



CL-350 TRAINING MANUAL

FIRE PROTECTION

14

AIRCRAFT SYSTEMS
TRAINING MANUAL

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FIRE PROTECTION

The fire protection system provides comprehensive detection and extinguishing capabilities for critical aircraft areas including engines, auxiliary power unit, main landing gear bays, and cargo compartment. The system employs dual-loop detection technology for enhanced reliability, utilizing thermistor-based sensors that detect overheating conditions through electrical resistance changes.

Fire extinguishing capability is provided by two Halon 1301 bottles strategically positioned to protect engine and APU compartments, with automatic discharge features for ground operations and manual control during flight. The system integrates with the EICAS for real-time monitoring and crew alerting, incorporating multiple test functions to ensure system readiness.

I. INTRODUCTION

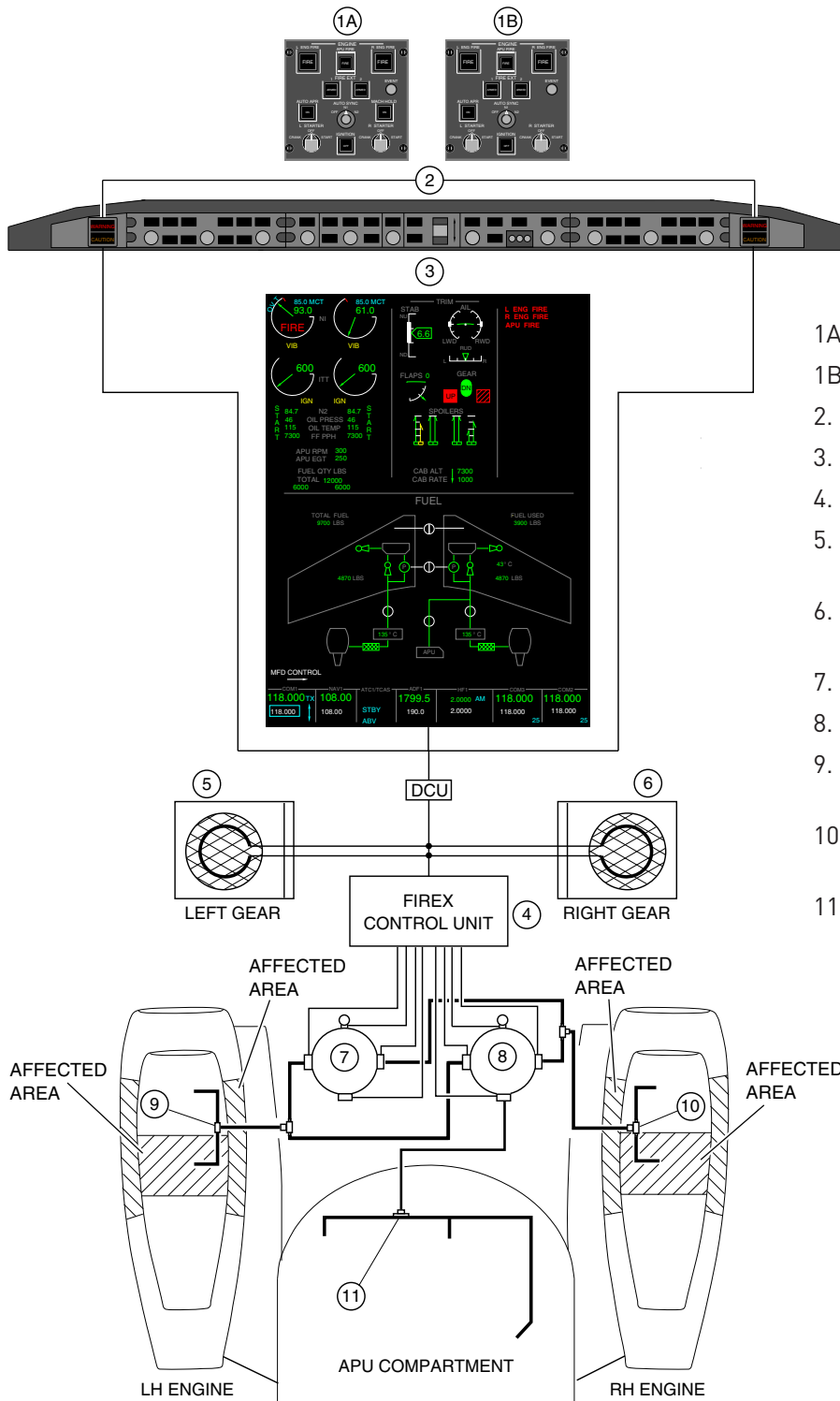
A. FIRE PROTECTION SPECIFICATIONS

Fire Protection System Specifications

Parameter	Value
Fire Detection Zones	Engines (2), APU, MLG Bays (2), Baggage Compartment
Detection System Type	Dual-loop thermistor-based (engines/APU), Single-loop (MLG)
Extinguisher Agent	Halon 1301
Fire Bottles	2 (Bottle #1: 2 squibs, Bottle #2: 3 squibs) APU Bottle #2 Only
Fire Control Unit (Aft Equipment Bay)	FIREX-CU (Fire Detection and Extinguishing Control Unit)
Loop Construction	Metal sheath with two internal wires separated by thermistor
Detection Logic	Both loops must sense fire condition to generate warnings
APU Ground Mode	Automatic shutdown and discharge after 5 seconds
APU Flight Mode	Manual discharge required after APU FIRE switch
Baggage Compartment Smoke Detector Type	Light-scatter
Gear Bay Detection	Single loop overheat detection
Fire System Test	SYSTEMS TEST rotary switch with FIRE DET position
Aural Warnings	"LEFT ENGINE FIRE", "RIGHT ENGINE FIRE", "APU FIRE"
Aerodrome Fire Category	4 (ICAO), A (FAA), 4 (TC)

NOTE: Main Landing Gear Bays and Baggage Compartment are detection only!

