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W69EK7 SERIES WOOD PROPELLER WITH 7/16" BOLT ATTACHMENT FOR DIAMOND DA-20-C1 AIRCRAFT: INSTALLATION, OPERATION, & MAINTENANCE Doc # W69EK7-CF Rev H 10-29-17

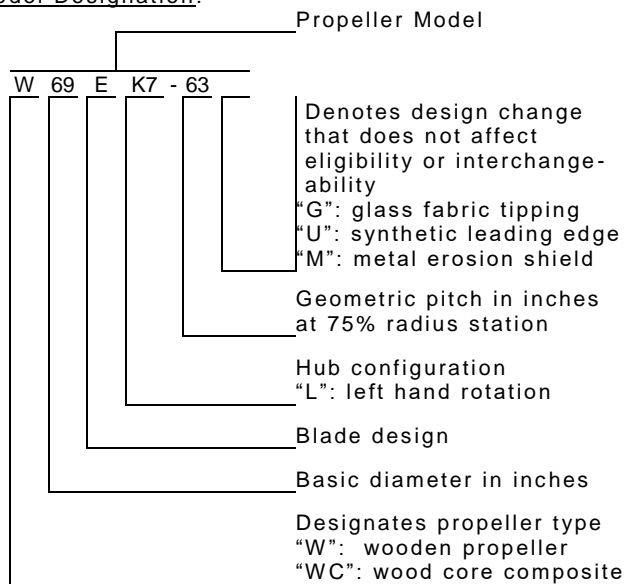
Your Sensenich wood propeller was manufactured from aircraft quality selected lumber. The laminations are bonded with high-strength waterproof resorcinol glue, and were assembled under closely controlled factory conditions. Propeller balance was strictly maintained during manufacture and verified before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

which point the side loads will rapidly lead to cracks in the propeller hub and/or failure of the propeller bolts.

It is recommended to install the W69EK7 series propeller on the DA20-C1 using MS21044N7 self locking nuts. It is also allowable to use AN310-7 castellated nuts with cotter pins. Installation and maintenance instructions for the propeller installed with castellated nuts are also given in this document. Use of the castellated nuts makes repetitive checking of the torque more difficult since the nuts must be aligned with the cotter pin holes in the bolts.

A bolt with extended thread is available. It is recommended that the extended thread bolt be used to attach the propeller. These bolts do not require the use of shims to ensure proper thread engagement.

Model Designation:



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. Install the spool adapter, if required. Spool adapter installation instructions are provided in the Diamond Aircraft Maintenance Manual. Clean the spool face.
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.
4. Clean both propeller faces using light grit scotch-brite pad and de-natured alcohol. Use a clean cloth and alcohol to insure both faces are clean.
5. Make sure the propeller attaching bolts, and the threads in the drive bushings are clean and dry.

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, they only drive the propeller if the prop bolts get loose on the flange, at

REQUIRED COMPONENTS (SELF LOCKING NUTS)

| P/N | DESCRIPTION | P/N SOURCE |
|---|----------------------------|-------------------|
| W69EK7-() | propeller | Sensenich |
| MS9320-13 | washers | |
| 22-6103-00-03 | 7/16" extended thread bolt | Diamond/Sensenich |
| MS21044N7 | Self locking nut | |
| 22-6103-60-00 | spinner rear bulkhead | Diamond |
| 22-6103-61-01 | spinner aft cone | Diamond |
| 22-6103-62-01 | spinner front cone | Diamond |
| 22-6103-00-01 | face plate | Diamond |
| 22-6103-01-00 | propeller spool extension | Diamond |
| Alternative Installation (in place of extended thread bolt) | | |
| AN7-47A | attaching bolts | |
| AN960-716 or NAS 1149F0763P | washers | |
| AN960-716L or NAS 1149F0732P | washers | |

Note: The 22-6103-00-03 extended thread bolts are identified by the D, A and X markings on the head.

INSTALLATION PROCEDURE (SELF LOCKING NUTS):

Installation of the propeller requires a front face plate, spinner assembly, attaching bolts, washer(s), and self locking nuts.

