FIRE PROTECTION SYSTEM

DESCRIPTION

The fire protection system provides the pilots with a simple, quick and reliable means of detecting and responding to hazardous overheat conditions and/or fires in either engine nacelle or in the area of the APU. The system incorporates two overheat/fire detectors routed inside fire zone I (accessories section) and zone II (core section), two containers and tubing system located in the aft fuselage, APU compartment fire extinguisher (and detectors) and warning and indicating system with continuous monitoring for failures.

Each engine nacelle has two designated detection zones, each zone having a dedicated sensor tube and responder switch; Zone 1 (forward part of the nacelle) includes the accessories and compressor section of the engine; Zone 2 (aft part of the nacelle) includes the combustor, turbine and tail pipe section of the engine.

Zone 1 is protected by the fire extinguishing system. If either fire or an overheat condition is sensed in this in this zone, the FIRE (upper) portion of the FIRE/OVERHT pushbutton comes on for the appropriate engine, ENG FIRE ◀ message comes on the EICAS.

Zone 2 is not protected by fire extinguishing system, since fire in this section is self controlled due to limited amount of flammable fluids in this section. If either fire or an overheat condition is sensed in this section, the OVERHT (lower) portion of the FIRE/OVERHT pushbutton comes on for the appropriate engine, ENG OVERHEAT ◀ message comes on the EICAS.

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The detection system consists of gas-filled sensor tubes, pressure-operated diaphragms alarm responder switches and detector integrity responder switches. The sensor tube coils around and encircles the engine at all critical points to provide large area overheating detection and concentrated, small area, spot detection of fire. Each sensor tube consists of stainless steel, hermetically sealed housing with permanently attached sensor element forming single unit.

Electrical connector and two pressure (responder) switches are enclosed in housing. Each sensor tube also contains a core (discrete element) which releases halogen gas when heated above a preset operating point. Each sensor tube is also precharged with helium gas which surrounds the core and provides an arithmetic average gas response feature, enabling detection of a general overheating condition within the nacelle when heated to a preset operating point. Therefore, increased pressure caused by general overheating or fire causes the FIRE light and ENG FIRE message or OVERHT light and ENG OVERHEAT message to come on, by closing the normally open contacts of alarm (responder) switch.

Both average and discrete functions are reversible, therefore, when the sensor cools, averaging gas pressure lowers, halogen is re-absorbed into the discrete core and, as a result, pressure drops causing the alarm switch contacts to open, turning off the FIRE/OVERHEAT lights, the EFIS message, and the audio alarm. An integrity responder switch, connected to the PRESS TO TEST pushbutton is installed in each sensor tube to check its integrity. It is similar to the alarm responder switch but operates at lower pressure and the contacts are normally closed. If the sensor tube is ruptured and gas pressure is lost, the contacts open, thus, when PRESS TO TEST pushbutton is pressed, FIRE/OVERHT warning lights, for affected side, will not illuminate, indicating sensor failure.

Engine Fire Protection

Warning for overheat or fire condition in zone 1 or zone 2 in an engine nacelle is indicated by illumination of the appropriate (left of right) FIRE or OVERHT light in the fire control panel located at top of center instrument panel and ENG FIRE or ENG OVERHEAT messages. (See FIRE EMERGENCIES, page II-6 for actions to be taken if FIRE or OVERHT lights come on). Either fire or an overheat condition in zone 1 sufficient to cause illumination of FIRE warning light will usually be accompanied by excessive ITT indication. If retarding power lever to idle and / or shutting down an engine does not extinguish the light, press the illuminated pushbutton as directed by the appropriate procedure in FIRE EMERGENCIES, page II-6. When the pushbutton is pressed it electrically closes fuel and hydraulic shutoff valves of affected engine and simultaneously arms both fire extinguishing agent containers to be directed for discharge at that engine.

Armed extinguishing agent containers are indicated by illumination of green ARM lights in upper half of both extinguishing agent container discharge (ARM/EMPTY) pushbutton.

Two fire extinguishing agent containers are located in the aft fuselage behind the baggage compartment. Each extinguishing agent container has two discharge cartridges. Left discharge port of each extinguishing agent container goes through common tube to the left engine nacelle. When FIRE pushbutton is pressed, both, respective (left or right) discharge cartridges of the extinguishing agent containers are armed for discharge at the affected engine only.

The right container is also tied to the APU. It is recommend the left container be used first.

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Fire extinguishing is accomplished by pressing either ARM pushbutton. When pressed, ARM pushbutton electrically ignites the respective armed cartridge causing rupture of the discharge port and discharge of extinguishing agent to the affected engine nacelle. ARM light then extinguishes and yellow EMPTY (bottom half of pushbutton) light comes on. If necessary, the remaining ARM light may be pressed to discharge remaining extinguishing agent container to the same engine, as stated above. When fire is extinguished, reversible actions of the sensor tube, as previously described, cause red FIRE warning light to go out.

