AIRCRAFT TECHNICAL BOOK COMPANY

B2

AVIATION MAINTENANCE TECHNICIAN CERTIFICATION SERIES

MAINTENANCE PRACTICES

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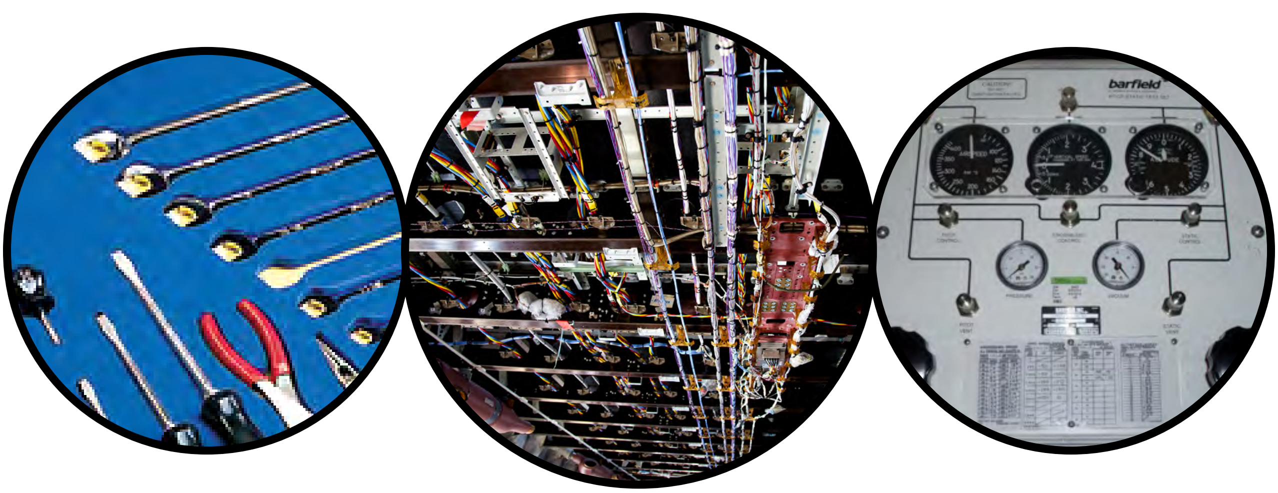

COMPLIANT WITH EASA European Aviation Safety Agency EASA PART 66/147

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	2020.03	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.

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

MAINTENANCE PRACTICES

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The inside of these tanks usually have spar and rib structures with various size and shape access holes between sections. Some wing center tanks, as well as many auxiliary tanks, are equipped with flexible fuel bladders. These bladders must be fastened in some manner to the metal walls, floors, and ceiling of integral tanks.

PREPARATION FOR ENTRY

Several steps must be completed prior to entering the fuel tank. These include electrically grounding and defueling the airplane, making adequate fire protection equipment readily available, and deactivating associated airplane systems such as fueling/defueling and fuel transfer systems. Three final steps must be performed to ensure a safe atmosphere for maintenance personnel.

ENSURING ADEQUATE VENTILATION

The single most important method of controlling the hazards associated with working in a fuel tank is ventilation. The more fresh air that is present in the tank, the safer the environment will be. Continuously pushing fresh air into a fuel tank helps to prevent a fuel vapor concentration from reaching its LFL. Fresh air also dilutes the toxic chemicals, reducing the risk of hazardous exposure. High volumes of fresh air will also prevent oxygen deficiency. Normal concentration of atmospheric oxygen in air is about 21 percent. At levels below 19.5 percent a person will begin to exhibit signs of oxygen starvation, including headache, nausea, drowsiness, and slurred speech. At increasingly lower concentrations, more severe reactions occur; ultimately death by asphyxiation. Oxygen deficiency is often caused by physically displacing the oxygen in a space. For example, pumping nitrogen into a fuel tank to prevent ignition will cause the oxygen concentration to decrease.

VENTILATION TECHNIQUES

The physical structure of airplane fuel tanks such as dead air spaces and small openings between tank sections which inhibits air flow presents challenges in ensuring adequate ventilation Ventilation equipment must be properly set up before entry is accomplished. The recommended method for conducting tank ventilation is the push-pull technique. First, an upstream "push" access hole should be opened. Next, a downstream "pull" hole should be opened. Finally, a blower should be located at the push hole, forcing fresh air into the tank. Exhaust fans can also be located at the pull hole to supplement the airflow through the tank.

