MODULE 07A

FOR B2 CERTIFICATION

MAINTENANCE PRACTICES

Aviation Maintenance Technician Certification Series

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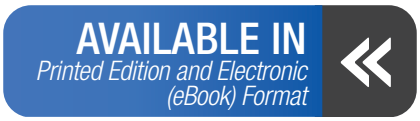

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WELCOME

The publishers of this Aviation Maintenance Technician Certification Series welcome you to the world of aviation maintenance. As you move towards EASA certification, you are required to gain suitable knowledge and experience in your chosen area. Qualification on basic subjects for each aircraft maintenance license category or subcategory is accomplished in accordance with the following matrix. Where applicable, subjects are indicated by an "X" in the column below the license heading.

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We wish you good luck and success in your studies and in your aviation career!

REVISION LOG

VERSION	EFFECTIVE DATE	DESCRIPTION OF CHANGE
001	2020 03	Module Creation and Release
001.1	2021 04	Enhanced Sub-Module 04; IFR 4000 and 6000 test equipment.
001.2	2021 10	Corrected description of file types (Sub-Module 07, Pages 3.15-3.16)

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A on the illustrated double broached hexagon wrench is nearer the centerline of the head and the wrench handle than point B, and also the centerline of nut C. If the wrench is inverted and installed on nut C, point A will be centered over side "Y" instead of side "X." The centerline of the handle will now be in the dotted line position. It is by reversing (turning the wrench over) the position of the wrench that a 15° arc may be made with the wrench handle.

Although box-end wrenches are ideal to break loose tight nuts or pull tight nuts tighter, time is lost turning the nut off the bolt once the nut is broken loose. Only when there is sufficient clearance to rotate the wrench in a complete circle can this tedious process be avoided.

After a tight nut is broken loose, it can be completely backed off or unscrewed more quickly with an open than with a box-end wrench. In this case, a combination wrench can be used; it has a box end on one end and an open-end wrench of the same size on the other. Another option for removing a nut from a bolt is the ratcheting box-end wrench, which can be swung back and forth to remove the nut or bolt. The box-end, combination, and ratcheting wrenches are shown in ***Figure 3-9***.

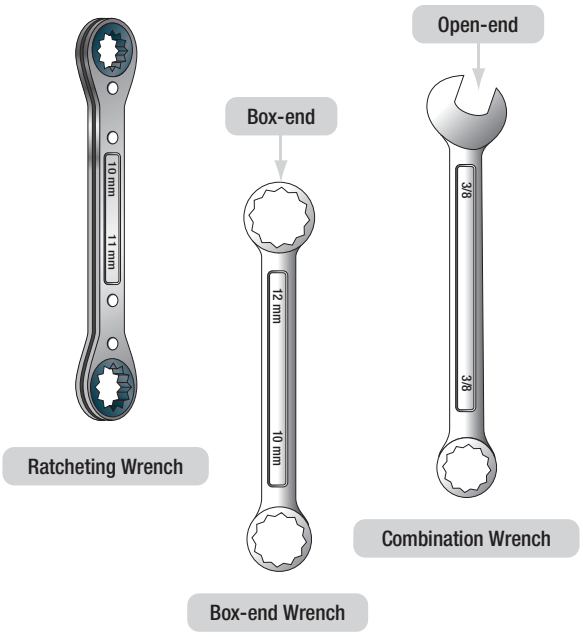

Figure 3-9. Box-end wrenches.

Socket Wrenches

Sockets with detachable handles usually come in sets and fit several types of handles, such as the T, ratchet, screwdriver grip, and speed handle. Socket wrench handles have a square lug on one end that fits into a square recess in the socket head. The two parts are held together by a light spring-loaded poppet. Two types of sockets, a set of handles, and an extension bar are shown in ***Figure 3-10***.

Adjustable Wrenches

The adjustable wrench is a handy utility tool that has smooth jaws and is designed as an open-end wrench. One jaw is fixed, but the other may be moved by a thumbscrew or spiral screwworm adjustment in the handle. The width of the jaws may be varied from 0 to 1/2 inch or more. The angle of the opening to the handle is 22.5 degrees on an adjustable wrench. One adjustable wrench does the work of several open-end wrenches. Although versatile, they are not intended to replace the standard open-end, box-end, or socket wrenches. When using any adjustable wrench, always exert the pull on the side of the handle attached to the fixed jaw of the wrench. To minimize the possibility or rounding off the fastener, use care to fit the wrench to the bolt or nut to be turned.

