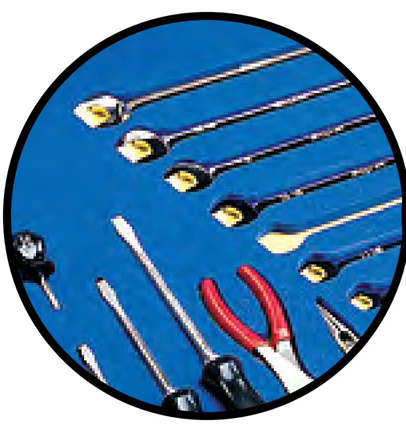
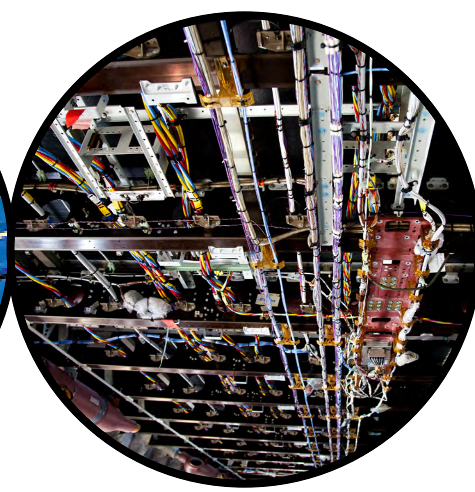
B2

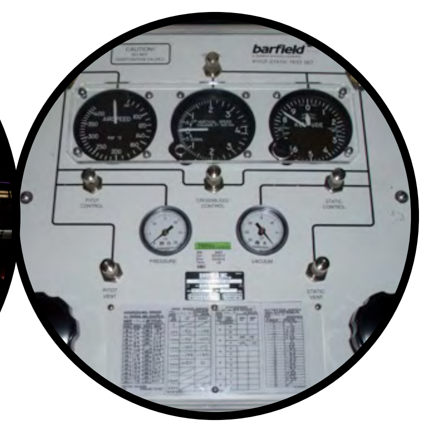
AVIATION MAINTENANCE TECHNICIAN CERTIFICATION SERIES

# MAINTENANCE PRACTICES

# 7








COMPLIANT WITH EASA European Aviation Safety Agency EASA PART 66/147

EASA 2023-989 COMPLIANT

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| VERSION | EFFECTIVE DATE | DESCRIPTION OF REVISION(S) |
|---|---|---|
| 001 | 2020.03 | Module creation and release. |
| 001.1 | 2021.04 | Enhanced Submodule 4; IFR 4000 and 6000 test equipment. |
| 001.2 | 2021.10 | Corrected description of file types (Submodule 7, pages 3.15-3.16). |
| 001.3 | 2023.04 | Inclusion of Measurement Standards for clarification, page iv. Minor appearance and format updates. |
| 002 | 2024.07 | Regulatory update for EASA 2023-989 Compliance. |
| 002.1 | 2025.01 | Page 5.9 - Corrected orientation of Figure 5-10B.<br>Page 5.25 - Corrected y axis identifier for Figure 5-36. |

Module was reorganized based upon the EASA 2023-989 subject criteria.

# MEASUREMENT STANDARDS

**SI Units**
The measurements used in this book are presented with the International System of Units (SI) standards in all cases except when otherwise specified by ICAO (for example, altitude expressed in feet or performance numbers as specified by a manufacturer). The chart below can be used should your studies call for conversions into imperial numbers.

**Number Groups**
This book uses the International Civil Aviation Organization (ICAO) standard of writing numbers. This method separates groups of 3 digits with a space, versus the European method by periods and the American method by commas.

For example, the number one million is expressed as:

| | |
|---|---|
| ICAO Standard | 1 000 000 |
| European Standard | 1.000.000 |
| American Standard | 1,000,000 |

**Prefixes**
The prefixes used in the table below form names of the decimal equivalents in SI units.

### PREFIX AND SYMBOLS CHART

| MULTIPLICATION FACTORS | PREFIX | SYMBOL |
|---|---|---|
| 1 000 000 000 000 000 000 = $10^{18}$ | exa | E |
| 1 000 000 000 000 000 = $10^{15}$ | peta | P |
| 1 000 000 000 000 = $10^{12}$ | tera | T |
| 1 000 000 000 = $10^{9}$ | giga | G |
| 1 000 000 = $10^{6}$ | mega | M |
| 1 000 = $10^{3}$ | kilo | k |
| 100 = $10^{2}$ | hecto | h |
| 10 = $10^{1}$ | deca | da |
| 0.1 = $10^{-1}$ | deci | d |
| 0.01 = $10^{-2}$ | centi | c |
| 0.001 = $10^{-3}$ | milli | m |
| 0.000 001 = $10^{-6}$ | micro | µ |
| 0.000 000 001 = $10^{-9}$ | nano | n |
| 0.000 000 000 001 = $10^{-12}$ | pico | p |
| 0.000 000 000 000 001 = $10^{-15}$ | femto | f |
| 0.000 000 000 000 000 001 = $10^{-18}$ | atto | a |

