Factual Report – Attachment 27

Atlas Air Stall Recovery Guidance

OPERATIONAL FACTORS

DCA19MA086

General

This section covers both recovery from an approach to stall, which is a training maneuver, as well as recovery from a fully developed stall. An approach to a stall is a controlled flight maneuver; a fully developed stall is an out-of-control, but recoverable, condition.

Initial Indications of a Stall

A stall warning is considered to be any warning readily identifiable to the pilot (e.g., stick shaker, initial buffet). Any of the following indications should be considered to be such a warning:

- Stick shaker
- Stall warning
- Initial buffet
- Rapid decrease of airspeed below V2 during takeoff or VREF during landing/go-around

Pitch Moment

A characteristic unique to airplanes with under-wing-mounted engines is a nose-up or nose-down pitch tendency when thrust is increased or reduced. Adding excessive amounts of thrust may cause a pitch-up moment that may be difficult for the elevator to counteract at lower speeds.

The approach to stall or stall recovery maneuver calls for the crew to advance the thrust levers as needed. Under certain conditions, where high thrust settings are already applied such as during takeoff or go-around, it may be necessary to reduce thrust in order to prevent the angle of attack from continuing to increase.

Flaps Up

With FLAPS UP, stall warning is first apparent as a very light buffet. This buffet occurs well above the required stall warning. Controls remain fully effective and performance is not significantly degraded. However, if a continued reduction in airspeed is tolerated, buffet intensity will increase and stick shaker will occur, followed by flight characteristics associated with the classic stall.

Flaps Extended

With flaps extended, stall warning is indicated by stick shaker and initial buffet. Under most circumstances stick shaker precedes buffet onset, but either should be considered indication of approaching stall regardless of which one occurs first.

Approach to Stall

Approaches to stalls are training maneuvers conducted in a full-flight simulator. The objective of the maneuvers is to familiarize the pilot with the stall warning and correct recovery techniques. Approach to stall maneuvers are trained in different phases of flight (approach, takeoff, and clean configuration).

Use of Automation

Approach to stall recovery maneuvers are performed with the autopilot engaged and the autothrottle disengaged.

Entry

The instructor will direct the initial conditions and set thrust to allow the airplane to decelerate. The trainee will effect the recovery at the first indication of the stall and apply the recovery actions. As the airplane decelerates the autopilot will continue to maintain in-trim until disengaged.

Use and Effect of Controls During Approach to Stall

Ailerons and Rudder

Lateral control is maintained using ailerons. Ailerons/spoilers should provide adequate rolling moment. Rudder input is never the preferred initial response for events such as an upset or unusual attitude recovery, wake vortex encounter, windshear, or to reduce bank angle preceding an imminent stall recovery.

Flaps

Do not retract flaps during the recovery. Retracting the flaps from the landing position, especially near the ground, causes an altitude loss during the recovery.

Speedbrakes

For any airspeed, the angle of attack is greater with speedbrakes extended, which increases initial buffet speed and stick shaker speed but has a lesser effect on actual stall speed. The aircraft exhibits no unusual flight characteristics during stall warning or recovery. Response to control inputs is immediate and positive.

Landing Gear

If the entry is made with the landing gear extended, do not retract it until after the recovery is complete.

Approach to Stall Recovery

Initiate stall recovery at the first indication of a stall. Recover from an approach to stall using one of the following techniques.

Low Altitude

- Simultaneously disengage the autopilot, push either autothrottle disengage switch, and advance the thrust levers as needed to accelerate.
- Adjust pitch, roll in the shortest direction to wings level, if needed, and retract the speedbrakes.
- A pitch attitude which results in intermittent stick shaker or initial aerodynamic buffet is the upper pitch attitude limit. Avoid abrupt control inputs as they may induce a secondary stall. Adjust pitch as necessary to stay out of stick shaker.
- If stick shaker is encountered, adjust the pitch attitude downward in small increments until the stall warning stops. Do not fly in stick shaker as a rapid loss of lift occurs as stall speed is approached.
- Abnormal control forces may be experienced. Nose down stabilizer trim may be needed.
- The pitch limit indicator indicates the attitude at which stick shaker activates, and may be used as a maximum pitch reference during the maneuver. It should not be used as a pitch command.
- The PM should monitor and call out the vertical flight path indications (vertical speed, altimeter, radio altimeter) to assist the PF in returning the aircraft to a positive rate of climb
- Maintain flap and landing gear position until out of the stall
- When terrain/obstacle clearance is assured, adjust thrust and resume normal speed and configuration.