Each fire extinguishing agent container is equipped with combined filler and thermal relief valve which are connected, by common tube, to red thermal discharge (blow-out disk) indicator on right side of fuselage, below the pylon. Thermal discharge of extinguishing agent container causes the disk to blow out, requiring replacement of extinguishing agent container. The disk must be checked during preflight inspection.

Each extinguishing agent container pressure may be read directly from gage mounted directly on the extinguishing agent container, through external access panel.

When OVERHT annunciator, ENG OVERHEAT and audio messages come on, either fire or an overheat condition exists in zone 2. The procedure is similar to FIRE warning, except for the need to activate fire extinguishers, since fire in this zone is self controlled.
Fire containment is provided by firewalls which isolate the engines from the pylons. In addition, inside cowl surfaces, above and below the pylons, are covered by stainless steel foil to prevent fire breakthrough.

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The fire detection system is continuously monitored for failures. The monitoring is indicated by continuous dim glowing of the FIRE/OVERHT lights. If system failure is detected, one of the four lights in PRESS TO TEST pushbutton comes on. The two left lights (upper and lower) indicate failures in zone 1 or zone 2 of the left engine, respectively. The two right lights indicate failures in zone 1 or zone 2 of the right engine in the same manner.

Under some failures, FIRE or OVERHT may come on simultaneously with one of the PRESS TO TEST lights. In this case only, the warning should be treated primarily as a system failure but other evidence of fire need to be checked.

NOTE

This failure occurs only if there is a short in FIRE or OVERHT detection circuits.
Monitor engine instrument indications. If engine instrument readings are abnormal, consider the indications as an actual FIRE or OVRHT situation.

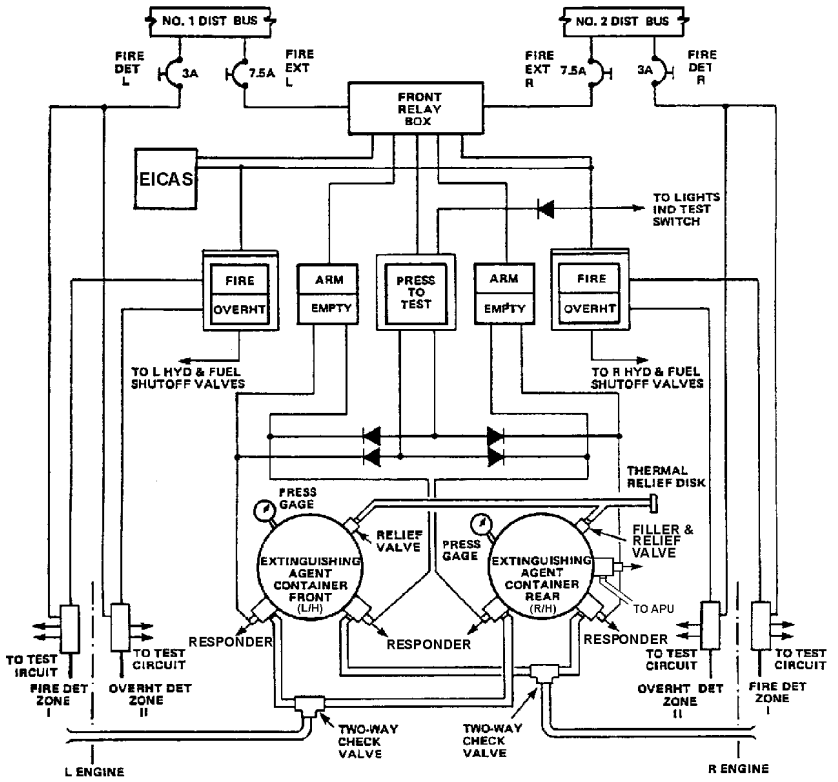

Figure 7-26-1. Engine Fire Protection System - Schematic

APU Fire Protection

The APU compartment is protected by the fire detection and extinguishing system. If a fire is sensed in the APU compartment, the APU FIRE annunciator on the overhead panel, APU FIRE message and aural message come on. The APU fire detection system provides fire warning. The APU compartment is equipped with one fire detector. The APU fire detector is similar to the engine fire / overheat detectors except for its length and the preset alarm temperature. During fire or overheat conditions the APU FIRE warning light comes on and stays on as long as the temperature is above its setting. Simultaneously, the APU FIRE EFIS message and the aural warning come on.

APU fire is extinguished by pressing APU FIRE pushbutton followed by APU ARM/EMPTY pushbutton.

During unattended ground operation, APU fire automatically shuts down. External horn sounds.
APU OVERTEMP message comes on to indicate of excessive temperature and APU did not enters automatic shut-down sequence.

