Appendix B.Torque Specifications

B-1. General Information

Tables in this appendix list torque values for Continental Motors' aircraft engine hardware. Refer to the appropriate manufacturer's maintenance and overhaul instructions for airframe or engine accessory torque specifications. Table B-1 is for bolts, nuts, screws, driving studs, and pipe plugs; Table B-2 is for fittings; Table B-3 is for hose fittings; Table B-4 lists specific component torque values. Torque values provided in Table B-5 must be used for the listed applications.

WARNING

Torque values listed are for use with clean 50 weight aviation engine oil applied to the threads, unless otherwise specified in Table B-5, which lists specific torque values for non-lubricated hardware.

Confirm items identified in Section C-2.3, "100% Parts Replacement Requirements" or Section C-2.4, "Mandatory Overhaul Replacement Parts" are replaced prior to assembly. Prior to torquing any hardware, unless otherwise specified, apply SAE 50 weight aviation oil to hardware listed in Table B-1 through Table B-4. If an application is not listed in the specific torque limits tables (Table B-4 and Table B-5), use the general torque limits in Table B-1 through Table B-3.

WARNING

Before installing nuts and bolts, verify the fastening hardware is lubricated according to instructions. Inspect all fasteners for proper plating and thread form. Failure to verify a fastener's serviceability or to correctly lubricate the fastener prior to installation will result in the fastener not being properly pre-loaded. Subsequent failure of the fastener may occur.

B-1.1. Torque Tips

WARNING

Do not apply <u>any</u> form of sealant to the crankcase cylinder deck, chamfer, cylinder mounting flange, cylinder base O-ring, or cylinder fastener threads. The use of RTV, silicone, Gasket Maker or <u>any</u> other sealant on the areas listed above during engine assembly will cause a loss of cylinder deck stud or through-bolt torque. Subsequent loss of cylinder attachment load, loss of main bearing crush and/or fretting of the crankcase parting surfaces will occur. The result will be cylinder separation, main bearing movement, oil starvation and catastrophic engine failure. USE ONLY CLEAN 50 WEIGHT AVIATION ENGINE OIL ON SURFACES LISTED.

- Check Table B-4 and Table B-5 first to determine if the hardware to be torqued requires a specific torque or treatment other than those for general hardware sizes listed in Table B-1 through Table B-3.
- Before installing hardware, verify the fastener size is correct.
- The accuracy of any torque indicating wrench depends on a smooth application of force and current calibration traceable to the National Institute of Standards and Technology (NIST), verifiable by the calibration data label affixed to the tool.
- If cotter pin holes must be aligned, set the torque wrench at the low limit and tighten the nut to the first hole beyond this torque, but do not exceed the maximum specified torque limit. This torquing procedure must be followed for all applications requiring cotter pin hole alignment except for connecting rod nuts.
- If a nut slot cannot be aligned with a cotter pin hole within the specified limits, substitute another serviceable nut to attain alignment.
- If the cotter pin hole in a stud lies beyond the nut slots, when the nut has been torqued properly, check the stud for proper installation or for backing out.
- Check studs for necking.
- Check the part for reduced thickness resulting from wear or incorrect part.

B-2. Cylinder Torque Procedure

Proper cylinder installation requires the bolts be torqued in multiple stages. Replace all through bolts and nuts at overhaul. Cylinder base stud threads, through bolt threads and nuts must be lubricated with clean 50 weight aviation oil. Through bolt nuts at cadmium plated washers require a lower torque value to achieve the same through-bolt pre-load since the lubricity of the cadmium plating reduces joint friction.

1. Torque cylinder through bolt nuts and cylinder base nuts to ½ of the specified torque value for the fastener.
2. Torque the cylinder through bolt nuts and cylinder base nuts to the specified value for the cylinder base stud nuts. Through bolt nuts must be torqued on both sides of the engine, even if only one cylinder is being installed.

