AIRCRAFT TECHNICAL BOOK COMPANY

CAT-A

AVIATION MAINTENANCE TECHNICIAN CERTIFICATION SERIES

MAINTENANCE PRACTICES

7

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

EASA 2023-989 COMPLIANT

REVISION LOG

Update notices for this book will be available online at www.actechbooks.com/revisions.html
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VERSION	EFFECTIVE DATE	DESCRIPTION OF REVISION(S)
001	2020.02	Module creation and release.
001.1	2021.10	Corrected description of file types (Submodule 7, pages 3.15-3.16).
001.2	2023.04	Submodule 8 - Added content on Friction and Mechanical lock blind rivet procedures. Inclusion of Measurement Standards for clarification, page iv. Minor appearance and format updates.
002	2024.04	Regulatory update for EASA 2023-989 Compliance.
002.1	2025.01	Page 5.8 - Corrected orientation of Figure 5-10B. Page 12.3 - Corrected orientation of checknuts Figure 12-9.

Module was reorganized based upon the EASA 2023-989 subject criteria. Enhancements included in this version 002.1 are:

7.1 *Fuel Tank Safety* - topic added.
7.1 *Ballistic Parachutes* - topic added.
7.4 *Avionics Test Equipment* - topic moved to Modules 11, 12, and 13 per 2023-989.
7.7 *Connector Pin Wire Support* - topic added.
7.7 *Soldering Electrical Wires* - topic added.
7.7 *HIRF Protection Principles* - topic added.
7.8 *Special Purpose Rivets and Fasteners* - topic added.
7.9 *Visual Inspection of Springs* - topic added.
7.9 *Inspecting Squareness of Springs* - topic added.
7.13 *Cable Tension Regulators* - topic added.
7.13 *Cable Guides and Adjustment* - topic added.
7.14 *Additive Manufacturing* - topic added.
7.15 *Welding* - submodule deleted per 2023-989.
7.18 *Structural Repair Manuals* - topic added.
7.18 *Dye Penetrant Color Contrast* - topic added.
7.19 *HIRF Test Equipment* - topic added.
7.21 *Documentation and Communication* - new submodule added.

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	(-)437.87 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
		A
7.1	**Safety Precautions – Aircraft and Workshop** Aspects of safe working practices including precautions to be taken when working with electricity, gases (especially oxygen), oils, and chemicals. 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** Care of tools / drills and reamers, control of tools, use of workshop materials; Dimensions, allowances and tolerances, workmanship standards; Calibration of tools and equipment, calibration standards.	3
7.3	**Tools** Common hand-tool types; Common power-tool types; Operation and use of precision-measuring tools; Lubrication equipment and methods; Operation, function, and use of electrical general test equipment.	3
7.4	**Submodule reserved for future use.**	–
7.5	**Engineering Drawings, Diagrams, and Standards** Drawing types and diagrams, their symbols, dimensions, tolerances and projections; Identification of title block information; Microfilm, microfiche, and computerised presentations; Specification 100 of the Air Transport Association (ATA) of America; Aeronautical and other applicable standards including ISO, AN, MS, NAS and MIL; Wiring diagrams and schematic diagrams.	1
7.6	**Fits and Clearances** Drill sizes for bolt holes, classes of fits; Common system for fits and clearances; Schedule of fits and clearances for aircraft and engines; Limits for bow, twist and wear; Standard methods for checking shafts, bearings, and other parts.	1
7.7	**Electrical Wiring Interconnection System (EWIS)** Continuity, insulation and bonding techniques and testing; Use of crimp tools: hand and hydraulic operated; Testing of crimp joints; Connector pin removal and insertion; Coaxial cables: testing and installation precautions; Identification of wire types, their inspection criteria and damage tolerance; Wiring protection techniques: cable looming and loom support, cable clamps, protective sleeving techniques including heat shrink wrapping, shielding; High-Intensity Radiated Fields (HIRF) and protection principles; Soldering of electrical wires, EWIS installations, inspection, repair, maintenance, and cleanliness standards.	1
7.8	**Riveting** Riveted joints, rivet spacing and pitch; Tools used for riveting and dimpling; Inspection of riveted joints.	1
7.9	**Pipes and Hoses** Bending and belling/flaring aircraft pipes; Inspection and testing of aircraft pipes and hoses; Installation and clamping of pipes.	1
7.10	**Springs** Inspection and testing of springs.	1
7.11	**Bearings** Testing, cleaning and inspection of bearings; Lubrication requirements for bearings; Defects in bearings and their causes.	1
7.12	**Transmissions** Inspection of gears, backlash; Inspection of belts and pulleys, chains and sprockets; Inspection of screw jacks, lever devices, push–pull rod systems.	1

