

**FIRE PROTECTION
TABLE OF CONTENTS**

CHAPTER 9

	Page
TABLE OF CONTENTS	09-00-1
DESCRIPTION	
General	09-10-1
Flight Compartment Fire Warning	09-10-2
Fire Detecting System	09-10-2
Wheel Well Overheat Warning	09-10-2
Fire Agent Discharge Indication	09-10-2
Smoke Detection	09-10-2
Portable Fire Extinguishers	09-10-2
System Overview Schematic	09-10-3
Fire Control Handles	09-10-4
Engine Fire Control Handle	09-10-5
APU Fire Control Handle	09-10-5
Synoptic Pages	09-10-6
Fire Extinguisher assembly	09-10-7
Fire Extinguisher Discharge Squibs	09-10-7
Fire Extinguisher Gauges	09-10-8
Fire Zone Discharge Schematic	09-10-8
FIDEEX Control Unit	09-10-9
Main Engine Fire Detection	09-10-10
Main Engine FIDEEX Control	09-10-11
Engine FIDEEX Control Schematic	09-10-12
APU Compartment Fire Detection	09-10-13
APU FIDEEX Control Schematic	09-10-14
APU FIDEEX/FADEC Interface	09-10-15
APU FIDEEX/FADEC Control Schematic	09-10-15
Main Wheel Well (MWW) Overheat Detection	09-10-16
Smoke Detection	09-10-17
Pilot Initiated Test	09-10-18
EICAS Messages	09-10-20
EMS CIRCUIT PROTECTION	
CB – Fire System	09-20-1

**FIRE PROTECTION
TABLE OF CONTENTS**

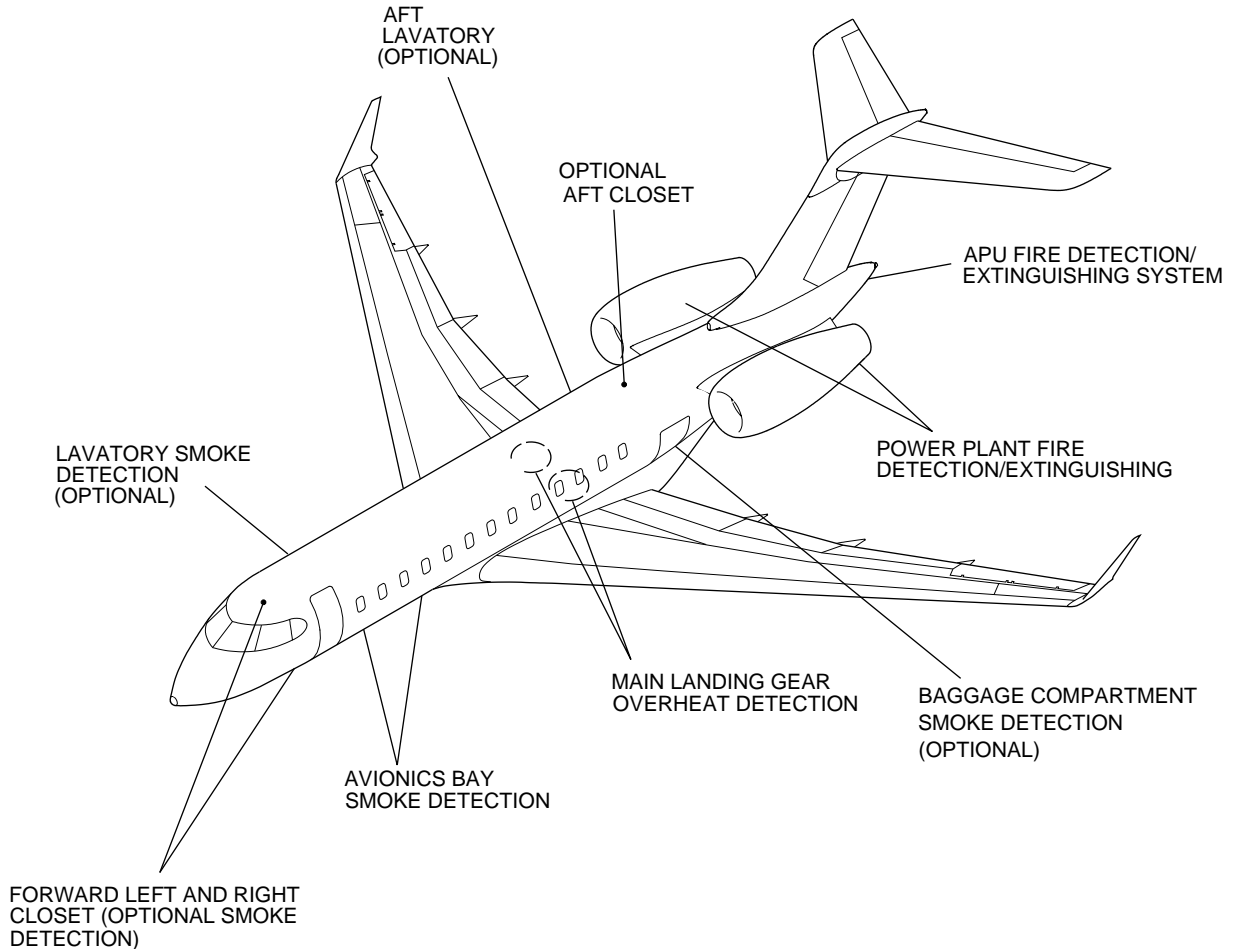
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GENERAL

A Fire Detection and Extinguishing (FIDEEX) system with fault discrimination is installed with fire detectors located in each engine nacelle and in the APU compartment.

The FIDEEX system interfaces with numerous airplane equipment and provides the following capabilities:

- Monitor zones for fire/overheat/smoke events and FIDEEX system health and status.
- Automatic detection and reporting of fire events for each of the two power plants and the Auxiliary Power Unit (APU).
- Fire extinguishing for each of the power plant and APU upon receipt of pilot initiated arming and discharging commands.
- Automatic detection and reporting of overheat events for the two Main Wheel Wells (MWWs).
- Automatic detection and reporting of smoke events for each of the lavatories (fwd/aft), baggage compartment, up to four cabin closets (requires installation of optional smoke detectors) and avionics bay.



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The FIDEEX system includes fire detector assemblies, sensing elements, smoke detectors, fire extinguishing containers and a FIDEEX control unit.

FLIGHT COMPARTMENT FIRE WARNING

The fire protection system provides the means to detect and extinguish a fire in the engine nacelles and in the Auxiliary Power Unit (APU) compartment. Engine/APU fire warning is provided by:

- MASTER warning lights (2).
- Aural warning.
- EICAS messages.
- Three red warning lights (one for each engine nacelle and one for the APU compartment), installed in the flight compartment fire handles.

Both the detection systems and extinguishing systems permit testing and/or monitoring for system faults from the flight compartment. A fire warning and extinguisher pre-flight test of the system is provided in the flight compartment.

FIRE DETECTING SYSTEM

An overheat detection system, installed in the pylon area for each engine, permits the flight crew to monitor any overheat condition in this area. A similar overheat detection system is installed in each main landing gear wheel well.

WHEEL WELL OVERHEAT WARNING

An element in the wheel well area warns of an overheat condition in either of the main wheel wells. Indication and test function is provided in the flight compartment.

FIRE AGENT DISCHARGE INDICATION

The fire extinguisher bottle is fitted with a low pressure switch. The switch provides an annunciation in the flight compartment when pressure drops below a predetermined pressure setting.

SMOKE DETECTION

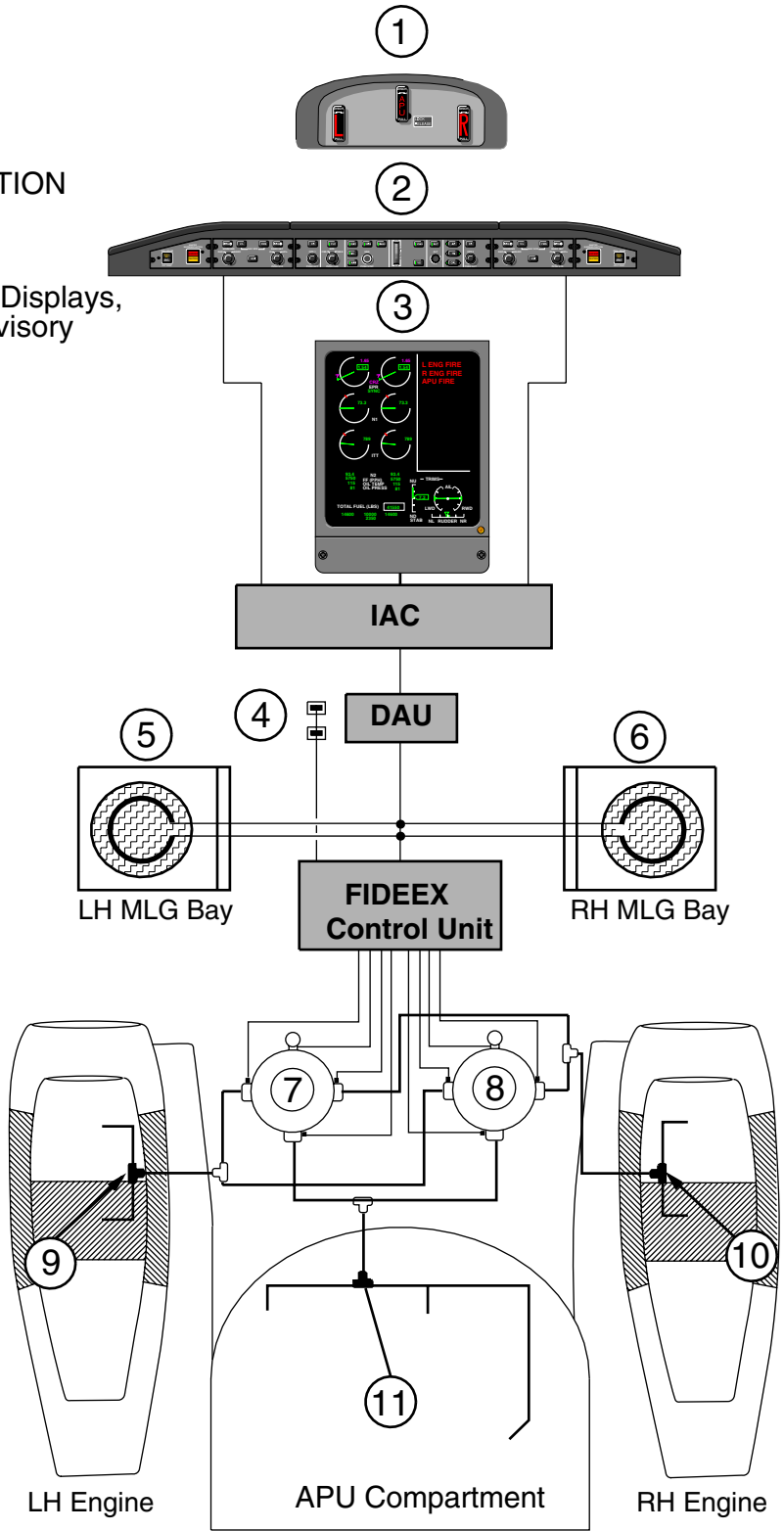
The FIDEEX system can provide smoke detection capability for the baggage compartment, forward and aft lavatories, up to four cabin closets and avionics bay.

PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers are located throughout the airplane. One halon type fire extinguisher is installed in the flight crew compartment. Refer to the EMERGENCY EQUIPMENT Chapter for additional information on the portable fire extinguishers.

SYSTEM OVERVIEW SCHEMATIC

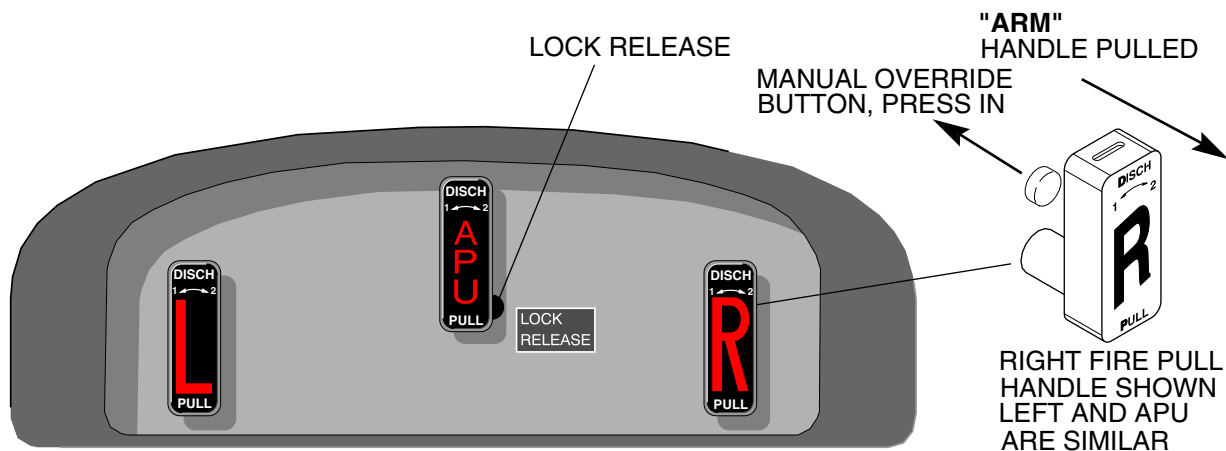
- ① Fire Control Handles.
- ② Master WARNING/CAUTION LIGHTS.
- ③ PRIMARY EICAS Page Displays, Warnings, Cautions, Advisory and Status Messages.
- ④ Avionics Bay (2).
- ⑤ Left Main Wheel Well Overheat Detection.
- ⑥ Right Main Wheel Well Overheat Detection.
- ⑦ Fire Extinguisher Bottle No.1.
- ⑧ Fire Extinguisher Bottle No. 2.
- ⑨ Left Engine Compartment Discharge Lines.
- ⑩ Right Engine Compartment Discharge Lines.
- ⑪ APU Compartment Discharge Lines.



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FIRE CONTROL HANDLES

The three fire control handles are provided for the engine and APU fire protection system. They are installed on the centre overhead panel in the flight compartment.

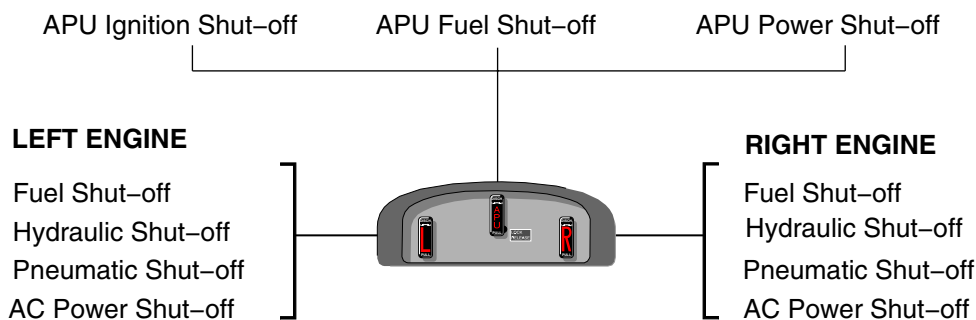


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To prevent accidental engine shut down and fire extinguisher discharges, each fire control handle is maintained in the stowed position by four centre springs and a solenoid operated switch.

When a fire warning is received, the Data Acquisition Unit unlocks the solenoid to allow ease of pulling the handle. To perform a precautionary engine shut down (no fire condition), the handle must be manually released by depressing the manual override button (front panel behind each handle). Each fire handle also has four lamps (bulbs) to illuminate each individual handle for fire detection.

When a handle is pulled to the armed position the following events occur:



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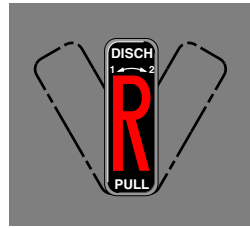
- Applicable (engine/APU) fuel Shut-Off Valve (SOV) closes.
- Each engine – applicable hydraulic SOV closes.
- Each engine and APU – applicable bleed SOV closes.
- A signal is sent to turn off the applicable Variable Frequency Generators (VFGs).
- A signal is sent to cancel ignition on the applicable engine or APU.
- Redundant commands are sent to ARM the FIDEEX control unit's discharge circuits.

If the warning persists following the pulling of the handle, the fire will be extinguished by discharging a fire extinguisher bottle.

FIRE CONTROL HANDLES (CONT'D)

Engine Fire Control Handle

"BOTTLE 1"
HANDLE PULLED, ROTATED
TO THE LEFT AND HELD IN
POSITION



"BOTTLE 2"
HANDLE PULLED, ROTATED
TO THE RIGHT AND HELD IN
POSITION

NOTE

The right fire handle is shown, left is similar in operation.

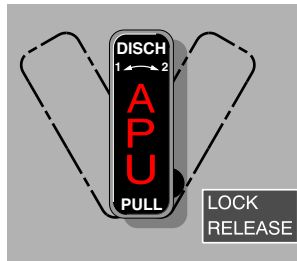
**ENGINE FIRE
PULL HANDLE**

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To discharge an engine bottle, the handle must be turned fully and held (at least one second) to overcome the spring force of the handle; counterclockwise (bottle 1) or clockwise (bottle 2). This action will send redundant commands to discharge the selected fire extinguisher bottle into the armed zone. When a handle is turned fully in the opposite direction, the remaining bottle will be discharged.

APU Fire Control Handle

"BOTTLE 1"
HANDLE PULLED, ROTATED
TO THE LEFT AND HELD IN
POSITION



"BOTTLE 2"
HANDLE PULLED, ROTATED
TO THE RIGHT AND HELD IN
POSITION

**APU FIRE
PULL HANDLE**

GF0910_006

To discharge the APU bottle, the handle must be turned fully and held (at least one second) to overcome the spring force of the handle; counterclockwise (bottle 1) or clockwise (bottle 2). This action will send redundant commands to discharge the selected fire extinguisher bottle into the armed zone.

To discharge a second extinguisher bottle in the APU, the lockout release pin must be slid to the opposite position, to allow the handle to be rotated past the centre position. When a handle is turned fully in the opposite direction, the remaining bottle will be discharged.

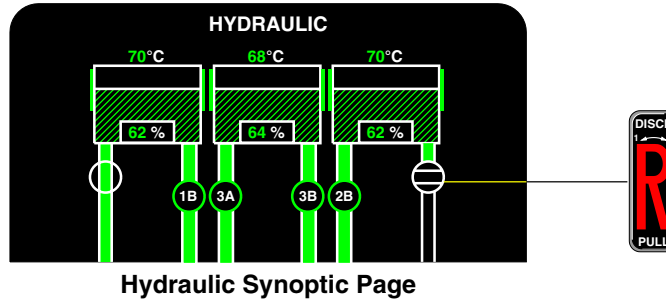
FIRE CONTROL HANDLES (CONT'D)

Synoptic Pages

The following valves are commanded closed as a function of pulling the applicable fire DISCH handle.

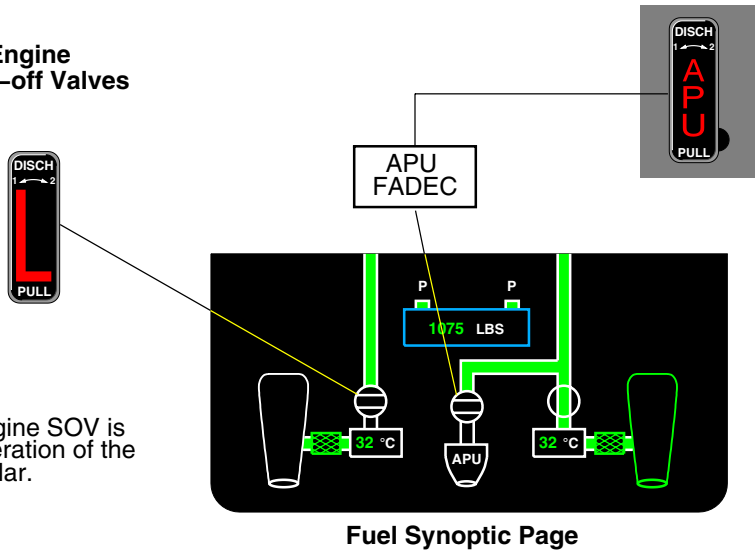
Hydraulic Shut-off Valves

NOTE
The right hydraulic SOV is shown, operation of the left is similar.



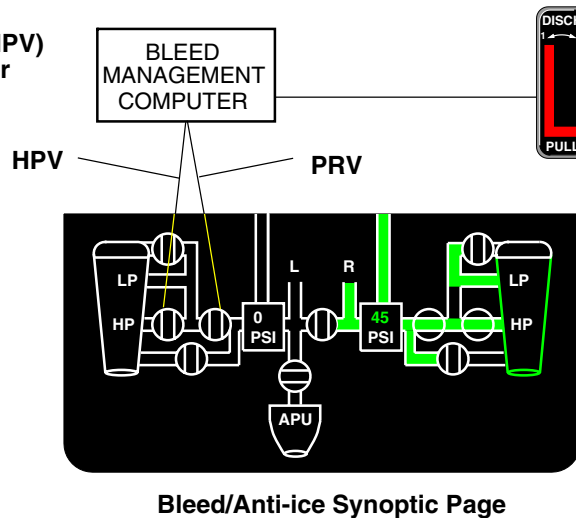
APU and Engine Feed Shut-off Valves

NOTE
The left engine SOV is shown, operation of the right is similar.