WARNING

Failure to torque through bolt nuts on both sides of the engine can result in a loss of main bearing crush with main bearing shift and subsequent engine failure.

NOTE: Through-bolt nuts P/N 634505 and 649496 have been superseded by P/N 652541.

Nut P/N 634505 is a flanged six-point (hex) nut requiring a torque value of 690-710 inch-pounds. Nut P/N 649496 is a flanged six-point (hex) nut requiring a torque value of 790-810 inch-pounds. At engine overhaul, all P/N 634505 and P/N 649496 flanged through bolt nuts must be replaced with 652541 flanged twelve-point nuts. If replacing P/N 634505 and P/N 649496 with 652541 in less than a complete set prior to engine overhaul, torque the 652541 twelve-point nuts to the torque value of the original fastener (P/N 634505 or P/N 649496).

3. Torque through-bolt nuts on both sides of the engine to the specified torque value.
4. For engines which incorporate the seventh cylinder deck stud, install the seventh stud cylinder bracket and conical stud nut. Torque the stud nut to the value specified for the fastener.

B-3. Torque Wrench and Extension Calculations

Torque wrenches measure the force applied to the fastener on the axis of the square drive socket adapter.

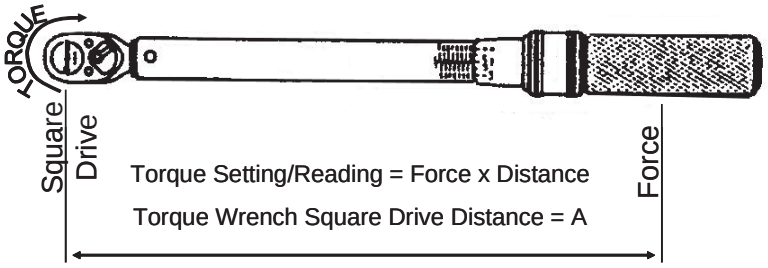

Figure B-1. Torque Wrench

Straight extensions and wobble extensions up to 15 degrees, which extend the square drive length, do not alter the amount of force applied to the square drive enough to cause concern. An offset adapter may be used with a torque wrench without affecting applied torque if the extension is positioned at a 90 degree angle in relation to the square drive adapter. In any other orientation, the extension alters the force applied to the fastener.

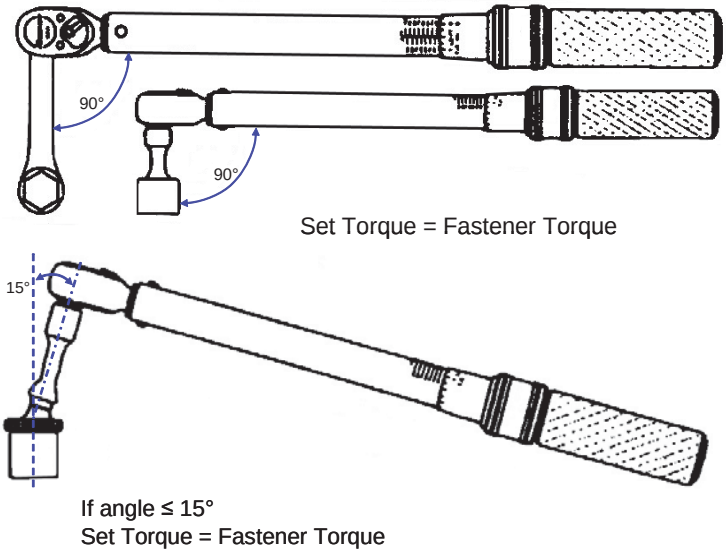

Figure B-2. Drive extensions

Apply the formula below to determine the appropriate torque wrench setting when using an extension:

$$S = \frac{T}{A + B} \times A$$

Where:
S = desired torque setting or reading
T= torque applied at square drive adapter
A= length of handle in inches
B= length of extension in inches

