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VERSION	EFFECTIVE DATE	DESCRIPTION OF REVISION(S)
001	2015.01	Module creation and release.
002	2016.01	Minor Revisions
003	2017.09	Format Updates
003.1	2019.02	Added section on Pneumatic and Pressure Pumps in Submodule 16.
003.2	2019.05	Corrected incorrect answers in Submodule 20.
004	2019.12	Typographic format updated; Sequencing of content to Appendix 1 refined.
004.1	2021.04	Enhanced content of M11A Submodule 08(b).
004.2	2023.01	Added Measurement Standards. Improved Figures 13-51, 18-5, and 18-6.
004.3	2023.04	Enhanced content in Submodule 14 - Lights.
005	2024.04	Regulatory update for EASA 2023-989 Compliance.
005.1	2024.05	Replaced Figures 1-39 and 5-69, adjusted small text errors throughout Module.
005.2	2025.01	Page viii and page 8.1 - Corrected Submodule 11.8(A) to level 3. Page 3.18 - Corrected term thermoplastics to thermoset polymers. Page 9.7 - Corrected the orientation of left side checknut. Page 12.16 - Replaced to improve Figure 12-27.

Module was reorganized based upon the EASA 2023-989 subject criteria. Enhancements included in this version 005.2 are:

11.1 *Drag Inducing Devices* - complete rewrite.
11.2 *Fuselage Components, Structural Assembly Techniques, Reinforcement* - added content.
11.3.1(B) *Airborne Towing Devices* - added content.
11.3.5 *Engine Mounts* - complete rewrite.
11.4(C) *Control and Indication Control Valves* - added content.
11.5.2 *Controller Pilot Datalink* - added content.
11.5.2 *Audio Systems* - added content.
11.5.2 *Cockpit Voice Recorders* - added content.
11.5.2 *Microwave Landing Systems* - added content.
11.5.2 *ARINC Communications* - added content.
11.5.2 *Avionics Test Equipment* - added content from Module 7.4.
11.6 *Battery Maintenance and Troubleshooting* - added content.
11.10 *Inert Gas Systems* - added content.
11.11 *Servicing Hydraulic Systems* - added content.
11.11 *Boeing 737NG Hydraulic System* - added content.
11.13 *Tail Protection and Tail Skids* - added content.
11.16 *Pneumatic System Components* - added content.
11.21 *Electronic Flight Bag Classifications* - added content.
Question and Answer updates for all Submodules.

PART 66 BASIC KNOWLEDGE REQUIREMENTS

SUBMODULE KNOWLEDGE DESCRIPTIONS		LEVEL
		B1
11.6	**Electrical Power (ATA 24)** — Installation and operation of batteries; — DC power generation; — AC power generation; — Emergency power generation; — Voltage regulation; — Power distribution; — Inverters, transformers, rectifiers; — Circuit protection; — External/ground power.	3
11.7	**Equipment and Furnishings (ATA 25)** (a) Emergency equipment: Emergency equipment requirements. (b) Cabin and cargo layout: — Seats, harnesses, and belts; — Cabin layout; — Equipment layout; — Cabin furnishing installation; — Galley installation; — Cargo handling and retention equipment; — Airstairs.	2 1
11.8	**Fire Protection (ATA 26)** (a) Fire and smoke detection system, and fire-extinguishing systems: — Fire and smoke detection and warning systems; — Fire-extinguishing systems; — System tests. (b) Portable fire extinguisher.	3 1
11.9	**Flight Controls (ATA 27)** (a) Primary and secondary flight controls: — Primary controls: aileron, elevator, rudder, spoiler; — Trim control, trim tabs; — High-lift devices; — System operation: manual; — Gust locks and gust lock systems; — Artificial feel, yaw damper, Mach trim, rudder limiter; — Stall-warning systems. (b) Actuation and protection: — Active load control; — Lift dump, speed brakes; — Hydraulic, pneumatic systems; — Stall-protection systems. (c) System operation: Electrical systems, fly-by-wire systems. (d) Balancing and rigging.	3 3 3 3
11.10	**Fuel Systems (ATA 28, ATA 47)** (a) Systems: — System layout; — Fuel tanks; — Supply systems. (b) Fuel handling: — Cross-feed and transfer; — Refuelling and defuelling. (c) Indication and warnings. (d) Special systems: — Dumping, venting, and draining; — Inert gas systems. (e) Balancing: Longitudinal balance fuel systems.	3 3 3 3 3