High Pressure Valve (HPV) and Pressure Regulator Valve (PRV)

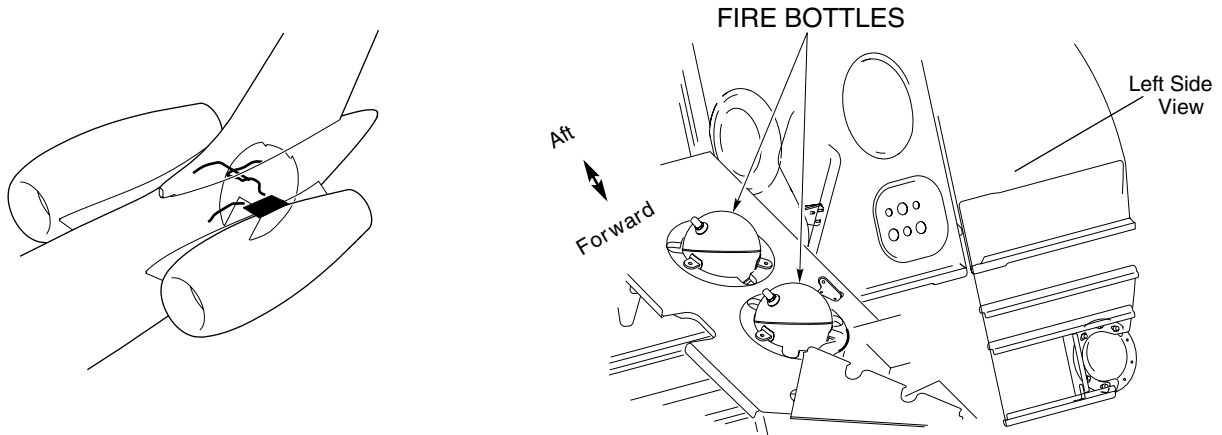
NOTE
The left bleed valves are shown, operation of the right is similar.



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FIRE EXTINGUISHER ASSEMBLY

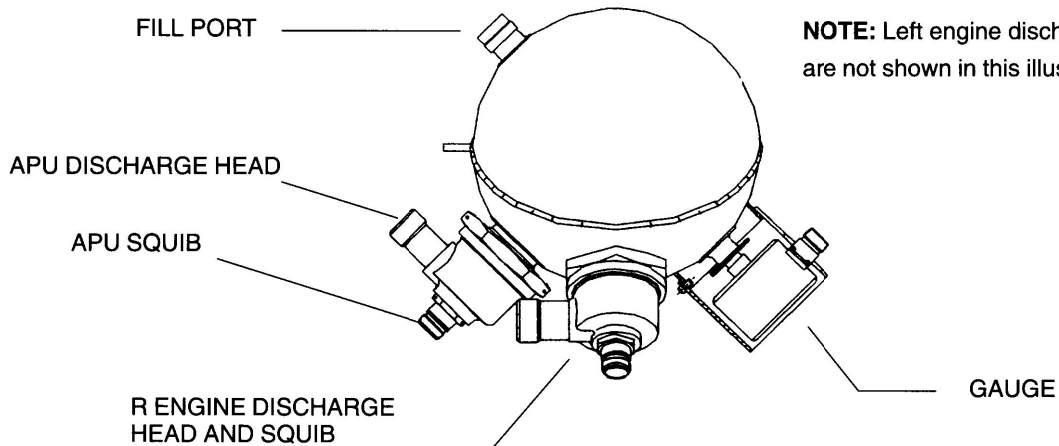
The designated fire zones are left engine, right engine and APU. There are two fire extinguisher bottles on each airplane attached to the left rear fuselage structure. Each fire extinguisher bottle incorporates a hermetically-sealed pressure vessel filled with Halon 1301. The forward fire extinguisher bottle is designated as bottle 1 and the aft fire extinguisher is designated as bottle 2.



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Fire Extinguisher Discharge Squibs

A fire extinguisher discharge squib (electro-explosive device) is installed in each fire extinguisher discharge port. Each of the three discharge squibs per extinguishing bottle is assigned to each of the three fire protection zones. The zones have two circuits, each of which is capable of firing the squib. One of the circuits is wired to channel A and the other to channel B of the FIDEEX control unit.



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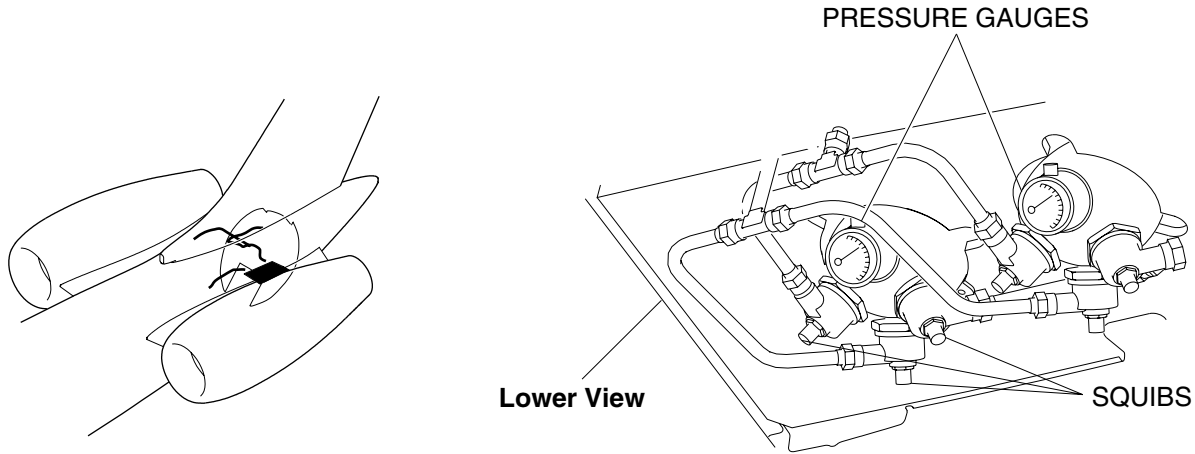
A pressure alarm gage displays fire extinguisher pressure at the extinguisher and includes a pressure switch. The pressure alarm gage automatically signals the FIDEEX control unit when the fire extinguisher pressure drops below the minimum operating pressure.

If one of the circuits detect a fault, it will report to Central Aircraft Information Maintenance System (CAIMS) and no EICAS message will be posted since there is no loss of bottle discharge capability. If both circuits to a squib are detected to be nonfunctional, a squib advisory message will be posted for the affected system.

FIRE EXTINGUISHER ASSEMBLY (CONT'D)

Fire Extinguisher Gauges

Each fire extinguisher assembly includes a pressure gauge to display fire extinguisher pressure at the extinguisher and a pressure switch to automatically signal below minimum operating pressure.

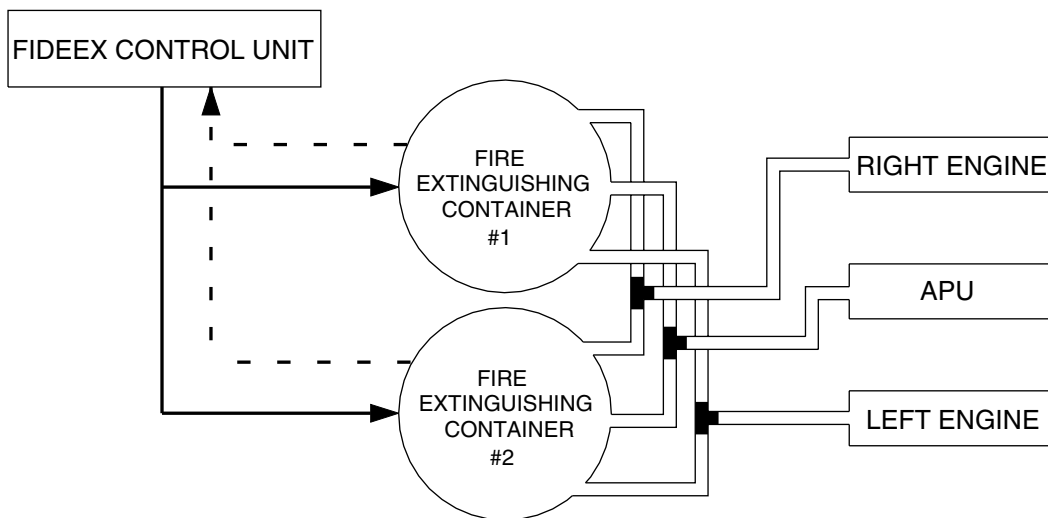


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- The pressure switch (monitored by the FIDEEX control unit) will generate the following cautions EICAS message **FIRE BTL 1 (2) LO PRESS** to alert the flight crew, if the fire extinguisher pressure drops below minimum operating pressure.

Fire Zone Discharge Schematic

Both extinguishing bottles have a discharge outlet for each zone. There are three fire extinguisher discharge heads on each fire extinguisher bottle assembly. Two of the discharge heads are for main engines and the other for APU.



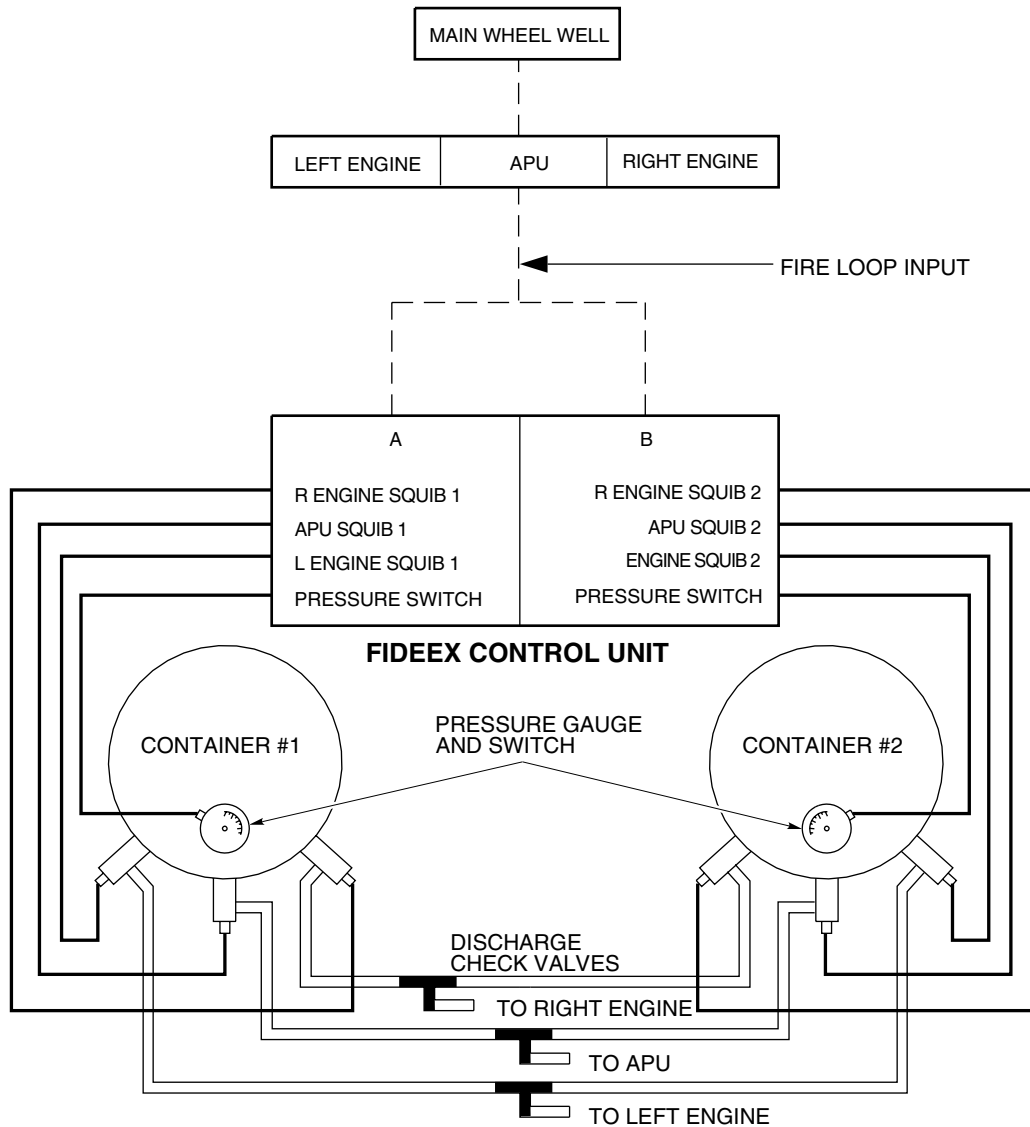
GF0910_011

Outlets designated for the same fire zone from the two extinguishing bottles are fed into a common distribution piping system. Discharging through any of the three outlets discharges the entire contents of the fire extinguisher bottle (one shot only).