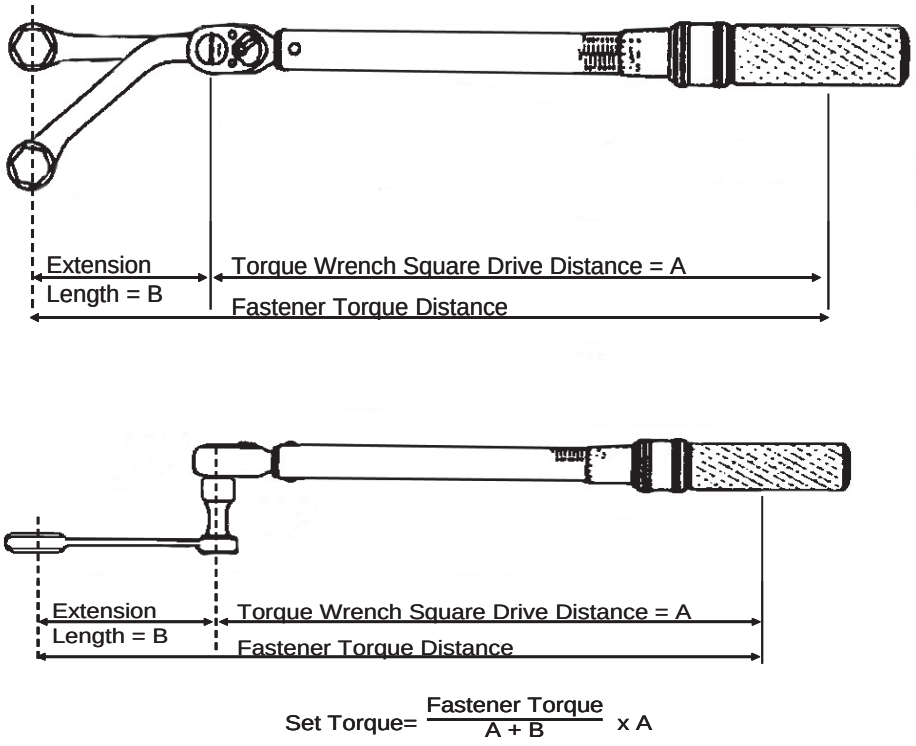

Figure B-3. Extension increases applied torque

Examples in Figure B-3 and Figure B-4 illustrate how extensions can alter the torque applied to the fastener. Examples in Figure B-3 adds the length of the extension to the torque wrench, increasing the leverage applied to the fastener. The position of the extension in Figure B-4 reduces the effective length of the handle and the applied leverage. The length of the extension (variable B) is subtracted from variable A in Figure B-4.

Let's assume the torque wrench has an effective length of 12 inches and the extension measures six inches from the center of the drive adapter to the center of the wrench. If we need to torque a nut and bolt to 45 inch-pounds, we set the dial on the wrench in Figure B-3 to 30 (45 ÷ (12+6) x 12). The same torque wrench, used with the extension in Figure B-4 must be set to 90 (45 ÷ (12-6) x 12) to apply 45 inch pounds of torque to the same nut and bolt.