FIRE PROTECTION SYSTEM OVERVIEW



- 1A. ENGINE PANEL WITHOUT AT SYSTEM
- 1B. ENGINE PANEL WITH AT SYSTEM
2. MASTER WARNING/CAUTION LIGHTS
3. LEFT MFD EICAS DISPLAY
4. FIREX CONTROL UNIT
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

II. ENGINE FIRE PROTECTION

A. DETECTION SYSTEM

Dual-Loop Configuration:

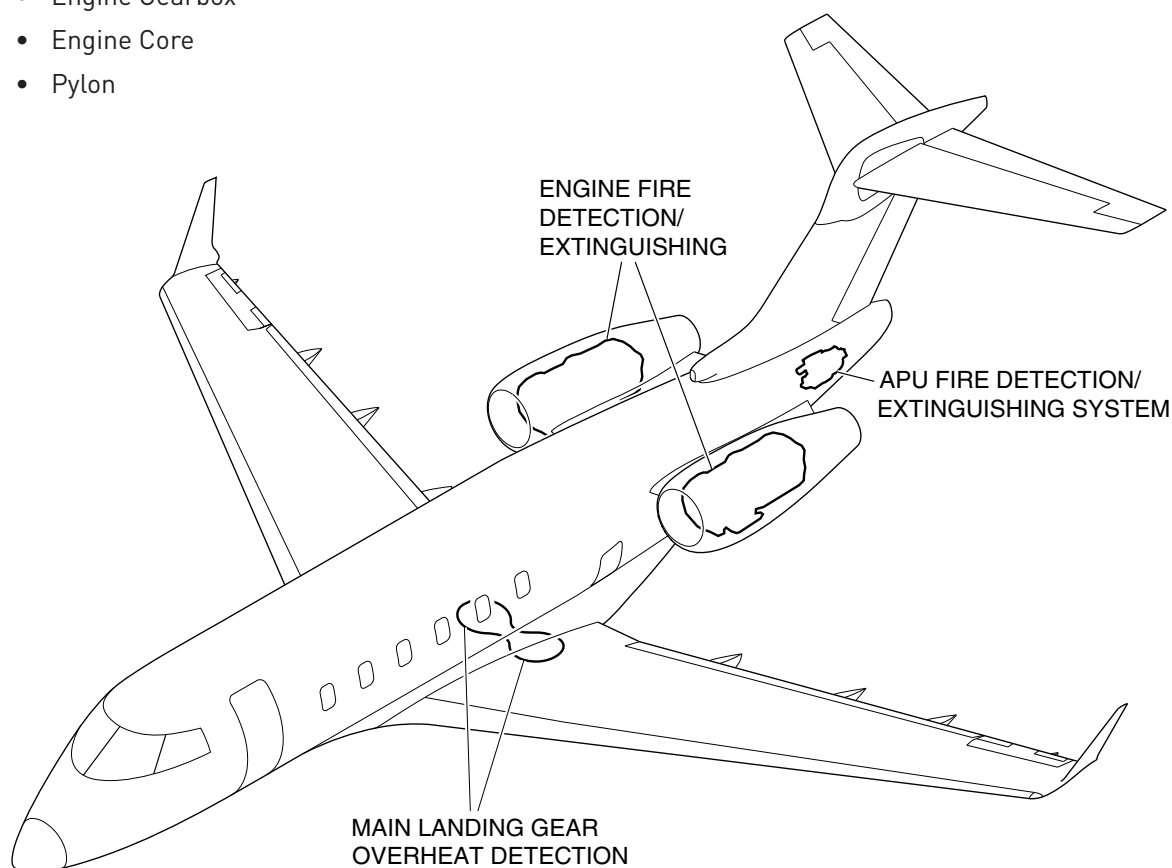
- Two independent fire detection loops per engine
- Both loops must sense fire conditions to trigger warning
- Single loop can detect fire if other loop fails
- Loops constructed with outer metal sheathing and internal thermistor material
- Resistance decreases with temperature increase

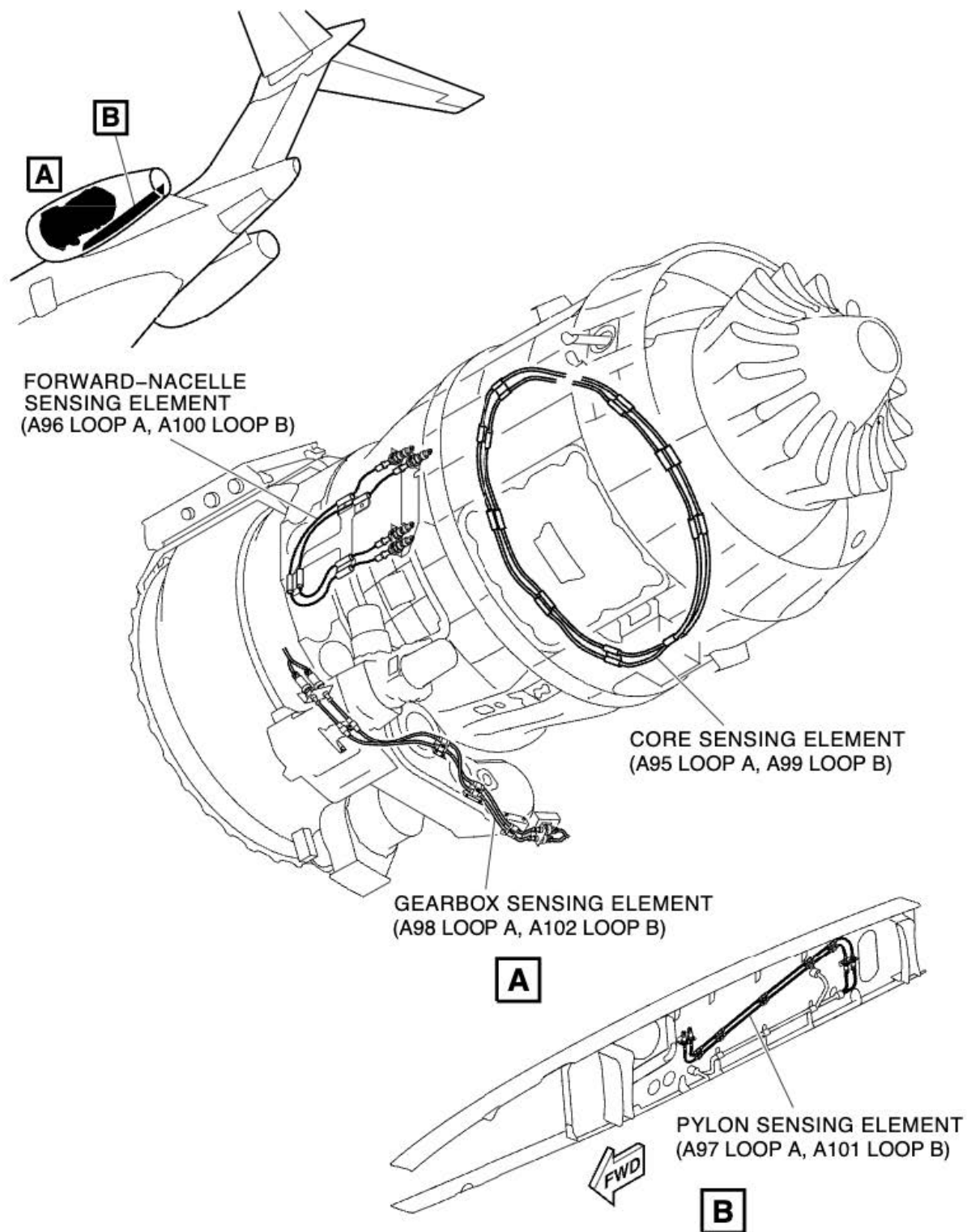
Loop Monitoring:

- FIREX-CU continuously monitors electrical resistance
- Preset time and resistance thresholds prevent false warnings
- Individual circuit monitoring for each loop
- Automatic fault detection and crew alerting

Loop Locations:

- Forward Engine Nacelle
- Engine Gearbox
- Engine Core
- Pylon





Engine Fire-Detection System – Component Location



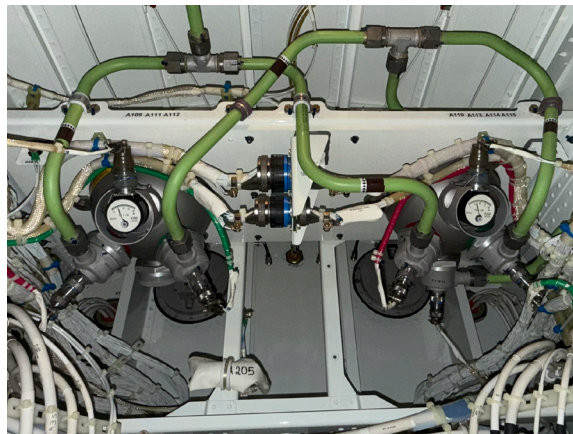
B. EXTINGUISHING SYSTEM

Fire Bottles Configuration:

- Bottle #1: Two discharge heads (one per engine)
- Bottle #2: Three discharge heads (both engines plus APU)
- Each squib has dual firing bridge wires
- Separate electrical circuits for redundancy

Discharge Operation:

- L/R ENG FIRE switch push: Shuts down engine and arms squib
- FIRE EXT 1 or 2 switch push: Discharges selected bottle
- Both bottles can discharge into single engine if required status, expect a post-discharge LOW advisory
- Pressure switches and gauges monitor bottle status, expect a post-discharge LOW advisory



NOTES

- Regardless of which engine has the fire, FIRE EXT 1 should always be pushed first since the APU compartment can only be extinguished by bottle #2. Wait ~10 seconds before discharging first bottle and ~30 before discharging the second bottle if CAS persists.

C. ENGINE FIRE SWITCH ACTIONS

When Pushed:

- Fuel shutoff valve closes
- Bleed-air shutoff valve closes
- Hydraulic shutoff valve closes
- Generator is selected offline
- FADEC commands engine shutdown
- Both fire bottle squibs armed
- Both FIRE EXT ARMED lights illuminate



III. APU FIRE PROTECTION

A. DETECTION SYSTEM

Detection Loops:

- Dual fire detection loops in APU enclosure
- Same thermistor technology as engine loops
- Both loops must sense overheat for fire indication
- Connected to FIREX-CU for monitoring

Loop Locations:

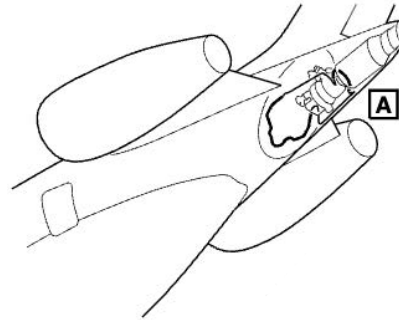
- APU Firewall
- APU Eductor

B. OPERATIONAL MODES**Ground Mode (Unattended):**

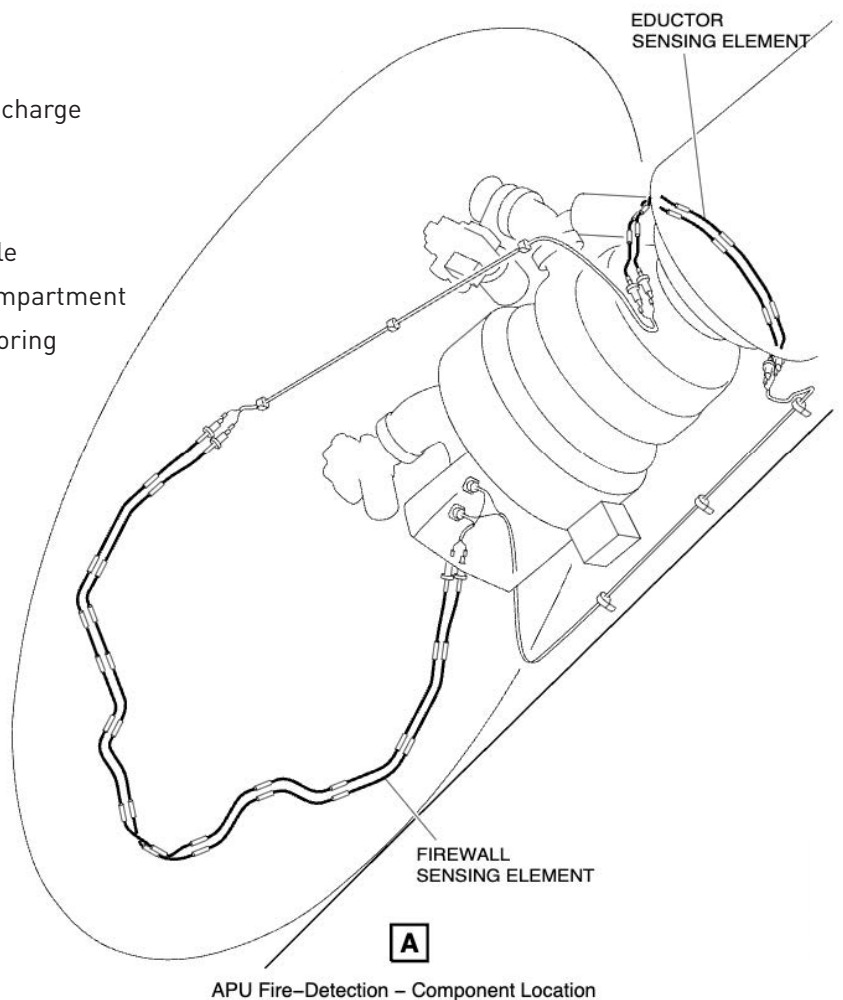
- Automatic APU shutdown upon fire detection
- Bottle #2 automatically discharges after 5 seconds
- No crew intervention required
- Protects aircraft during ground operations