FIDEEX CONTROL UNIT

All interfaces from the airplane's power and fire control handles pass through the FIDEEX control unit before they reach the fire extinguishers. The FIDEEX control unit is located below the baggage compartment floor. The following functions/components are monitored continuously:

- Continuity of the squib circuits.
- Continuity of the pressure switches.
- Existence of 28VDC on the two fire extinguishing power supply lines.



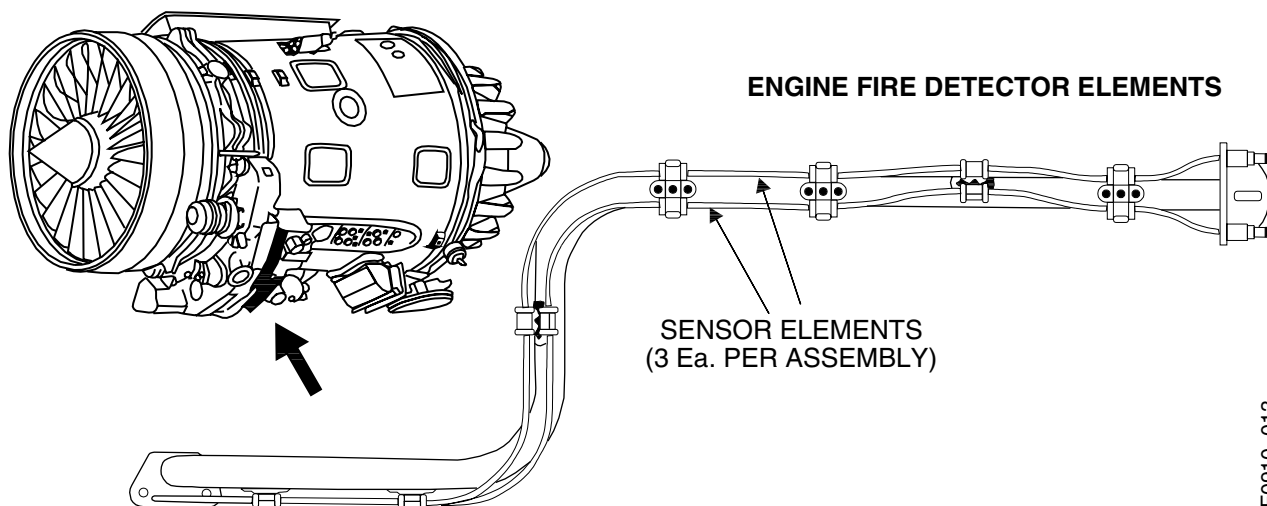
GF0910_012

The FIDEEX control unit is divided into two redundant channels (A and B). The channels power and monitor both loops of the main engines and APU and each of the MWW loops. Both channels independently determine the presence of a fire condition. The FIDEEX control unit performs internal and operator initiated built-in-tests and reports all health and status to the flight compartment EICAS system.

MAIN ENGINE FIRE DETECTION

Main engine fire detection is provided by a dual-loop system; each loop (loop A and loop B) consisting of three sensing elements, located on the accessory gear box, under the engine core, and along the fixed cowl. Each zone's elements are mounted on support tubes. The FIDEEX system provides fire detection and extinguishing to both main engine zones. The power plant zones that include fire detecting and extinguishing are:

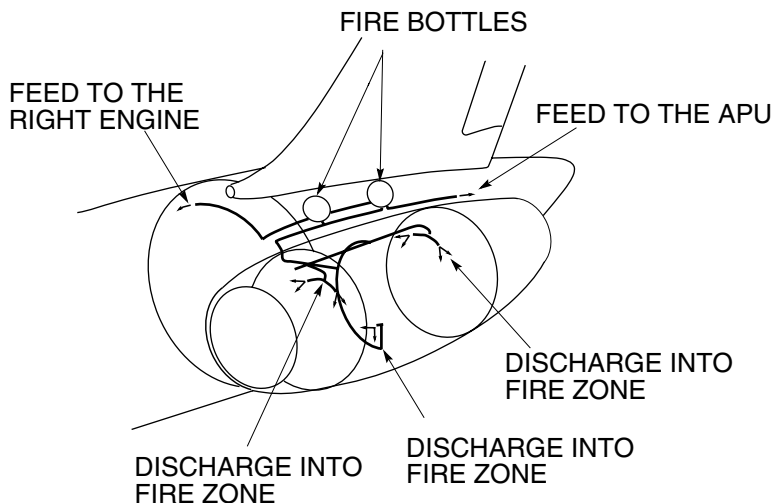
- Accessory gear box.
- Engine core.



The detection loops of both zones are monitored as a single zone and the fire extinguishing system when discharged, supplies both zones simultaneously.

NOTE

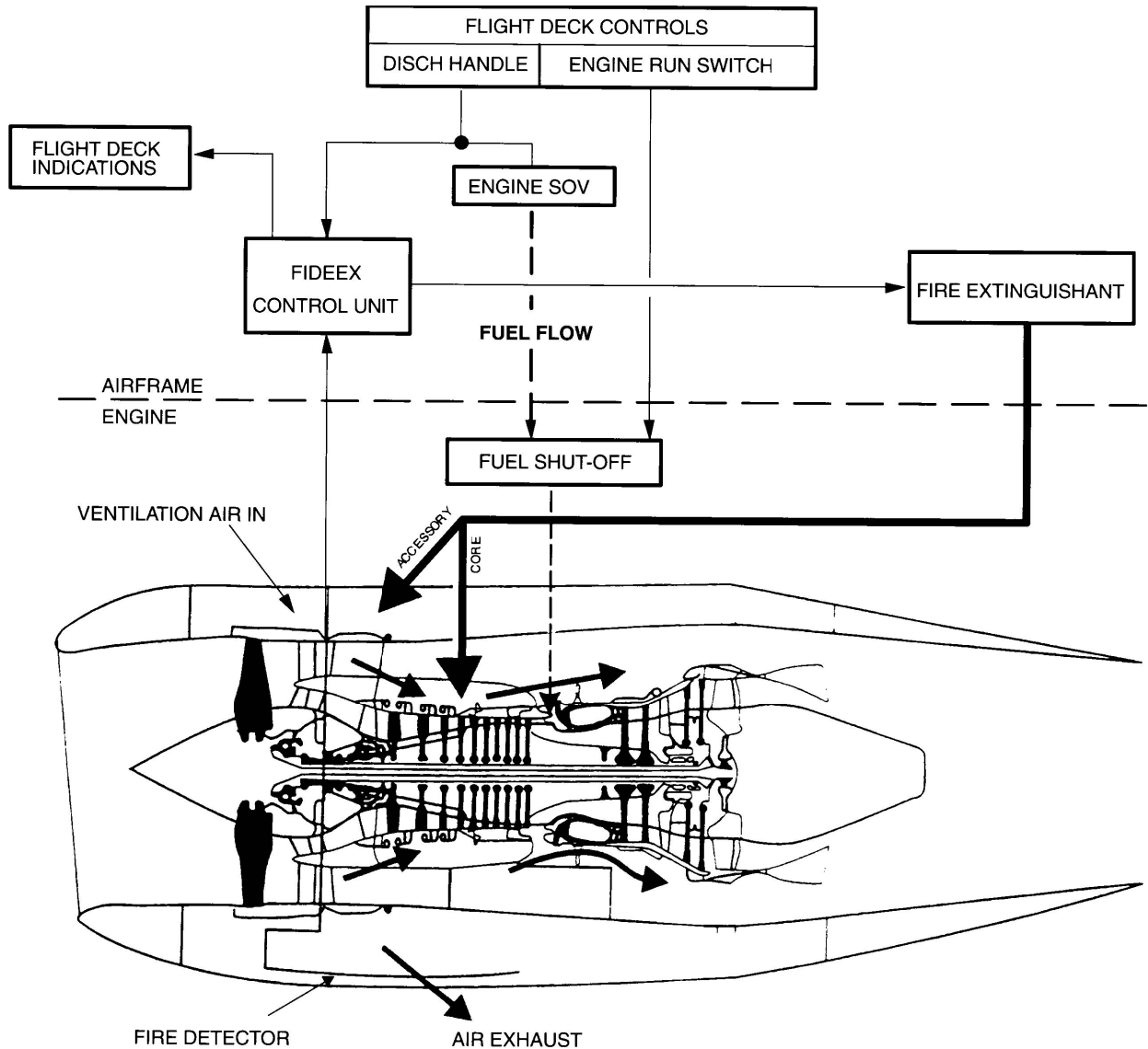
Discharge into RH engine is similar, but not shown.



The fire extinguishing for the main engine is supplied by two discharges (shots) of extinguishant, which can be independently directed by pilot's selection, to either main power plant. The extinguishing piping from the bottles extend through the pylon to the engine. The piping is then directed within the engine to a tee which divides the flow into two zones, accessory and core. A nozzle assembly directs halon to different sections of each zone.

MAIN ENGINE FIDEEX CONTROL

The FIDEEX control unit monitors the engine fire detecting elements. It sends information to the flight compartment and commands the fire bottle to discharge the extinguishing agent.



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When an engine DISCH fire handle is pulled, the ENGINE SOV is commanded closed preventing fuel flow to the engine.