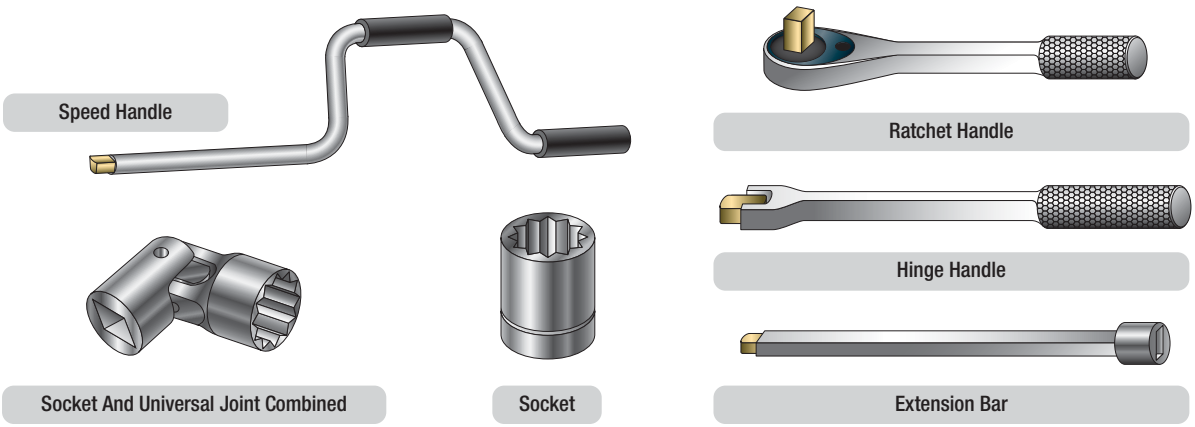

Figure 3-10. Socket wrench set.

Special Wrenches

The category of special wrenches includes the crowfoot, flare nut, spanner, torque, and Allen wrenches. (***Figure 3-11***)

The crowfoot wrench is normally used when accessing nuts that must be removed from studs or bolts that cannot be accessed using other tools.

The flare nut wrench has the appearance of a box-end wrench that has been cut open on one end. This opening allows the wrench to be used on the B-nut of a fuel, hydraulic, or oxygen line. Since it mounts using the standard square adapter, like the crowfoot wrench, it can be used in conjunction with a torque wrench.

The hook spanner is for a round nut with a series of notches cut in the outer edge. This wrench has a curved arm with a hook on the end that fits into one of the notches on the nut. The hook is placed in one of these notches with the handle pointing in the direction the nut is to be turned.

Some hook spanner wrenches are adjustable and will fit nuts of various diameters. U-shaped hook spanners have two lugs on the face of the wrench to fit notches cut in the face of the nut or screw plug. End spanners resemble a socket wrench, but have a series of lugs that fit into corresponding notches in a nut or plug. Pin spanners have a pin in place of a lug, and the pin fits into a round hole in the edge of a nut. Face pin spanners are similar to the U-shaped hook spanners except that they have pins instead of lugs.

Most headless setscrews are the hex-head Allen type and must be installed and removed with an Allen wrench. Allen wrenches are six-sided bars in the shape of an L, or they can be hex-shaped bars mounted in adapters for use with hand ratchets. They range in size from 3⁄64 to 1⁄2 inch and fit into a hexagonal recess in the setscrew.

Strap Wrenches

The strap wrench can prove to be an invaluable tool for the AMT. By their very nature, aircraft components such as tubing, pipes, small fittings, and round or irregularly shaped components are built to be as light as possible, while still retaining enough strength to function properly. The misuse of pliers or other gripping tools can quickly damage these parts. If it is necessary to grip a part to hold it in place, or to rotate it to facilitate removal, consider using a strap wrench that uses a plastic covered fabric strap to grip the part. (***Figure 3-12***)