Flight Mode:

- APU FIRE switch push shuts down APU
- ECU closes APU fuel metering valve
- APU bleed-air shutoff valve closes
- APU generator selected offline
- Arms bottle #2 squib
- FIRE EXT 2 illuminates ARMED
- Crew must push FIRE EXT 2 to discharge

**C. EXTINGUISHING SYSTEM****Bottle #2 Dedicated Functions:**

- Exclusive APU fire protection bottle
- Single explosive squib for APU compartment
- Pressure switch and gauge monitoring
- Halon 1301 extinguishing agent





Engine Fire Protection - Firex Bottle Pressures

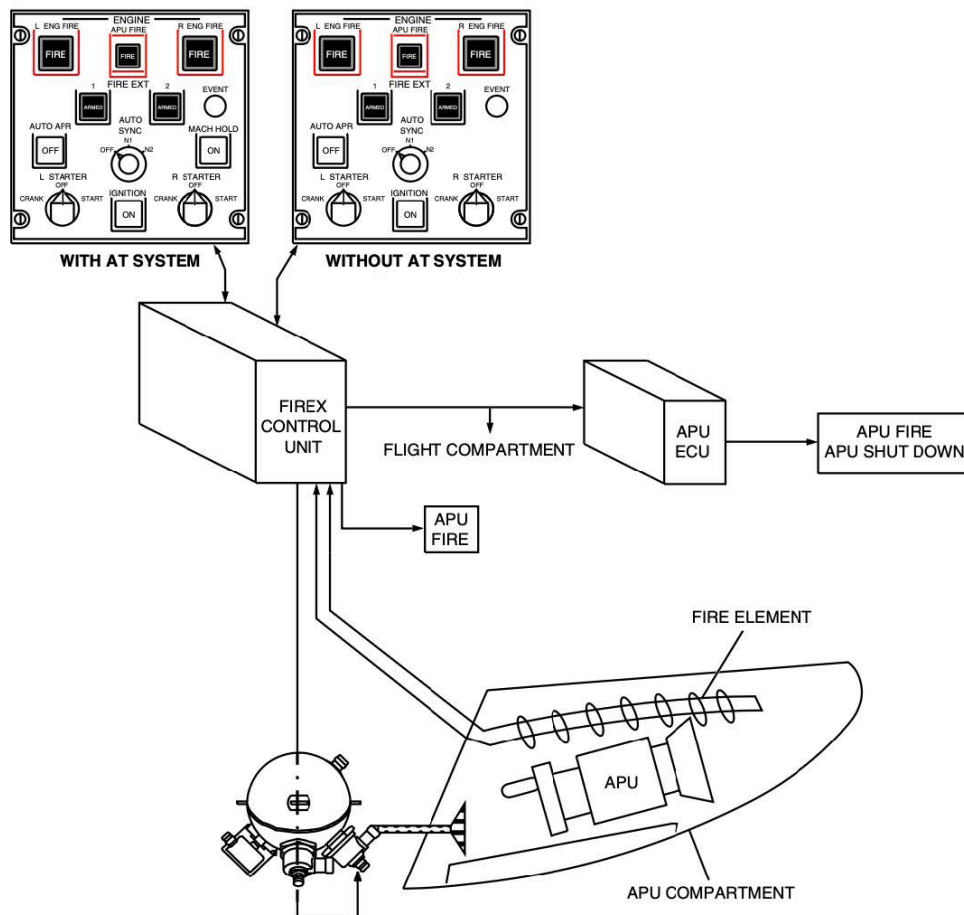
During checks on the FIREX bottles, the following pressure/temperature chart can be used to determine if bottle pressure is within acceptable limits for bottle temperature. The table provided applies to bottles with a 4.3 lb nominal weight.

Minimum/Maximum FIREX Bottle Pressure (4.3 lb nominal weight)			
Temperature		Gauge Reading (psig)	
°C	(°F)	Minimum	Maximum
-55	(-67)	251	343
-50	(-58)	277	354
-45	(-49)	288	367
-40	(-40)	302	380
-35	(-31)	315	394
-30	(-22)	330	410
-25	(-13)	347	427
-20	(-4)	365	445
-15	(5)	384	465
-10	(14)	404	486
-5	(23)	427	508
0	(32)	450	533
5	(41)	476	559
10	(50)	503	587
15	(59)	532	616
20	(68)	563	648
25	(77)	596	681
30	(86)	631	717
35	(95)	668	755
40	(104)	708	795
45	(113)	750	838
50	(122)	796	886
55	(131)	849	941
60	(140)	895	982
65	(149)	964	1096
70	(158)	1032	1165

Engine Fire Protection - Firex Bottle Pressures

During checks on the FIREX bottles, the following pressure/temperature chart can be used to determine if bottle pressure is within acceptable limits for bottle temperature. The table provided applies to bottles with a 4.3 lb nominal weight.