NOTE

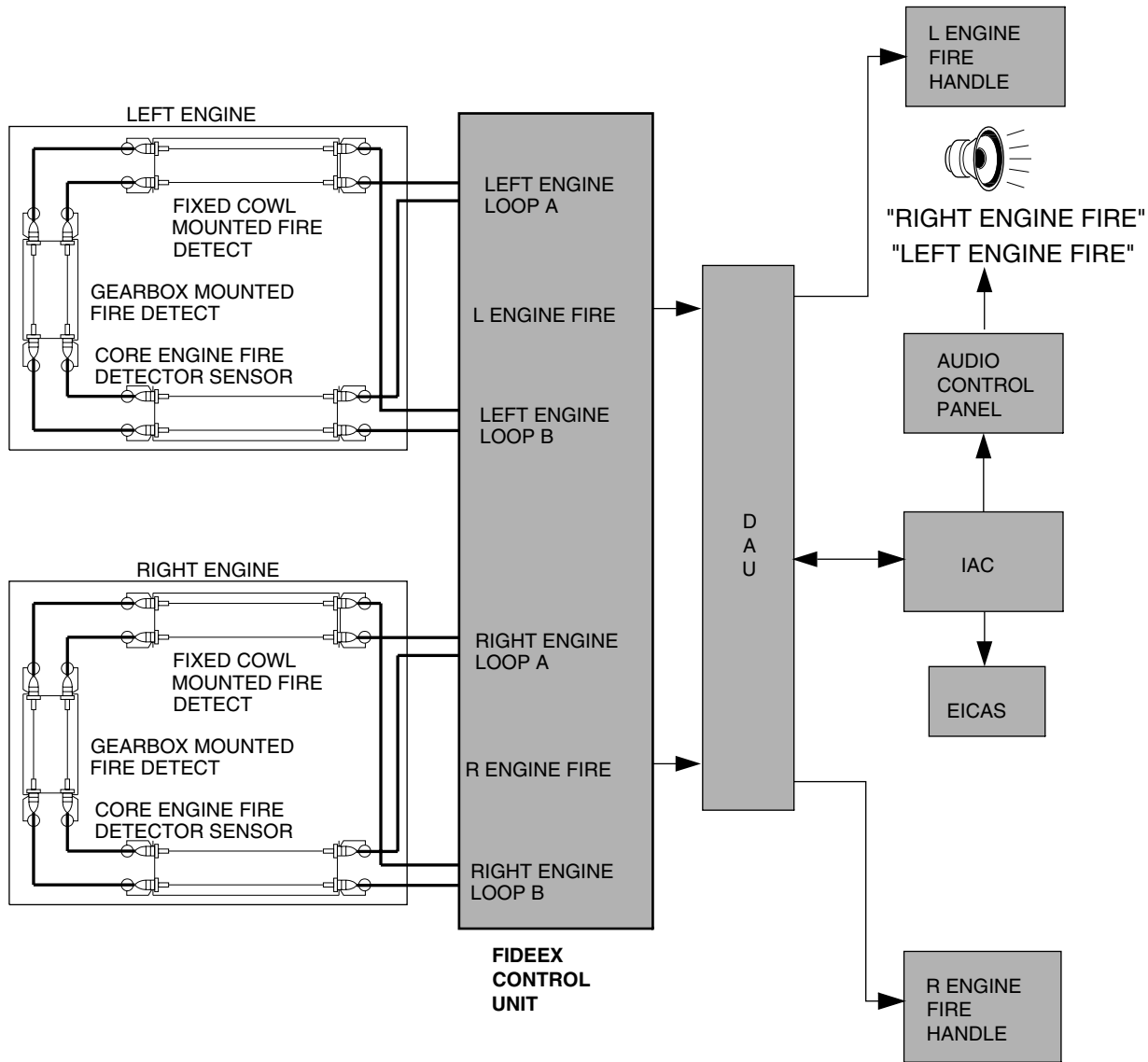
Pulling the fire DISCH handle does not command an immediate engine shut down. In the event of a fire, the engine should be shut down using the ENGINE RUN switches.

When the engine DISCH fire handle is turned, a command is sent to the FIDEEX control unit to discharge the fire bottle. The EICAS will display the result of the extinguisher discharge.

MAIN ENGINE FIDEEX CONTROL (CONT'D)

When an engine fire is detected, the applicable engine fire DISCH handle will illuminate, MASTER WARNING lights flash, a warning message will appear on EICAS and a voice message "LEFT or RIGHT ENGINE FIRE" will sound.

ENGINE FIDEEX CONTROL SCHEMATIC



GF0910_016

The engine fire loop elements send their information to the FIDEEX control unit. The FIDEEX control unit in turn, sends information to the DAU. In the event of a fire, the DAU will signal the applicable engine fire DISCH handle to illuminate. The DAU reports the status of the detection system to the IAC which provides warning conditions to the EICAS and audio control panel.

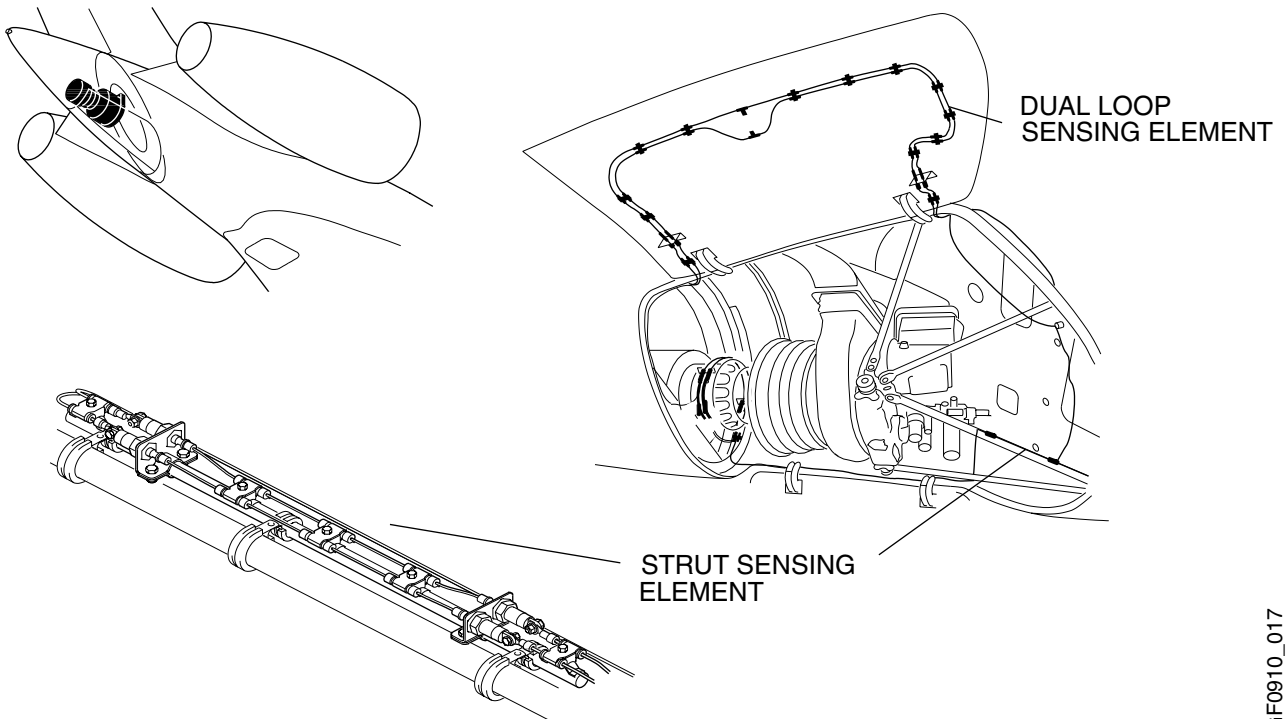
APU COMPARTMENT FIRE DETECTION

The APU fire protection system provides a means for detection of a fire condition within the APU enclosure. The APU uses the left or right fire bottle located in the aft fuselage section. Pulling the APU fire handle will signal the APU FADEC unit to initiate APU shut down. Turning the handle will discharge the selected fire extinguisher bottle.

On the ground, the FADEC will automatically shut down the APU if a fire signal is received for at least 5 seconds and the APU fire handle is not pulled. Although the APU will automatically shut down if a fire is detected, there is no automatic discharging of the fire extinguishing agent. Therefore, the APU must not be left unattended for ground operations.

The APU fire detection is self contained within the APU compartment. The detection system consists of the following:

- Fire loop elements inside the compartment for fire detection.
- Flight deck indication (red) through the fire handle and shut down signal to the APU FADEC.
- Aural fire warning on the flight deck.
- Automatic APU shut down on the ground, if necessary.

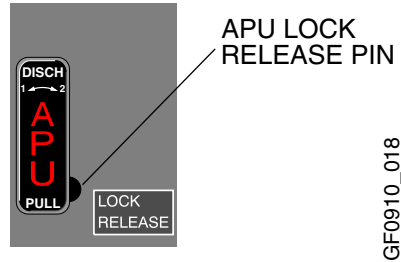


The APU fire detection is provided by a dual loop system; each loop consists of sensing elements. Two element pairs are mounted directly to the airplane structure and the other element is mounted to a support tube.

GF0910_017

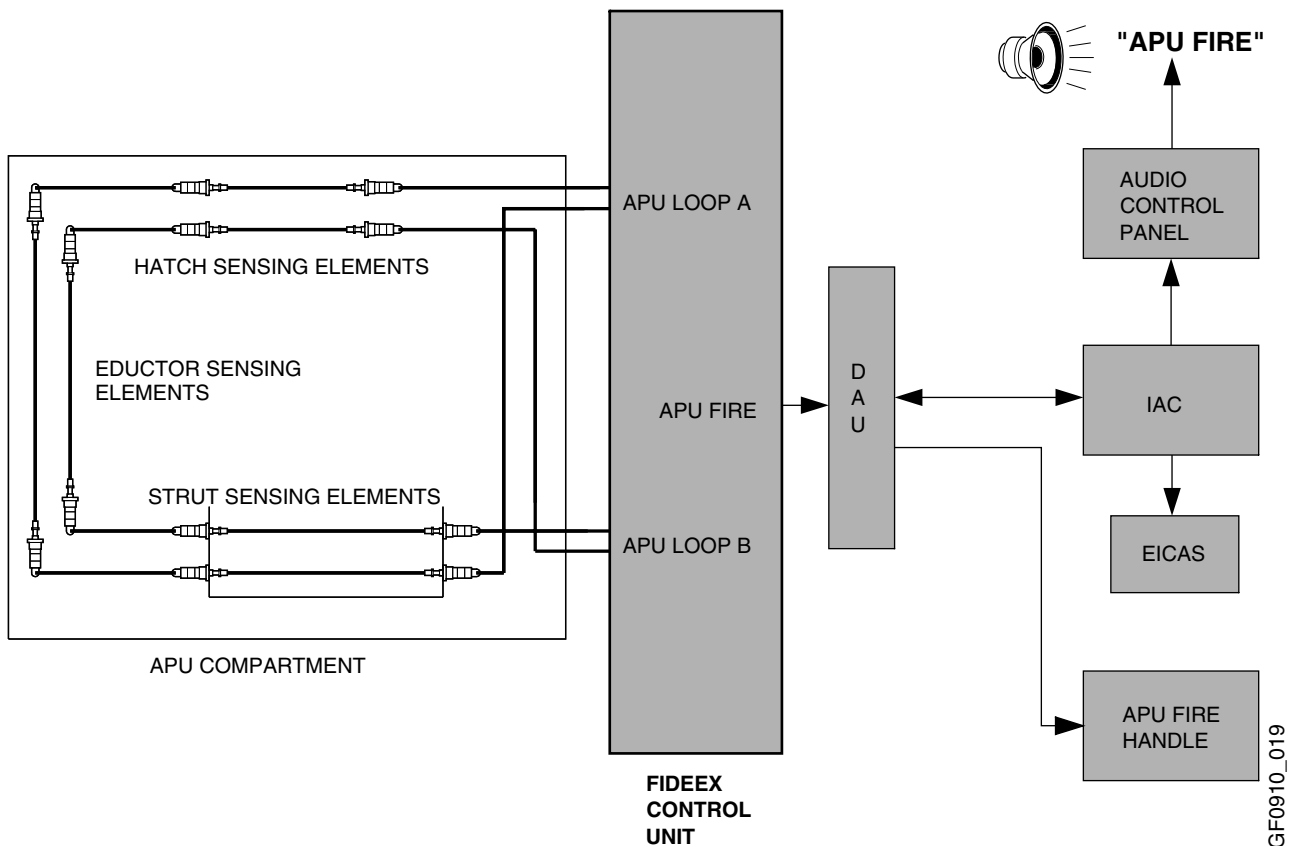
APU COMPARTMENT FIRE DETECTION (CONT'D)

The APU compartment is protected by a two shot fire extinguishing system. Each discharge is independently directed by the pilot, with provision to guard against accidental discharge of both extinguishers into the APU.