High Altitude

- Simultaneously disengage the autopilot, push either autothrottle disengage switch, and advance the thrust levers as needed to accelerate.
- Smoothly apply nose down elevator to reduce the angle of attack until buffet or stick shaker stops. Nose down stabilizer trim may be needed.
- As the aircraft accelerates, continue to adjust pitch attitude as required to return to the appropriate speed

Note: At higher altitudes, normally above 20,000 feet, the airplane becomes increasingly thrust limited. If an approach to stall indication is experienced, nose down elevator and stabilizer trim is required to initiate a descent. This is because when the airplane is thrust limited, altitude needs to be traded for airspeed. Therefore a recovery at high altitude results in a greater altitude loss than a recovery at low altitudes.

CAUTION: Do not extend flaps during a high altitude stall recovery. Aircraft speed may be above the mach limit and the incremental drag may be greater than available thrust.

Fully Developed Stall Recovery

An aircraft may be stalled in any attitude (e.g., nose high, nose low, high angle of bank) or any airspeed (accelerated stall). It is not always intuitively obvious that the aircraft is stalled. An aircraft stall is characterized by any one or a combination of the following conditions:

- Buffeting, which could be intense
- Lack of pitch authority
- Lack of roll control
- Inability to arrest descent rate

These conditions are usually accompanied by a continuous stall warning. A fully developed stall must not be confused with the stall warning that warns of an approaching stall. Recovery from an approach to a stall is different than recovery from a fully developed stall.

In a fully developed stall, the autopilot should be disengaged and the autothrottle disengaged. To recover from a fully developed stall, angle of attack must be reduced below the stalling angle by applying nose-down pitch control and maintaining it until the wings are no longer stalled.

Application of as much as full forward control column and use of some nose-down stabilizer trim should provide sufficient elevator control to produce a nose-down pitch rate. It may be difficult to determine the amount of stabilizer trim to use; care must be taken to avoid excessive trim inputs. Do not use stabilizer trim to fly the aircraft and stop trimming nose down when G forces or required elevator forces lessen.

Under certain conditions it may be necessary to reduce thrust in order to prevent increasing angle of attack. Once stall recovery is complete, upset recovery actions may be initiated and thrust reapplied as needed. If normal pitch inputs do not stop an increasing pitch rate in a nose-high situation, rolling the aircraft to a bank angle that starts the nose down may be effective. Approximately 45° of bank, up to a maximum of 60°, may be needed.

Normal roll controls (up to full aileron and spoiler) may be used. Unloading the wing by maintaining continuous nose-down elevator pressure keeps the angle of attack as low as possible, making the normal roll controls as effective as possible. Finally, if normal pitch control then roll control is ineffective, careful rudder input in the direction of the desired roll may be required to initiate a rolling recovery.

WARNING: Excessive pitch trim or rudder inputs or rudder inputs applied too quickly or held too long may aggravate the upset or result in loss of control or structural damage.

Approach to Stall or Stall Recovery

All recoveries from approach to stall should be done as if an actual stall has occurred. Immediately do the following at the first indication of stall (buffet or stick shaker).

Note: Do not use flight director commands during the recovery.

PF	PM
Initiate the recovery: • Hold the control column firmly. • Disengage autopilot and autothrottle. • Smoothly apply nose down elevator to reduce the angle of attack until buffet or stick shaker stops. Nose down stabilizer trim may be needed.*	• Monitor altitude and airspeed. • Verify all required actions have been done and call out any omissions. • Call out any trend toward terrain contact.
Continue the recovery: • Roll in the shortest direction to wings level if needed.** • Advance thrust levers as needed. • Retract the speedbrakes. • Do not change gear or flap configuration, except during liftoff if flaps are up, call for flaps 1.	• Monitor altitude and airspeed. • Verify all required actions have been done and call out any omissions. • Call out any trend toward terrain contact. • Set the FLAP lever as directed.
Complete the recovery: • Check airspeed and adjust thrust as needed. • Establish pitch attitude. • Return to the desired flight path. • Re-engage the autopilot and autothrottle if desired.	• Monitor altitude and airspeed. • Verify all required actions have been done and call out any omissions. • Call out any trend toward terrain contact.

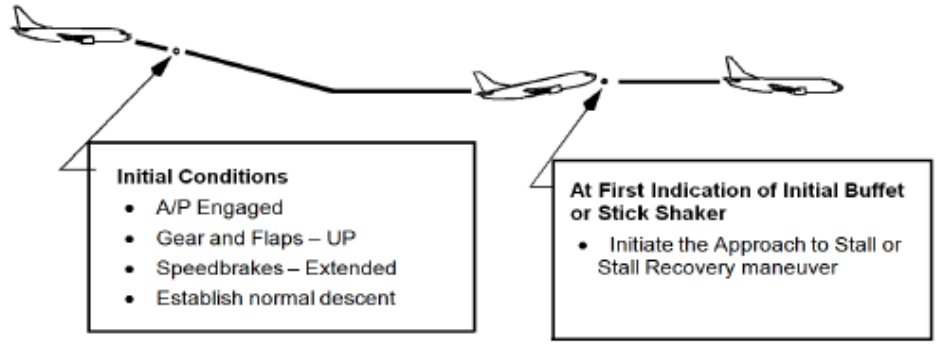
WARNING: *If the control column does not provide the needed response, stabilizer trim may be necessary. Excessive use of pitch trim may aggravate the condition, or may result in loss of control or in high structural loads.