- Place the spinner rear bulkhead onto the spool flange. Orient the bulkhead so that the propeller blades will be horizontal.
- Locate the propeller on the spool flange with blade number 1 (#1 stamped on front hub face) at the 9 o'clock position.
- Place the spinner aft cone and face plate on the front hub face and insert bolts through the assembly. The bolt heads must be aligned with the face plate to avoid rotation.
- Align the screw holes in the spinner aft cone and rear bulkhead flange. Install self-locking nuts and MS9320-13 washers. If using the AN7-47A bolts use AN960-716 or AN960-716L washers under the nut as required to get 1-3 threads above nut. If these washers are required, add the same to all bolts.

If using 22-6103-00-03 extended thread bolts then more than 3 threads above nut are allowed and AN960-716 or AN960-716L shim washers are not required.

- Using a standard ratchet, tighten all the nuts using a star pattern until the propeller and spinner assembly is snug.

- Tighten the attaching nuts in small increments, moving diagonally across the bolt circle. It is good practice to check blade track frequently while tightening the nuts. Take care to tighten nuts on opposite sides of the blade centerline evenly so that blade-to-blade conformity of angles is maintained. Torque all nuts to the minimum as specified in **Table 1. This value includes the nut drag torque.**

**TABLE 1.
ATTACHING BOLT INSTALLATION TORQUE
(SELF LOCKING NUTS ONLY)**

| Recommended Bolt Torque | |
|-------------------------|--------------|
| Minimum | Maximum |
| 370 (in-lbs) | 380 (in-lbs) |
| 31 (ft-lbs) | 32 (ft-lbs) |
| 42 (N-m) | 43 (N-m) |

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.

- Since a small part of the wood compression is plastic (permanent), it is good practice to allow the wood to stabilize for one hour under full torque. After one hour check the torque (in a tightening direction) and retighten if needed. **DO NOT** remove the bolt torque, rather apply the torque in a tightening direction.
- Check the tip track of the propeller. The track should be within 1/8".

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 which will begin to elongate the 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 can occur and 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 the W69EK7 propeller

is 0.020", 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 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 for **self locking nuts**:

1. **After First Flight** – After the first flight, recheck the bolt torque. Refer to Bolt Torque Check Procedure (Self Locking Nuts Only) and **Table 2**.
2. **After First 25 Hours** – After the first 25 hours, recheck the propeller bolt torque. Refer to Bolt Torque Check Procedure (Self Locking Nuts Only) 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 (Self Locking Nuts Only) 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:
(SELF LOCKING NUTS)**

1. Be certain that magneto switch is off, and that both magnetos are grounded.
2. With a calibrated dial type torque wrench, check nut torque by applying the torque in a tightening direction until the nut begins to turn. Check torque limits 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.

IMPORTANT! If using AN7-47A bolts be certain that no more than 3 threads are showing above nut. Add AN960-716 or AN960-716L washers if required. Add the same to all bolts.

If using 22-6103-00-03 extended thread bolts then more than 3 threads showing is allowed and AN960-716 or AN960-716L shim washers are not required.

TABLE 2.

**BOLT TORQUE CHECK VALUES / ACTIONS
(SELF LOCKING NUTS)**

| Actual Torque | Required Action |
|---|---|
| Below 230 (in-lbs) 19 (ft-lbs) 26 (N-m) | Remove Propeller Inspect hub for damage (see propeller hub inspections section) |
| Between 230 - 370 (in-lbs) | Adjust torque, see Table 1. |
| Between 370 - 380 (in-lbs) | No further action Required |
| Above 380 (in-lbs) | Loosen Bolts, re-torque see Table 1 |

REQUIRED COMPONENTS (CASTELLATED NUTS):

It is recommended to install the W69EK7 propeller with self locking nuts as described above. However, it is also possible to install the propeller with castellated nuts and cotter pins.

| P/N | DESCRIPTION | P/N SOURCE |
|---------------------------------|---------------------------|------------|
| W69EK7-() | propeller | Sensenich |
| AN7-47 | attaching bolts | |
| AN960-716 or NAS 1149F0763P | washers | |
| AN960-716L or NAS 1149F0732P | washers | |
| AN310-7 | castellated nuts | |
| MS24665-300 | cotter pins | |
| 22-6103-60-00 | spinner rear bulkhead | Diamond |
| 22-6103-61-01 | spinner aft cone | Diamond |
| 22-6103-62-01 | spinner front cone | Diamond |
| 22-6103-00-01 | face plate | Diamond |
| 22-6103-01-00 | propeller spool extension | Diamond |

INSTALLATION PROCEDURE (CASTELLATED NUTS):

Installation of the propeller requires a front face plate, spinner assembly, attaching bolts, washer(s), castellated nuts, and cotter pins.