On the APU fire handle assembly, there is an additional lockout release pin located on the front panel. This release pin must be moved in conjunction with twisting the handle in order to discharge a second shot into the APU. The additional step for the APU is deemed necessary to preserve one shot for possible engine fire.

APU FIDEEX CONTROL SCHEMATIC



- When a fire is detected, the APU fire warning handle will illuminate, MASTER WARNING lights will illuminate, a warning message will appear on EICAS and a voice message “APU FIRE” will sound.

The APU fire loop elements send their information to the FIDEEX control unit. The FIDEEX control unit in turn sends information to the DAU. The DAU reports the status of the detection system to the IAC which signal the EICAS and audio control panel of the warning condition.

APU FIDEEX/FADEC INTERFACE

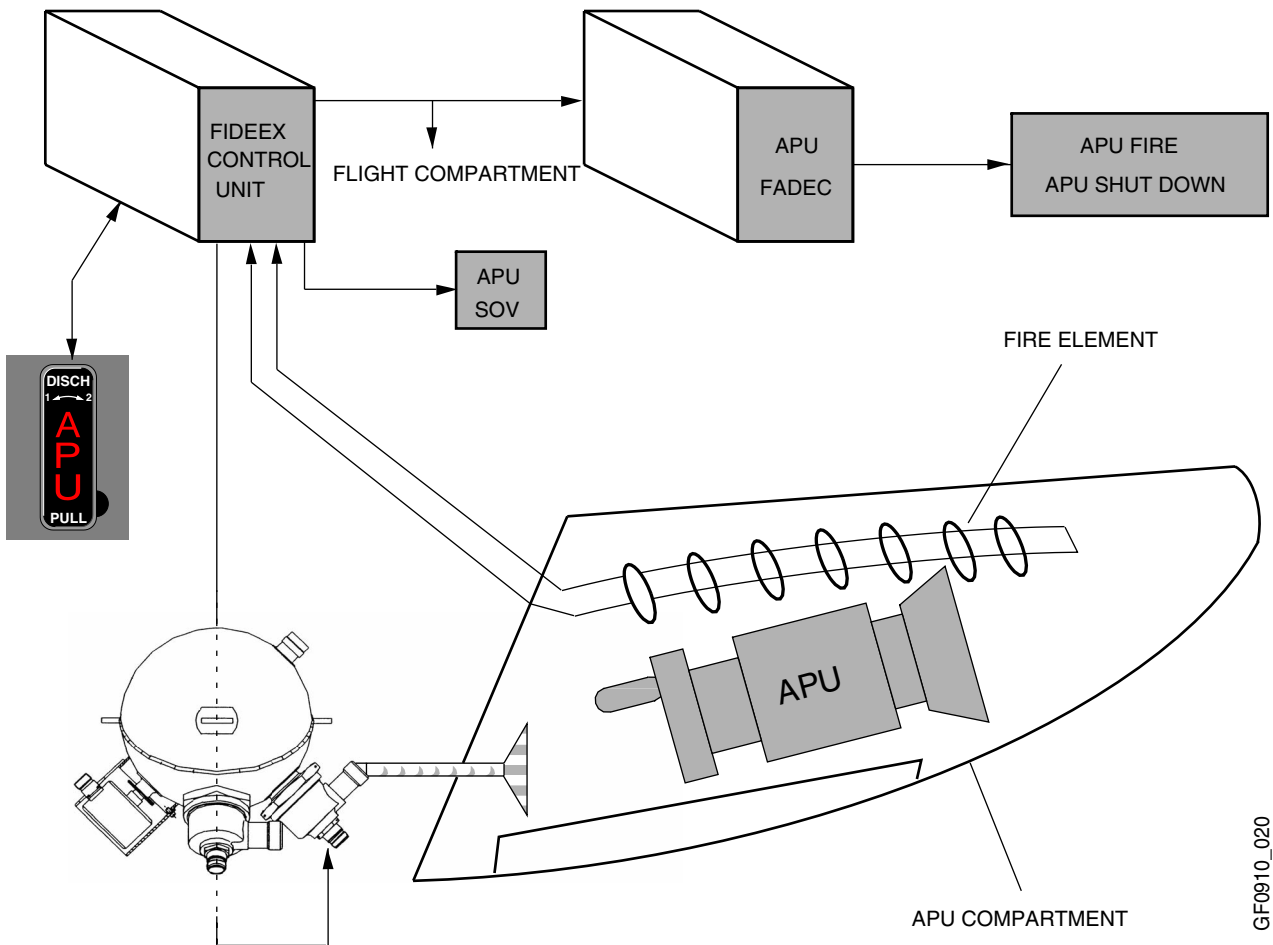
The fire loop elements inside the APU compartment detect a fire and send this information to the FIDEEX control unit. The FIDEEX control unit in turn sends information to the APU FADEC which commands an APU shut down.

NOTE

If APU fire is detected on the ground and the fire handle signal (pulled) is not detected within 5 seconds, the FADEC will command an auto shut down of the APU.

During normal APU operation, the APU FADEC signals the fuel management system to open the APU SOV. If an APU fire were detected and the APU fire DISCH handle pulled, the FIDEEX control unit will close the APU SOV.

APU FIDEEX/FADEC CONTROL SCHEMATIC



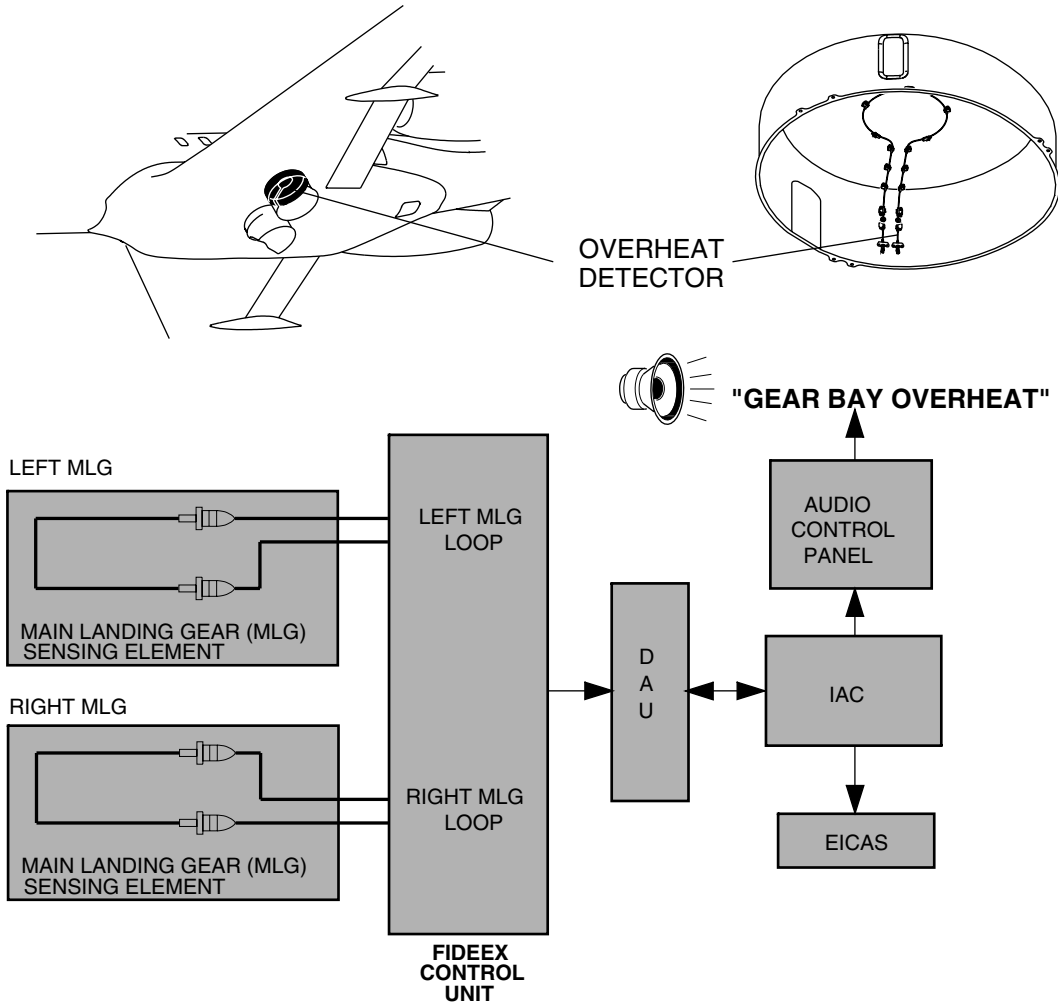
GF0910_020

When the APU DISCH fire handle is turned, a command is sent to the FIDEEX control unit to discharge the fire bottle. The EICAS will display the result of the extinguisher discharge.

MAIN WHEEL WELL (MWW) OVERHEAT DETECTION

The main landing gear bays can be subjected to overheat conditions due to brake/tire overheat or fire. The MWW overheat detection is provided by a single loop system for each main wheel well (left and right); each loop consists of one sensing element. The sensing elements are mounted in the vicinity of the brakes on the top surface of each MWW bin.

The FIDEEX control unit continuously monitors the heat sensing elements in the main landing gear area. Any overheat condition or system fault detected by the monitoring system is annunciated on EICAS in the form of a main landing gear bay overheat warning message, overheat fail caution message or main landing gear bay overheat fault. The gear bay overheat warning message will be accompanied by an aural warning.