WARNING: **Excessive use of pitch trim or rudder may aggravate the condition, or may result in loss of control or in high structural loads.

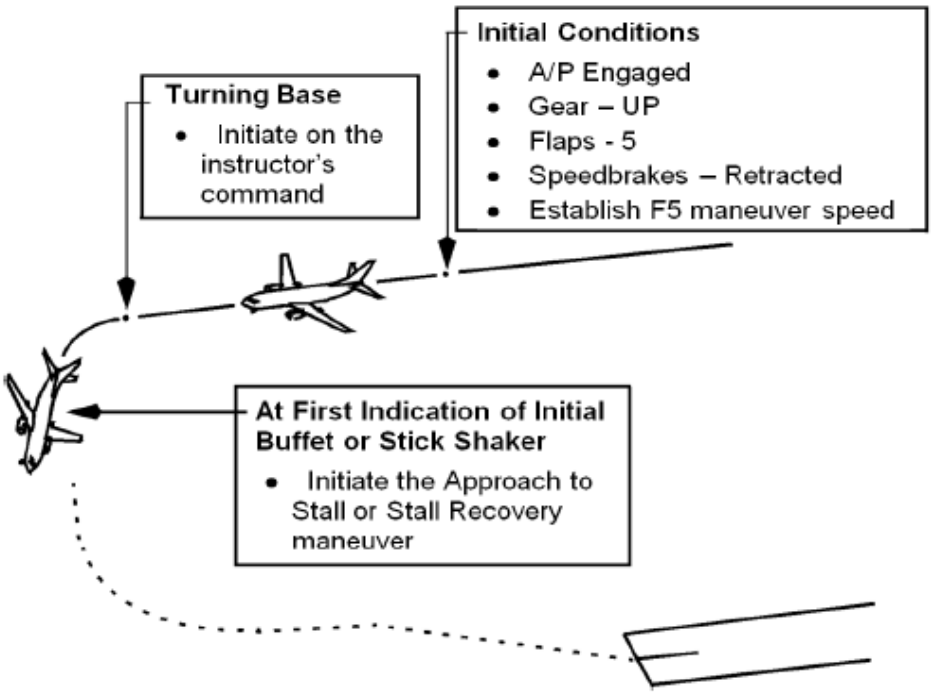
Approach to Stall Recovery Exercises

The following exercises are intended for simulator training only.

Level Off

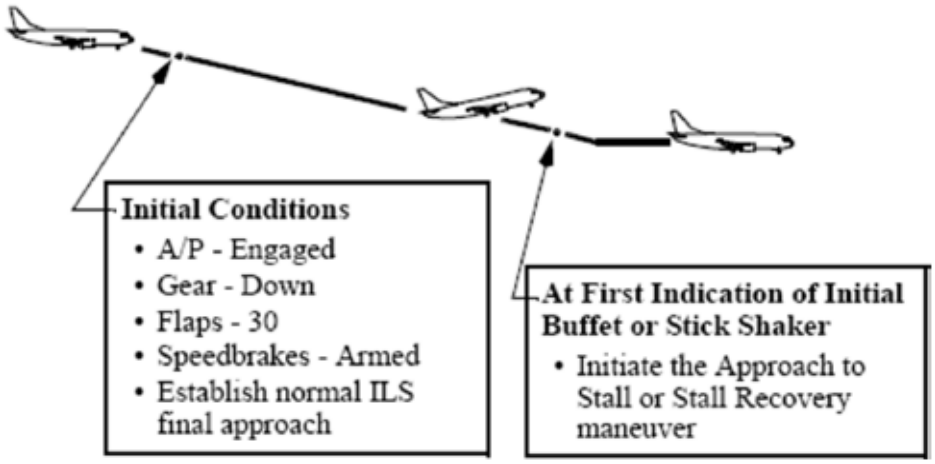


Turning Base



Note: The instructor commands initiation of the turn to base when the airspeed is at minimum maneuvering speed (top of the amber band), or at flap 5 maneuver speed for airplanes without an amber band display. This ensures the initial buffet or stick shaker during the turn.

ILS Final Approach



Note: If during the ILS final approach exercises the decision is made to go-around, the Approach to Stall or Stall Recovery maneuver must be completed before the go-around is initiated.

Completion of the Recovery

Upon completion of the maneuver, recover to the command speed, adjust thrust as needed, and follow previous instructions (e.g. heading, altitude). Re-engage the autopilot and autothrottle in accordance with normal procedures.