FIREWALLS

Engines and their pylons are divided into fireproof zones by bulkheads made of stainless steel, titanium or thermoset polymers. These zones divide the spaces between the engine and nacelle into compartments to limit the spread of fire. Normally the hinged nacelle doors are also part of the firewall, surrounding the engine with airtight fireproof seals.[**Figure 3-43**]

The functions of fire seal are to:

- Prevent combustible materials from entering areas where ignition may occur.
- Confine the effects of engine or pneumatic duct ruptures to a single area.
- Prevents air from the engine hot sections from circulating into the cool section areas.

ENGINE MOUNTS

The engine mounts on turbine engines perform the basic functions of supporting the engine and transmitting the loads imposed by the engine to the aircraft structure. Turbine engine mounts are typically constructed from chrome/molybdenum steel tubing in light aircraft and chrome/nickel/molybdenum assemblies in larger aircraft. Some engine mounting systems use two mounts to support the forward end of the engine and a single mount at the rear end.

Vibration isolator engine mounts additionally isolate the airplane structure from adverse engine vibrations. The forward vibration isolator engine mounts carry vertical, side, and axial (thrust) loads and allows for engine growth due to thermal expansion. The aft mounts take only vertical and side loads; however, they will also accommodate thermal expansion. Vibration isolators consist of a resilient material permanently enclosed in a metal case. As an engine vibrates, the resilient material deforms slightly, thereby dampening the vibrations before they reach the airplane structure. [**Figure 3-43**]

Figure 3-43. A turboprop engine mount with vibration isolation, in front of a stainless steel firewall.

Fire Protection (ATA 26)

Submodule
8

SUBMODULE KNOWLEDGE DESCRIPTIONS		LEVEL
		B1
11.8	**Fire Protection (ATA 26)** (a) Fire and smoke detection system, and fire-extinguishing systems: — Fire and smoke detection and warning systems; — Fire-extinguishing systems; — System tests.	 3
	(b) Portable fire extinguisher.	1

11.8 FIRE PROTECTION (ATA 26)

SECTION A

FIRE AND SMOKE DETECTION SYSTEMS AND FIRE EXTINGUISHING SYSTEMS

FIRE PROTECTION

A complete fire protection system on modern aircraft, and on many older aircraft, includes a fire detection system and a fire extinguishing system. Fire detection is accomplished in many different ways explained below. Fire extinguishing is accomplished with fixed and portable fire agent dispensing systems also explained in this *Submodule*.

REQUIREMENTS FOR FIRE TO OCCUR

Three things are required for a fire: (1) fuel - something that will, in the presence of heat combine with oxygen, thereby releasing more heat and as a result reduces itself to other chemical compounds; (2) heat - accelerates the combining of oxygen with fuel, in turn releasing more heat; and (3) oxygen—the element which 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. [**Figure 8-1**] Remove any one of these things and the fire extinguishes.

Figure 8-1. The fire triangle; all three elements shown are required for fire to occur.

CLASSES OF FIRES

The following classes of fires that are likely to occur onboard aircraft, as defined in the United States National Fire Protection Association (NFPA) Standard 10, Standard for Portable Fire Extinguishers, 2007 Edition, are as follows:

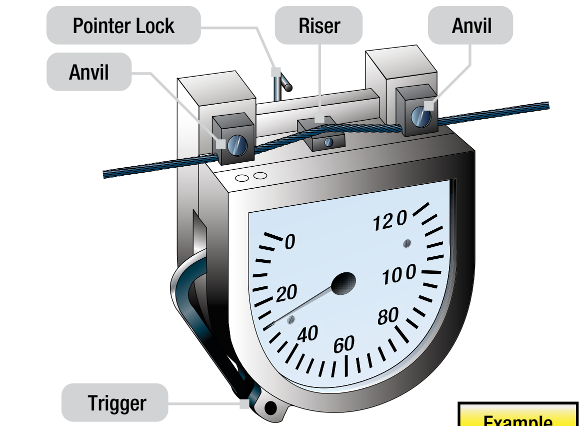
- *Class A*—fires involving ordinary combustible materials, such as wood, cloth, paper, rubber, and plastics.
- *Class B*—fires involving flammable liquids, petroleum oils, greases, tars, oil-based paints, lacquers, solvents, alcohols, and flammable gases.
- *Class C*—fires involving energized electrical equipment in which the use of an extinguishing media that is electrically non-conductive is important.
- *Class D*—fires involving combustible metals, such as magnesium, titanium, zirconium, sodium, lithium, and potassium.