### COMMON CONVERSIONS CHART

| IMPERIAL | TO | SI (METRIC) |
|---|---|---|
| **Distance** | | |
| 1 Inch | is equal to | 2.54 Centimeters |
| 1 Foot | is equal to | 0.304 Meters |
| 1 (Statute) Mile | is equal to | 1.609 Kilometers |
| **Weight** | | |
| 1 Pound | is equal to | 0.454 Kilograms |
| **Volume** | | |
| 1 Quart | is equal to | 0.946 Liters |
| 1 Gallon | is equal to | 3.785 Liters |
| **Temperature** | | |
| ˚0 Fahrenheit | is equal to | -17.778 Celsius (˚C) |
| ˚0 Fahrenheit | is equal to | 255.37 Kelvin (K) |
| **Area** | | |
| 1 Square Inch | is equal to | 6.451 Square Centimeters |
| 1 Square Foot | is equal to | 0.093 Square Meters |
| 1 Square Mile | is equal to | 2.59 Square Kilometers |
| **Velocity** | | |
| 1 Foot Per Second | is equal to | 0.304 Meters Per Second |
| 1 Mile Per Hour | is equal to | 1.609 Kilometers Per Hour |
| 1 Knot | is equal to | 1.852 Kilometers Per Hour |

| SI (METRIC) | TO | IMPERIAL |
|---|---|---|
| **Distance** | | |
| 1 Centimeter | is equal to | 0.394 Inches |
| 1 Meter | is equal to | 3.28 Feet |
| 1 Kilometer | is equal to | 0.621 Miles |
| **Weight** | | |
| 1 Kilogram | is equal to | 2.204 Pounds |
| **Volume** | | |
| 1 Liter | is equal to | 1.057 Quarts |
| 1 Liter | is equal to | 0.264 Gallons |
| **Temperature** | | |
| ˚0 Celsius (˚C) | is equal to | 33.8˚ Fahrenheit |
| ˚0 Kelvin (K) | is equal to | -459.67 Fahrenheit |
| **Area** | | |
| 1 Square Centimeter | is equal to | 0.155 Square Inches |
| 1 Square Meter | is equal to | 10.764 Square Feet |
| 1 Square Kilometer | is equal to | 0.386 Square Miles |
| **Velocity** | | |
| 1 Meter Per Second | is equal to | 3.281 Feet Per Second |
| 1 Kilometer Per Hour | is equal to | 0.621 Miles Per Hour |
| 1 Kilometer Per Hour | is equal to | 0.540 Knots |

| **Pressure** | | |
|---|---|---|
| pounds per square inch (psi) | kiloPascals (kPa) | 6.897 |
| pounds per square inch (psi) | Pascals (Pa) | 6.894 |

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.

| EASA LICENSE CATEGORY CHART MODULE NUMBER AND TITLE | | A1 Airplane Turbine | B1.1 Airplane Turbine | B1.2 Airplane Piston | B1.3 Helicopter Turbine | B1.4 Helicopter Piston | B2 Avionics |
|---|---|---|---|---|---|---|---|
| 1 | Mathematics | X | X | X | X | X | X |
| 2 | Physics | X | X | X | X | X | X |
| 3 | Electrical Fundamentals | X | X | X | X | X | X |
| 4 | Electronic Fundamentals | | X | X | X | X | X |
| 5 | Digital Techniques, Electronic Instrument Systems | X | X | X | X | X | X |
| 6 | Materials and Hardware | X | X | X | X | X | X |
| 7 | Maintenance Practices | X | X | X | X | X | X |
| 8 | Basic Aerodynamics | X | X | X | X | X | X |
| 9 | Human Factors | X | X | X | X | X | X |
| 10 | Aviation Legislation | X | X | X | X | X | X |
| 11 | Aeroplane Aerodynamics, Structures and Systems | X | X | | | | |
| 12 | Rotorcraft Aerodynamics, Structures and Systems | | | | X | X | |
| 13 | Aircraft Aerodynamics, Structures and Systems | | | | | | X |
| 14 | Propulsion | | | | | | X |
| 15 | Gas Turbine Engine | X | X | | X | | |
| 16 | Piston Engine | | | X | | X | |
| 17 | Propeller | X | X | X | | | |

**Basic knowledge requirments as outlined in Part-66, Appendix I**

The knowledge level indicators are defined on 3 levels as follows:

**Level 1**

A familiarization with the principal elements of the subject.

Objectives:

a. The applicant should be familiar with the basic elements of the subject.
b. The applicant should be able to give a simple description of the whole subject, using common words and examples.
c. The applicant should be able to use typical terms.

**Level 2**

A general knowledge of the theoretical and practical aspects of the subject and an ability to apply that knowledge.

Objectives:

a. The applicant should be able to understand the theoretical fundamentals of the subject.
b. The applicant should be able to give a general description of the subject using, as appropriate, typical examples.
c. The applicant should be able to use mathematical formula in conjunction with physical laws describing the subject.
d. The applicant should be able to read and understand sketches, drawings and schematics describing the subject.
e. The applicant should be able to apply his knowledge in a practical manner using detailed procedures.

