



NTSB National Transportation Safety Board

The anatomy of an accident: Colgan Air flight 3407

Robert L. Sumwalt
February 12, 2010

Background

- February 12, 2009
- 10:17 pm Eastern Standard Time
- Colgan Air, Inc.
 - Operated as Continental Connection
- Bombardier DHC-8-400
- On approach to Buffalo, New York
- 50 fatalities
 - 2 pilots
 - 2 flight attendants
 - 45 passengers
 - 1 resident killed

History of flight

- Crew engaged in almost continuous conversation throughout flight
 - Conversation mostly extraneous to flight operations
- Conversation preempted timely performance of flight-related duties
 - Approach briefing, descent checklist, approach checklist



History of flight

- Approximately 3 miles from outer marker:
 - power was reduced to slow for approach
 - gear extended
 - props to max RPM
- Airspeed decreased 50 kts in 21 seconds

Stall, Upset, Loss of Control

- Stick shaker (stall warning) activated at 131 knots
- Autopilot disconnected
- Captain reacted with “startle and confusion”
- Captain pulled nose to 19 degrees nose up pitch
- Stall, extreme roll
- Stick pusher activated 3 times
 - countered by captain’s actions of pulling
- Loss of control



NTSB



Local Time (hh:mm:ss)	FDR SRN (seconds)	Source	Event
22:14:39.8	95434.9	CAM	[sound similar to engine power increase]
22:15:06.3	95461.4	HOT-1	flaps five.
22:15:08.1	95463.2	HOT-2	what?
22:15:08.8	95463.9	HOT-1	flaps five please.
22:15:11.2	95466.3	CAM	[sound similar to flap handle movement]
22:15:13.5	95468.6	APP	Colgan thirty four zero seven three miles from KLUMP turn left heading two six zero maintain two thousand three hundred until established localizer. cleared ILS approach runway two three.
22:15:22.2	95477.3	RDO-2	left two sixty two thousand three hundred 'til established and cleared ILS two three approach Colgan thirty four zero seven.
22:15:31.7	95486.8	HOT-1	alright approach is armed.
22:15:32.8	95487.9	HOT-2	roger.
22:15:59.5	95514.6	CAM	[sound similar to decrease in engine power]
22:16:04.1	95519.2	HOT-1	gear down...loc's alive.
22:16:06.2	95521.3	CAM	[sound similar to landing gear handle movement]
22:16:06.4	95521.5	APP	Colgan thirty four zero seven contact tower one two zero point five. have a good night.
22:16:07.4	95522.5	CAM	[sound similar to landing gear deployment]
22:16:11.5	95526.6	RDO-2	over to tower you do the same thirty four zero seven.
22:16:21.2	95536.3	HOT-2	gear's down.
22:16:23.5	95538.6	HOT-1	flaps fifteen before landing checklist.
22:16:26.0	95541.1	CAM	[sound similar to flap handle movement]
22:16:26.6	95541.7	HOT-2	uhhh.
22:16:27.4	95542.5	CAM	[sound similar to stick shaker continues for 6 7

22:16:26.0	95541.1	CAM	[sound similar to flap handle movement]
22:16:26.6	95541.7	HOT-2	uhhh.
22:16:27.4	95542.5	CAM	[sound similar to stick shaker continues for 6.7 seconds]
22:16:27.7	95542.8	HOT	[sound similar to autopilot disconnect horn repeats until end of recording]
22:16:31.1	95546.2	CAM	[sound similar to increase in engine power]
22:16:35.4	95550.5	CAM	[sound similar to stick shaker continues until end of recording]
22:16:37.1	95552.2	HOT-2	I put the flaps up.
22:16:42.2	95557.3	HOT-1	[sound of grunt]
22:16:45.8	95560.9	HOT-2	should the gear up?
22:16:46.8	95561.9	HOT-1	gear up.
22:16:50.1	95565.2	CAM	[increase in ambient noise]
22:16:51.9	95567.0	CAM	[sound of thump]
22:16:53.9	95569.0		End of Transcript; End of Recording

HOT-2: gear's down.

HOT-1: flaps fifteen before landing checklist.