MONITORING AIR IN FUEL TANKS

To determine if the atmosphere in the tank is suitable for entry, the conditions should be continuously monitored for oxygen concentration, flammable and toxic vapor concentration. Entry may not be permitted unless the oxygen concentration is between 19.5 - 23.5 percent. [**Figure 1-5**]

Instruments are available that can simultaneously monitor the oxygen and flammable vapor concentration, but the measurement of oxygen is the most critical. Measurements outside of the permitted range can also cause faulty readings of other devices used to detect flammable vapors. Monitoring instruments must be calibrated for the type of vapor determined to be present. For Jet-A-type jet fuels, a monitor calibrated with hexane will be reasonably accurate. If other types of fuels or chemicals are present, the monitor must be calibrated for those vapors.

CONDITIONS REQUIRED FOR ENTRY

The most important factor in preventing injury during fuel tank work is a properly trained and equipped entry crew. The entry crew is composed of the entrant, the entry supervisor and a standby attendant. The supervisor authorizes the work and ensures it is conducted according to procedure. The standby attendant stays outside of the tank to monitor conditions in and around the work area and is authorized to order evacuation if conditions change and put the entry person at risk. Entry personnel must be able to recognize potential hazards and evacuate the tank if working conditions deteriorate.

COMMUNICATION

Continuous voice communication should be maintained between the entrant and the standby attendant throughout the process. Voice communication can be assisted by radio as long as the device is rated for use in potentially flammable atmospheres.

RESPIRATORY PROTECTION

Entry personnel must wear a respirator. Air-purifying respirators can be used if the oxygen concentration is at above 19.5 percent. If the potential exists for further depletion supplied-air respirators are required. [**Figure 1-6**]

ELECTRICALLY POWERED EQUIPMENT

Technicians may need to use a variety of energized equipment including lighting, testing equipment, and powered tools. All electric powered equipment must be rated for use in a flammable atmosphere. All pneumatic tools should be powered only by compressed air, not by nitrogen or other inert gases that could displace the oxygen inside the tank.

Figure 1-5. An oxygen deficiency monitor is critical for personnel working in fuel tanks.

Figure 1-6. A high quality respirator is always required equipment to enter a fuel tank.

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.

properly sealed, dry, and free of oils or other contamination. Defects involving the installation of components to the airframe and basic cleanliness may be corrected by the AMT. There are no user or AMT serviceable parts in a ballistic parachute system. Defects involving damage to any component, including loose, wet, or contaminated seals must be referred to the manufacturer.

Manufacturers have set required service limits for both the parachute repacks and pyrotechnic and rocket replacements. For the canopy, a 5-6 year required factory repack for sealed units is typical, or sooner if damage or contamination is present. A canopy which has inadvertently been opened or removed from its container must be factory repacked before returning to service. Rocket devices typically require replacement every 10 years. In all cases, contact the manufacturer for further details.

INSTALLATION AND REMOVAL

Certain items are critical for the installation of any ballistic parachute system. Among them are the following:

- Mounting of the container and rocket assembly to the airframe.
- Correct routing of cables and bridal system to the airframe.
- Routing and securing of the activation handle.
- Direction of rocket fire in relation to the airframe.

Many other installation concerns exist. Seeking factory instructions and checklists are advised. In all situations it is advisable to seek instruction from the system's manufacturer and further confirmation after installation that you have done the job correctly. [**Figure 1-10 and 1-11**]

Removal of systems is similar to other devices with the exception of the highest attention required when working around the activation mechanisms and awareness of where the device is "pointed" at all times.

Figure 1-10. The internal mounting of a ballistic parachute system in a Cessna 182. Notice the rocket firing position through the rear window.

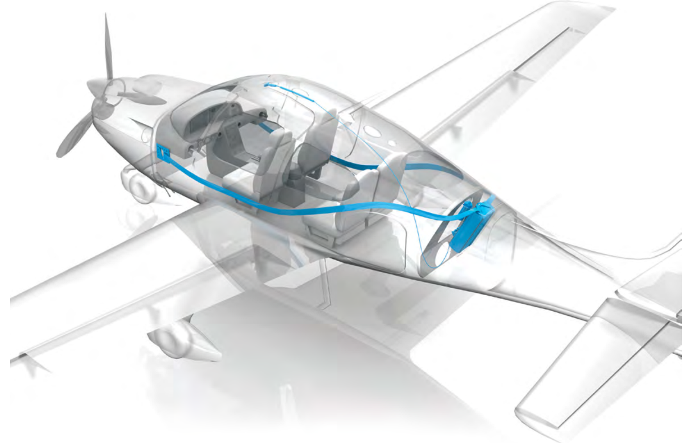

Figure 1-11. Drawing shows the placement of the parachute system and its supporting harness on a Cirrus SR22sys.