**Level 3**

A detailed knowledge of the theoretical and practical aspects of the subject and a capacity to combine and apply the separate elements of knowledge in a logical and comprehensive manner.

Objectives:

a. The applicant should know the theory of the subject and interrelationships with other subjects.
b. The applicant should be able to give a detailed description of the subject using theoretical fundamentals and specific examples.
c. The applicant should understand and be able to use mathematical formula related to the subject.
d. The applicant should be able to read, understand and prepare sketches, simple drawings and schematics describing the subject.
e. The applicant should be able to apply his knowledge in a practical manner using manufacturer's instructions.
f. The applicant should be able to interpret results from various sources and measurements and apply corrective action where appropriate.

# PART 66 BASIC KNOWLEDGE REQUIREMENTS

| SUBMODULE KNOWLEDGE DESCRIPTIONS | | LEVEL |
|---|---|---|
| | | B2 |
| 7.1 | **Safety Precautions – Aircraft and Workshop**<br>Aspects of safe working practices including precautions to be taken when working with electricity, gases (especially oxygen), oils, and chemicals.<br>Fuel tank safety, fuel tank entry procedures and precautions. Awareness and precautions regarding aircraft equipped with ballistic recovers systems. Also, instructions in the remedial action to be taken in the event of a fire or another accident with one or more of these hazards including knowledge of fire extinguishing agents. | 3 |
| 7.2 | **Workshop Practices**<br>Care of tools / drills and reamers, control of tools, use of workshop materials;<br>Dimensions, allowances and tolerances, workmanship standards;<br>Calibration of tools and equipment, calibration standards. | 3 |
| 7.3 | **Tools**<br>Common hand-tool types; Common power-tool types;<br>Operation and use of precision-measuring tools;<br>Lubrication equipment and methods;<br>Operation, function, and use of electrical general test equipment. | 3 |
| 7.4 | **Submodule reserved for future use.** | – |
| 7.5 | **Engineering Drawings, Diagrams, and Standards**<br>Drawing types and diagrams, their symbols, dimensions, tolerances and projections;<br>Identification of title block information;<br>Microfilm, microfiche, and computerised presentations;<br>Specification 100 of the Air Transport Association (ATA) of America;<br>Aeronautical and other applicable standards including ISO, AN, MS, NAS and MIL;<br>Wiring diagrams and schematic diagrams. | 2 |
| 7.6 | **Fits and Clearances**<br>Drill sizes for bolt holes, classes of fits;<br>Common system for fits and clearances;<br>Schedule of fits and clearances for aircraft and engines;<br>Limits for bow, twist and wear;<br>Standard methods for checking shafts, bearings, and other parts. | 1 |
| 7.7 | **Electrical Wiring Interconnection System (EWIS)**<br>Continuity, insulation and bonding techniques and testing;<br>Use of crimp tools: hand and hydraulic operated;<br>Testing of crimp joints;<br>Connector pin removal and insertion;<br>Coaxial cables: testing and installation precautions; Identification of wire types, their inspection criteria and damage tolerance;<br>Wiring protection techniques: cable looming and loom support, cable clamps, protective sleeving techniques including heat shrink wrapping, shielding;<br>High-Intensity Radiated Fields (HIRF) and protection principles;<br>Soldering of electrical wires, EWIS installations, inspection, repair, maintenance, and cleanliness standards. | 3 |
| 7.8 | **Riveting**<br>Riveted joints, rivet spacing and pitch;<br>Tools used for riveting and dimpling;<br>Inspection of riveted joints. | - |
| 7.9 | **Pipes and Hoses**<br>Bending and belling/flaring aircraft pipes;<br>Inspection and testing of aircraft pipes and hoses;<br>Installation and clamping of pipes. | - |
| 7.10 | **Springs**<br>Inspection and testing of springs. | - |
| 7.11 | **Bearings**<br>Testing, cleaning and inspection of bearings;<br>Lubrication requirements for bearings;<br>Defects in bearings and their causes. | - |
| 7.12 | **Transmissions**<br>Inspection of gears, backlash;<br>Inspection of belts and pulleys, chains and sprockets;<br>Inspection of screw jacks, lever devices, push–pull rod systems. | - |