Minimum/Maximum FIREX Bottle Pressure (4.3 lb nominal weight)			
Temperature		Gauge Reading (psig)	
°C	°F	Minimum	Maximum
75	[167]	1100	1235
80	[176]	1168	1305
85	[185]	1235	1375
90	[194]	1303	1445
95	[203]	1371	1515
100	[212]	1439	1585



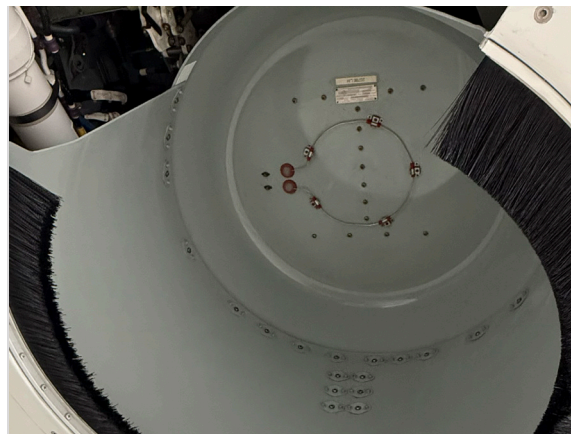


IV. MAIN LANDING GEAR OVERHEAT DETECTION

A. SYSTEM DESIGN

Detection Configuration:

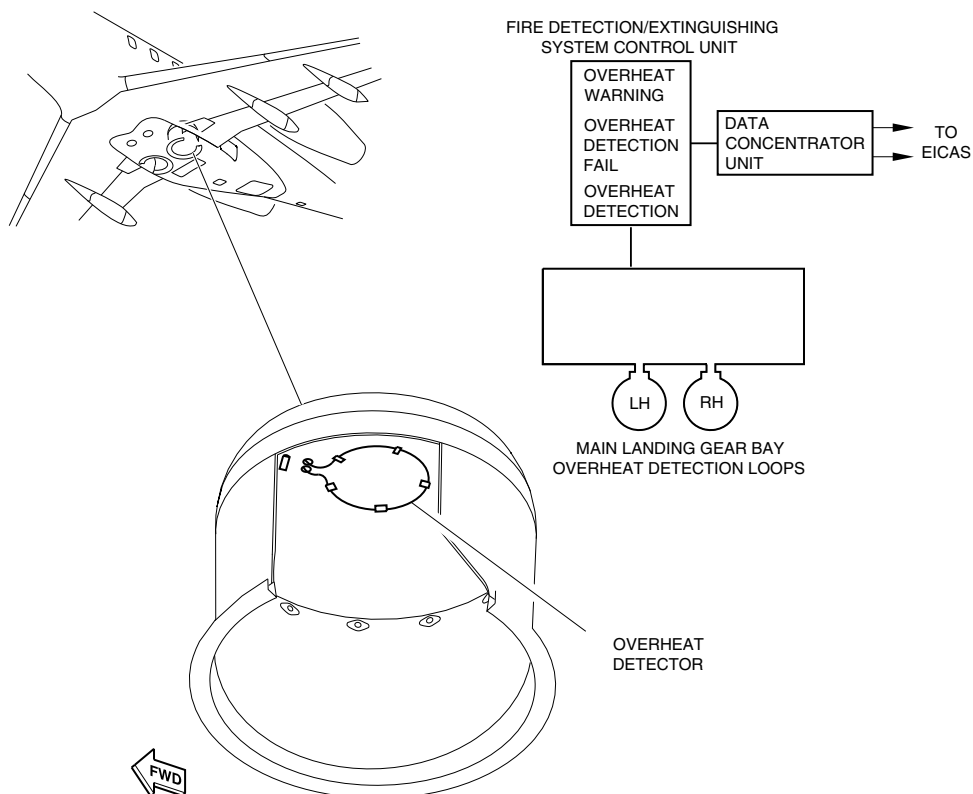
- Single overhear detection loop per MLG bay
- Dual channel overhear detection unit
- Loops installed around the top of the inner wheel bin surface of each MLG wheel bin
- Brake/Tire overhear detection after takeoff, protects the composite-material wheel wells



B. OPERATION

Detection Process:

- Thermistor material resistance decreases with heat
- Control unit monitors resistance changes
- Overheat signal sent to Data Concentrator Unit
- DCU routes signals to EICAS



Crew Alerting:

- Master warning lights illuminate
- Triple chime sounds
- **GEAR BAY OVHT** (W) CAS message
- No fire suppression capability (detection only)

V. BAGGAGE/CARGO COMPARTMENT FIRE PROTECTION**A. SMOKE DETECTION****Detector Specifications:**

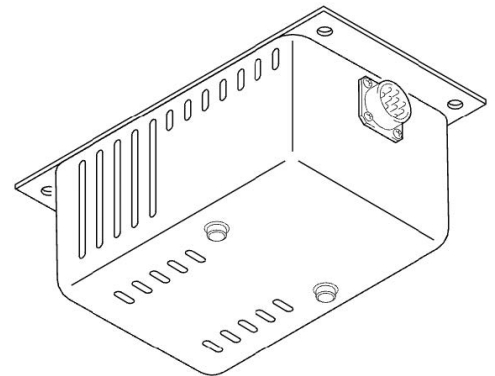
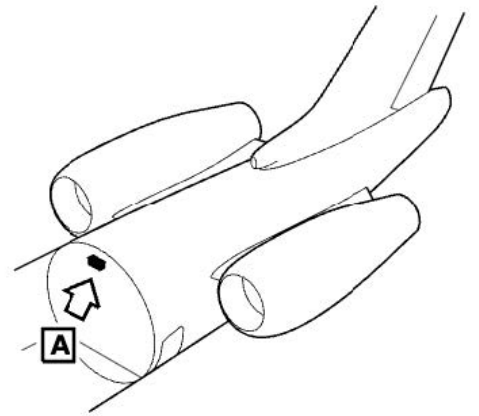
- Light-scatter type smoke detector
- Ceiling-mounted in cargo bay
- Specific smoke concentration threshold
- Connected to warning systems

B. FIRE SUPPRESSION**Portable Extinguishers:**

- Located behind copilot's seat bulkhead
- Additional unit in right aft enclosure (in lavatory)
- Manual operation required
- Used for baggage compartment and flight compartment fires

C. FALSE ALARMS**Known Causes:**

- Mobile transceiver operation near detectors
- Ground equipment exhaust fumes



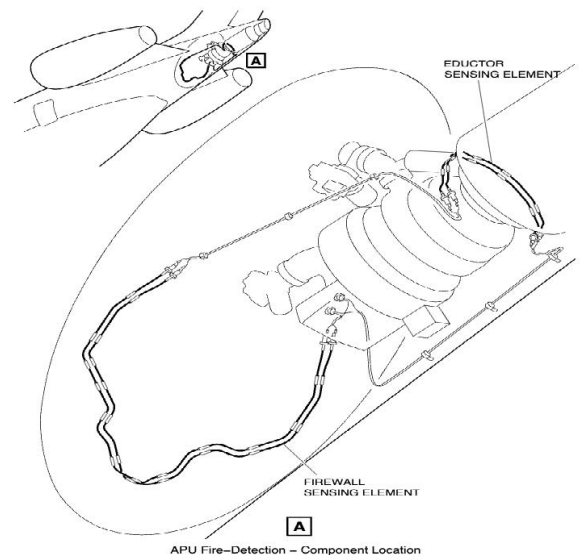
BAGGAGE-COMPARTMENT SMOKE DETECTOR (A92)