FIRE SAFETY

Performing maintenance on aircraft and their components requires the use of electrical tools that can produce sparks, heat producing tools and equipment, flammable and explosive liquids and gasses. As a result, a high potential exists for fire to occur. Measures must be taken to prevent a fire from occurring and to have a plan for extinguishing it if it does.

The key to fire safety is knowledge of what causes a fire, how to prevent it, and how to put it out. This knowledge must be instilled in each technician, emphasized by their supervisors through sound safety programs, and occasionally practiced. Airport or other local fire departments can normally be called upon to assist in training personnel and helping to establish fire safe programs for the hangar, shops, and flight lines.

REQUIREMENTS FOR A FIRE TO OCCUR

Three things are required for a fire. Remove any one of these things and the fire extinguishes: [**Figure 1-12**]

1. Fuel – combines with oxygen in the presence of heat, releasing more heat. As a result, it reduces itself to other chemical compounds.
2. Heat – accelerates the combining of oxygen with fuel, in turn releasing more heat.
3. Oxygen – the element that combines chemically with another substance through the process of oxidation. Rapid oxidation, accompanied by a noticeable release of heat and light is called combustion or burning.

CLASSIFICATION OF FIRES

Fire classification and extinguisher identifying labels differ throughout the world with the most common systems being those of Europe and Australia and those in the United States. [**Table 1-1**]

ORDINARY COMBUSTIBLES

Class A fires consist of ordinary combustibles such as wood, paper, fabric, and most kinds of trash. The European system categorizes this material as A1 for normal combustibles and A2 for fire resistant combustibles. The US system categorizes all as simply Class A.

FIRE CLASSES		EUROPEAN STANDARD	UNITED STATES STANDARD	SUITABLE SUPPRESSION
	Combustible Materials (Wood, Paper, Fabric, etc.)	Class A1/A2	Class A	Most Suppression Techniques
	Flammable Liquids	Class B	Class B	Dry Chemical or Halon
	Flammable Gases	Class C	Class B	Dry Chemical or Halon
	Flammable Metals	Class D	Class D	Specialist Suppression Required
	Electrical Fires	Class E	Class C	Same as Combustibles, but conductive agents such as water should not be used
	Cooking Oils and Fats	Class F	Class K	Removal of Oxygen

Table 1-1. Fire classes chart.

Figure 1-12. The fire triangle; all three elements shown are required for fire to occur.

FLAMMABLE LIQUID AND GAS

The US system designates all liquid and gas fires as Class B. In the European/Australian system, flammable liquids are designated Class B having flash point less than 100°C; while gases are designated Class C. A solid stream of water should never be used because it can cause the fuel to scatter, spreading the flames. The most effective way to extinguish a liquid or gas fire is by inhibiting the chemical reaction of the fire with dry chemical and Halogenated agents.

ELECTRICAL

Electrical fires involve energized electrical equipment. The US system designates these Class C while the European/Australian system designates them Class E. This sort of fire may be caused by short-circuiting machinery or overloaded electrical cables. These fires are a hazard when using water or other conductive agents, as electricity may be conducted from the fire, through water, to the fire fighter's body, and then earth. If the fire is electrically energized, it can be fought with any agent rated for electrical fire such as carbon dioxide or dry chemical powder. Once electricity is shut off, it will generally become an ordinary combustible fire.

METAL

Class D fires involve combustible metals like lithium, potassium, and alkaline metals such as magnesium, and group 4 metals such as titanium and zirconium. Metal fires represent a unique hazard because people are often unaware of the characteristics and not properly prepared to fight them. Certain metals such as sodium burn in contact with air or water which exacerbates this risk. Generally speaking, masses of combustible metals do not represent great fire risks because heat is conducted away from hot spots so efficiently that the heat of combustion cannot be maintained. As so, significant heat energy is required to ignite a mass of metal. Generally, metal fires are a hazard when the metal is in the form of dust or shavings which combust more rapidly than large blocks. Care must be taken when extinguishing metal fires. Water and other common agents can excite metal fires and make them worse. Fire protection agencies recommend that metal fires be fought with dry powder that works by smothering and heat absorption. Different metals require different agents which cannot always be substituted for another. The most common agents are sodium chloride and graphite powder. Using a dry chemical extinguisher in error, in place of dry powder, can be actually increase the intensity of a metal fire.

COOKING OILS

Fires that involve cooking oils are designated Class K. Though such fires are technically a subclass of the flammable liquids, the higher flash points are important enough to recognize separately. A class K extinguisher will smother the fire by turning the oil into a foam. A water mist can also extinguish such fires. As with Class B, a solid stream of water should never be used because it can cause the fuel to scatter.

EUROPEAN STANDARDS

The European classification system EN-13501-1 further breaks down these designations as:

Fire behavior:

Class A1 (highest level)