Stall

Review of the Fundamentals, the Procedure and the Training

Presented by
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Content

• Introduction

• Stall phenomenon
• Angle of Attack Control and Stall Recovery
• Stall v/s Approach to Stall
• New Procedures
• Airbus Training Proposal (Operator Training Telex)
INTRODUCTION

• Accidents following failure to recover from stall still occur

• It is also an issue for the transport aircraft environment

• Objective of this presentation:

  “Make the operational community aware of the review of the traditional methods of STALL and APPROACH TO STALL recovery techniques.”
INTRODUCTION

• Stalls are frequently performed in flight test by all aircraft manufacturers for development and certification

• Unique experience to be shared with operational community
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Lift = \( \frac{1}{2} \rho S V^2 C_l \)

- \( \rho \): air density
- \( S \): wing surface
- \( V \): CAS
- \( C_l \): lift coefficient
LIFT COEFFICIENT

• CI has a direct relationship to AoA

For a given configuration, a given speed and a given altitude,

Lift is only linked to Angle of Attack
STALL

- CL has a direct relationship to AoA
- At a given AoA, the air flow separates from the profile, the CL drops. The wing profile is stalled

For a given aircraft configuration and speed, An aircraft stalls for a given Angle of Attack
Key message:

Stall is an Angle of Attack (AoA) problem only
- it is NOT directly a speed issue
STALL DEMONSTRATION
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Pitch control is a **direct** AoA command

- The elevators control DIRECTLY the AoA.
- A nose down command has an IMMEDIATE effect: an AoA decrease
The pitch control is a direct AoA command

- The elevators control DIRECTLY the AoA.
- A nose down command has an IMMEDIATE effect: an AoA decrease.
AoA CONTROL - out of normal law

- Aircraft with engine below aircraft CG

⇒ Thrust has a significant pitch effect
AoA CONTROL - out of normal law

- Aircraft with engine below aircraft CG
  ⇒ Thrust has a significant pitch effect

Thrust increase ⇒ AoA increase
AoA CONTROL - out of normal law

- Aircraft with engine below aircraft CG
  ⇒ Thrust has a significant pitch effect
AoA CONTROL - out of normal law

- Aircraft with engine below aircraft CG
  ⇒ Thrust has a significant pitch effect

Thrust reduction ⇒ AoA decrease
STALL RECOVERY

When Aircraft is stalled

• FIRST: AoA MUST BE REDUCED
  • Release back pressure on stick or column
  • Nose down pitch input may be needed

  Note: Thrust has an adverse effect on AoA for Aircraft with engines below aircraft CG

• SECOND: When out of the stall, increase speed if needed
  • Smoothly increase thrust, with care due to thrust pitch effect

AoA comes first, speed second
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STALL v/s APPROACH TO STALL

• **Traditional** APPROACH TO STALL TRAINING is characterized by controlled deceleration to stall warning, followed by a power recovery with minimum altitude loss.

• Difference between an APPROACHING STALL and an actual STALL is not easy to determine, even for specialists!

• Numerous accidents where the APPROACH TO STALL procedure was applied whereas the aircraft was actually STALLED.
STALL v/s APPROACH TO STALL

• Traditional APPROACH TO STALL PROCEDURE focused on:
  • thrust application
  • minimum loss of altitude

• NOT appropriate for recovery from ACTUAL STALL condition:
  • Possible inability to reduce AoA with the high thrust application
  • Recovery may even require thrust reduction
  • Recovery from a stall may require altitude loss

A new SINGLE PROCEDURE had to be defined focusing on AoA reduction (covering Approach to Stall and Actual Stall)
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Rationale for the new procedure:

- One single procedure to cover
  - Approach to Stall and
  - Actual Stall

- Focus on AoA reduction

- Remove TOGA as first action
The new procedure

**STALL RECOVERY**

As soon as any stall indication (could be aural warning, buffet...) is recognized, apply the immediate actions:

- NOSE DOWN PITCH CONTROL .................................. APPLY
  This will reduce angle of attack

  **NOTE**: In case of lack of pitch down authority, reducing thrust may be necessary

- BANK ................................................................. WINGS LEVEL

- **When out of stall (no longer stall indications)**:

  - THRUST .................. INCREASE SMOOTHLY AS NEEDED

    **NOTE**: In case of one engine inoperative, progressively compensate the thrust asymmetry with rudder

  - SPEEDBRAKES ...................... CHECK RETRACTED
  - FLIGHT PATH ...................... RECOVER SMOOTHLY

- **If in clean configuration and below 20 000 feet**:

  - FLAP 1 ...........................(without master)

  **NOTE**: If a risk of ground contact exists, once clearly out of stall (no longer stall indications), establish smoothly a positive climb gradient.
Spurious Stall Warning at Lift Off

STALL WARNING AT LIFT-OFF

Spurious stall warning may sound in NORMAL law, if an angle of attack probe is damaged. In this case, apply immediately the following actions:

- THRUST .................................................. TOGA

At the same time:

- PITCH ATTITUDE ........................................ 15°
- BANK .................................................. WINGS LEVEL

NOTE: When a safe flight path and speed are achieved and maintained, if stall warning continues, consider it as spurious.
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Proposed Training

• Thorough briefing before the session, reviewing the stall fundamentals, the QRH procedures e.g.
  • FCOM emergency procedures / stall recovery
  • QRH stall recovery
  • FCTM abnormal operations / operating techniques / stall recovery
  • Power point presentation on Airbus World portal
  • Safety First magazine, issue 11, edition January 2011

• Stall recovery exercises during a visual circuit as described in the following slides (may be integrated in the Recurrent Training as convenient)

Remark: MFF pilots need to make the training on one type only
Proposed Scenario for Training:

- Select a weight equivalent to the maximum landing weight
- Select CAVOK conditions
- Perform a standard visual pattern

Caution!
Training shall be conducted only after receiving full information by Airbus - Operator Training Telex, Training Recommendation - Recovery from Stall.
Scenario for Training:

- Configure the aircraft according SOP

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Scenario for Training:

- Turning on base leg, ask the trainee to reduce thrust to idle and to maintain the present altitude
- Introduce Alternate Law

Caution!
Training shall be conducted only after receiving full information by Airbus - Operator Training Telex, Training Recommendation - Recovery from Stall.
Scenario for Training:

- When the trainee observes a stall warning or any other stall indication/clues (aural warning, buffet...):

- the actions according FCOM and QRH must be applied immediately.

- After the stall recovery, stop the exercise

- Reposition on downwind, repeat the exercise until trainee feels confident and is proficient.

- Training time required about 15 minutes/trainee

Caution!
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Operations Training Telex

• This new training proposal will be published soon via OTT (Operations Training Telex) containing more details on the conduct of the exercise.

• OTT is a new tool by Airbus to communicate with you regarding significant training issues.

• OTT-Stall Training will be published within the next few weeks.

• Your feedback is highly welcome!
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