A**VI. CONTROLS AND INDICATIONS****A. COCKPIT CONTROLS****Fire Switches:**

- L ENG FIRE switch (guarded, push-to-activate)
- R ENG FIRE switch (guarded, push-to-activate)
- APU FIRE switch (guarded, push-to-activate)
- FIRE EXT 1 switch (push to discharge)
- FIRE EXT 2 switch (push to discharge)

B. TEST SYSTEM**SYSTEMS TEST Switch:**

- Located on pedestal near PARK/EMER brake
- Rotate to FIRE DET position for system test

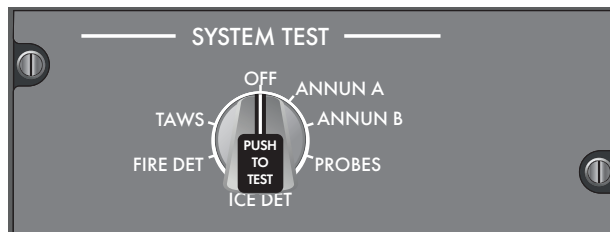


APU Fire-Detection - Component Location

- Press to initiate test sequence
- No preflight test required (continuous monitoring)

Test Sequence Actions:

- Warning CAS messages illuminate (L ENGINE FIRE, R ENGINE FIRE, APU FIRE, GEAR BAY
- OVHT, CARGO SMOKE) Control unit tests detection/extinguishing components
- **FIRE SYS IN TEST** (S) CAS message
- Master warning lights flash
- Master warning chime activation
- 15-second aural test ("LEFT ENGINE FIRE" repeats)
- All fire switches illuminate
- **FIRE SYS TEST** OK upon completion



VII. SYSTEM ARCHITECTURE

A. COMPONENTS LOCATION

Aft Equipment Bay:

- FIREX Control Unit
- Fire extinguisher bottles (2)
- Associated pressure gauges
- Squib connections and wiring

Engine Nacelles:

- Dual detection loops per engine
- Loop routing through fire zones
- Connection to FIREX-CU

APU Compartment:

- Dual detection loops
- Discharge nozzles from bottle #2
- APU ECU interface connections

B. ELECTRICAL INTEGRATION

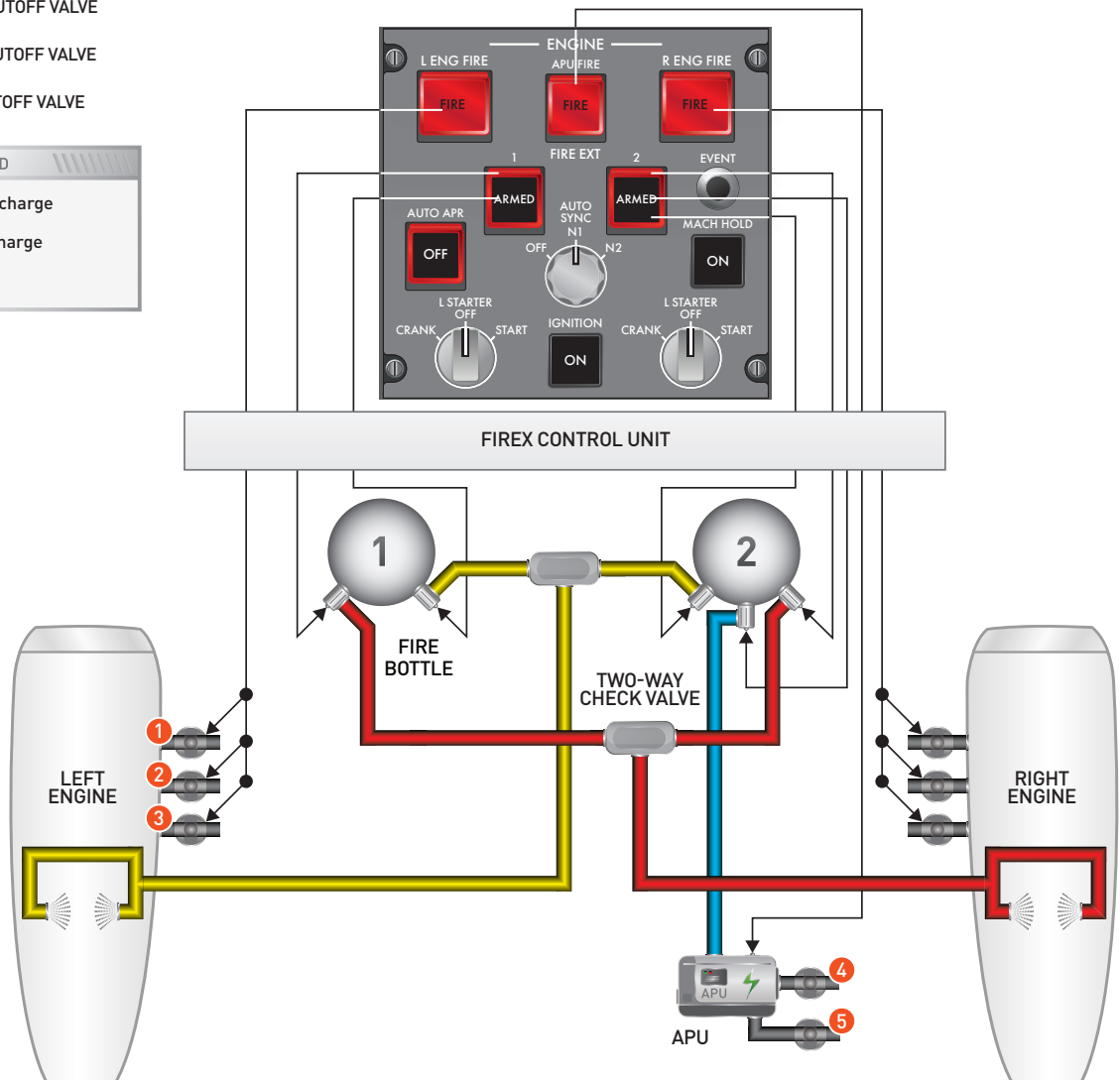
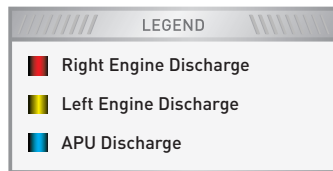
Power Sources:

- LEFT ESS Bus: FIRE DET CH A
- RIGHT MAIN Bus: FIRE DET CH B
- LEFT BATT Bus: FIREX A
- RIGHT BATT Bus: FIREX B
- Dual channel redundancy maintained



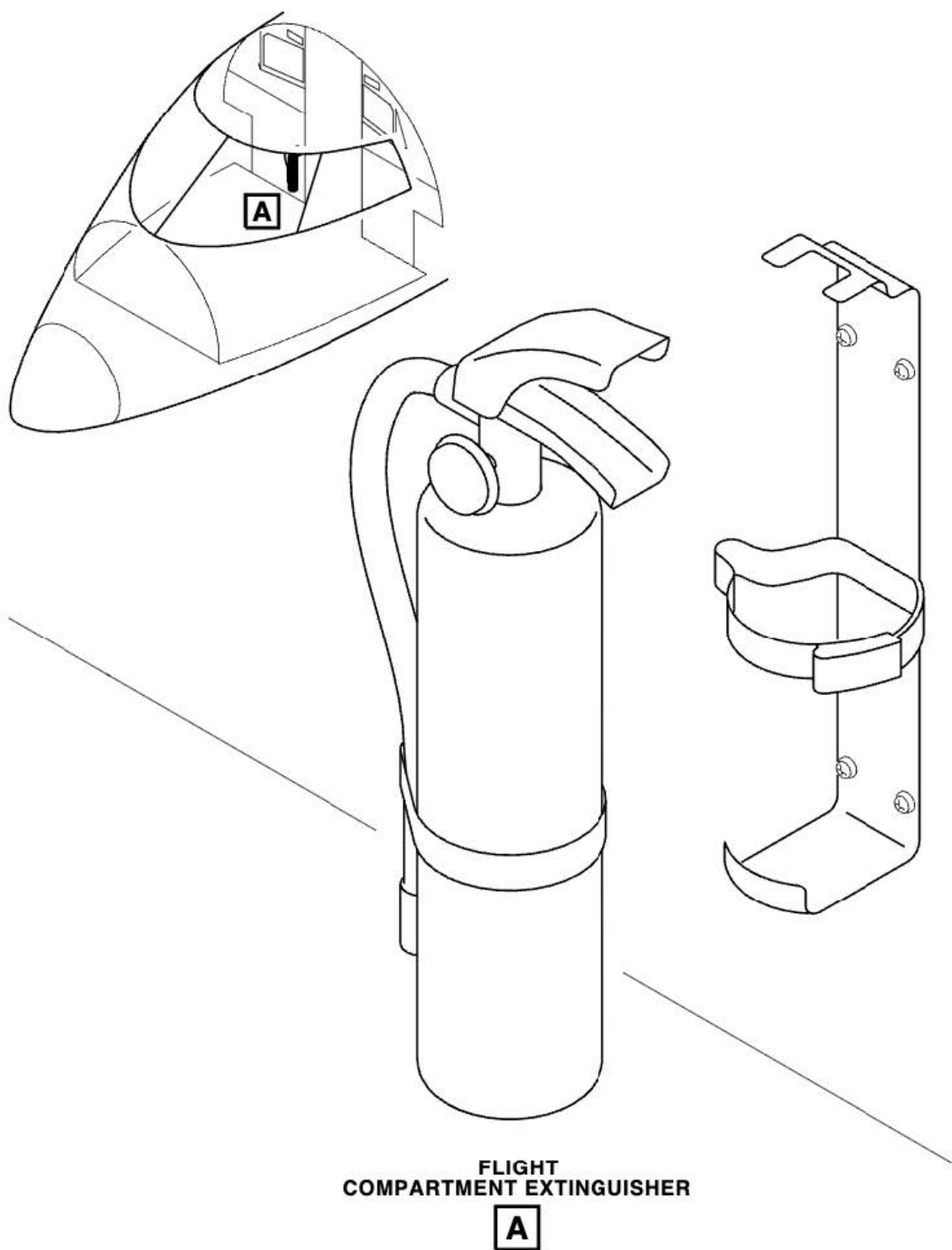
FIREX CONTROL UNIT SCHEMATIC

- 1 HP AND IP BLEED-AIR VALVES
- 2 FUEL SHUTOFF VALVE
- 3 HYDRAULIC SHUTOFF VALVE
- 4 APU BLEED SHUTOFF VALVE
- 5 APU FUEL SHUTOFF VALVE



- | | |
|-------------------------------|----------------------------|
| 1. HP and IP Bleed-Air Valves | 4. APU Bleed Shutoff Valve |
| 2. Fuel Shutoff Valve | 5. APU Fuel Shutoff Valve |
| 3. Hydraulic Shutoff Valve | 6. Two-Way Check Valve |

Note: The two-way check valve at each engine prevents agent from a second-discharged bottle from backfilling into the bottle that was discharged first.



VIII. EICAS MESSAGES

A. WARNING MESSAGES

WARNING MESSAGES

Immediate crew action required

Message	Meaning	Inhibits	Aural Warning
APU FIRE	Fire has been detected in the APU compartment	—	Triple Chime "APU Fire"
L (R) ENGINE FIRE	The L (R) ENGINE FIRE CAS, FIRE EI in the N ₁ indicator, FIRE indication in the L (R) ENG FIRE switch, or "LEFT (RIGHT) ENGINE FIRE" voice message indicates that the engine fire detection loop has activated. An engine fire is usually accompanied by other indications, such as: excessive ITT, erratic or rough engine operation, fluctuating engine indications, or smoke in the cabin	—	Triple Chime "Left (Right) Engine Fire"
CARGO SMOKE	Smoke has been detected in the cargo (baggage) area	—	Triple Chime
GEAR BAY OVHT	An overheat condition has been detected in the main landing gear bays	TO/LAND	Triple Chime