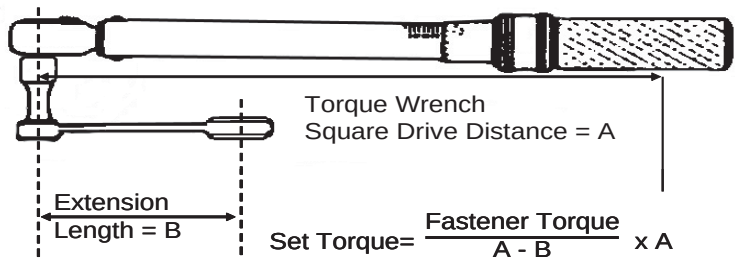

Figure B-4. Extension decreases applied torque

Table B-1. General Torque Specification

Bolts, Nuts, Screws		
	Torque	
Size	In. lbs.	Ft. lbs.
#2-56	1.4-2.6	N/A
#4-40	2.9-5.5	N/A
#6-32	5.3-10.1	N/A
#8-32	17.5-22.5	1.5-1.9
#10-32	36-50	3.0-4.2
#10-24	21-25	1.7-2.0
.250-20	75-85	6.3-7.1
.250-28	90-100	7.5-8.3
.3125-18	155-175	12.9-14.6
.3125-24	180-220	15.0-18.3
.375-16	220-260	18.3-21.7
.375-24	275-325	22.9-27.1
.44-20	400-450	33.3-37.5
.50-20	550-600	45.8-50.0
Driving Studs		
.250-20	50-70	4.2-5.8
.3125-18	100-150	8.3-12.5
.375-16	200-275	16.7-22.9
.44-14	300-425	25.0-35.4
Pipe Plugs		
.062-27	30-40	2.5-3.3
.125-27	60-80	5.0-6.7
.250-18	130-150	10.8-12.5
.375-18	185-215	15.4-18.0
.500-14	255-285	21.3-23.8
.750-14	310-350	25.8-29.2

Table B-2. Tube Fitting Torque Specifications

Size	Hose Assembly	Tube O.D.	Torque (In-lbs)
.31-24	#2 Brass / Aluminum	.125	15-30
.31-24	#2 Steel	.125	15-50
.38-24	#3 Brass / Aluminum	.188	40-65
.38-24	#3 Steel	.188	50-90
.44-20	#4 Brass / Aluminum	.250	60-80
.44-20	#4 Steel	.250	70-120
.44-24	Steel	.190	60-80
.56-18	#6 Brass / Aluminum	.375	75-125
.56-18	#6 Steel	.375	90-150
.75-16	#8 Brass / Aluminum	.500	150-250
.75-16	#8 Steel	.500	135-250
.88-14	#10 Brass / Aluminum	.625	200-350
.88-14	#10 Steel	.625	300-400

Table B-3. Hose Fitting (“B” Nut) Torque Specification

Hose Size	Hose End Fitting Material	Torque (In-lbs)
#2 (.31-24)	Brass/Aluminum Fitting	50-80
#2 (.31-24)	Steel Fitting	75-120
#3 (.38-24)	Brass/Aluminum Fitting	70-105
#3 (.38-24)	Steel Fitting	95-140
#4 (.4375-20)	Brass/Aluminum Fitting	100-140
#4 (.4375-20)	Steel Fitting	135-190
#5 (.500-20)	Brass/Aluminum Fitting	130-180
#5 (.500-20)	Steel Fitting	170-240
#6 (.5625-18)	Brass/Aluminum Fitting	150-195
#6 (.5625-18)	Steel Fitting	215-280
#8 (.750-16)	Brass/Aluminum Fitting	270-350
#8 (.750-16)	Steel Fitting	470-550
#10 (.875-14)	Brass/Aluminum Fitting	360-430
#10 (.875-14)	Steel Fitting	620-745
#12 (1.063-12)	Brass/Aluminum Fitting	460-550
#12 (1.063-12)	Steel Fitting	855-1055