Portable Fire Extinguishers

Two portable, hand-operated fire extinguishers are also provided: One, in cockpit and one, in the passenger cabin. Since location of these extinguishers may vary with each customized interior aircraft configuration, pilots should determine specific locations for each aircraft.

To use portable extinguisher, remove from quick-release bracket, hold upright by gripping hand grip with spray nozzle pointing forward. Slide red safety-catch down, with thumb and point nozzle to direct spray at base of fire. Squeeze lever in hand grip with palm of hand to discharge spray. Ruptured, red indicator disk indicates partial or total discharge of extinguisher, which should be replaced immediately after use.

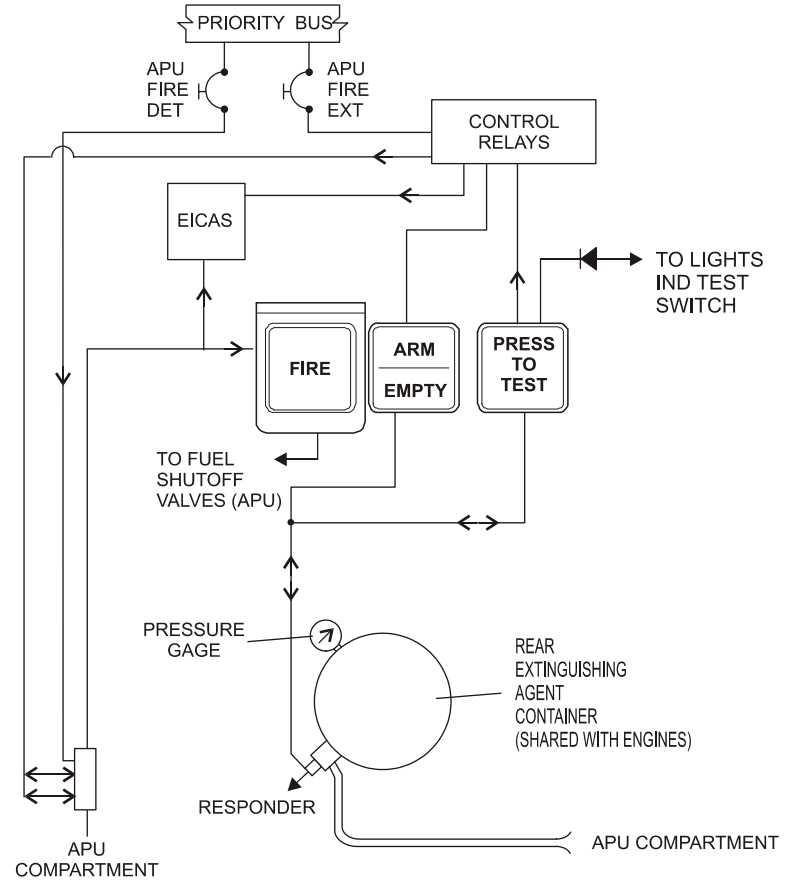

Figure 7-26-2. APU Fire Protection System - Schematic

FIRE PROTECTION SYSTEM CONTROLS AND INDICATORS

FIRE/OVERHT Pushbutton Indicator Left and Right (red lights) - Located at top of Center Instrument Panel - FIRE comes on if either overheating or fire occur in zone 1. OVERHT comes on if overheating or fire occurs in zone 2. The pushbuttons are covered with clear guards. When pressed, they close fuel and hydraulic shutoff valves and arm both extinguisher discharge cartridges for affected engine; ARM/EMPTY pushbuttons comes on.

Both FIRE/OVERHT lights have a dim glow, to indicate continuous self monitoring for fire detection systems failures.

ARM Pushbutton Indicator left and right (Green Light) - Located at top of center instrument panel. Upper half of ARM/EMPTY (discharge) pushbuttons, ARM lights come on to indicate that discharge cartridges for affected engine are armed. Each ARM light goes out and EMPTY light comes on when ARM pushbutton is pressed and the respective extinguishing agent container is discharged to affected engine.

EMPTY Indicator left and right (yellow light) - Located at top of Center Instrument Panel. Lower Half of ARM/EMPTY (discharge) pushbuttons. EMPTY light comes on to indicate that the respective extinguisher extinguishing agent container has been discharged. When electrical power is on, the lights stay on until extinguishing agent container is replaced.

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PRESS TO TEST pushbutton (four integral lights) - Located at top of center instrument panel. It tests fire protection system; when pressing the pushbutton:

Both FIRE lights and ENG FIRE message come on to indicate integrity of sensor (detection) tubes in zone 1.

Both OVERHT lights and ENG OVERHEAT message come on to indicate integrity of sensor tubes in zone 2.

Both ARM and EMPTY lights comes on to indicate continuity of electrical circuits.