1. Place the spinner rear bulkhead onto the spool flange. Orient the bulkhead so that the propeller blades will be horizontal.
2. Locate the propeller on the spool flange with blade number 1 (#1 stamped on front hub face) at the 9 o'clock position.
3. Place the spinner aft cone and face plate on the front hub face and insert bolts through the assembly. The bolt heads must be aligned with the face plate to avoid rotation. The drilled cotter pin hole must be aligned as shown in **Figure 1**. Install washer(s) and castellated nuts finger tight lubricated with AeroShell 22 grease or equivalent (MIL-G-81322D). The nuts must thread on bolts freely.

- Align the screw holes in the spinner aft cone and rear bulkhead flange and, then using a standard ratchet, tighten all the nuts using a star pattern until the propeller and spinner assembly is snug.
- Tighten the attaching nuts in small increments, moving diagonally across the bolt circle. It is good practice to check blade track frequently while tightening the nuts. Take care to tighten nuts on opposite sides of the blade centerline evenly so that blade-to-blade conformity of angles is maintained. Torque all nuts to the minimum as specified **Table 3**. Ensure that 1-3 threads are showing above the nut. Adjust washers accordingly. Use the same on all bolts.

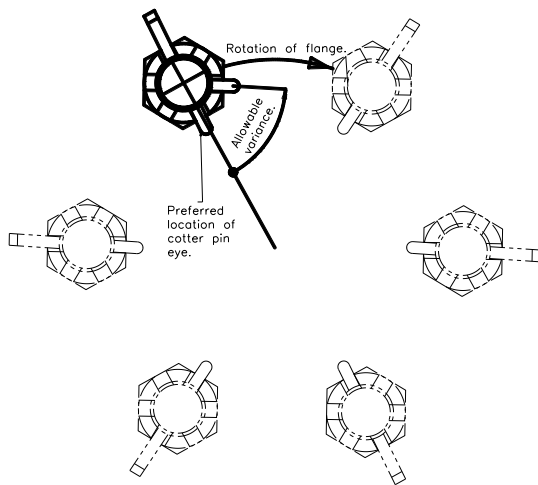


Figure 1
(Looking Forward)

TABLE 3.
ATTACHING BOLT INSTALLATION TORQUE
(CASTELLATED NUTS ONLY)

| Recommended Bolt Torque | |
|-------------------------|--------------|
| Minimum | Maximum |
| 285 (in-lbs) | 315 (in-lbs) |
| 24 (ft-lbs) | 26 (ft-lbs) |
| 32 (N-m) | 36 (N-m) |

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.

- Tighten the attaching nuts as necessary to align cotter pin holes while observing that the maximum torque as specified in **Table 3** is not exceeded.
- Since a small part of the wood compression is plastic (permanent), it is good practice to allow the wood to

stabilize for one hour under full torque. After one hour check the torque (in a tightening direction) and retighten if needed. **DO NOT** remove the bolt torque, rather apply the torque in a tightening direction.

- Check the tip track of the propeller. The track should be within 1/8".
 - Install cotter pins, reference **Figure 1**.
- PROPELLER MAINTENANCE (BOLT TORQUE):**

It is important to follow the maintenance schedule below for **castellated nuts**:

- After First Flight** – After the first flight, recheck the bolt torque. Refer to Bolt Torque Check Procedure (Castellated Nuts Only) and **Table 4**.
- After First 25 Hours** – After the first 25 hours, recheck the propeller bolt torque. Refer to Bolt Torque Check Procedure (Castellated Nuts Only) and **Table 4**.
- 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 (Castellated Nuts Only) and **Table 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:
(CASTELLATED NUTS ONLY)

- Be certain that magneto switch is off, and that both magnetos are grounded.
- Remove the six (6) cotter pins.
- With a calibrated dial type torque wrench, check nut torque by applying the torque in a tightening direction until the nut begins to turn. Check torque limits are given in **Table 4**.

