

WARNING AND TEST

MASTER WARNING AND MASTER CAUTION SYSTEMS

The Master Warning and Master Caution systems are discussed here in conjunction with the Warning and Test Systems, primarily to cover the procedures for testing these systems and to clarify their relationship with the engine indicating and crew alerting system (EICAS). The Master Warning and Caution systems operate in concert with the EICAS system, which is a function of avionics, and is covered in more detail in Section 3, Avionics. The EICAS system is designed to provide the pilots with an easily interpreted comprehensive digital display of selected airplane system conditions. The EICAS system introduces versatility, comprehensiveness and redundancy not previously available with electromechanical annunciators and separate audio visual indicators; it replaces, and its capabilities go far beyond, those of the traditional annunciator panel. The crew alerting system (CAS) portion of the EICAS system refers to that part of the EICAS system which presents textual messages in the lower left-center part of the center display unit. The MASTER CAUTION and MASTER WARNING annunciator lights, one of each in front of each pilot, work in conjunction with the red and amber digital indications of the CAS system to draw the pilots' attention to conditions requiring timely corrective action. The MASTER WARNING light works in conjunction with red CAS messages and the MASTER CAUTION works in conjunction with the amber CAS messages. The annunciator system is powered from the main direct current (DC) buses through the WARNING CONT 1 and 2 circuit breakers on the left circuit breaker panel in the cockpit. The MASTER WARNING lights (pilot and copilot) will flash when activated, until the event is acknowledged by pressing one of the respective lights. The MASTER CAUTION lights will illuminate steadily, until acknowledged by pressing one of the lights. The annunciator lights are dimmed during night operation. For MASTER WARNINGS an audio tone will be repeated a maximum of three times until the warning is acknowledged. The message will blink until acknowledged. It will also appear on the multifunction display (MFD) until acknowledged, at which time it will disappear from the MFD. For MASTER CAUTION lights the illumination of the light will be accompanied by an attention chime.

The MASTER WARNING and MASTER CAUTION lights can be tested by placing the rotary TEST selector on the center pedestal to the ANNU position. This will illuminate all the lights and cause the MASTER WARNING and the MASTER CAUTION lights to illuminate.

Red digital crew alerting system (CAS) messages will cause the MASTER WARNING to illuminate. Both MASTER WARNING lights will flash when the following annunciations occur: AUTO SLATS FAIL, TR AUTOSTOW L-R, BATT 1-2 O'TEMP, APU FIRE, BAGGAGE SMOKE, CABIN ALTITUDE, CHECK PFD, EMERGENCY DESCENT, ENG VIBRATION L-R, ENGINE FAILED L-R, ENGINE FIRE L-R, HYD O'TEMP A-B, HYD PUMP FAIL A-B, NO TAKEOFF, OIL PRESS LOW L-R, PYLON BLEED LEAK L-R, RUDDER LIMIT FAIL, STAB BLD LEAK L-R, and GEN OFF L-R. The GEN OFF L and R annunciations are amber, however, if a second generator should fail after one generator has already failed and been annunciated, the digital CAS message will turn red, annunciating both failures, and the MASTER WARNING will flash.

There are approximately 137 possible amber digital CAS messages, depending upon optional equipment installed. These messages are discussed in Section 3, Avionics, under Engine Indicating and Crew Alerting System (EICAS).

The MASTER WARNING or MASTER CAUTION lights can be reset by pressing either light. Resetting the warning or caution lights re-arms the system so that it will function with the presentation of another red or amber digital message on the CAS area of the EICAS display unit. The master warning lights will also flash during the test mode and the MASTER CAUTION will illuminate, but they are not resettable in this mode.

AFT POWER AND AC JUNCTION BOXES, AND LOGIC MODULES

The main left and right power junction boxes and the alternating current (AC) junction boxes are located in the aft baggage compartment. These junction boxes incorporate a number of major relays, logic modules, and circuit breakers that supply remote signals which provide warning and caution messages to the EICAS system. Some of the logic modules record circuit breaker trips and system malfunctions for facilitation of later ground maintenance. Other logic modules are located in the pilot's side console. Refer to the airplane Maintenance Manual and to the Wiring Diagram Manual for a listing of the circuit breakers by number and function for each of the junction boxes and logic modules.

ALTITUDE AND SPEED BRAKE MONITOR SYSTEM

The altitude and speed brake monitor system provides a warning through the appearance of an amber SPEED BRAKES CAS message if the airplane is airborne but at less than 500 feet in altitude and the speed brakes are not stowed. It is designed to warn that the speed brakes are in use below 500 feet altitude, which could result in an undesirable rate of descent near the ground. A ground signal is provided from the radio altimeter when the airplane is at less than 500 feet in altitude; a ground-in-air signal is then obtained from the left and right squat switches and the monitor circuit outputs a SPEED BRAKE signal to the CAS system.