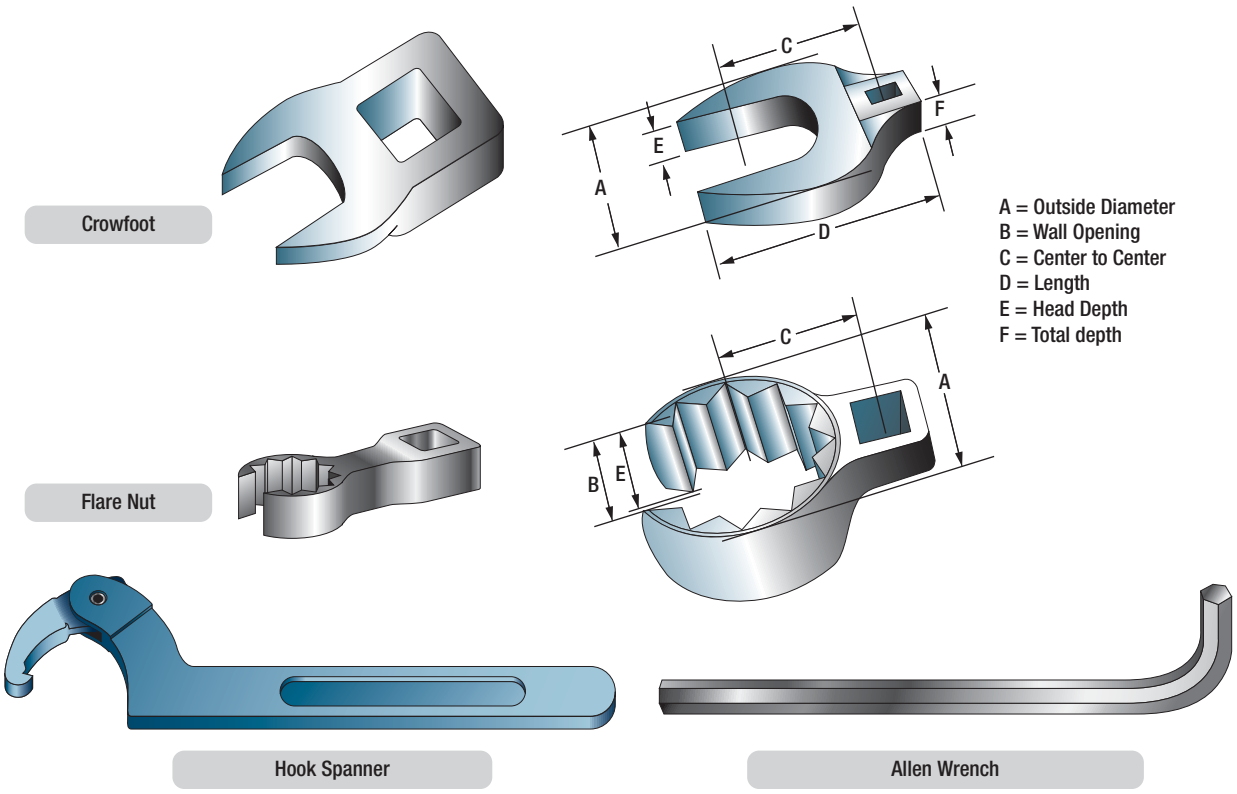

Figure 3-11. Special wrenches.

Figure 3-12. Strap wrench.

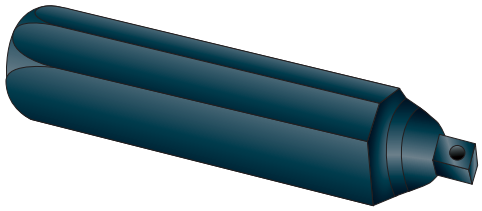

Figure 3-13. Impact driver.

Impact Wrenches

Although not typically used on aircraft, except with extreme care on some heavy structures, an impact driver may be required. Struck with a mallet, the impact driver uses cam action to impart a high amount of torque in a sharp impact to break loose a stubborn fastener. The drive portion of the impact driver can accept a number of different bits and sockets. The use of special bits and sockets specifically manufactured for use with an impact driver is required. (***Figure 3-13***)

TORQUE WRENCHES

There are times when a specific pressure must be applied to a nut or bolt as it is installed. In such cases a calibrated torque wrench must be used. A calibrated torque wrench is a precision tool consisting of a torque indicating handle and appropriate adapter or attachments. It measures the amount of turning or twisting force applied to a nut, bolt, or screw. Commonly used torque wrenches include the deflecting beam, dial indicating, micrometer, and electronic setting types. (***Figure 3-14***)

Figure 3-14. Torque wrenches.

When using the deflecting beam and dial indicating torque wrenches, the torque is read visually on a dial or scale mounted on the handle of the wrench. The micrometer setting torque wrench is preset to the desired value. When this torque is reached, the operator notices a sharp impulse or breakaway "click"

Under controlled conditions, the amount of force required to turn a fastener is directly related to the tensile strength of the fastener. The amount of torque, measured in inch-pounds or foot-pounds, is the product of the force required to turn the fastener multiplied by the distance between the center of the fastener and the point at which the force is applied. For example, a torque wrench has a length permanently established between the center of the drive hub and a pivot in the handle. The force is measured by the amount the beam deflects or by the tension set by a calibrated spring inside the wrench handle. Hooke's Law states that the amount a beam deflects is directly related to the force applied. Therefore, if the lever is exactly 12 inches long, and a force of 30 pounds is applied to the handle, a torque of 360 inch-pounds is produced on the fastener.