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

MAINTENANCE PRACTICES

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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**]

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

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

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

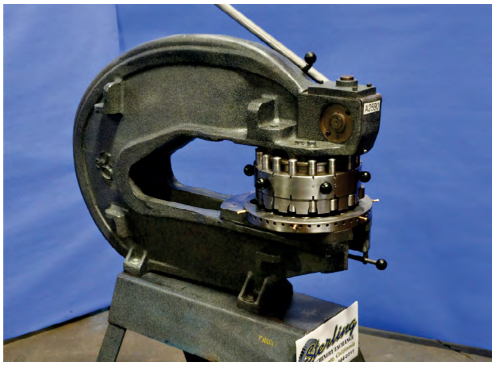

Figure 3-44. Rotary punch press.

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.

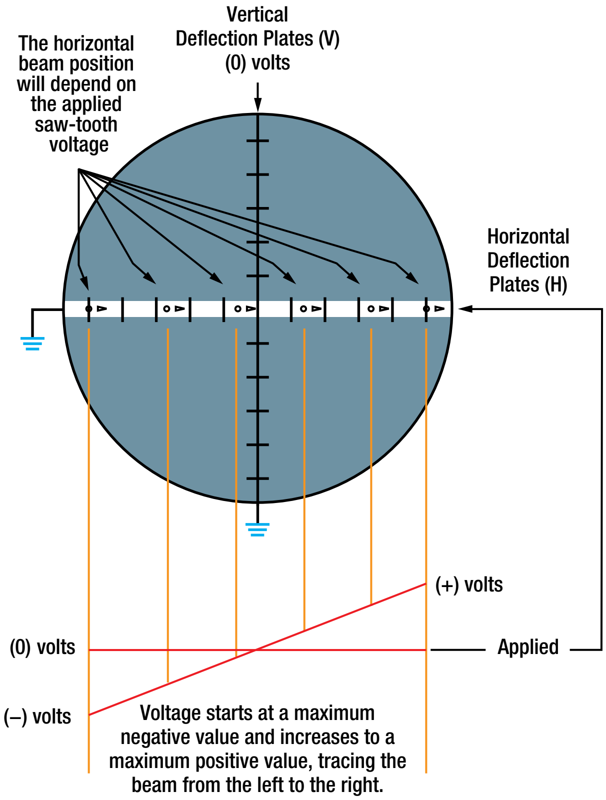

Figure 3-112. Saw-tooth applied voltage.

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.