FIRE ZONES

Because fire is one of the most dangerous threats to an aircraft, the potential fire zones of modern multi-engine aircraft are protected by a fixed fire protection system.

A fire zone is an area, or region, of an aircraft designed by the manufacturer to require fire detection and/or fire extinguishing equipment and a high degree of inherent fire resistance. The term "fixed" describes a permanently installed extinguishing system in contrast to any type of portable fire extinguishing equipment, such as a hand held Halon or water fire extinguisher. Typical zones on aircraft that have a fixed fire detection and/or fire extinguisher system are:

1. Engines and auxiliary power unit (APU)
2. Cargo and baggage compartments
3. Lavatories on transport aircraft
4. Electronic bays
5. Wheel wells
6. Bleed air ducts



No. 1			Riser	No. 2		No. 3	
Diameter			Tension (lb)				
1/16	3/32	1/8		5/32	3/16	7/32	1/4
12	16	21	30	12	20		
19	23	29	40	17	26		
25	30	36	50	22	32		
31	36	43	60	26	37		
36	42	50	70	30	42		
41	48	57	80	34	47		
46	54	63	90	38	52		
51	60	69	100	42	56		
			110	46	60		
			120	50	64		

Figure 9-13. Cable Tensiometer and conversion chart.

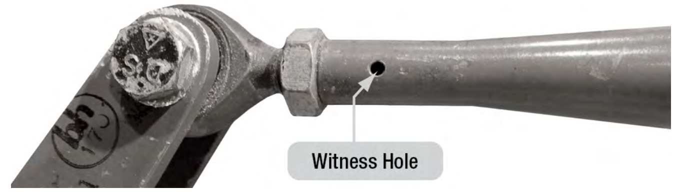


Figure 9-15. Witness hole in push-pull tube. When the terminal end is adequately threaded into the tube, the threads will block the witness hole.

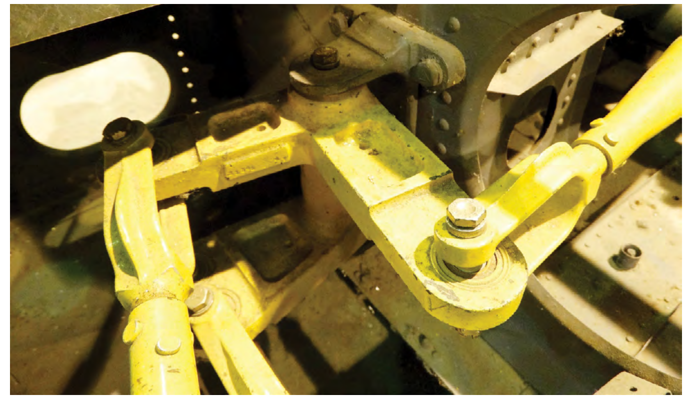


Figure 9-16. Bell crank with push-pull tubes.

TORQUE TUBES

Torque tubes are used in many areas of the flight control system. Torque tubes apply torsional, or rotating, motion to a member of the control system. Often torque tubes receive their input from control cables or push-pull rods. [**Figure 9-18**]

GUST LOCKS AND GUST LOCK SYSTEMS

Aircraft that use mechanical flight control systems will typically include a method for locking the controls when the aircraft is parked. Normally referred to as gust locks, these mechanism may either be separate from the control system or an integral part of the control. Separate gust locks may consist of a device that extends from a stationary part of the aircraft, such as the wing, and passes over and locks in place the flight control surface (e.g., the ailerons). Another technique is to lock the movement of the flight controls with pins and other devices. Rather than being on the exterior of the aircraft, such locking devices are installed in the flight compartment to keep the controls from moving. By physically locking the flight controls in place, damage to the structure or control network is eliminated during times when the aircraft is parked and the wind acts to deflect the flight control surfaces. [**Figure 9-19**] Gust locks will typically include a warning streamer with the following or similarly worded phrase: "REMOVE BEFORE FLIGHT."