12 inches × 30 lbs = 360 inch-pounds

For additional information on the installation of fasteners requiring the use of a torque wrench, refer to "Installation of Nuts, Washers, and Bolts" located in *Module 06, SubModule 05*.

Before each use, the torque wrench should be visually inspected for damage. If a bent pointer, cracked glass, or signs of rough handling are found, the wrench must be tested or recalibrated to ensure accuracy. In addition, all torque wrenches should be professionally recalibrated by a metrology lab at least once per year. ***Figure 3-15*** shows a professional calibration device.

When an extension (***Figure 3-16***) is needed to reach a particular fastener, the length of the torque wrench changes and so the indication of torque needs to be recalculated to find the actual torque being applied.

For example, if the length from the drive head to the handle is 20 inches and a 5-inch extension is added, a reading of 120 inch-pounds results in 150 inch-pounds of torque actually applied. To find the torque applied to a fastener when using an extension, use this formula: (***Figure 3-17***)

$$T_A = \frac{T_W(L + E)}{L}$$

T_A = desired torque
T_W = indicated torque
L = length of torque wrench without extension
E = added or subtracted length of extension from hub of wrench

By shifting the variables, this similar formula can be used to determine what a torque wrench will indicate for a given torque on a fastener.

$$T_W = \frac{T_A \times L}{(L + E)}$$

Using the figures above, we find that in order to apply 150 inch-pounds on a fastener with a straight 5 inch extension, the torque indicator needs to read 120 inch-pounds.

Figure 3-15. Torque wrench calibration tool.

Figure 3-16. A typical torque wrench extension in the straight position.

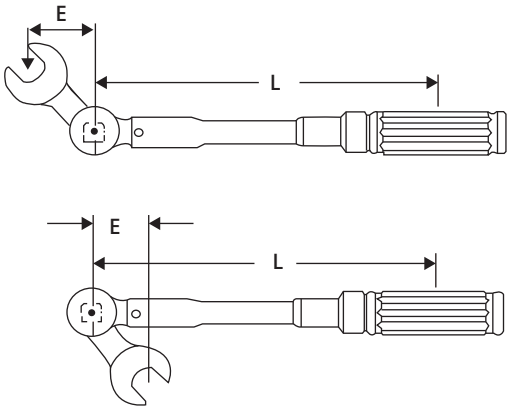

Figure 3-17. Variables for torque formula.

Torque Tables

Use the standard torque table as a guide in tightening nuts, studs, bolts, and screws whenever specific torque values are not called out in maintenance procedures. The following rules apply for correct use of the torque table: (***Figure 3-18***)

1. To obtain values in foot-pounds, divide inch pounds by 12.
2. Do not lubricate nuts or bolts except for corrosion resistant steel parts or where specifically instructed to do so.
3. Always tighten by rotating the nut first if possible. When space considerations make it necessary to tighten by rotating the bolt head, approach the high side of the indicated torque range. Do not exceed the maximum allowable torque value.
4. Maximum torque ranges should be used only when materials and surfaces being joined are of sufficient thickness, area, and strength to resist breaking, warping, or other damage.
5. For corrosion resisting steel nuts, use torque values given for shear type nuts.
6. The use of any type of drive end extension on a torque wrench changes the dial reading required to obtain the actual values indicated in the