| SUBMODULE KNOWLEDGE DESCRIPTIONS | | LEVEL |
|---|---|---|
| | | B2 |
| 7.13 | **Control Cables**<br>Swaging of end fittings;<br>Inspection and testing of control cables;<br>Bowden cables;<br>aircraft flexible control systems. | - |
| 7.14 | **Material Handling** | |
| 7.14.1 | **Sheet Metal**<br>Marking out and calculation of bend allowance;<br>Sheet metal working, including bending and forming;<br>Inspection of sheet metal work. | - |
| 7.14.2 | **Composite and Non-metallic**<br>Bonding practices;<br>Environmental conditions;<br>Inspection methods. | - |
| 7.14.3 | **Additive Manufacturing**<br>Common additive manufacturing techniques and their influence on the mechanical properties of the finished part;<br>Inspection of additive manufactured parts and common production failures. | 1 |
| 7.15 | **Submodule reserved for future use.** | – |
| 7.16 | **Aircraft Weight and Balance**<br>(a) Calculation of centre-of-gravity / balance limits: use of relevant documents.<br>(b) Preparation of aircraft for weighing;<br>Aircraft weighing. | 2<br>- |
| 7.17 | **Aircraft Handling and Storage**<br>Aircraft taxiing/towing and associated safety precautions;<br>Aircraft jacking, chocking, securing and associated safety precautions;<br>Aircraft storage methods;<br>Refuelling/defuelling procedures;<br>De-icing/anti-icing procedures;<br>Electrical, hydraulic, and pneumatic ground supplies;<br>Effects of environmental conditions on aircraft handling and operation. | 2 |
| 7.18 | **Disassembly, Inspection, Repair, and Assembly Techniques**<br>(a) Types of defects and visual inspection techniques; Corrosion removal, assessment and reprotection;<br>(b) General repair methods, structural repair manual; Ageing, fatigue, and corrosion control programmes;<br>(c) Non-destructive inspection techniques including penetrant, radiographic, eddy current, magnetic particle, ultrasonic and borescope inspections; including practical training in colour contrast penetrant inspection;<br>(d) Disassembly and reassembly techniques;<br>(e) Troubleshooting techniques. | 3<br>-<br>1<br><br>2<br>2 |
| 7.19 | **Abnormal Events**<br>(a) Inspections following lightning strikes and HIRF penetration;<br>(b) Inspections following abnormal events such as heavy landings and flight through turbulence. | 2<br>- |
| 7.20 | **Maintenance Procedures**<br>Maintenance planning;<br>Modification procedures;<br>Stores procedures;<br>Certification/release procedures;<br>Interface with aircraft operation;<br>Maintenance Inspection / Quality Control / Quality Assurance;<br>Additional maintenance procedures;<br>Control of life-limited components. | 2 |
| 7.21 | **Documentation and Communication**<br>Documentation: elements and criteria for writing work reports, troubleshooting reports, and shift handover instructions.<br>Communication: clear, comprehensive, and concise. | 2 |

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## MAINTENANCE PRACTICES

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Figure 1-8. An actuation handle with its remove-before-flight safety pin in place.

### AIRPLANE DAMAGE CONSIDERATIONS

Personnel performing fuel tank work may damage the airplane if they are not trained to avoid such damage. The mating surfaces of the access hole and covers should be protected during entry so that the surfaces are not scratched or otherwise damaged. Components inside the tanks, such as fuel pumps, quantity systems and associated wiring and conduits are also vulnerable if they are struck or dislodged. Finally, the containment properties of the fuel tank can be compromised if the sealant is dislodged or if fuel tank bladders are penetrated.

## BALLISTIC RECOVERY SYSTEMS

### AWARENESS AND PRECAUTIONS REGARDING BALLISTIC RECOVERY SYSTEMS

### BASIC UNDERSTANDING

Once the domain of microlights and small homebuilt aircraft, ballistic recovery systems can now be found on many general aviation aircraft including Cessna, Cirrus and even some light jets. These systems are designed as a last resort in the event of a collision, structural failure or engine failure over inhospitable terrain. While these events are extremely rare, the principle manufacturer claims over 380 "saves" to date, and many light aircraft manufacturer's now offer this option to ease the fears of buyers. Therefore, it not be uncommon for a light aircraft AMT to come across these systems in their daily work. [**Figure 1-7**]

### PRIMARY COMPONENTS

Most ballistic recovery systems are rocket fired where a small solid fueled rocket type device pulls the parachute from its container stored inside the aircraft. However, some older systems operate more like a mortar where an explosive charge pushes the tightly packed canopy from a tube. In either case, the principle components of all systems include the parachute itself (canopy, suspension lines and risers), a pyrotechnic device and its igniter, an in-cockpit actuation handle, and the various structural components to house these parts and attach them to the aircraft.

In the event of an emergency, the system is activated by the pilot via an actuation handle in the cockpit. [**Figure 1-8**] The handle activates a rocket motor which extracts a harness and the packed canopy from its container located inside the aircraft. Once the canopy is extended it unfurls and lowers the aircraft at a survivable rate.[**Figure 1-9**]

### SAFETY AROUND BALLISTIC RECOVERY SYSTEMS

The primary safety concern when working with or near ballistic systems is the unintentional firing of the rocket itself. Being struck by this device exiting the aircraft can be fatal. Never position yourself or allow others in the potential path of the rocket device. When handling a device that is not installed on the aircraft be aware of where the rocket is pointed at all times. Treat the device like a loaded gun. Even with the safety flag installed in the activation handle, know that a potential for an unintentional firing still exists, particularly if the device has been subjected to shock or high Gs. Mishandling or attempting to modify the igniter, rocket or any other component of a ballistic system can also cause an unintentional firing.