The following configuration will give rise to an amber CAS message from the altitude and speed brake monitoring system:

- Speed brakes not in the STOWED position.
- Airplane is airborne at less than 500 feet in altitude.

An asymmetrical deployment of the speed brakes in which the asymmetry exceeds 5% will also result in an amber SPEED BRAKE CAS message, to warn of the abnormal condition.

Separate monitoring will provide a white CAS signal when the speed brakes are purposely deployed - simply as a reminder to the pilot that the speed brakes are in use. This circuit will be active any time the speed brakes are deployed in excess of 5%.

NO TAKEOFF WARNING SYSTEM

The no takeoff warning system is designed to prevent a takeoff when a hazardous condition exists which would render the takeoff unsafe due either to airplane configuration or to system malfunction(s). A cyan or red digital NO TAKEOFF annunciation advises of an unacceptable configuration or condition for takeoff. The cyan message will occur when either throttle lever angle (TLA) is less than 60 degrees and the weight-on-wheels (squat) switches show an on-ground condition. The digital NO TAKEOFF message will change to red when the TLA of either throttle is increased past 60 degrees. At this time the "NO TAKEOFF" aural warning will sound. The no takeoff annunciation can be cleared only when the situation causing it is corrected. Conditions which contribute to a NO TAKEOFF message are:

- Flaps above 5 degrees or down beyond 15 degrees
- Stabilizer trim set out of takeoff range
- Rudder or aileron trim out of takeoff range
- Speedbrakes extended
- Slats asymmetrical
- Left or right slat not deployed
- Yaw damper not centered
- Park brake on
- Either Start Valve Open
- Fuel level low
- Pitch/Roll disconnected
- Engines synchronizer on
- Left or right start valve open

The no takeoff warning system is deactivated by the landing gear squat switch when the airplane is in flight.

DOOR UNLOCKED WARNING SYSTEM

The cabin door is locked with an overcenter main bellcrank, which in turn drives ten pins out of the door into receiving holes in the door frame. Inspection windows near the door handle and each pin allow for visual inspection of the locking mechanism. A green flag indicates proper pin engagement and proper handle position. Monitoring switches on the two upper and two lower pins and on the overcenter bellcrank are connected to the engine indicating and crew alerting system (EICAS), so that an amber textual CABIN DOOR OPEN message will appear in the crew alerting system (CAS) part of the EICAS display if any door pin, or the handle, does not indicate a safe condition. The digital message will appear and the MASTER CAUTION will illuminate steadily if one switch indicates differently from the others. The lower aft locking pin, when in the door locked position, actuates a pneumatic valve which allows the primary door seal to pressurize. Loss of pressure to the seal is indicated by an amber CABIN DOOR SEAL CAS message, accompanied by illumination of the MASTER CAUTION light.

If the cabin vent door is unsafe, in that the cabin door vent proximity switch does not sense a closed condition, an amber CBN VENT DOOR message and MASTER CAUTION indication will appear.

The baggage compartment door has one pin, the lower forward, which depresses a door lock sensing switch; the same pin also opens the door seal pressurization valve which causes the baggage door seal to inflate. The door handle is also equipped with a proximity switch which signals the safety of the baggage door to the EICAS system. An amber digital BAGGAGE DOOR message will appear if the lower forward pin does not secure the door safety switch located at that pin position, and/or the baggage door handle is not secured.

Any time the cabin door is open with power on the airplane, the CABIN DOOR OPEN message will illuminate steadily; the MASTER CAUTION can be extinguished by acknowledging it. If the door is closed and one or more monitoring switches do not agree with the others, the CABIN DOOR OPEN will remain illuminated and the MASTER CAUTION will illuminate.

If the CABIN DOOR CAS message illuminates the flight crew should physically determine if the door is, in fact, secure. Once satisfied of this they can acknowledge the message. Acknowledgement of the message causes the logic to ignore the element that triggered the message. However, if the door is subsequently reopened and shut, the logic will be reset and will reactivate the CAS message. Upon acknowledgment the CAS message will go away only if one switch has been triggered. If two or more switches have been triggered, the message can be acknowledged (stop flashing) but it will remain on the EICAS display.

An amber digital NOSE DOOR OPEN L-R, TAILCONE DOOR, TOILET DOOR OPEN, NACELLE OPEN, BAGGAGE DOOR OPEN, or FUEL DOOR OPEN annunciation will appear if the respective nose avionics door, tailcone maintenance door, toilet service door, left or right nacelle, baggage door, or the single point refueling and/or gravity fuel doors are not properly closed. The MASTER CAUTION will also illuminate, as above, with the amber messages.