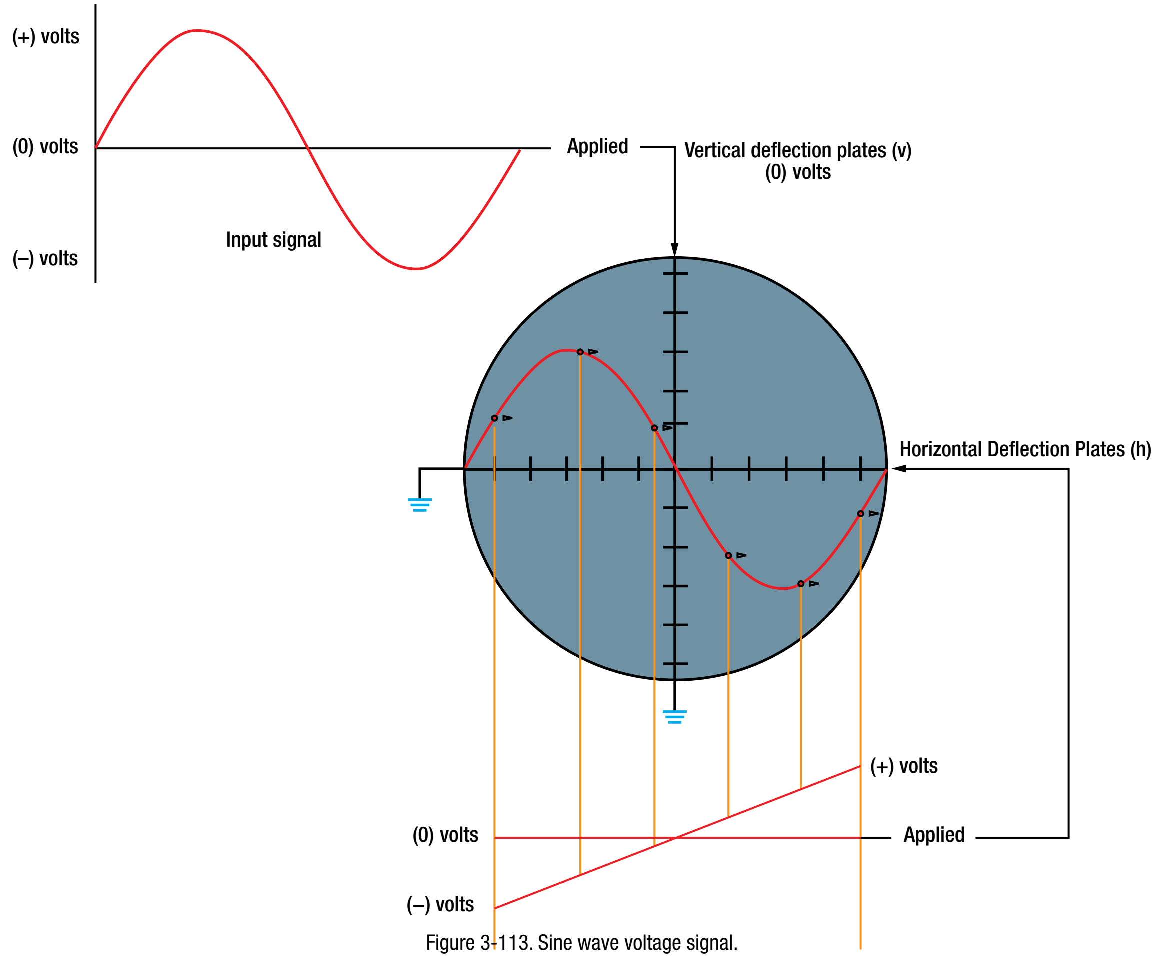

Figure 3-113. Sine wave voltage signal.

decimal form. When very accurate dimensions are necessary, decimal allowances are used. Fractional allowances are sufficient when precise tolerances are not required. Standard tolerances of –0.010 or –1⁄32 may be given in the title block of many drawings, to apply throughout the drawing.

FINISH MARKS
Finish marks are used to indicate the surface that must be machine finished. Such finished surfaces have a better appearance and allow a closer fit with adjoining parts. During the finishing process, the required limits and tolerances must be observed. Do not confuse machined finishes with those of paint, enamel, chromium plating, and similar coating.

SCALE
Some drawings are made the same size as the drawn part; reflecting a scale of 1:1. Other scales may be used. However, when drawings are made on a computer, drawing sizes may be easily increased (zoom in) or decreased (zoom out). Some electronic printers have the same capability. Furthermore, when a 1:1 copy of a print is made, the copy size may differ slightly from that of the original. For accurate information, refer to the dimensions shown on the drawing. [**Figure 5-3H**]

METHODS OF ILLUSTRATION

APPLIED GEOMETRY
Geometry is the branch of mathematics that deals with lines, angles, figures, and certain assumed properties in space. Applied geometry, as used in drawings, makes use of these properties to accurately and correctly represent objects graphically. In the past, draftsmen utilized a variety of instruments with various scales, shapes, and curves to make their drawings. Today, computer software graphics programs show drawings at nearly any scale, shape, and curve imaginable, outdating the need for additional instruments. Several different methods are used to illustrate objects graphically. The most common are orthographic projections, pictorial drawings, diagrams, and flowcharts.