Large aircraft that have hydraulic assist systems to move flight control surfaces often include gust dampers in their power control units. By using hydraulic fluid contained within the power control units that drive the flight control surfaces during flight, movement of the control surfaces by wind feeds a force into the hydraulic units. These mechanisms provide gust snubbing by forcing hydraulic fluid through special bypass valves and other devices. The end result is that the flight control surfaces are protected from wind gust damage.

ARTIFICIAL FEEL, YAW DAMPER, MACH TRIM, RUDDER LIMITER

ARTIFICIAL FEEL

Aircraft that use purely mechanical flight control systems do not require artificial feel on the controls. The resistance transmitted through the control system provides the pilot with a natural feel regarding the magnitude of control input and associated stresses placed on the aircraft. [**Figure 9-20**]

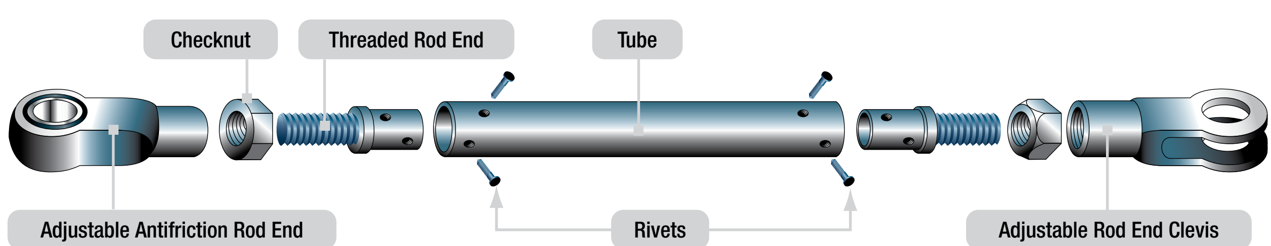


Figure 9-14. Exploded view of push-pull rod.

