

# Propeller Bolt Torque Procedure

Gary Hertzler

[Hertzler@yahoo.com](mailto:Hertzler@yahoo.com)

Columbia flyin

May 2024

# Bolt Patterns – AS127

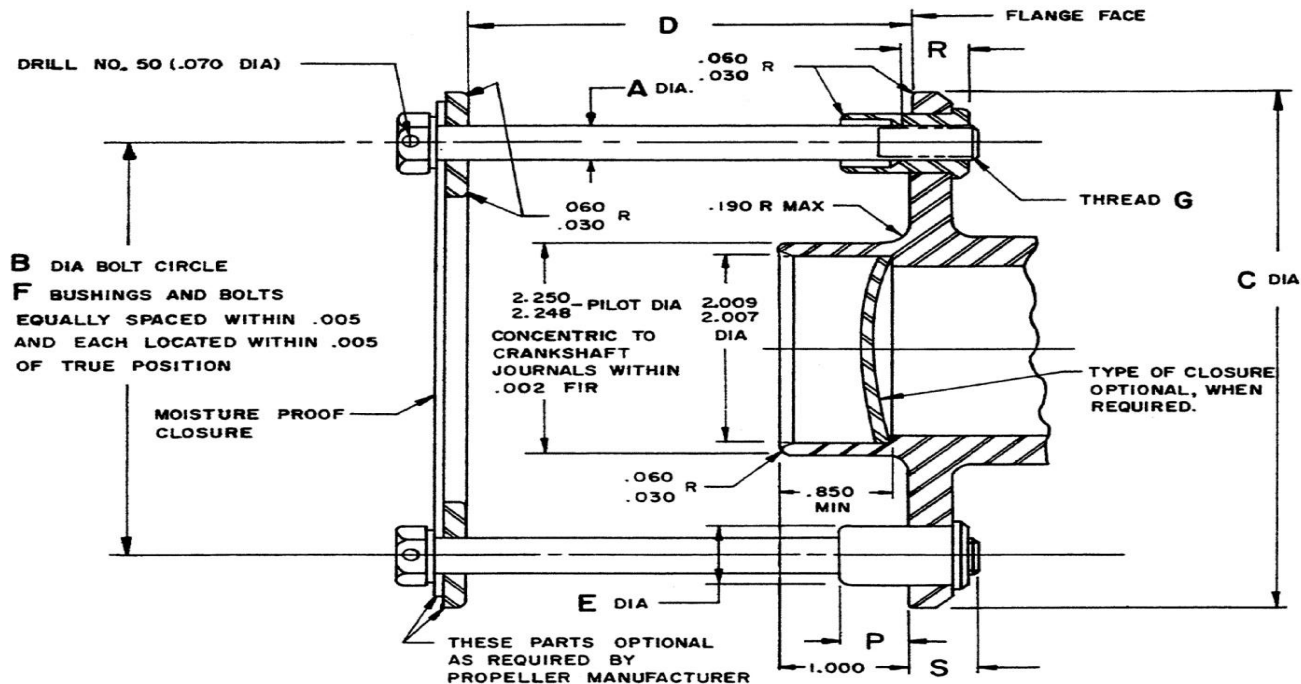


FIGURE I

SAE NUMBER	A +.000 -.005	B BASIC	C	D (a)	E +.000 -.002	F NUMBER OF BOLTS	G	P (a) ±.030	R MIN THD LENGTH	S MAX.
1	.375	4.375	5.500	3.380	.624	6	.375-24UNF-3A	.500	.500	.500
2	.375	4.750	6.000	3.500	.624	6	.375-24UNF-3A	.500	.500	.500
3	.375	5.250	6.500	4.000	.624	8	.375-24UNF-3A	.500	.500	.500
4	.4375	6.000	7.000	5.000	.687	8	.4375-20UNF-3A	.500	.500	.500
5	.4375	4.750	6.000	-	.624	6	.4375-20UNF-3A	.375	.680	.562
6	.500	4.750	6.000	-	.750	6	.500-20UNF-3A	.375	.810	.688

# Importance of proper propeller bolt torque

- Wood propellers receive their drive torque through static friction. The drive lugs provide little torque transfer to the propeller
- Aluminum propellers receive their drive torque through both static friction and the drive lugs.