B. CAUTION MESSAGES

CAUTION MESSAGES

Timely crew awareness/action needed

Message	Meaning	Inhibits
APU FIRE DET FAIL	The APU fire detection system has detected a failure that will not allow the detection system to indicate a fire	TO/LAND
CARGO SMOKE DET FAIL	The cargo smoke detection system has failed	TO/LAND
L (R) FIRE DET FAIL	The engine fire detection system has failed	TO/LAND
FIRE SYS FAULT	The fire detection and extinguishing system has detected a fault	TO/LAND
FIREX APU SQUIB FAIL	APU fire extinguisher squib on bottle No. 2 has failed (NO low pressure indication)	TO/LAND
GEAR BAY DET FAIL	The gear bay overheat detection has failed	TO/LAND



C. ADVISORY MESSAGES

ADVISORY MESSAGES

Crew awareness - no immediate action required

Message	Meaning	Inhibits
FIRE SYS FAULT	The FIREX control unit has detected a fault	TO/LAND
FIREX BTL 1 (2) FAULT	The respective bottle squib for the left or right engine has failed	TO/LAND
FIREX BTL 1 (2) LOW	The respective bottle pressure is low	TO/LAND

D. STATUS MESSAGES

STATUS MESSAGES

Information only - no crew action required

Message	Meaning
FIRE SYS IN TEST	The fire detect test system is conducting the manually activated system test
FIRE SYS TEST OK	The fire detected test system has passed the system test

NOTES

- All warning messages are accompanied by aural warnings as specified
- "APU Fire" voice warning for APU FIRE message
- "Left (Right) Engine Fire" voice warning for L (R) ENGINE FIRE message
- "TO/LAND" indicates the message is inhibited during takeoff and landing phases
- L (R) notation indicates the message can appear for either left or right engine

IX. LIMITATIONS

A. OPERATIONAL LIMITATIONS

System Availability:

- Continuous monitoring when electrical power available
- Ground mode automatic features require APU ECU power
- Test functions available when FIREX-CU is powered
- Preflight Fire System Test not required (fire system continually monitored)

Environmental Considerations:

- False alarm potential from radio transmissions
- Exhaust fume interference possible

B. DISPATCH LIMITATIONS

No-Go Items:

- **APU FIRE** indication
- **L (R) ENGINE FIRE** indication
- **CARGO SMOKE** indication
- **GEAR BAY OVHT** indication
- Simultaneous **L (R) FIRE DET FAIL** and **APU FIRE DET FAIL**

MEL Relief Available:

- Single detection loop failure (engine/APU)
- Cargo smoke detector (with door monitoring)
- MLG OVHT inop (MEL/DDG)
- Various system fault conditions

X. CIRCUIT BREAKERS

Fire Protection System Circuit Breakers

CB Name	Bus	Location
FIRE DET CH A	LEFT ESS	CB1-A11
FIRE DET CH B	RIGHT MAIN	CB2-A11
FIREX A	LEFT BATT	CB5-A3
FIREX B	RIGHT BATT	CB6-A4
LAV SMK DET	RIGHT MAIN	CB4-D4



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XI. FIRE PROTECTION QUIZ

1. How many fire detection loops are installed per engine?
 - A) One
 - B) Two
 - C) Three
 - D) Four
2. What type of extinguishing agent is used in the fire bottles?
 - A) CO₂
 - B) Halon 1211
 - C) Halon 1301
 - D) Foam
3. How many discharge heads (squibs) does bottle #1 have?
 - A) One
 - B) Two
 - C) Three
 - D) Four
4. After how many seconds does bottle #2 automatically discharge during ground mode APU fire?
 - A) 3 seconds
 - B) 5 seconds
 - C) 10 seconds
 - D) 15 seconds
5. What type of smoke detector is used in the Baggage/Cargo Compartment?
 - A) Ionization type
 - B) Light-scatter type
 - C) Photoelectric type
 - D) Thermal type
6. Where is the FIREX Control Unit located?
 - A) Cockpit overhead panel
 - B) Forward equipment bay
 - C) Aft equipment bay
 - D) Nose compartment
7. What happens when an engine FIRE switch is pushed?
 - A) Only arms the fire bottle
 - B) Shuts down engine and arms squib
 - C) Automatically discharges bottle
 - D) Only silences the alarm

8. How many detection loops are in each main landing gear bay?
- A) One
 - B) Two
 - C) Three
 - D) None
9. What is the ICAO Aerodrome Fire Category for the Challenger 350?
- A) 2
 - B) 3
 - C) 4
 - D) 5
10. Which bus powers the FIRE DET CH A circuit breaker?
- A) LEFT MAIN
 - B) LEFT ESS
 - C) LEFT BATT
 - D) RIGHT ESS
11. What aural warning is associated with APU FIRE?
- A) Triple chime only
 - B) "APU Fire" voice message
 - C) Continuous bell
 - D) Single chime
12. Where are the portable fire extinguishers located?
- A) Only in the cockpit
 - B) Behind copilot's seat and right aft enclosure in lav
 - C) Only in cargo bay
 - D) Under passenger seats
13. What must both engine fire loops sense to trigger a fire warning?
- A) Smoke presence
 - B) Pressure change
 - C) Resistance decrease within preset time
 - D) Voltage increase
14. Which bottle can be discharged into the APU compartment?
- A) Bottle #1 only
 - B) Bottle #2 only
 - C) Either bottle
 - D) Both bottles simultaneously
15. What CAS message appears during fire system test?
- A) **FIRE TEST ACTIVE**
 - B) **FIRE SYS IN TEST**
 - C) **TEST MODE ON**
 - D) **FIRE DET TEST**



16. How many squibs does bottle #2 have?
- A) One
 - B) Two
 - C) Three
 - D) Four
17. What happens to the master warning lights during FIRE DET test?
- A) Remain steady
 - B) Flash
 - C) Turn off
 - D) Alternate left/right
18. Which detection system uses single loops instead of dual?
- A) Engine fire
 - B) APU fire
 - C) Main landing gear overheat
 - D) Baggage Compartment smoke
19. What inhibit condition applies to FIREX BTL LOW messages?
- A) None
 - B) TO only
 - C) LAND only
 - D) TO/LAND
20. How long does the "LEFT ENGINE FIRE" aural test last?
- A) 5 seconds
 - B) 10 seconds
 - C) 15 seconds
 - D) 20 seconds

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