Torque Values in Inch-Pounds for Tightening Nuts

Bolt Stud or Screw Size		On standard bolts studs and screws having a tensile strength of 125 000 to 140 000 psi		On bolts studs and screws having a tensile strength of 140 000 to 160 000 psi	On high-strength bolts studs and screws having a tensile strength of 160 000 psi and over
		Shear type nuts (AN320 AN364 or equivalent)	Tension type nuts and threaded machine parts (AN-310 AN365 or equivalent)	Any nut except shear type	Any nut except shear type
8–32	8–36	7–9	12–15	14–17	15–18
10–24	10–32	12–15	20–25	23–30	25–35
1/4–20		25–30	40–50	45–49	50–68
	1/4–28	30–40	50–70	60–80	70–90
5/16–18		48–55	80–90	85–117	90–144
	5/16–24	60–85	100–140	120–172	140–203
3/8–16		95–110	160–185	173–217	185–248
	3/8–24	95–110	160–190	175–271	190–351
7/16–14		140–155	235–255	245–342	255–428
	7/16–20	270–300	450–500	475–628	500–756
1/2–13		240–290	400–480	440–636	480–792
	1/2–20	290–410	480–690	585–840	690–990
9/16–12		300–420	500–700	600–845	700–990
	9/16–18	480–600	800–1000	900–1 220	1 000–1 440
5/8–11		420–540	700–900	800–1 125	900–1 350
	5/8–18	660–780	1 100–1 300	1 200–1 730	1 300–2 160
3/4–10		700–950	1 150–1 600	1 380–1 925	1 600–2 250
	3/4–16	1 300–1 500	2 300–2 500	2 400–3 500	2 500–4 500
7/8–9		1 300–1 800	2 200–3 000	2 600–3 570	3 000–4 140
	7/8–14	1 500–1 800	2 500–3 000	2 750–4 650	3 000–6 300
1"–8		2 200–3 000	3 700–5 000	4 350–5 920	5 000–6 840
	1"–14	2 200–3 300	3 700–5 500	4 600–7 250	5 500–9 000
1 1/8–8		3 300–4 000	5 500–6 500	6 000–8 650	6 500–10 800
	1 1/8–12	3 000–4 200	5 000–7 000	6 000–10 250	7 000–13 500
1 1/4–8		4 000–5 000	6 500–8 000	7 250–11 000	8 000–14 000
	1 1/4–12	5 400–6 600	9 000–11 000	10 000–16 750	11 000–22 500

Figure 3-18. Standard torque table (inch-pounds).

standard torque range tables. When using a drive end extension, the torque wrench reading must be computed by use of the proper formula, which is included in the handbook accompanying the torque wrench.

CUTTING TOOLS

Powered and non-powered metal cutting tools available to the aviation technician include various types of saws, nibblers, shears, sanders, notchers, and grinders. Both hand-held power tools and larger shop-based power

tools are used during aviation maintenance. They tend to accomplish a job faster than non-powered tools and may even perform tasks not possible with non-powered hand tools. Extreme caution must be exercised when using any power tool. An incorrectly used power tool can cause injury and even death. Always seek instruction on how to use a tool that is unfamiliar.

In general, power tools are either electrically powered or pneumatically powered. Large shop tools are typically electrically powered. The fact that they are stationary and located a long distance from the aircraft permits the advantages of electric power without too much concern of fire danger. Powered hand tools are electric or pneumatic. Pneumatic tools are preferred in the hangar and on the ramp since they are spark free and pose little threat of fire compared to electric tools. A large, remotely located air compressor with a manifold of rigid tubing throughout the hangar or shop can usually supply enough pneumatic power for an entire operation. The technician simply connects one end of a flexible hose into the manifold and the other end to the pneumatic tool for power.

Due to the dominance of aluminum in aircraft construction, many of the power tools used in aviation are metal working tools. Of these, cutting tools, drilling tools and forming tools are common. Also due to size, weight, and/or power source, shop tools are usually in a fixed location, and the airframe part to be constructed or repaired is brought to the tool.

HAND SNIPS

There are several kinds of hand snips, each of which serves a different purpose. Straight, curved, hawksbill, and aviation snips are in common use. Straight snips are used for cutting straight lines when the distance is not great enough to use a squaring shear and for cutting the outside of a curve. The other types are used for cutting the inside of curves or radii. Snips should never be used to cut heavy sheet metal.

Aviation snips are designed especially for cutting heat treated aluminum alloy and stainless steel. They are also adaptable for enlarging small holes. The blades have small teeth on the cutting edges and are shaped for cutting very small circles and irregular outlines. The handles are the compound leverage type, making it possible to cut material as thick as 0.051 inch. Aviation snips are available in two types, those which cut from right to left and those which cut from left to right.

Aviation snips have colored handles to identify the direction of the cuts: yellow aviation snips cut straight, green aviation snips curve right, and red aviation snips curve left. (***Figure 3-19***)

Unlike the hacksaw, snips do not remove any material when the cut is made, but minute fractures often occur along the cut. Therefore, cuts should be made about 1/32 inch from the layout line and finished by hand filing down to the line.

Metal Shears

Straight snips, or sheet metal shears, have straight blades with cutting edges sharpened to an 85° angle. (***Figure 3-20***) Available in sizes ranging from 6 to 14 inches, they cut aluminum up to 1/16 of an inch. Straight snips can be used for straight cutting and large curves, but aviation snips are better for cutting circles or arcs.

Hacksaws

The common hacksaw has a blade, a frame, and a handle. The handle can be obtained in two styles: pistol grip and straight. (***Figure 3-21***)

Hacksaw blades have holes in both ends; they are mounted on pins attached to the frame. When installing a blade in a hacksaw frame, mount the blade with the teeth pointing forward, away from the handle.

Figure 3-19. Aviation snips.

Figure 3-20. Straight snips.