# What happens if clamp load is insufficient?

- Relative movement between prop and crankshaft flange creates heat
- Paint softens and wood chars
- Clamp load further degrades
- Drive lugs beats the holes larger
- Prop bolts bend and eventually break
- Airplane quickly becomes a glider as prop departs



# What causes low clamp load?

- Improper torque applied to the prop bolts on installation
- Silver Bullet bolt torque recommendations

Bolt diameter	Prop Hub Diameter	Bolt Torque
3/8"	5 ½"	18 ft lbs
3/8"	6"	20 ft lbs
3/8"	7"	24 ft lbs
7/16"	6"	23 ft lbs
7/16"	7"	28 ft lbs
1/2"	7"	30 ft lbs

- Follow your propeller manufacturer's recommendation

# What causes low clamp load? (cont)

- A change in weather from cool and humid to hot and dry.
  - Maple moisture content dropping from 7% to 6% will cause a 4" thick prop to shrink .009"
  - A properly torqued 3/8" bolt will stretch .004" while the 4" thick hub will elastically compress .011 inches or a total of .015" of "spring"
  - Well over half the clamp load will be lost with a 1% reduction in moisture content.

# What causes low clamp load? (cont)

- Insufficient thread length or excessive bolt length causing the prop bolt thread to bottom in the drive lug giving false indication that the proper torque had been achieved

Shiny area indicates interference with drive lug thread



# Prop bolts come in several varieties

- AN8 bolt (1/2" dia.)
  - Thread length = 0.68"
  - Tensile strength = 126 ksi
- Grade 8 bolt (1/2" dia)
  - Thread length = 1.0"
  - Tensile strength = 150 ksi
- 1/2" prop bolt from Saber Mfg.
  - Thread length = 1.40"
  - Tensile strength = 180 ksi





# Propeller installation procedure

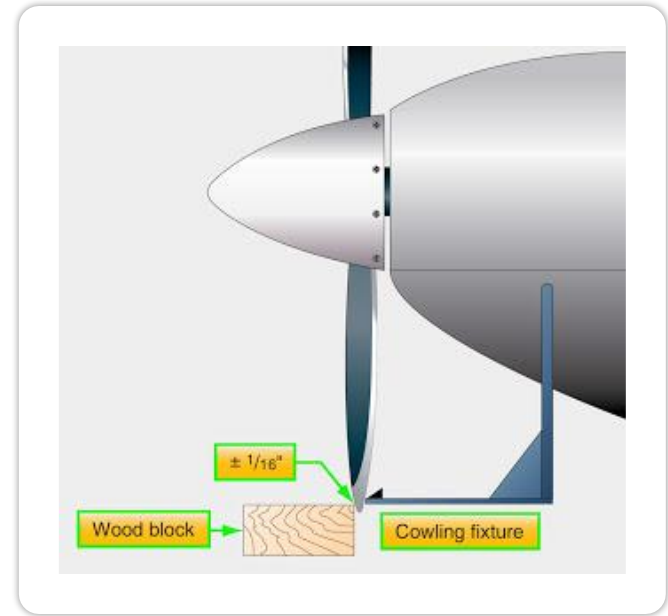
- Clean the clamping surfaces of the prop and prop extension
- Clean the prop bolt threads. Bolts should turn in by hand when engaging the drive lug threads.
- Lubricate threads in drive lugs with engine oil
- With any cylinder at TDC install prop in the 12-1 o'clock position. Use rubber dead blow hammer if necessary
- Install crush plate and secure with prop bolts and appropriate washers and lightly tighten bolts until prop is seated

# Propeller installation procedure (cont)

- Note that at least 2 threads are extending beyond the drive lug.
- Remove one bolt and reinstall without the washer. Bolt head should seat on the crush plate indicating that sufficient threads are available
- Reinstall washer and torque bolts using a calibrated torque wrench to specified level in 5 ft# increments in a star pattern.