HOT-2: uhhh.



National Transportation Safety Board Board Meeting

22:16:27

130

knots

2280

feet

Shaker ON

Pusher OFF

Power

Condition

Flap



Heading

247°

Pedal



Auto Pilot

OFF

Gear DOWN

Rating



Max



0

5

10

15

Flight

Idle

Min

Max

0

5

10

15



NTSB

National Transportation Safety Board

Office of Research and Engineering

Flightpath

Loss of Control on Approach
Colgan Air, Inc., Operating as
Continental Connection Flight 3407
Bombardier DHC-8-400, N200WQ

Clarence Center, New York

February 12, 2009

DCA09MA027

Board Meeting





NTSB Findings

- Flight crew and airplane properly certificated
- No evidence of any preimpact structural, engine, or systems failures
- Aircraft had minimal aircraft performance degradation from ice accumulation
 - this did not affect the flight crew's ability to fly and control the airplane.

Major Areas of Focus



Airspeed
Selection

Cockpit
Discipline

Crew Reaction
to Stall Warning
and Stall



NTSB



Primary Flight Display



Ice Protection Panel

Mismatch of Landing Ref Speeds

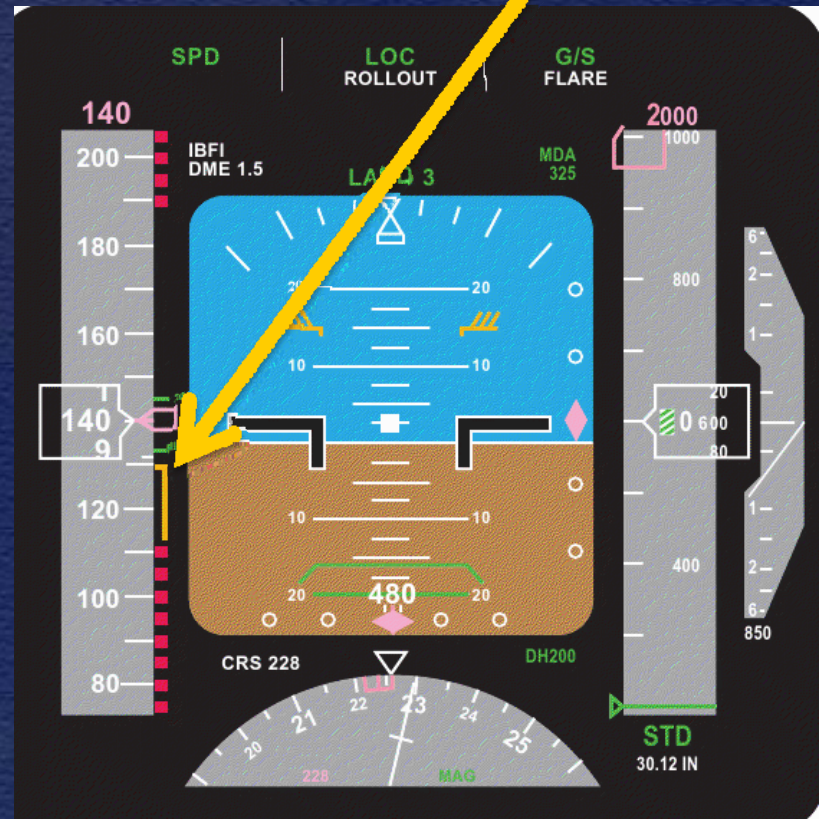
- Flight operated in light-to-moderate icing en route and on approach
- Captain set reference speeds switch to increase (icing conditions)
- First officer obtained landing speeds for non-icing conditions
 - Mismatch with position of ref speeds switch resulted in landing speed that was 13 knots lower than stick shaker activation speed
 - 118 vs. 131 knots

No Cautionary Range



Q400

Cautionary Range



Exemplar Display

NTSB Findings

- The Q400 airspeed indicator lacked low-speed awareness features, such as an amber band above the low-speed cue ...that would have facilitated the flight crew's detection of the developing low-speed situation.
- An aural warning in advance of the stick shaker would have provided a redundant cue of the visual indication of the rising low-speed cue and might have elicited a timely response from the pilots before the onset of the stick shaker.

