737 MAX SOFTWARE UPDATE

Overview

The Maneuvering Characteristics Augmentation System (MCAS) flight control law was designed and certified for the 737 MAX to enhance the pitch stability of the airplane – so that it feels and flies like other 737s.

MCAS is designed to activate in manual flight, with the airplane's flaps up, at an elevated Angle of Attack (AOA).

Boeing has developed an MCAS software update to provide additional layers of protection if the AOA sensors provide erroneous data. The software was put through hundreds of hours of analysis, laboratory testing, verification in a simulator and two test flights, including an in-flight certification test with Federal Aviation Administration (FAA) representatives on board as observers.

The additional layers of protection include:

- Flight control system will now compare inputs from both AOA sensors. **If the sensors disagree by 5.5 degrees or more with the flaps retracted**, MCAS will not activate. An indicator on the flight deck display will alert the pilots（下の写真参照）.
- If MCAS is activated in non-normal conditions, it will only provide one input for each elevated AOA event. There are no known or envisioned failure conditions where MCAS will provide multiple inputs.
- MCAS can never command more stabilizer input than can be counteracted by the flight crew pulling back on the column. **The pilots will continue to always have the ability to override MCAS and manually control the airplane**.

These updates reduce the crew's workload in non-normal flight situations and prevent erroneous data from causing MCAS activation.

We continue to work with the FAA and other regulatory agencies on the certification of the software update.

Training

To earn a Boeing 737 type rating, pilots must complete 21 or more days of instructor-led academics and simulator training. Differences training between the NG and MAX include computer-based training (CBT) and manual review.

Boeing has created updated CBT to accompany the software update. Once approved, it will be accessible to all 737 MAX pilots. This course is designed to provide 737 type-rated pilots with an enhanced understanding of the 737 MAX Speed Trim System, including the MCAS function, associated existing crew procedures and related software changes.

Pilots will also be required to review:

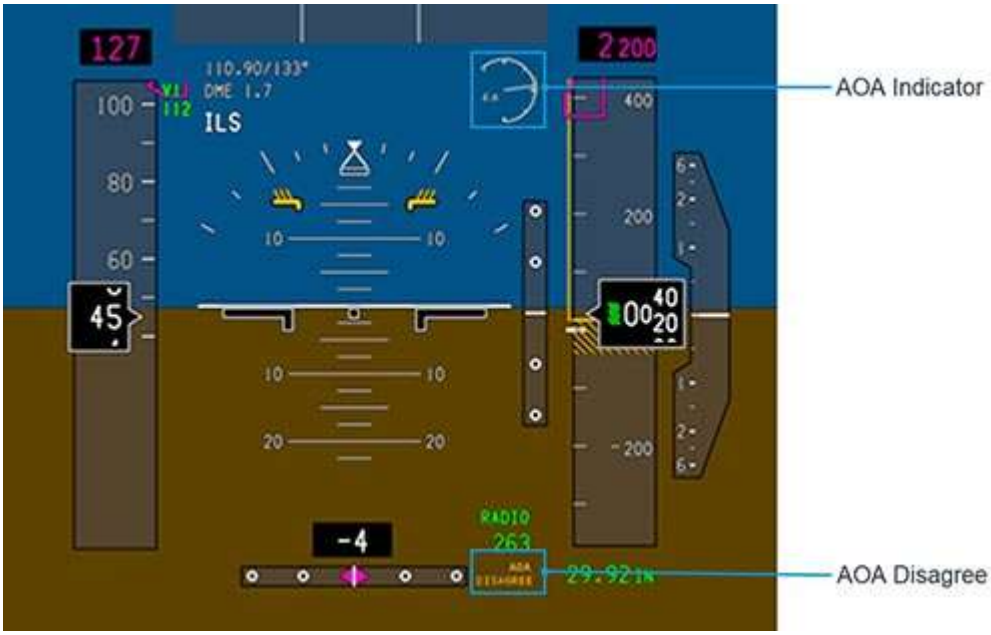
- Flight Crew Operations Manual Bulletin
- Updated Speed Trim Fail Non-Normal Checklist
- Revised Quick Reference Handbook

737 MAX Flight Deck Displays

All primary flight information required to safely and efficiently operate the 737 MAX is included on the baseline primary flight display. This is true of all our commercial products. Boeing doesn't put a price on required safety features. Crew procedures and training for safe and efficient operation of the airplane are focused around airplane roll and pitch attitude, altitude, heading and vertical speed, all of which are integrated on the primary flight display. All 737 MAX airplanes display this data in a way that is consistent with pilot training and the fundamental instrument scan pattern that pilots are trained to use.

The AOA (angle of attack) indicator provides supplementary information to the flight crew. The AOA disagree alert provides additional context for understanding the possible cause of air speed and altitude differences between the pilot's and first officer's displays. Information for these features is provided by the AOA sensors.

There are no pilot actions or procedures during flight which require knowledge of angle of attack.



Key Definitions

Maneuvering Characteristics Augmentation System (MCAS) – flight control law implemented on the 737 MAX to improve aircraft handling characteristics and decrease pitch-up tendency at elevated angles of attack.
Angle of Attack (AOA) – the difference between the pitch angle (nose direction) of the airplane and the angle of the oncoming wind.
Angle of Attack Sensor / Vane – hardware on the outside of the airline that measures and provides angle of attack information to onboard computers; also referred to as an AOA vane.
Angle of Attack Disagree – a software-based information feature that alerts flight crews when data from left and right angle of attack sensors disagree. This can provide pilots insight into air data disagreements and prompts a maintenance logbook entry.
Angle of Attack Indicator – a software-based information feature that provides angle of attack data to the flight crew through the primary flight displays. It is an option that can be selected by customers.
Control law – a set of software that performs flight control function or task
FCOM (Flight Crew Operations Manual Bulletin) – supplementary operations information
FOTB (Flight Operations Technical Bulletin) – supplementary technical information
Speed trim system – a system that uses multiple components to provide additional speed or pitch stability when needed