ORTHOGRAPHIC PROJECTION
To show the exact size and shape of all the parts of complex objects, several views are necessary. This is the system used in orthographic projection.

In orthographic projection, there are six possible views of an object, because all objects have six sides—front, top, bottom, rear, right side, and left side. **Figure 5-10A** shows an object placed in a transparent box, hinged at the edges. The projections on the sides of the box are the views as seen looking straight at the object through each side. If the outlines of the object are drawn on each surface of the box, and the box is then opened [**Figure 5-10B**] to lay flat [**Figure 5-10C**], the result is a six-view orthographic projection.

It is seldom necessary to show all six views to portray an object clearly; therefore, only those views necessary to illustrate the required characteristics of the object are drawn. One, two, and three-view drawings are the most common. Regardless of the number of views used, the arrangement is generally as shown in

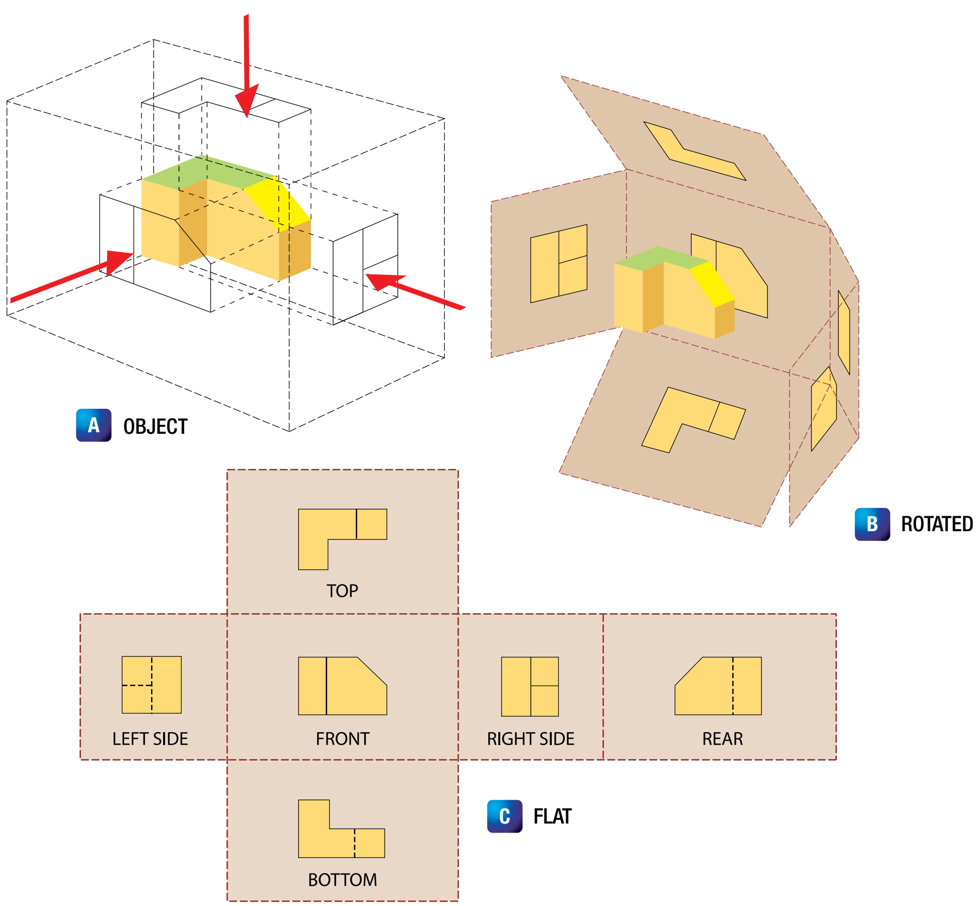

Figure 5-10. Orthographic projection.