Major Areas of Focus



Airspeed
Selection

Cockpit
Discipline

Crew Reaction
to Stall Warning
and Stall



NTSB



Crew Activities

- Captain should have seen rising low-speed cue during instrument scan, as well as high pitch attitude
 - No evidence explained why these were missed
- First officer should have detected captain's error
 - Duties directed her attention away from primary flight display
- Missed cues reflects breakdown in monitoring and workload management

Leadership Training

- Captain did not establish appropriate tone or show strong command authority
 - Operators not required to provide upgrading captains with leadership training
- Recommendation issued in this area

NTSB Finding

- The captain's failure to effectively manage the flight
 - enabled conversation that delayed checklist completion and conflicted with sterile cockpit procedures, and
 - created an environment that impeded timely error detection.

NTSB Report

“Because of their conversation, the flight crewmembers squandered time and their attention, which were limited resources that should have been used for attending to operational tasks, monitoring, maintaining situational awareness, managing possible threats, and preventing potential errors.”

Major Areas of Focus



Airspeed
Selection

Cockpit
Discipline

Crew Reaction
to Stall Warning
and Stall



Response to Stick Shaker

- Captain's actions inconsistent with trained recovery procedures
- Captain's aft control column inputs led to stall
- Power advanced but not to rating detent
- Neither pilot made callouts or commands associated with stall recovery

Crew's Reaction

- Stick pusher activated three times
- After each activation, captain continued to pull back on control column
 - Exacerbated airplane's stalled condition
 - Prevented potential recovery

Actions During Stall Event

- Captain's actions did not indicate well-learned habit pattern
- Improper inputs consistent with startle and confusion
- History of training failures may have played role

Actions During Stall Event

- First officer's uncommanded raising of flaps and suggestion to raise gear not consistent with recovery procedures
- Reasons for first officer's actions could not be determined

Airline “approach to stall” training

- Air carrier pilots trained on “approach to stall,” requiring recovery with minimal altitude loss
- Altitude loss standards not appropriate for fully developed stall
 - Positive nose-down control force necessary once actual wing aerodynamic stall occurs

Stall Training

- Conformed to industry standard practices
- Not conducted with element of surprise
- Did not involve autopilot disconnect
- Did not address actions needed to recover from fully developed stalls

NTSB Findings

- The current air carrier approach-to-stall training did not fully prepare the flight crew for an unexpected stall and did not address the actions that are needed to recover from a fully developed stall.
- Realistic, fully developed stall models should be incorporated into flight simulators.
- Pilots should have stick pusher demonstrated to them during training.

Other Issues Examined



- Role of Fatigue
- Tailplane Icing/Stall
- Pilot Selection

Role of Fatigue

- Captain
 - Reduced sleep opportunities
 - Stayed overnight in crew room
 - Accessed company computer at 0310
 - Accident occurred at normal bedtime
- First officer
 - Overnight transcontinental commute
 - Slept on airplanes and in crew room

NTSB Finding

- The pilots' performance was likely impaired because of fatigue, but the extent of their impairment and the degree to which it contributed to the performance deficiencies that occurred during the flight cannot be conclusively determined.

Tailplane Icing

- NASA In-Flight Icing video explains that tailplane stall recovery is to:
 - Pull back on control wheel
 - Retract flaps to previous setting
 - Decrease power (aircraft dependent)
- Even though there is no evidence the Q400 was susceptible to tailplane stall, Colgan showed this video in ground school.

Tailplane Icing

- NASA video also stated that pilots need to properly diagnose icing problems because the difference between a wing and a tailplane stall were subtle but the recovery techniques were different.
- Captain reacted within approximately one second
- NTSB Finding: It is unlikely that the captain was deliberately attempting to perform a tailplane stall recovery.