The emergency exit door on the right side of the airplane is monitored by a proximity switch on the upper door frame. If the locking pin in that position is unsafe the switch will send a signal to the CAS system which will illuminate an amber message ESCAPE HATCH OPEN. The MASTER CAUTION will also illuminate.

OVERSPEED WARNING SYSTEM

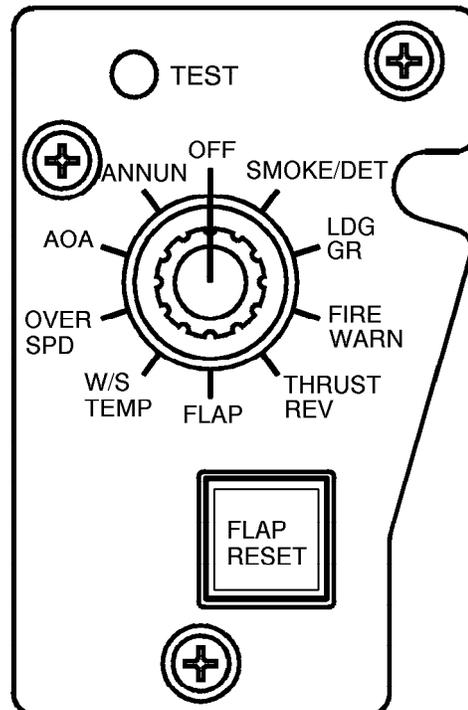
The on-side micro air data computer (MADC), backed up by the opposite MADC, feeds Mach and airspeed information to the aural warning system, which sounds a pulsing horn when speed exceeds V_{MO} or M_{MO} (maximum operating speed limit).

TEST SYSTEM

The rotary test selector switch is located in the right side of the center pedestal and offers a means of testing visual and aural warning systems. The system will function only when at least one battery switch is in BATT. A red light above the test selector switch illuminates whenever the test selector switch is in any position but OFF.

TEST SELECTOR SWITCH

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Figure 2-49

Test Selector Switch Positions

SWITCH POSITION	TEST FUNCTION	CAS MESSAGE	AURAL	LIGHTS	INHIBITS
SMOKE/DET	Performs a self-test of the smoke detector and checks the integrity of its aural/visual warning interface.	BAGGAGE SMOKE	CHIME ¹	Master Warning	—
LDG GR	Performs a self-test of the landing gear warning systems and a lamp test of landing gear indicator lights. ²	—	LANDING GEAR WARNING HORN (flaps must= \leq 24°)	Landing gear module lights	—
FIRE WARN	Performs self-test of the engine fire detection systems and checks the integrity of its aural/visual warning interface.	ENGINE FIRE L-R	—	Master warning, APU fire, Engine FW Lights	Aurals muted
THRUST REV	Performs a check of the thrust reverser indicator lights.	—	—	All TR lights and Master Warning	—
FLAP	Performs a self-test of the flap controller.	FLAPS FAIL ³	—	Master Caution and 2 flap annun. lights	—
W/S TEMP	Checks automatic control and operation of the electric windshield system. ⁴ Performs RAT test (CAS msg if test fail) ⁵ .	WSHLD HEAT INOP L WSHLD HEAT INOP R WSHLD O'TEMP L-R RAT HEAT FAIL	CHIME	Master Caution	—
OVERSPD	Tests overspeed warning horn	—	OVERSPEED HORN	—	—

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1. A double chime.
2. The gear warning horn is a dedicated horn for the landing gear only.
3. Message is displayed for the duration of the built-in test (approximately five seconds). Also flap pointer changes to amber.
4. The W/S ANTI-ICE switches must be in the ON position in order for the associated CAS messages to be displayed.
5. The PITOT-STATIC ANTI-ICE switches must be in the ON position in order for the associated CAS message to be displayed.

Test Selector Switch Positions (Continued)

SWITCH POSITION	TEST FUNCTION	CAS MESSAGE	AURAL	LIGHTS	INHIBITS
AOA	Self tests the AOA computers, checks the stick shakers and auto slats system ⁶ ; checks the optional LCD AOA display, and AOA indexer.	AOA PROBE FAIL L-R AUTO SLATS FAIL STALL WARN L-R	—	Optional Indexer —	Aurals muted
ANNUN	Performs lamp test of discrete annunciators.	OIL PRESS LOW L-R ⁷ FUEL PRESS LOW L-R HYD PUMP FAIL A-B	—	Optional annunciator lights, GPWS and wind shear annunciators.	Aurals muted
OFF	Disables all test functions. Red light will be off.	—	—	—	—

6. During the test, AOA computers receive a test signal to deploy slats. If there is sufficient hydraulic pressure the slats will deploy. AUTO SLATS FAIL message will appear whether or not the slats actually deploy.
7. The engine shutdown inhibits are removed. All annunciations associated with master warning will occur except aural signals, which are muted.