Bolts, re-torque see Table 1</b>
AN7 7/16" bolts	Below 150 (in-lbs) 13 (ft-lbs) 17 (N-m)	<b>Remove Propeller</b> Inspect hub for damage (see <b>Propeller Hub Inspections</b> section)
	Between 150-225 (in-lbs)	<b>Adjust torque, see Table 1.</b>
	Between 225-275 (in-lbs)	<b>No further action required</b>
	Above 275 (in-lbs)	<b>Loosen Bolts, re-torque see Table 1</b>
AN8 ½" bolts	Below 183 (in-lbs) 15 (ft-lbs) 21 (N-m)	<b>Remove Propeller</b> Inspect hub for damage (see <b>Propeller Hub Inspections</b> section)
	Between 183-275 (in-lbs)	<b>Adjust torque, see Table 1.</b>
	Between 275-325 (in-lbs)	<b>No further action required</b>
	Above 325 (in-lbs)	<b>Loosen Bolts, re-torque see Table 1</b>

**\*NOTE REGARDING SELF LOCKING NUTS:** For self locking nuts only, add nut drag torque to the torque values above.

## PROPELLER HUB INSPECTIONS:

1. Be certain that magneto switch is off, and that both magnetos are grounded. Remove the spinner dome, if applicable.
2. Remove safety wire on propeller mounting bolts. Loosen and remove bolts, face plate, and front spinner bulkhead (if used).
3. Remove propeller from flange. A slight rocking may be necessary to remove propeller. Be careful during the removal; if the propeller is tight on the flange it is possible to tear out the back of the hub around the center bore and bolt hole counterbores.
4. Clean both propeller hub faces using light grit scotch pad and de-natured alcohol. It should be possible to remove most of any fretting marks and darkened areas.
5. Inspect the propeller rear hub face for cracks and or elongation of the bolt holes and/or counterbores where the engine flange drive bushings are inserted.

(a) **Cracks** - If cracks are evident on the hub face, take a razor blade and very gently try to insert a corner of the blade. Most cracks will be paint cracks only, however, if the tip of the razor easily goes into a crack more than 1/16" then the propeller must be returned to the factory for closer inspection.

(b) **Bolthole/Counterbore Elongation** - The bolt-holes and counterbores will naturally elongate since the wood will shrink and expand differently with and against the grain. When inspecting the counterbores, look for a ridge from .375 - .75" deep from the mounting hub face that would indicate that the flange drive bushings were hitting against the side. Also check the bolt holes for elongation. If any bolt hole elongation or ridge height inside a counterbore is more than 1/32", then the propeller **MUST** be returned to Sensenich Wood Propeller factory for closer inspection and the attaching bolts **MUST** be replaced.

6. 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-alodined (for aluminum parts only), then the parts must be replaced. Clean the flange faces for re-installation.

**TABLE NO. 3  
PROP ADAPTER INSTALLATION (not for wood props)  
RECOMMENDED WRENCH TORQUE**

Size of Steel Aircraft Bolts Specification	dia. (inches)	Recommended Wrench Torque (in-lbs)
AN6	3/8	280 to 300
AN7	7/16	480 to 540
AN8	1/2	720 to 780

**NOTE:** These torque values are only for mounting prop adapters on engine flanges. **DO NOT** use these torques for mounting wooden propellers.

## AIRWORTHINESS LIMITATIONS

The Airworthiness Limitations section is FAA approved and specifies maintenance required under sections 43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved.

Life limited components - None

## CONTINUED AIRWORTHINESS REQUIREMENTS:

The following practices will add to the service life of your wood propeller.

1. Inspect and check propeller attaching bolt torque at least every 50 hours according to the Bolt Torque Check Procedure and Propeller Maintenance sections. More frequent inspection may be necessary when climatic changes are extreme, such as change of seasons.
2. 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.
3. Do not use the propeller as a tow-bar to move your aircraft.
4. Protect your propeller from moisture and UV exposure by waxing with an automotive type paste wax at least once a year. Keep the tip drain holes in metal tipping clear.
5. Avoid running-up in areas containing loose stones and gravel.
6. Finish loss off the leading edge is a normal wear item, and is dependent on the amount of operation in rain and grit.
7. Touch up worn finish areas and scratches with spar varnish. Return the propeller to the factory or approved repair station for total areas larger than 4x4" or scratches deeper than 1/32".
8. Inspect frequently for bruises, scars, or other damage to wood and blade leading edge protection. Damage to the wood or leading edge that is 1/16" deep or less without breaking the finish is acceptable.
9. Assume that your propeller is un-airworthy after any kind of impact until it has been inspected by qualified personnel.
10. All wood and metal tipping repairs must be made by an FAA approved propeller repair station or at the factory.  
NOTE: The saw slots in metal tipping are designed to crack across after several hours of use. This prevents cracks from occurring at other locations.
11. Check propeller balance whenever there is evidence of roughness on operation. For new

propeller installations, rotating the propeller 180 degrees and reinstalling will often help.

12. If your propeller begins to show any of the following damage, it should be retired from service:

- (a) Cracks in hub bore, bolt holes or counter bores,
- (b) A deep cut across the wood grain,
- (c) A long, wide, or deep crack parallel to the grain,
- (d) A separated lamination,
- (e) Oversize or elongated hub bore or bolt holes,
- (f) An appreciable warp (discovered by inspection or through rough operation),
- (g) More than 1" of the tips broken or an appreciable portion of wood missing,

or (h) Obvious damage or wear beyond economical repair.

NOTE: There is no specified overhaul time. The propeller is removed from service when it does not meet the Continued Airworthiness Requirements.

Factory repairs are done in accordance with process specification SP-123.

## PROPELLER PERFORMANCE

In selecting a propeller, keep in mind that both aircraft and engines of the same model may vary in performance, and that operators may want different performance characteristics. For instance, one person may require a high climb rate while another seeks maximum cruising efficiency.

### STANDARD PITCH / NORMAL FLYING

For normal or cross country flying, a fixed pitch propeller that turns between rated engine RPM and 50 RPM over rated at full throttle level flight at sea level will give best all-around performance.

### CRUISE PITCH

A cruise propeller will turn 50 to 100 RPM under rated engine RPM at full throttle level flight. While cruise pitches will provide 4-6 mph higher airspeeds at cruise power rpm's, maximum level flight speeds are no better than climb or standard pitches, and the take-off and climb performance will noticeably suffer.

### CLIMB PITCH / HIGH ALTITUDE OPERATION

For improved take-off and climb performance, use a climb pitch propeller that will turn 100 to 150 RPM over rated engine RPM at full throttle level flight (*refer to your particular aircraft Type Certificate for propeller limitations*). Climb pitches will typically reduce flight speeds by 4-6 mph at cruise power RPM's. A climb pitch is also recommended for aircraft operating from high density altitude runways.