Table B-4. Component Specific Torque Specifications

Size	Fastener	Torque Value		Models Affected
		In-Lbs	Ft-Lbs	
Crankcase				
.25-28	Nut, Crankcase Flange-bottom	90-110	7.5-9.9	All Models (AR)
.31-18	Bolt, Oil Sump Flange	155-175	12.9-14.6	All Models (AR)
.31-24	Nut-Crankcase Flange	180-220	15.0-18.3	All Models (AR)
.31-24	Nut-Crankcase Backbone	240-280	20.0-20-3	(AR) Stainless Steel hardware Only
.31-24	Nut, Magneto to Crankcase	100-120	8.3-10.0	All Model (AR)
.38-16	Bolt-Engine Mount to Crankcase	220-260	18.3-21.7	IO-550-G
.38-24	Nut-Crankcase Through Bolts, Upper Rear	275-325	22.9-27.1	All Models (AR)
.38-24	Nut-Crankcase Tie Bolts	370-390	30.8-32.5	All Models (AR)
.38-24	Nut-Mounting Bracket to Crankcase	275-325	22.9-27.1	All Models (AR)
.44-20	Nut-Crankcase Tie-Bolts-Nose & Below Camshaft	440-460	36.7-38.3	All Models (AR)
.44-20	Nut-Cylinder to Crankcase Studs (including 7th stud)	490-510	40.8-42.5	All Models (AR)
.44-20	Nut-Through Bolt at Cadmium Plated Washer	440-460	36.7-38.3	All Models (AR)
.44-20	Nut-Through Bolt at Cylinder Flange	490-510	40.8-42.5	All Models (AR)
.44-20	Nut-Through Bolt at Front Mount Belt-Driven Alternator	490-510	40.8-42.5	All Models (AR)
.50-20	Nut-Crankcase Through Bolt at Cadmium Plated Washer	615-635	51.2-52.9	All Models (AR)
.50-20	Nut-Crankcase Through Bolt at Cylinder Flange, 6 point/0.33” tall (Part No. 634505)	690-710	57.5-59.2	All Models (AR)
.50-20	Nut-Crankcase Through Bolt at Cylinder Flange, 12 point (Part No. 652541)	790-810	65.8-67.5	All Models (AR)
.50-20	Nut-Crankcase Nose Tie Bolts	640-660	53.5-55.0	All Models (AR)
.62-18	Plug (with crush washer)	190-210	15.8-17.5	All Models (AR)
Gears				
.31-24	Bolt-Gear to Camshaft	240-260	20.0-21.7	All Models (AR)
.31-24	Bolt-Gear to Crankshaft (Bolt Hardness Rc 38-42)[1]	380-420	31.7-35.0	All Models (AR)
.31-24	Bolt, Face Gear to Crankshaft	140-150	11.7-12.5	All Models (AR)

Table B-4. Component Specific Torque Specifications

Size	Fastener	Torque Value		Models Affected
		In-Lbs	Ft-Lbs	
Connecting Rods				
.44-20	Nut, Connecting Rod (Spiralock) (Nut P/N 643215 w/bolt P/N 643112)	550-600	45.8-50.0	All Models (AR)
.44-20	Nut, Connecting Rod (Spiralock (12 point nut P/N 654490)	690-710	57.5-59.2	For Specific Application, See Footnote[2]
Miscellaneous Fuel Injection				
#8-32	Screw, Aneroid Body Hold Down (AN500-8-14)	17.5-22.5	1.5-1.9	All Fuel Injected Model (AR) with Aneroid Pump
#8-32	Screw, Manifold Cover Hold Down (AN503-8-12)	22-26	1.8-2.2	All Fuel Injected Model (AR)
.125-27	Fitting, Vapor Separator Fuel Pump Cover	60-80	5.0-6.7	All Fuel Injected Model (AR)
.125-27	Nozzle, Fuel Injector (w/anti-seize compound)	55-65	4.6-5.4	All Fuel Injected Model (AR)
.19-24	Through Bolt, Fuel Pump	29-31	2.4-2.6	All Fuel Injected Model (AR)
.25-28	Ejector, Fuel Pump Cover (Vapor Separator)	90-100	7.5-8.3	All Fuel Injected Model (AR)
.25-48	Aneroid Stem Jam Nut	25-30	2.1-2.5	All Fuel Injected Model (AR) with Aneroid Pump
.31-24	Nozzle, Fuel Injector (w/anti-seize compound)	55-65	4.6-5.4	All Fuel Injected Model (AR)
.31-24	Nut, Throttle and Mixture Control Levers to Shaft	100-120	8.3-10.0	All Fuel Injected Model (AR)
.31-32	Nut, Fuel Injection Line	40-45	3.3-3.7	All Fuel Injected Model (AR)
.38-24	Nut, Fuel Injection Line	55-60	4.5-5.0	All Fuel Injected Model (AR)
.62-18	Plug & Screen Assembly Metering Unit w/New Gasket	120-130	10.0-10.8	All Fuel Injected Model (AR)
Miscellaneous Lubrication System Fasteners				
.25-20	Bolt, Oil Cooler to Adapter	100-110	8.3-9.2	All Models (AR)
.25-20	Bolt, Oil Pump Cover to Crankcase	75-85	6.3-7.1	All Models (AR)
.25-28	Nut, Governor Oil Transfer Collar Assembly	75-85	6.3-7.1	All Models (AR)
.62-18	Plug, Oil Cooler (w/crush washer)	190-210	15.8-17.5	All Models (AR)
.62-18	Plug, Oil Suction Tube (w/crush washer)	190-210	15.8-17.5	All Models (AR)
.62-18	Plug, Oil Sump Drain	190-210	15.8-17.5	All Models (AR)
.62-18	Oil Filter, Cartridge	180-216	15.0-18.0	All Models (AR)