GF0910_021a

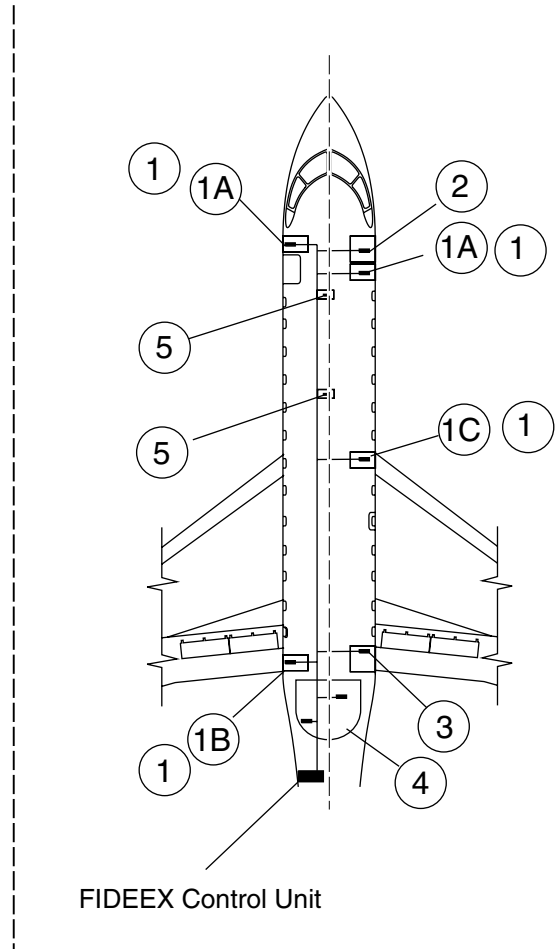
The FIDEEX control unit receives signals from the MWW sensing elements and in turn sends information to the DAU. The DAU reports the status of the detection system to the IAC which signal the EICAS and audio control panel for warning conditions.

The main landing gear overheat detection system and fault conditions may be tested through the Electrical Management System (EMS) in the flight compartment (refer to the Fire Test in the ELECTRICAL SYSTEM Chapter). Test result messages are displayed on EICAS.

SMOKE DETECTION

The avionics bay has smoke detection as part of the baseline configuration. The completion Centre Handbook provides the location/requirements for the closets, lavatories and baggage compartment optional smoke detectors.

- ① **CLOSET** (Optional)
 - Smoke detection
 - Hand held portable fire extinguisher
- ①A **CLOSET FWD** (Optional)
 - Smoke detection
 - Hand held portable fire extinguisher
- ①B **CLOSET AFT** (Optional)
 - Smoke detection
 - Hand held portable fire extinguisher
- ①C **SMOKE CABIN** (Optional)
 - Smoke detection
 - Hand held portable fire extinguisher
- ② **FORWARD LAVATORY** (Optional)
 - Smoke detection
 - Hand held portable fire extinguisher
- ③ **AFT LAVATORY** (Optional)
 - Smoke detection
 - Hand held portable fire extinguisher
- ④ **BAGGAGE COMPARTMENT** (Optional)
 - Smoke detection
 - Hand held portable fire extinguisher
- ⑤ **AVIONICS BAY**
 - Smoke detection



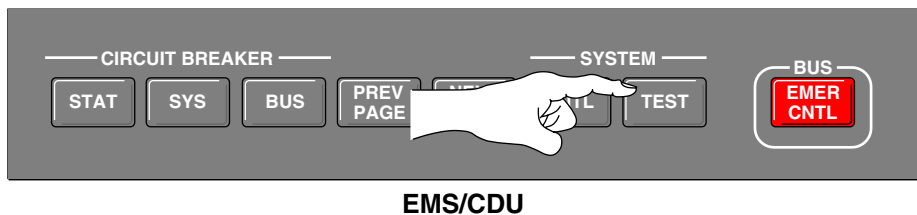
The FIDEEX control unit and the avionics system have built-in provisions for the smoke detectors located in the baggage compartment, lavatories, cabin closets and avionics bay. The smoke detectors are checked during power up and during pilot initiated test. The flight deck activates the following warning devices:

- - Flashing MASTER WARNING lights (glareshield).
 - Appropriate smoke warning message on EICAS.
 - Sounds the appropriate smoke warning voice message in the flight compartment.

Fire suppression for the baggage compartment, lavatories and cabin closets is provided via hand held portable fire extinguishers. Provisioning and certification of the smoke detectors and hand held extinguishers are the responsibility of the completion centre and are not further described in this Chapter.

PILOT INITIATED TEST

A Pilot Initiated Test (PIT) of the fire extinguishing system shall be commanded as part of the airplane pre-flight and can be carried out at any time during normal operation of the system.

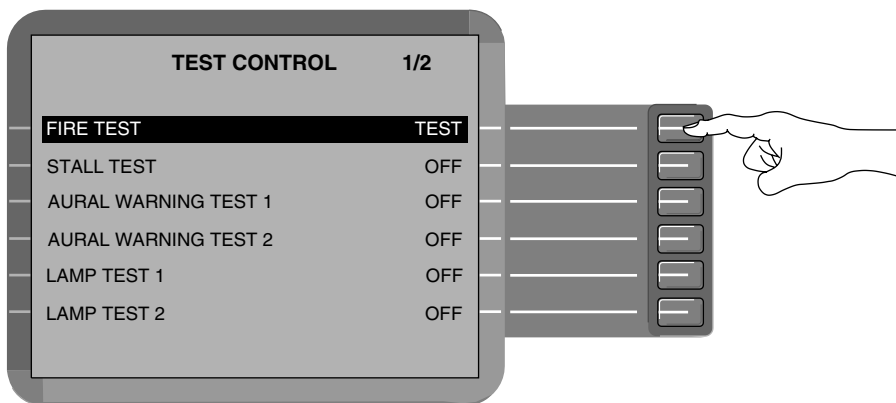


GF0910_023

To initiate the fire system test, press the “TEST” activation button on the EMS/CDU. The command test signal is sent to the FIDEEX control unit. The crew initiated fire test consists of:

- A test of all fire/overheat loops with all flight deck reporting active.
- A smoke detector test of all installed smoke detectors.

When the “TEST” button on the EMS/CDU is selected, the FIRE TEST is automatically highlighted on the SYSTEM TEST page.



GF0910_024a

To initiate the test, the right side button must be selected. Test will automatically terminate after approximately 15 seconds or can be aborted by a reselect of the FIRE TEST key.

A PIT is successful if each of the following events occur:

- Both MASTER WARNING lights flash and an aural warning sounds.



Glareshield

Triple Chime



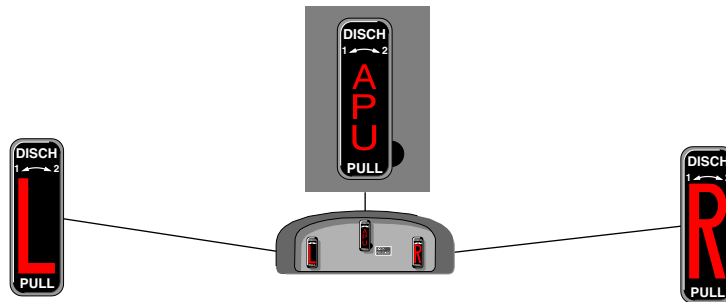
Aural

**"LEFT ENGINE FIRE,
RIGHT ENGINE FIRE,
APU FIRE,
GEAR BAY OVERHEAT,
SMOKE"**

GF0910_025

PILOT INITIATED TEST (CONT'D)

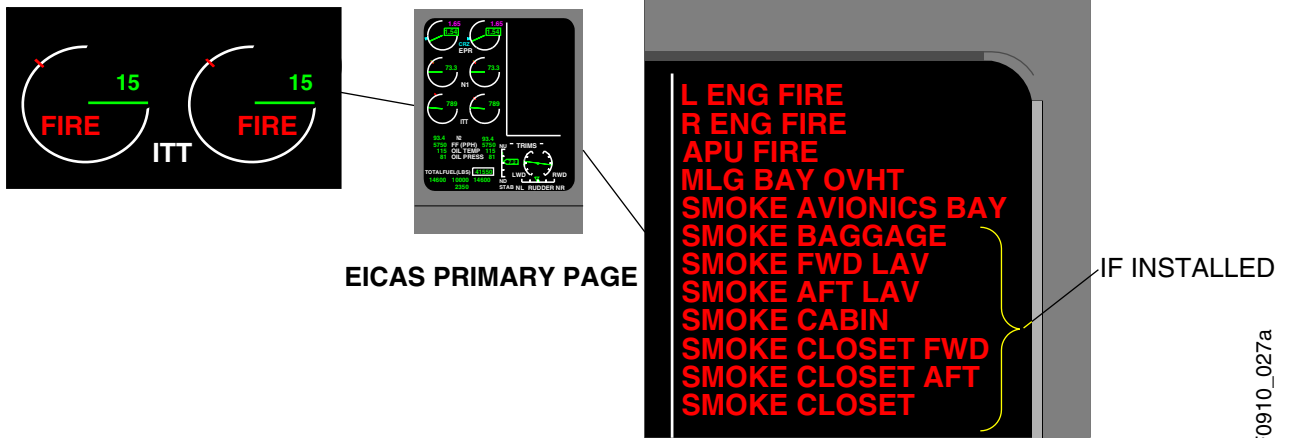
Left engine, right engine and APU fire handles illuminate.



GF0910_026

The following EICAS warning messages appear:

- • L (R) ENG FIRE
- • APU FIRE
- • MLG BAY OVHT
- SMOKE AVIONICS BAY
- SMOKE BAGGAGE, SMOKE FWD LAV, SMOKE AFT LAV and SMOKE CABIN, SMOKE CLOSET FWD, SMOKE CLOSET AFT, (if smoke detectors are installed).