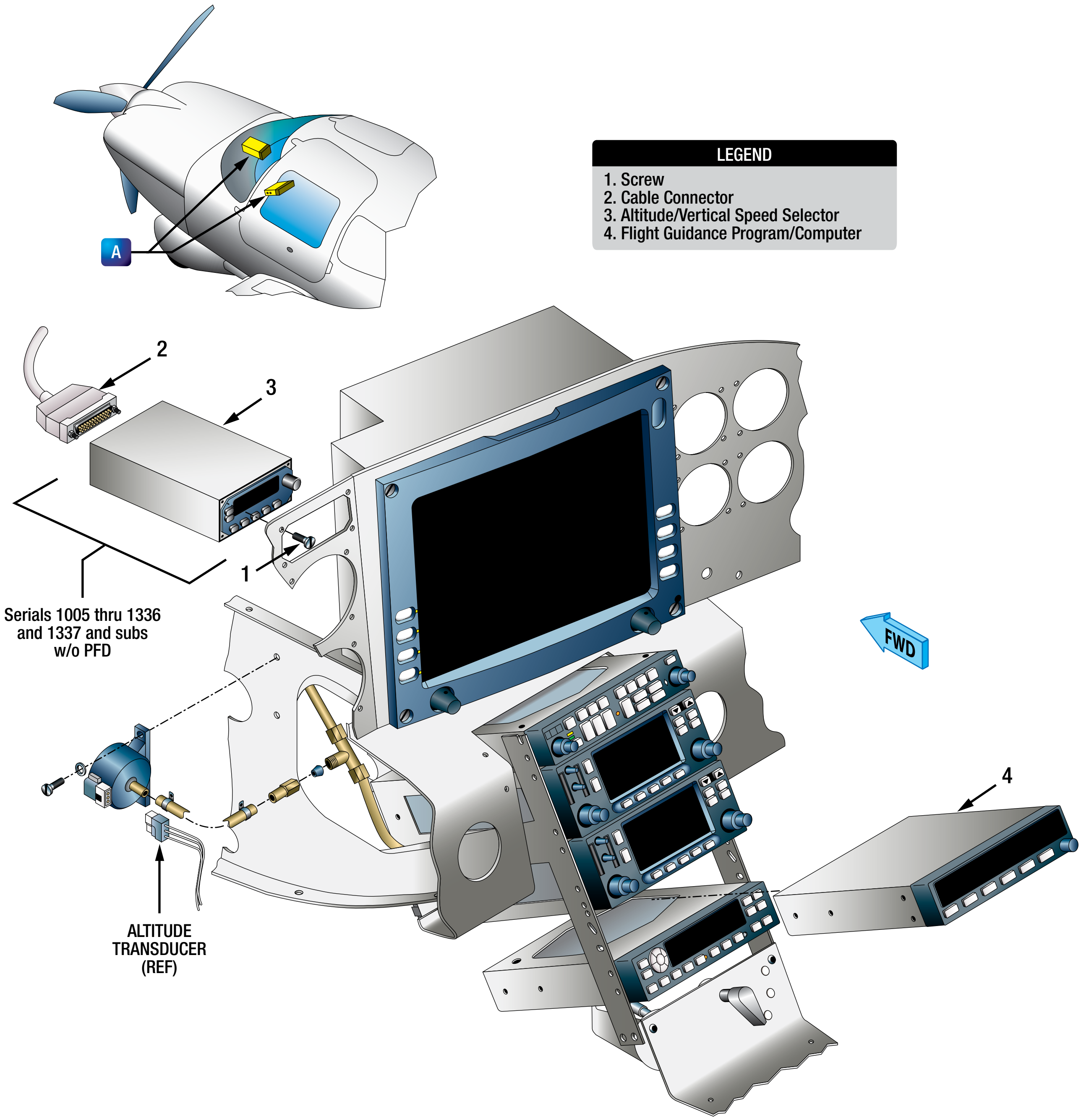

Figure 5-28. Example of an installation diagram (flight guidance components).