### INSPECTION AND MAINTENANCE

Preflight and other inspections of ballistic parachute systems are primarily for a system's cleanliness, contamination, corrosion and other damage, and for the proper and secure attachment of all components; particularly the actuation handle, bridals and other attach points to the airframe. The parachute container must be

Figure 1-7. A ballistic parachute recovery of a Cirrus SR22.


Figure 1-9. The firing sequence of a rocket propelled parachute system.

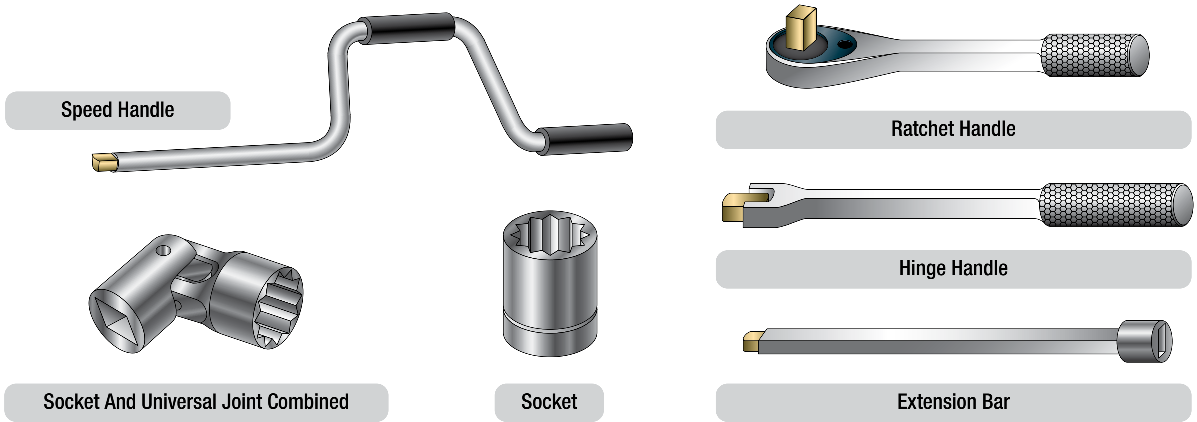

Figure 3-10. Socket wrench set.

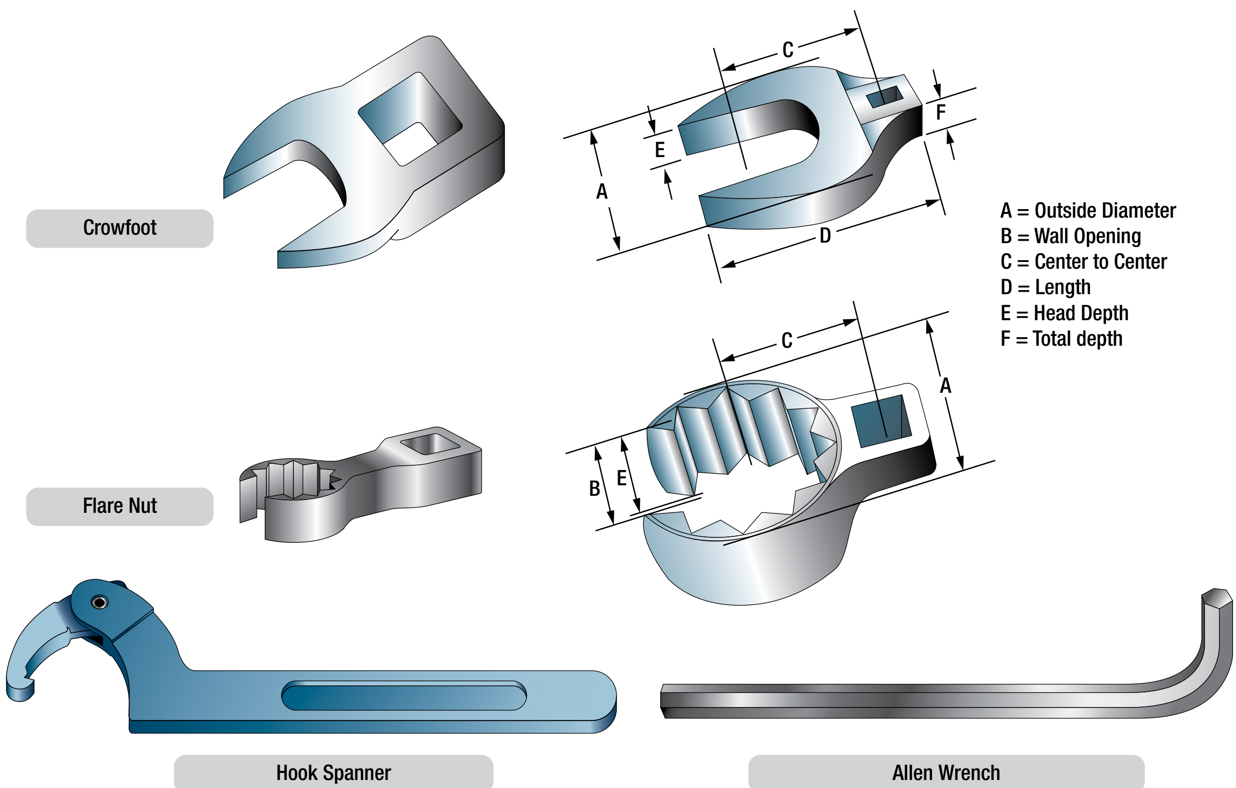

Figure 3-11. Special wrenches.