Table B-4. Component Specific Torque Specifications

Size	Fastener	Torque Value		Models Affected
		In-Lbs	Ft-Lbs	
.75-16	Oil Filter, Disposable	192-216	16.0-18.0	All Models (AR)
.88-16	Plug, Oil Bypass	240-260	20.0-21.7	All Models (AR)
1.00-14	Vernatherm (Oil Temperature Control Valve)	440-460	36.7-38.3	All Models (AR)
1.12-18	Housing, Oil Pressure Relief Valve	240-260	20.0-21.7	All Models (AR)
1.25-18	Plug, Special Vernatherm	310-320	20.8-29.2	All Models (AR)
1.25-18	Vernatherm (Oil Temperature Control Valve)	410-420	34.2-35.0	All Models (AR)
1.375-16 LH	Housing, Tachometer Drive	250-350	20.8-29.2	All Models (AR)
1.75-16	Oil Filter Screen (w/new crush gasket) (Install Gasket with parting line against screen face)	500-520	41.6-43.3	All Models (AR)
Miscellaneous Cylinder Hardware				
.071 (18mm)	Spark Plug [3]	300-360	25.0-30.0	All Models
.125-27	Connector, Cylinder Drain	60-80	5.0-6.7	All Models (AR)
.19-32	Screw, Cylinder Baffle	10-20	.84-1.7	All Models (AR)
.25-20	Screw, Rocker Cover	55-65	4.6-5.4	All Models (AR)
.25-20	Screw, Intake Flange	85-110	7.1-9.2	All Models (AR)
.25-20	Bolt, Through Bolted Rocker Shaft	90-100	7.5-8.3	IO-550-A, B & C
.25-28	Nut, Exhaust (self locking)	120-130	10.0-10.8	All Models (AR)
.25-28	Nut, Exhaust Manifold Flange (Spirotallic Gasket)	100-110	8.3-9.2	All Models (AR)
.31-18	Bolt, Rocker Shaft Hold Down [4]	190-210	15.8-17.5	IO-550-G, N, P & R
.31-24	Bolt, Rocker Shaft Hold Down[5]	85-110	7.1-9.2	IO-550-A, B & C
.31-24	Nut, Exhaust Manifold Flange (Spirotallic Gasket)	200-210	16.7-17.5	All Models (AR)