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.

IMPORTANT! Be certain that the castellated nut is not bottomed on the grip portion of the bolt. Add AN960-716 or AN960-716L washers if required. Add the same to all bolts.

TABLE 4.

**BOLT TORQUE CHECK VALUES / ACTIONS
(CASTELLATED NUTS ONLY)**

| Actual Torque | Required Action |
|---|---|
| Below 190 (in-lbs) 16 (ft-lbs) 21 (N-m) | Remove Propeller Inspect hub for damage (see propeller hub inspections section) |
| Between 190-285 (in-lbs) | Adjust torque, see Table 1 |
| Between 285-315 (in-lbs) | No further action Required |
| Above 315 (in-lbs) | Loosen Bolts, re-torque see Table 1 |

PROPELLER HUB INSPECTIONS

- Remove the ten (10) screws from the spinner front cone.
- Loosen and remove nuts, then remove bolts, face plate, and spinner aft cone.
- Remove propeller from flange. A slight rocking may be necessary to remove propeller if tight on the flange. 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.
- 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.
- Inspect the propeller rear hub face for cracks and or elongation of the bolt hole counterbores where the engine flange drive bushings are inserted.
 - 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.
 - Bolthole/Counterbore Elongation** - The bolt holes and counterbores will naturally elongate as the wood will shrink and expand differently with and against the grain. When inspecting the counterbores, look for a ridge about 0.8" deep from the hub face that would indicate that the flange drive bushings were hitting against the side. If the ridge is higher than 1/32" then the propeller must be returned to Sensenich Wood Propeller factory for closer inspection and the attaching bolts **MUST** be replaced.
- Inspect the spinner rear bulkhead and engine extension flange for fretting. If the fretting is severe and cannot be dressed out with emery cloth and re-Alodined, then the parts must be replaced. Clean the flange faces for re-installation.

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.

- Check propeller attaching bolt torque at least every 50 hours according to the Bolt Torque Check Procedure and Propeller Maintenance sections. More frequent inspection is necessary when climatic changes are extreme, such as change of seasons.
- Store propeller in a horizontal position and cover with a waterproof cover if exposed to the weather.
- Do not use the propeller as a tow-bar to move your aircraft.
- Protect your propeller from moisture and UV exposure by waxing with an automotive type paste wax at least once a year.
- Avoid running-up in areas containing loose stones and gravel.
- Finish loss off the leading edge is a normal wear item, and is dependent on the amount of operation in rain and grit.
- 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".
- Inspect frequently for bruises, scars, or other damage to wood and blade leading edge protection. Damage to the wood or leading edge that is 1/8" deep or less without breaking the finish or puncturing the metal erosion shield is acceptable.
- Assume that your propeller is un-airworthy after any kind of impact until it has been inspected by qualified personnel.
- All wood and metal tipping repairs must be made by an FAA approved propeller repair station or at the factory.
- 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 removed from service and inspected by a rated repair station before next operation:

- (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 wood lamination,
- (e) Oversize or elongated hub bore or bolt holes,
- (f) Fabric tipping tears, delaminations or blisters totaling 2x2" or greater,
- (g) Significant damage to metal erosion shield, including cracks, looseness, edge debonds, puncture or erosion through metal or dents larger than 3/8 x 3/8 x 1/8",
- (h) An appreciable warp (discovered by inspection or through rough operation),
- (i) More than 1" of the tips broken or an appreciable portion of wood missing,
- or (j) 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.

Refer to "Supplemental Airworthiness Instructions for Bonded Metal Erosion Shields" Rev A dated 8-14-2018 for additional information on damage limits and inspection.

Refer to the latest FAA publication AC43.13 for further information on fixed-pitch wood propeller maintenance.

PROPELLER PERFORMANCE

In selecting a propeller, keep in mind 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.