

STALL WARNING AND IDENTIFICATION SYSTEM - DESCRIPTION AND OPERATION

1. General (Figure 1)

The stall warning and identification system provides mechanical warning of approach to the stall and identification near the stall. Approach to the stall is indicated by stick-shake and identification near the stall by stick-push.

These warnings are initiated by two signal summing units (SSU) which receive inputs from airflow angle sensors, flap position microswitches and weight-on-wheel (squat) switches. The SSU's are disabled on the ground; the warning sub-system is enabled on aircraft lift-off and the identification sub-system about six seconds later.

A press-to-test facility, effective on the ground only, is also provided.

Each SSU determines wing incidence by combining the airflow angle sensor signals with signals derived from flap position microswitches.

As wing incidence increases, the first (stall) warning level is reached. This causes the stick shaker motors, affixed to the control columns, to be energized. Further increase in wing incidence results in the second (identification) warning level being attained; the actual angle at which warning occurs is reduced proportionally if the airflow angle sensor output increases at rates exceeding 1°/second. The identification warning initiates a nose-down pitching movement, through extension of a hydraulic jack associated with the elevator controls; this results in stick push. Extension is only possible with the two solenoid-operated hydraulic valves energized. Each valve is separately controlled; by a warning signal from one SSU together with an identification signal from the other.

A third channel provides back-up for the normal SSU control. The third channel is controlled by a stall detector which senses right-hand pitot head, forward static plates and wing vent pressures. The third channel links together the two hydraulic valve (stick-push) control circuits when wing incidence, as determined by the detector, is above the warning level but below the identification level.

The autopilot is disengaged at the first (stick-shake) warning level. Disengagement is effected by a stick-shake motor relay or (Pre-Mod.253146) by a second stall detector which triggers just below the warning level. The stick-shake motor relays also isolate the Ground Proximity Warning System (if fitted).

Identification channel faults result in the IDNT legend of the applicable annunciators coming on; pressing the annunciator inhibits the channel and lights the INHIB legend. The complete identification function is inhibited if both IDNT 1/INHIB and IDNT 2/INHIB annunciators are pressed simultaneously.

Magnetic indicators on a diagnostic panel are used to display SSU BITE faults.

NOTE: *If a fault condition develops which results in the resistance of the primary or secondary AOA sensor vane windings becoming excessive, the SSU test function will lock out, and no fault warning will be displayed. (Nominal resistance values for the primary and secondary windings are 34 ohms and 90 ohms respectively).*

Electrical heating elements are used to de-ice airflow angle sensors.

2. Stall warning *(Figure 2)*

Stall warning is provided by two mainly independent but similar sub-systems. They are linked together by stick-shaker motor control relays and other components forming part of the stall identification channels.

Each sub-system comprises of: an airflow angle sensor, SSU, warning relay and stick-shaker motor.

The airflow angle sensor transmits voltages, proportionate to its vane displacement, to the SSU which determines vane angle and rate of change of vane angle (used for stall identification). A flap position discriminant of either 0°, 15-25° or 45° is also input to the SSU.

On aircraft lift-off, each SSU is armed. When the wing incidence reaches the warning level, each SSU provides a ground for its associated warning relay coil. The relay energizes and, through its contacts, energizes a stick-shaker motor relay. The stick-shaker motor relays will:

- Disengage the autopilot
- Inhibit GPWS.
- Energize the stick-shaker motors.

3. Stall identification *(Figure 4)*

Stall identification is performed by three sub-systems, referenced Channel one, two and three. They are inter-linked to ensure stick-push, even if channel one or two are inhibited.

On aircraft lift-off, each SSU's warning sub-system is armed, followed after a delay of 6.5 ± 1.5 seconds., by arming of the identification sub-system. When the wing incidence reaches the stall warning angle, the SSU energizes its associated warning relay. If wing incidence is further increased, to just below the identification level, the third channel stall detector output will cause the warning level outputs of each SSU to be linked together via third channel relays. Thus a warning output from either SSU will energize both warning relays. The third channel relay contacts also:

- Link channels one and two
- Remove ground from:
 - Channel one if Warning two relay de-energized or Inhibit one relay set to INHIB position
 - Channel two if Warning one relay de-energized or Inhibit two relay set to INHIB position
- Initiate IDNT 3 annunciator and MWS STALL IDENT warnings if both Warning 1 and Warning 2 relays are de-energized.

When wing incidence reaches the stall identification angle, each SSU energizes its related identification relay which is then held on.

Provided inhibit relays are not in inhibit state, the solenoid-operated stick-push valve circuits are completed. The STALL VLV A and STALL VLV B annunciators come on, and the stick-push is effected.

When both valves are in the 'extend' position, pressurized hydraulic fluid is directed to a jack which extends. This extension rotates an idle lever which, through contact with the elevator cable control systems, causes the elevator to move down and the control columns to move forward.

De-energizing either or both solenoids results in the valve(s) returning to the 'retract' position. Springs, connected to the idle lever and loaded during jack extension, compress the jack and restore the idle lever to the 'no contact' position.