Table B-4. Component Specific Torque Specifications

Size	Fastener	Torque Value		Models Affected
		In-Lbs	Ft-Lbs	
Miscellaneous Fasteners				
---	Clamp, Induction Hose	25-35	2.0-2.9	All Models (AR)
.25-62	Clamp, Magneto Pressurization Hose	10-14	0.8-1.17	All Models with Pressurized Magnetos
.31-18	Bolt, Alternator Mounting	150-180	12.5-15.0	All Models (AR)
.38-24	Bolt, Freon Compressor Bracket Mount	275-325	22.9-27.1	All Models (AR)
.38-24	Jam Nut, Freon Compressor Belt Tension Adjustment	275-325	22.9-27.1	All Models (AR)
.38-24	Nut, Freon Compressor to Bracket Mount	275-325	22.9-27.1	All Models (AR)
.38-24	Slide Nut, Freon Compressor Belt Tension Adjustment	300-350	25.0-29.2	All Models (AR)
.38-24	Nut, Starter to Adapter	200-220	16.7-18.3	All Models (AR)
.56-18	Nut, Starter Shaft Gear[6]	450-500	37.5-41.6	IO-550-B & C
.56-18	Nut, Generator Pulley Drive	450-500	37.5-41.7	All Models (AR)
.56-18	Screw, Shoulder, Freon Compressor Idler Sheave	800-850	66.6-70.8	All Models (AR)
.56-24	Tach Sensor, Magneto	35-40	2.9-3.3	All with Magneto Tach Sensor
.62-32	Nut, Alternator Hub Assembly	300-450	25.0-37.5	All Models (AR)
.66-20	Nut, Alternator or Generator Pulley	450-500	37.5-41.7	All Models (AR)
.68-24	Tach Sensor, Magneto	35-40	2.9-3.3	All with Magneto Tachometer Sensor

1. Heat crankshaft gear to 300°F; install on crankshaft immediately for shrink fit. Ensure the gear seats tightly against the end of the crankshaft by tapping lightly with a brass hammer.
2. Connecting Rod Application:
   Rod 655001 Superseded by 655911 (Nut 654490 & Bolt 643112) — IO-550-A, B, C, D, E, F, G, L, N, P, R;
   Rod 655503 Superseded by 655913 (Nut 654490 & Bolt 643112) — IO-550-B, C Special Edition Only
   Rod 655913 — IO-550-B, C, D, F, G, N Special Edition & Platinum
3. Lubricate spark plug threads with spark plug manufacturer's recommended lubricant.
4. Do not realign hex cap screw to mate with tab washer.
5. Must be reworked to through bolt rocker shaft configuration according to most current revision of Service Document M92-6.
6. Align and tension belt according to most current revision of Service Document M89-6.

Table B-5. Specific Torque for Non-Lubricated Hardware

Size	Fastener	Torque Value		Model Affected
		In-lbs	Ft-lbs	
#8-32	Screw, Throttle Lever	17.5-22.5	1.5-1.9	All
#10-32	Nut, Magneto Ground Terminal	17-19	1.41-1.58	S-1200 Series Magnetos
#10-32	Nut, Magneto Ground Terminal	15-17	1.25-1.41	S-20/200 Series Magnetos
Various	Nut, Magneto Ground Terminal	13-15	1.08-1.25	Slick Magnetos
Various	Nut, Ignition Harness Cable Outlet Plate	18-22	1.5-1.8	S-1200 Series Magnetos
Various	Screw, Ignition Harness Cable Outlet Plate	18-22	1.5-1.8	S-20/200 Series Magnetos
Various	Screw, Ignition Harness Cable Outlet Plate	18-25	1.5-2.08	Slick Magnetos
0.125-27 (dry seal)	Fuel Injector Nozzle to Cylinder[1]	55-65	4.6-5.4	All
0.31-32	B-Nut, Fuel Injection Line to Fuel Injector Nozzle	40-45	3.3-3.8	All
0.375-24	B-Nut, Fuel Injection Line to Fuel Manifold Valve[1]	55-60	4.6-5.0	All Non-FADEC Fuel Injected
0.625-24	B-Nut, Ignition Lead to Spark Plug	90-95	7.5-7.91	All
0.75-20	B-Nut, Ignition Lead to Spark Plug	110-120	9.2-10.0	All
1.00-14	Oil Temperature Control Valve[2]	440-460	36.7-38.3	All
1.12-18	Oil Pressure Relief Valve Housing	240-260	20.0-21.7	All

1. Apply P/N 646943 Anti-Seize Lubricant
2. Apply Loctite Pipe Sealant 592