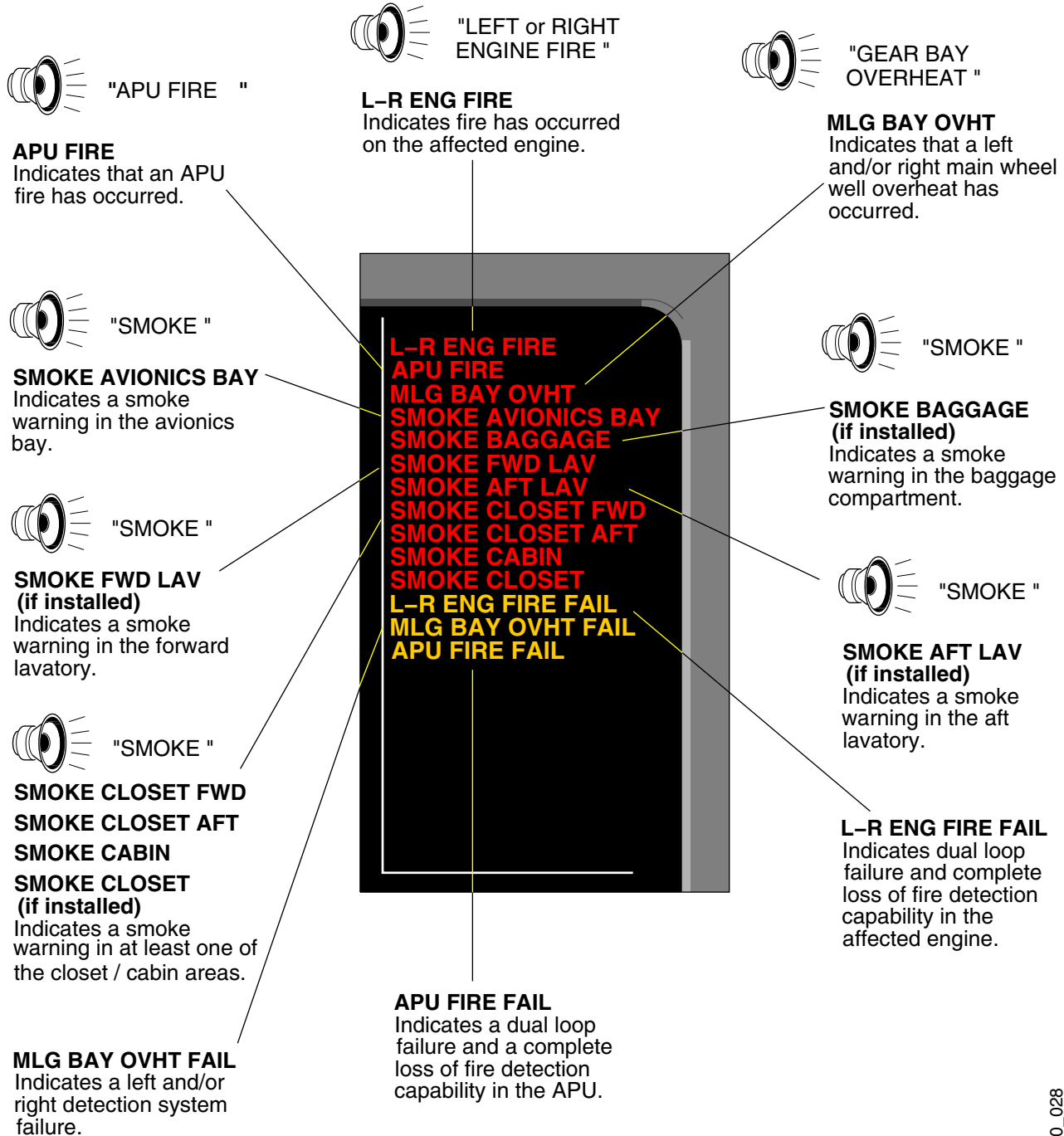


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- The FIRE TEST duration is approximately 10 seconds. When the fire test is completed, all warning messages will go out, fire aural warning will deactivate, MASTER WARNING lights will go out and the fire DISC handle lights will go out.

If loss of detection for either engine, APU, MWW or smoke sensing is detected by the FIDEEX, the appropriate zone fire fail caution message will be displayed on the EICAS until the fail condition no longer exists.

EICAS MESSAGES



GF0910_028

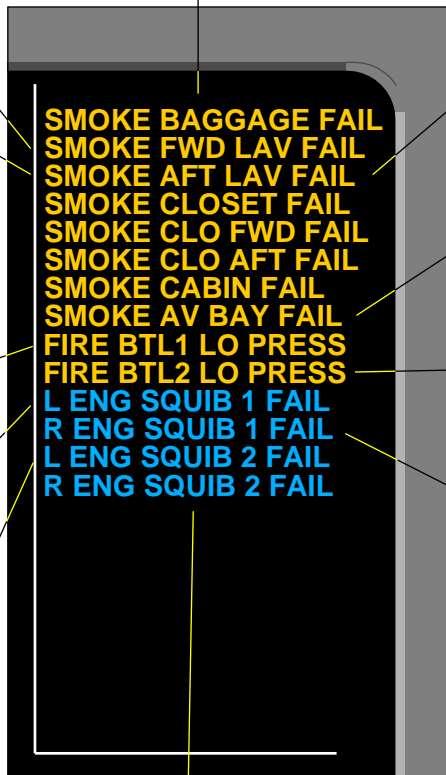
EICAS MESSAGES (CONT'D)

SMOKE FWD LAV FAIL
Indicates the smoke detector in the forward lavatory has failed.

SMOKE BAGGAGE FAIL
Indicates one or both smoke detectors in the baggage area has failed.

SMOKE AFT LAV FAIL
Indicates the smoke detector in the aft lavatory has failed.

SMOKE CLOSET FAIL
SMOKE CLO FWD FAIL
SMOKE CLO AFT FAIL
SMOKE CABIN FAIL (If installed)
Indicates one or more closet smoke detectors have failed.



SMOKE AV BAY FAIL
Indicates one or more (if two are installed) smoke detector(s) in the avionics bay has failed.

FIRE BTL 1 LO PRESS
Indicates low pressure in fire extinguishing bottle 1.

FIRE BTL 2 LO PRESS
Indicates low pressure in fire extinguishing bottle 2.

L ENG SQUIB 1 FAIL
Indicates that the left engine squib 1 has failed. Fire bottle 1 is not available to the left engine.

R ENG SQUIB 1 FAIL
Indicates that the right engine squib 1 has failed. Fire bottle 1 is not available to the right engine.

L ENG SQUIB 2 FAIL
Indicates that the left engine squib 2 has failed. Fire bottle 2 is not available to the left engine.

R ENG SQUIB 2 FAIL
Indicates that the right engine squib 2 has failed. Fire bottle 2 is not available to the right engine.

GF0910_029

EICAS MESSAGES (CONT'D)

APU SQUIB 2 FAIL

Indicates that APU squib 2 failed. Fire bottle 2 is not available to the APU.

APU SQUIB 1 FAIL

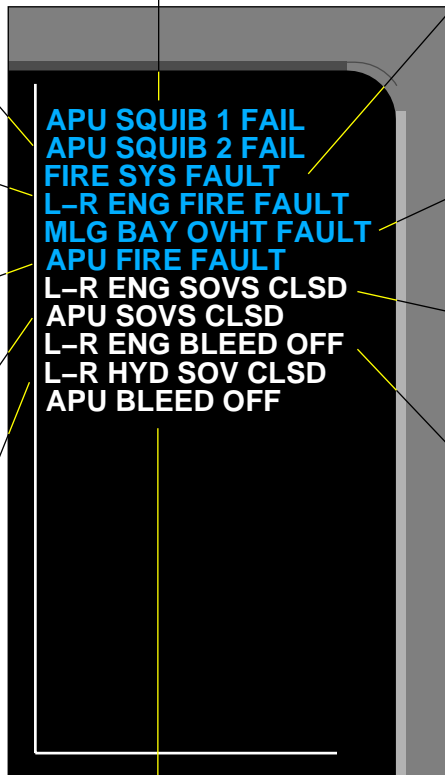
Indicates that APU squib 1 failed. Fire bottle 1 is not available to the APU.

FIRE SYS FAULT

Indicates FIDEEX system fault. Engine and APU fire detection and extinguishing system is operational. Other fire system functions may be unreliable.

L-R ENG FIRE FAULT

Indicates the affected engine fire detection element system fault. One channel of the system is unreliable, other channel is still operational.



MLG BAY OVHT FAULT

Indicates a detection element system fault. One channel of the system is unreliable, other channel is still operational.

APU FIRE FAULT

Indicates a fire detection element system fault. One channel of the system is unreliable, other channel is still operational.

L-R ENG SOVS CLSD

Indicates the applicable valves are closed with the fire handle pulled:

APU SOVS CLSD

Indicates the applicable valve is closed with the fire handle pulled:

- APU SOV
- APU LCV

- PRV and HPV
- R or L ENG SOV
- HYD SOV 1 or 2

L-R ENG BLEED OFF

Indicated when the bleed manual switch is selected off or L-R fire handle pulled and no "L-R ENG SOVS CLSD" status message is posted.

L-R HYD SOV CLSD

Indicated when the affected valve remains closed with the fire handle pulled or manually selected via the L(R) HYD SOV switch and no "L-R ENG SOVS CLSD" status message is posted.

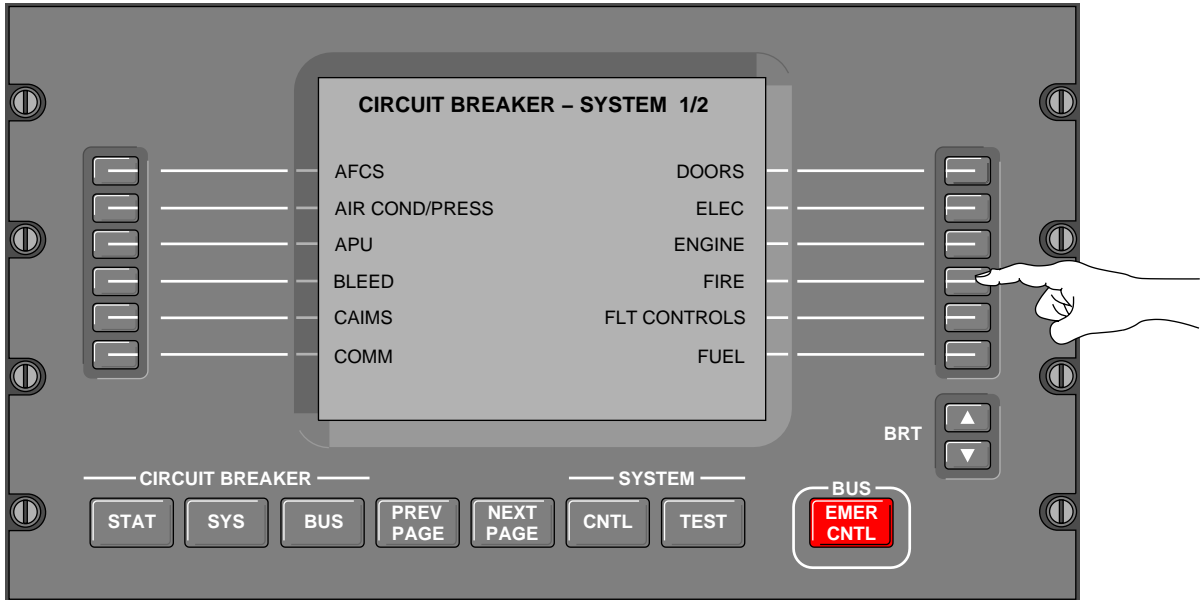
APU BLEED OFF

Indicated when the APU manual bleed is selected off and the LCV closes, or APU fire handle pulled and no "APU SOVS CLSD" status message is posted.

GF0910_030

FIRE PROTECTION EMS CIRCUIT PROTECTION

CB - FIRE SYSTEM



CB - FIRE SYSTEM			1/2
APU FIRE HANDLE	BATT		IN
FIRE DETECT CH A	BATT		IN
FIRE DETECT CH B	BATT		IN
FIREX CH A	DC EMER	DCPC	IN
FIREX CH B	DC EMER	DCPC	IN
L FIRE HANDLE	BATT		IN
CB - FIRE SYSTEM			2/2
R FIRE HANDLE	BATT		IN

GF0920_001

**FIRE PROTECTION
EMS CIRCUIT PROTECTION**

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