Pilot Selection



Captain's record of failed FAA checkrides

Date of Checkride	Certificate Attempted
October 1991	Instrument Rating
May 2002	Commercial SEL
March 2004	Commercial MEL
October 2007	ATP and Saab 340 type rating

Additional training difficulties

Date	Difficulty Encountered	Checking Event
October 2005	graded “train to proficiency”	initial Saab 340 flight check
October 2006	unsatisfactory	recurrent Saab 340 flight check
October 2007	unsatisfactory	Saab 340 upgrade proficiency check

- Captain had not established good foundation of attitude instrument flying skills early in career
- Weaknesses in basic aircraft control and instrument flying continued
- Colgan did not proactively address these issues

- Successful transition to Q400 in Dec. 2008
 - Flying Q400 for 2 months at time of accident
- Simulator instructor: captain was rough on flight controls and over-controlled roll axis
 - Consistent with previous aircraft control problems

Pilot Records Improvement Act

- PRIA requires airlines to check for verification of:
 - current airman certification and medical certification
 - any FAA certificate actions and violations
 - drug and alcohol test results
 - records pertaining to the individual's performance, including discipline, as a pilot
 - check of National Driver Registry (DUI convictions, suspensions, or revocations)
- Does not require records of FAA notice of disapprovals (checkride busts), or records from non-air carrier employers



NTSB



Probable Cause

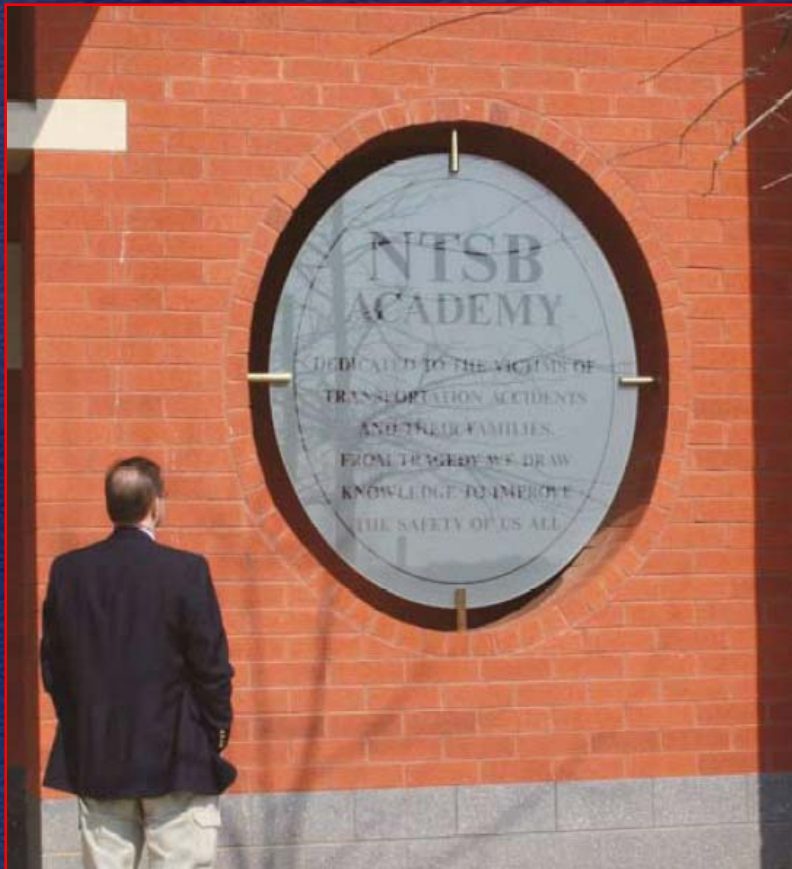
- The captain's inappropriate response to the activation of the stick shaker, which led to an aerodynamic stall from which the airplane did not recover.

Contributing to the accident:

- 1) the flight crew's failure to monitor airspeed in relation to the rising position of the low-speed cue
- 2) the flight crew's failure to adhere to sterile cockpit procedures
- 3) the captain's failure to effectively manage the flight
- 4) Colgan Air's inadequate procedures for airspeed selection and management during approaches in icing conditions.

25 recommendations to FAA

- Strategies to prevent flight crew monitoring failures
- Pilot professionalism
- Fatigue
- Remedial training
- Pilot records
- Stall training
- Airspeed selection procedures
- FAA oversight



“From tragedy we draw knowledge to improve the safety of us all.”

NTSB