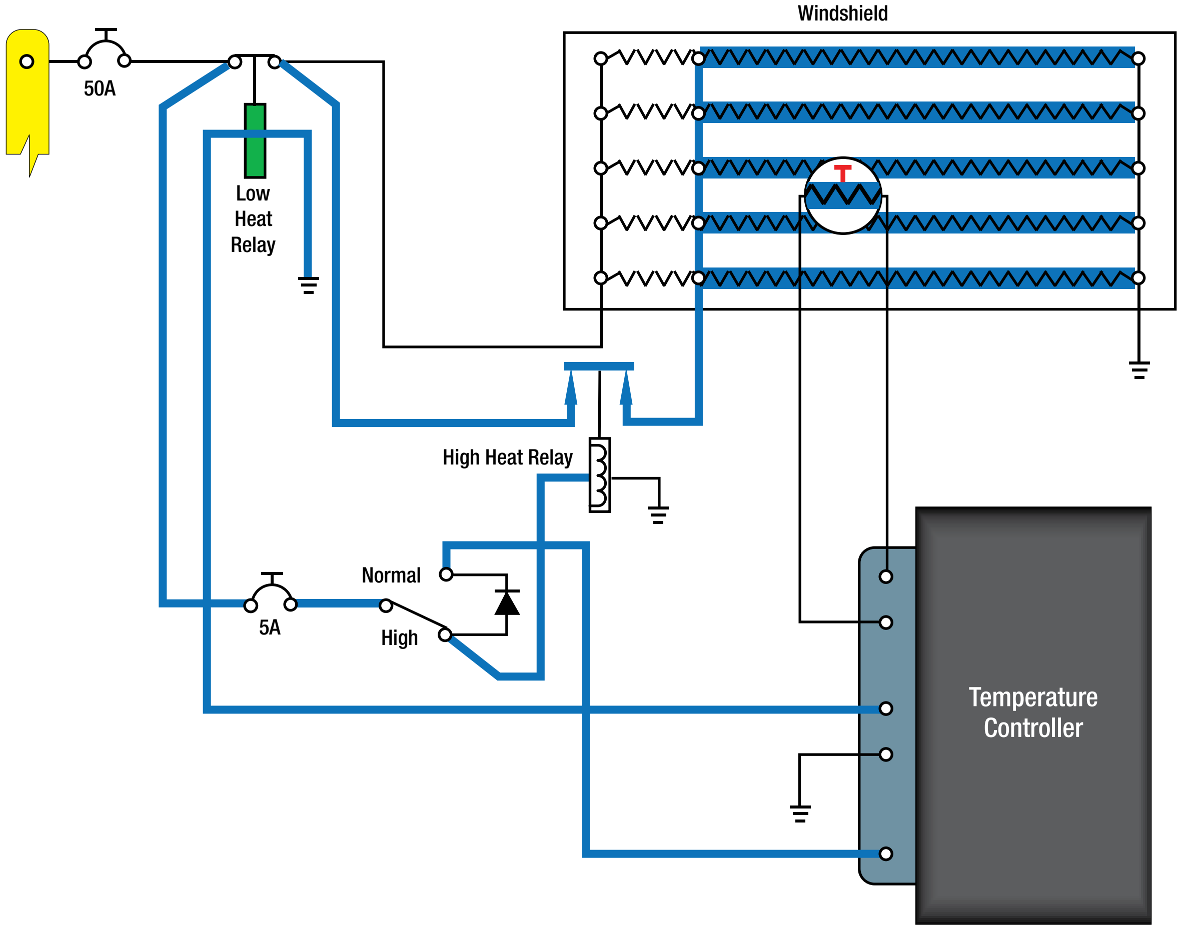


Figure 12-25. Electric windshield heat schematic.

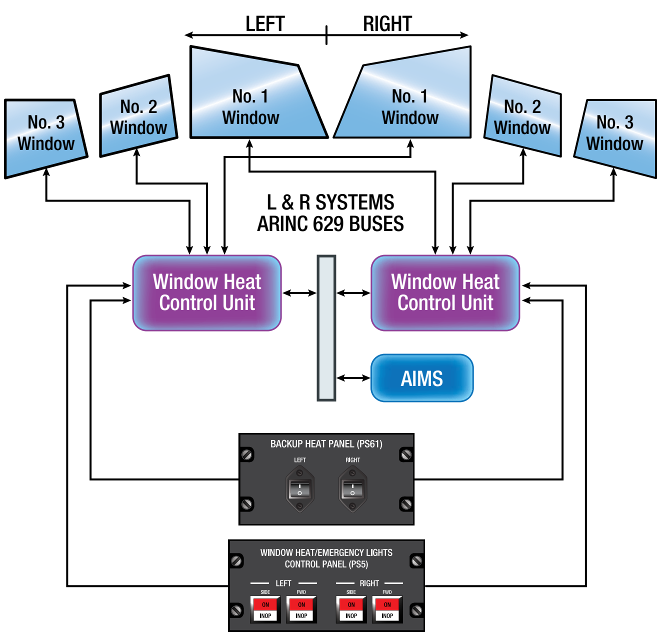


Figure 12-26. Electric window heat synoptic diagram for a Boeing 777.

Large aircraft WAI systems are similar to the business jet system just described. However, the larger engines with multiple stage compressor bleed air tap-offs usually do not require that ambient air is mixed with the bleed air for temperature control.

Figure 12-27. Beechcraft King Air with thermal WAI system.

The ducting of WAI systems on large aircraft usually consists of aluminum alloy, titanium, stainless steel, or molded fiberglass tubes. The tube, or duct, sections are attached to each other by bolted end flanges or by band type V-clamps. In some locations, the ducting is covered with a fire-resistant, heat-insulating material, such as fiberglass. Thin stainless steel expansion bellows are used at strategic positions in the ducting to absorb any distortion or expansion of the ducting that may occur due to temperature variations. The joined sections of ducting are hermetically sealed by sealing rings. These seals are fitted into annular recesses in the duct joint faces.