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 ½-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**]

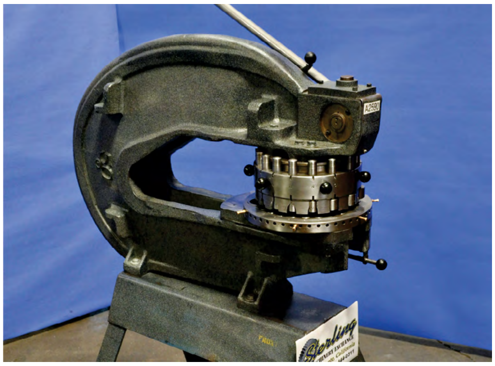

Figure 3-44. Rotary punch press.


Figure 3-45. Foot-operated squaring shear.

Figure 3-46. Power squaring shear.

When cutting to a line, place the sheet on the bed of the shears in front of the cutting blade with the cutting line even with the cutting edge of the bed. To cut the sheet with a foot shear, step on the treadle while holding the sheet securely in place.

Squaring requires several steps. First, one end of the sheet is squared with an edge (the squaring fence is usually used on the edge). Then, the remaining edges are squared by holding one squared end of the sheet against the squaring fence and making the cut, one edge at a time, until all edges have been squared.

When several pieces must be cut to the same dimensions, use the backstop, located on the back of the cutting edge on most squaring shears. The supporting rods are graduated in fractions of an inch and the gauge bar may be set at any point on the rods. Set the gauge bar the desired distance from the cutting blade of the shears and push each piece to be cut against the gauge bar. All the pieces can then be cut to the same dimensions without measuring and marking each one separately.

## SANDERS

### DISK SANDER

Disk sanders have a powered abrasive-covered disk or belt and are used for smoothing or polishing surfaces. The sander unit uses abrasive paper of different grits to trim metal parts. [**Figure 3-47**]

It is much quicker to use a disk sander than to file a part to the correct dimension. The combination disk and belt sander has a vertical belt sander coupled with a disk sander and is often used in a metal shop.

### BELT SANDER

The belt sander uses an endless abrasive belt driven by an electric motor to sand down metal parts much like the disk sander unit. The abrasive paper used on the belt comes in different degrees of grit or coarseness. The belt sander is available as a vertical or horizontal unit. The tension and tracking of the abrasive belt can be adjusted so the belt remains centered on its rollers. [**Figure 3-48**]

## GRINDERS

Grinding machines come in a variety of types and sizes, depending upon the class of work for which they are to be used. Dry and/or wet grinders are found in airframe repair shops. Grinders can be

Figure 3-47. Disk Sander.

Figure 3-48. Belt sander.

drills used to cut steel and cast iron, the angle should be 59° from the axis of the drill. For faster drilling of soft materials, sharper angles are used.

The twist drill should be sharpened at the first sign of dullness. For most drilling, a twist drill with a cutting angle of 118° (59° on either side of center) will be sufficient; however, when drilling soft metals, a cutting angle of 90° may be more efficient. Typical procedures for sharpening drills are as follows: [**Figure 3-72**]

a. Adjust the grinder tool rest to a height for resting the back of the hand while grinding.
b. Hold the drill between the thumb and index finger of the right or left hand. Grasp the body of the drill near the shank with the other hand.
c. Place the hand on the tool rest with the centerline of the drill making a 59° angle with the cutting face of the grinding wheel. Lower the shank end of the drill slightly.
d. Slowly place the cutting edge of the drill against the grinding wheel. Gradually lower the shank of the drill as you twist the drill in a clockwise direction. Maintain pressure against the grinding surface only until you reach the heel of the drill.
e. Check the results of grinding with a gauge to determine whether or not the lips are the same length and at a 59° angle.

Alternatively, there are commercially available twist drill grinders available, as well as attachments for bench grinders which will ensure consistent, even sharpening of twist drills.

### DRILL BIT SIZES

Drill diameters are grouped by three size standards: number, letter, and fractional. The decimal equivalents of standard drill are shown in **Figure 3-73**.

The diameter of a twist drill may be given in one of three ways: (1) by fractions, (2) letters, or (3) numbers. Fractionally, they are classified by sixteenths of an inch (from 1⁄16 to 3½-inch), by thirty-seconds (from 1⁄32 to 2½-inch), or by sixty-fourths (from 1⁄64 to 1¼-inch).