# Propeller installation procedure (cont)

- Remove 1 spark plug/cyl
- Check blade track 2-4" from the tip
- 1/8" blade to blade variation is acceptable



# Prop torque maintenance for wood core propellers

- Run engine to power in short bursts and shut down
- Recheck torque and install safety wire
- Recheck torque again after 5 hours of engine operation
- Check torque at each oil change and if climate conditions change significantly

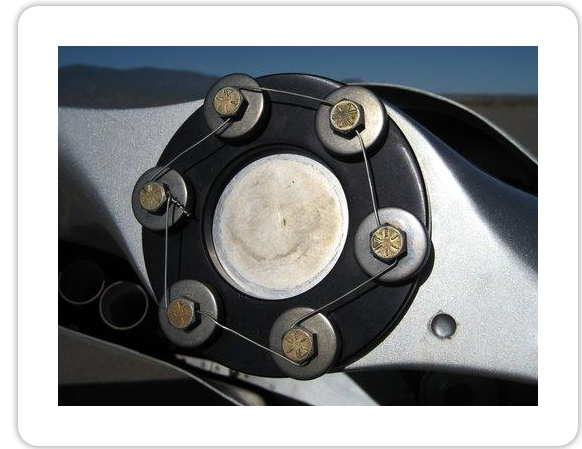
# Belleville washers reduce prop bolt torque maintenance

- A 1% reduction in moisture content will shrink prop thickness by .009" reducing clamp load by 60%

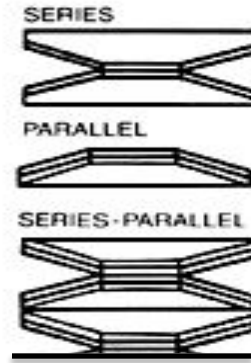
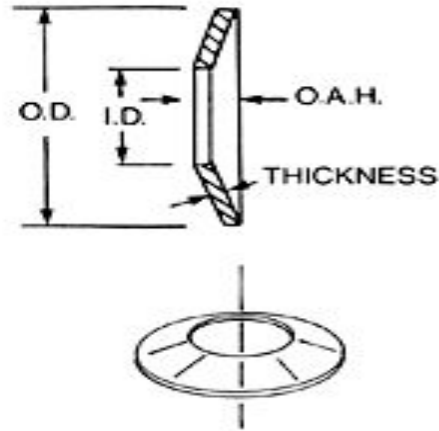
$$.009/.015=.60$$

- Adding belleville washers will reduce the clamp load loss to 15%

$$.009/ (.015+.044)=.15$$



# Belleville washer terminology



Same spring rate  
Twice the stroke

Twice the spring rate  
Same stroke

Twice the stroke  
Twice the spring rate

	Overall HT	Thickness	Max Compression	Max Load
3/8" washer	.147"	.125"	.022"	5150#
Series	.294"		.044"	5150#
Parallel	.269"		.022"	10300#
Series-Parallel	.538		.044"	10300#

# Belleville washer installation

CAUTION! This installation is for use on Silver Bullet propellers ONLY as it is dependent on the wood core material.

This procedure has been updated to add a torque values and is a supplement to the propeller installation instructions "Getting the Most Out of Your Silver Bullet"

- Chase thread in both the drive lugs and prop bolts so they can be easily turned by hand
- Lubricate the drive lug threads with engine oil
- Install prop so that one blade is between 12 and 1 o'clock when any piston is at TDC
- On each 3/8" or 1/2" prop bolt stack 2 belleville washers in series (outside diameters touching) and one AN960 steel washer per configuration below. The steel washer will be bearing against the crush plate and the outer most Belleville washer will contact the bolt head.
- On each 7/16" prop bolt stack 4 belleville washers in a series/parallel configuration and one AN970 steel washer per the configuration below.
- Torque the prop bolts to the specified value below per propeller installation instructions
- Lockwire bolts per standard procedures.

Prop bolt dia./Prop hub dia.	Number of washers per bolt	Belleville part number*	Final bolt torque (ft-#s)
3/8" / 6"	2**	620125177	20
3/8" / 7"	2**	620125177	24
7/16" / 6"	4***	7H89	23
7/16" / 7"	4***	7H89	28
1/2" / 7"	2**	828131	30

\*Solon Mfg. Co.

\*\*



\*\*\*



# Recommended torques for aluminum prop extensions and propellers\* to the crankshaft flange

- 3/8 inch      23 to 25 lb-ft (280 to 300 lb-in)
- 7/16 inch    40 to 45 lb-ft (480 to 540 lb-in)
- 1/2 inch      60 to 65 lb-ft (720 to 780 lb-in)