Four indicator lights in PRESS TO TEST pushbutton come on to indicate integrity of respective extinguisher extinguishing agent container discharge cartridges.

If one of the white lights comes on at any time, it indicates failure of one of the FIRE or OVERHT detection system sensors.

Red Thermal Discharge Indicator - Located at left side of fuselage, below the pylon. If blown out, thermal discharge of extinguished extinguishing agent container is indicated. Must be checked during preflight inspection.

APU FIRE pushbutton indicator (red light) - Comes on when fire or overheating occurs in the APU compartment. When pressed, the right container discharge cartridge is armed and the ARM/EMPTY pushbutton comes on.

ARM-EMPTY pushbutton-indicator: The ARM Indicator (green light) is The upper half of the ARM/EMPTY (discharge) pushbutton. ARM light comes on to indicate that the APU discharge cartridge in the right container is armed. The ARM light goes out and the EMPTY light comes on when the ARM pushbutton is pressed and the right container is discharged.

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EMPTY indicator (yellow light): The lower half of the ARM/EMPTY (discharge) pushbutton EMPTY light comes on to indicate that the right container has been discharged.

PRESS TO TEST pushbutton: Tests the APU fire protection system. When the pushbutton is pressed:

FIRE light and APU FIRE message come on to indicate integrity of the sensor tube in the APU compartment.

Both ARM and EMPTY lights come on to indicate continuity of electrical circuits.

The PRESS TO TEST light comes on to indicate integrity of the right extinguishing container discharge cartridges.

External warning horn sounds.

External warning horn - Triggered by the APU fire sensor, comes on to warn during unattended ground operations.

Warning Messages

ENG FIRE - Overheating or fire in zone 1 (accessories section)
ENG OVERHEAT – Overheating or fire in zone 2 (combustor section)
APU FIRE - APU fire. APU enters automatic shut-down sequence

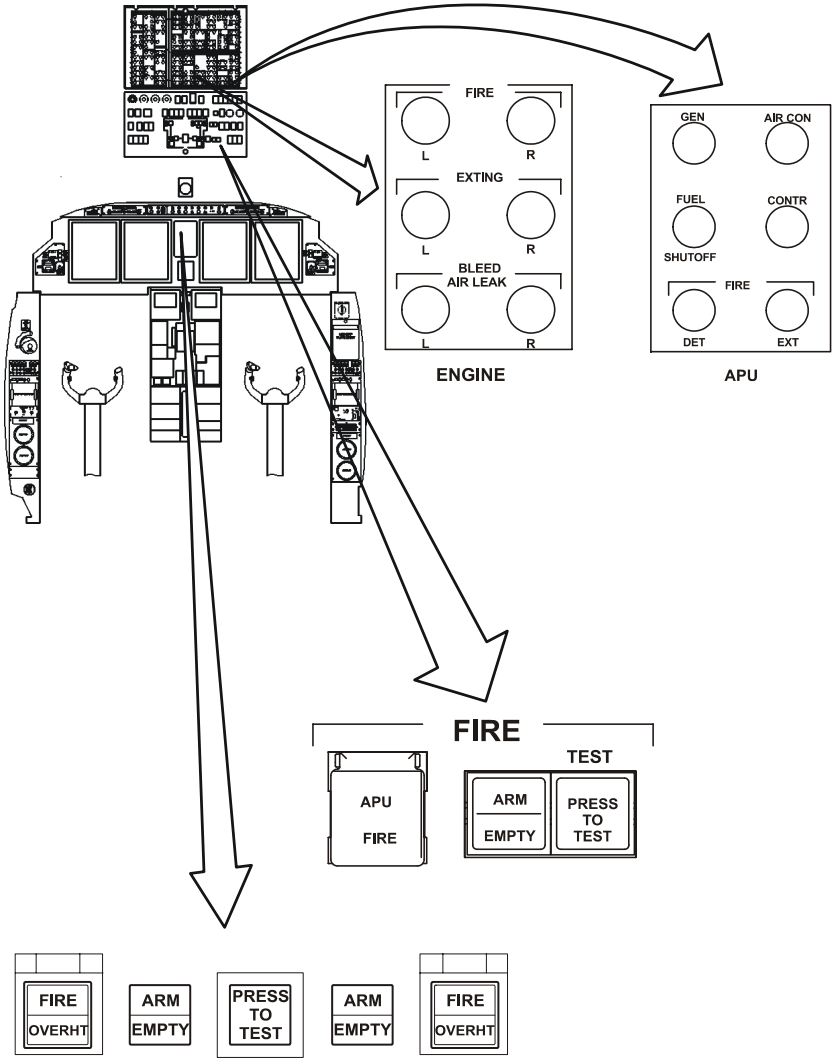

Figure 7-26-3. Fire Protection System Controls and Indicators