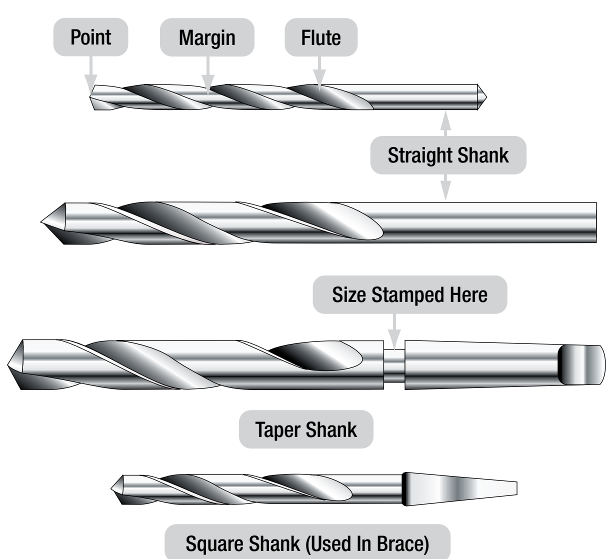


Figure 3-71. Drill types.

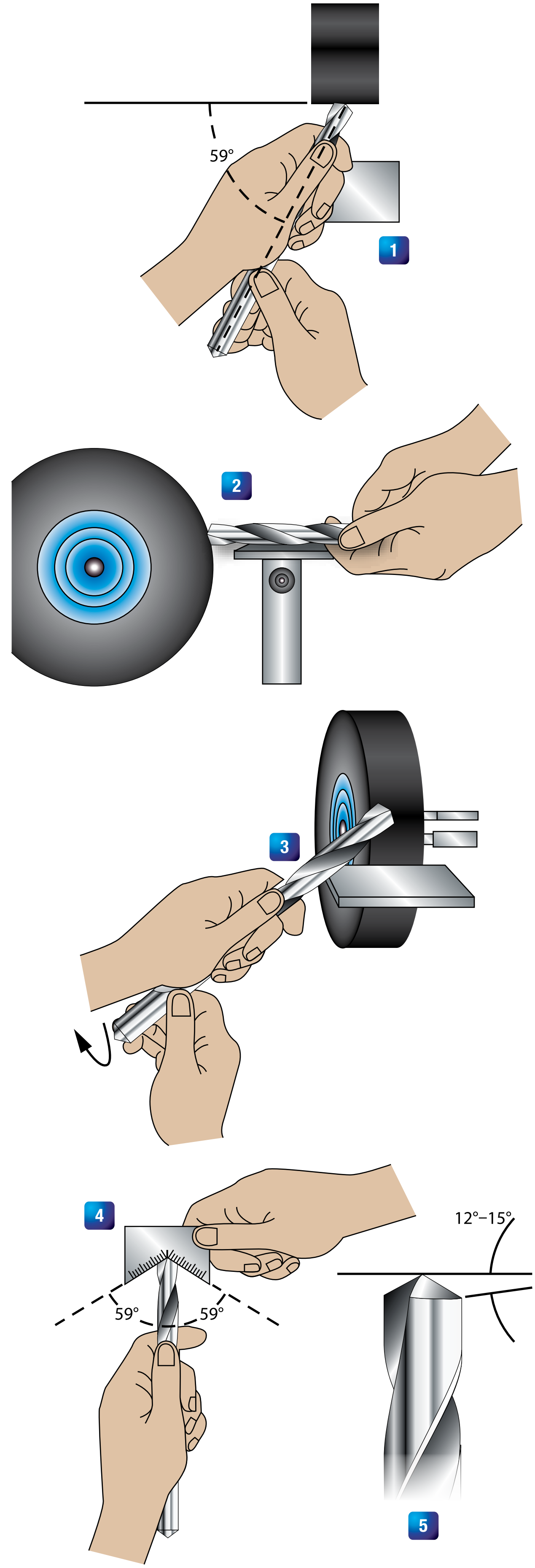


Figure 3-72. Drill sharpening procedures.

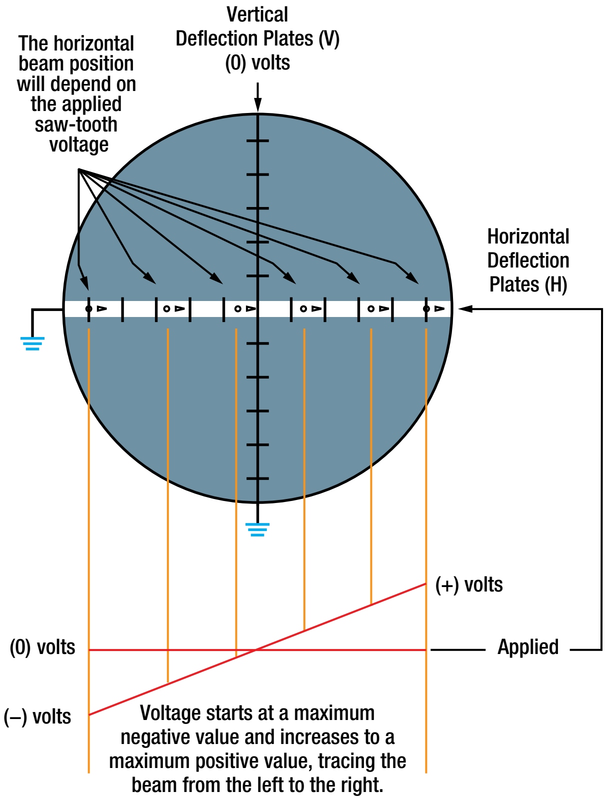

Figure 3-112. Saw-tooth applied voltage.

When the saw-tooth reaches the end of its sweep from left to right, the beam then rapidly returns to the left side and is ready to make another sweep. During this time, the electron beam is stopped or blanked out and does not produce any kind of a trace. This period of time is called flyback.

### VERTICAL DEFLECTION

If this same signal were applied to the vertical plates, it would also produce a vertical line by causing the beam to trace from the down position to the up position.

### TRACING A SINE WAVE

Reproducing the sine wave on the oscilloscope combines both the vertical and horizontal deflection patterns. [**Figure 3-113**] If the sine wave voltage signal is applied across the vertical deflection plates, the result will be the vertical beam oscillation up and down on the screen. The amount that the beam moves above the centerline will depend on the peak value of the voltage. While the beam is being swept from the left to the right by the horizontal plates, the sine wave voltage is being applied to the vertical plates, causing the form of the input signal to be traced out on the screen.

### CONTROL FEATURES ON AN OSCILLOSCOPE

There are many different styles of oscilloscopes, which range from the simple to the complex, they all have some controls in common. Apart from the screen and the ON/OFF switch, some of these controls are listed next.

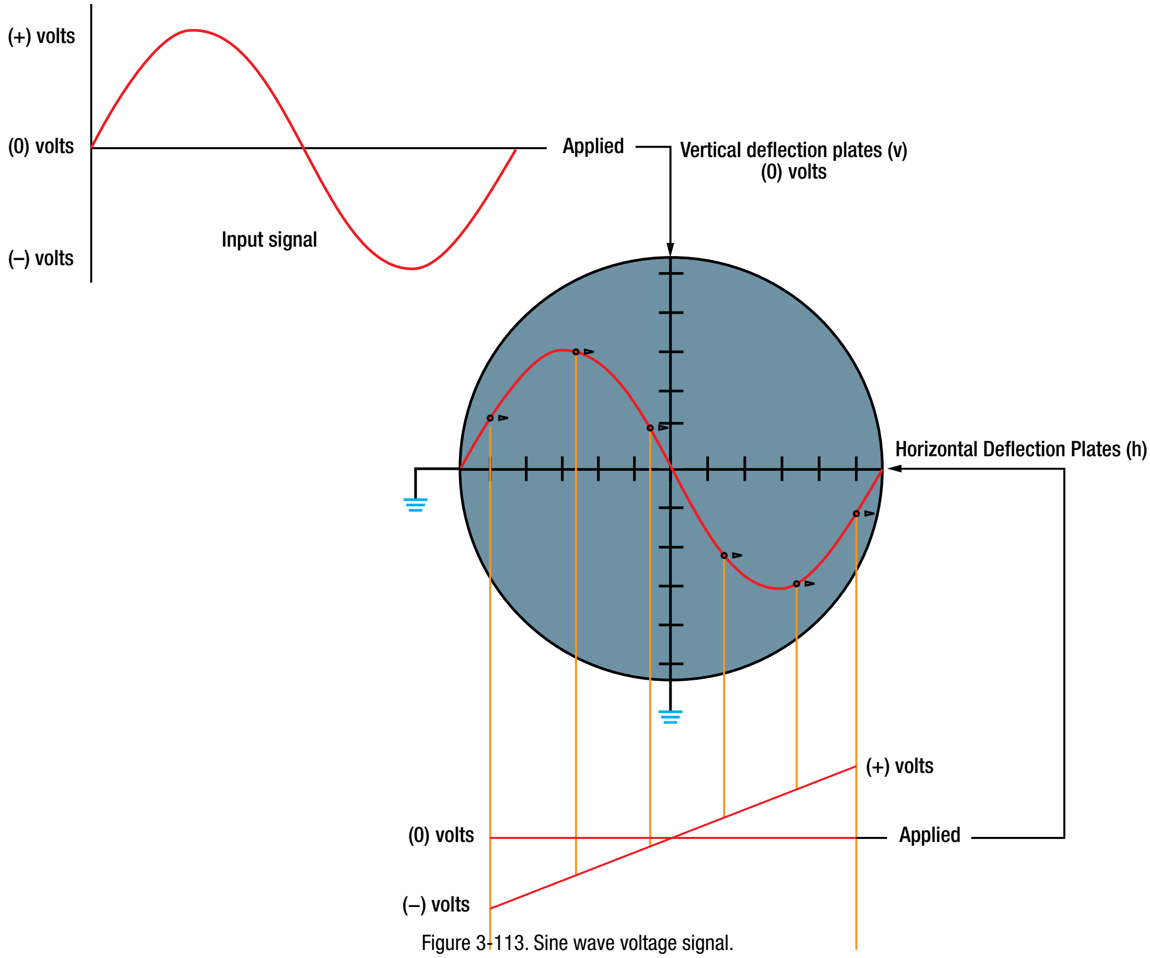

Figure 3-113. Sine wave voltage signal.