Docket No. SA-531

Exhibit No. 2-A

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C.

Operations Group Chairman
Factual Report

(42 Pages)

NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

April 22, 2009

GROUP CHAIRMAN'S FACTUAL REPORT

OPERATIONS GROUP

DCA09MA027

A. ACCIDENT

Operator:	Colgan Air operating as Continental Connection flight 3407
Location:	Clarence Center, New York
Date:	February 12, 2009
Time:	2217 Eastern Standard Time[1] (EST)
Aircraft:	Bombardier DHC8-400, N200WQ

B. OPERATIONS/HUMAN PERFORMANCE GROUP

Roger Cox
Senior Aviation Safety Investigator
National Transportation Safety Board
Washington, D.C.

Evan Byrne
Human Performance Investigator
National Transportation Safety Board
Washington, D.C.

Eugene Conway
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Harlan Simpkins
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Ken Webster
Regional Senior Investigator
Transportation Safety Board Canada
Toronto, Canada

Tim Dittmar
Captain and APD, Q400
Colgan Air, Inc.
Manassas, Virginia

Mike Wickboldt
Captain, Q400
Colgan Air, Inc.
Air Line Pilots Association
Herndon, VA

[1] All times are Eastern Standard Time based on a 24-hour clock, unless otherwise noted. Actual time of accident is approximate.

C. SUMMARY

On February 12, 2009, about 2217 eastern standard time (EST), a Colgan Air Inc., Bombardier Dash 8-Q400, N200WQ, d.b.a. Continental Express flight 3407, crashed during an instrument approach to Runway 23, at the Buffalo-Niagara International Airport (BUF), Buffalo, New York. The crash site was approximately 5 nautical miles northeast of the airport in Clarence Center, New York, and confined to one residential house. The four flight crew and 45 passengers were fatally injured and the aircraft was destroyed by impact forces and post crash fire. There was one ground fatality. Night visual meteorological conditions prevailed at the time of the accident. The flight was a Code of Federal Regulations (CFR) Part 121 scheduled passenger flight from Liberty International Airport (EWR), Newark, New Jersey to BUF.

D. DETAILS OF THE INVESTIGATION

The Operations/Human Performance Group was formed February 13, 2009, in Buffalo New York. Group Chairman for Operations was Roger Cox, NTSB, and for Human Performance, Evan Byrne, NTSB. Other group members were Eugene Conway, Federal Aviation Administration (FAA), Harlan Simpkins, Bombardier Aerospace, Ken Webster, Transportation Safety Board Canada, Tim Dittmar, Colgan Air, and Mike Wickboldt, Air Line Pilots Association

From February 14 to February 19, 2009, the group gathered flight documents, sorted and reviewed operational items recovered from the aircraft, and conducted interviews with Colgan pilots who had had contact with the accident crew.

The group reconvened at the offices of NTSB in Washington, D.C. on March 9, 2009. From March 9 until March 12, the group interviewed flight instructors and check airmen who had trained or checked the accident crew, as well as Colgan Air operations managers. During this time, the group also interviewed a Colgan flight crew which had had a recent stall warning incident.

The group reconvened March 16 and conducted further interviews on March 16, March 17, and March 19. The group continued to interview instructors and Colgan managers, and also interviewed the FAA Principal Operations inspector (POI) and Aircrew Program Manager (APM) for Colgan Air, as well as the former APM for that company.

1.0 History of Flight

According to Colgan Air records, the flight crew was scheduled to report for duty at the company's base at EWR at 1330 EST. The first two flights of the day, planned as a round trip returning to EWR, were cancelled. High winds were reported at EWR that day. According to the Colgan Air Regional Chief Pilot, Continental Airlines EWR Operations called him and cancelled multiple Continental Connection Colgan Air flights that day. He said that Captain Renslow came in sometime between 1200 and 1400 EST, and asked to

perform office duties during the afternoon since his first flight was cancelled. He said such work is paid voluntary work. Renslow's duties that afternoon were to insert revisions into the Airplane Operating Manuals (AOM) on board company aircraft, and he completed the work for six or eight books. The Regional Chief Pilot did not observe First Officer Shaw.

The Sabre CrewTrac Pairing Print Report for the crew on the day of the accident showed a planned departure time for flight 3407 of 1945 EST and a planned arrival time of 2221 EST. The company dispatch release for flight 3407, which was issued at 1800 EST, showed an estimated time of departure (ETD) of 1910 EST and an estimated time enroute (ETE) of 53 minutes. An Arinc OpCenter report of ACARS transmissions from N200WQ, the accident aircraft, showed that the aircraft arrived at the gate in EWR following its last flight prior to the accident flight at 1854 EST. That same report showed an Initialization Data Request at 1923 EST for flight 3407, followed by a Departure Clearance Request at 1930 EST and an OUT (pushback from the gate) report at 1945 EST. According to FAA records, EWR Ground Control gave the flight taxi instructions at 2030 EST, and EWR Tower cleared the flight for takeoff at 2118. The ACARS[2] report showed the flight OFF (airborne) at 2119 EST.

According to the flight's dispatch release, the intended route of flight was from EWR to COATE intersection, then via airway V-126 to Lake Henry VOR (LHY), Elmira VOR (ULW) and BENEE intersection, and airway V-164 to Buffalo. The intended cruise altitude was 16,000' MSL. According to FAA records[3], the flight was cleared by New York Center to maintain 16,000' MSL at 2131 EST.

The last reported weather at the Buffalo-Niagara International Airport prior to the accident was the Automatic Terminal Information Service (ATIS) broadcast at 2154 EST. It was wind 250 degrees at 15 gusting to 22 knots, visibility 3 miles in light snow and mist, with few clouds at 1,100', ceiling 2,100' broken clouds, 2,700 overcast, temperature 1, dew point -1, altimeter 29.79. According to the Flight Data Recorder (FDR) the propeller deice, the pitot deice, and the airframe deice equipment were selected on. The approach in use was the ILS 23. The Decision Altitude (DA) for the approach was 928' MSL (200' height above touchdown) and the minimum required visibility ½ statute mile.

According to FAA Air Traffic Control records, at 2157 EST Cleveland Center cleared the flight to cross BENEE intersection at 11,000' MSL. At 2203 Cleveland Center instructed the flight to change to Buffalo Approach Control. Buffalo Approach Control cleared the flight direct to TRAVA intersection and gave it a series of intermediate descent clearances, the last of which, at 2212 EST, was to 2,300' MSL. According to ATC radar records, the flight crew intercepted the final approach course from the left. According to Flight Data Recorder (FDR) data[4], at 2215:12 EST, the crew extended the flaps from 0° to 5°. At the time, the indicated airspeed was 172 kts, the autopilot was engaged and pitch trim was 3° nose up.

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[2] Aircraft Communications Addressing and Reporting System
[3] See ATC Group chairman's Report
[4] See FDR Group Chairman's Report

At 2215:14 EST, Buffalo Approach Control transmitted, “Colgan thirty four zero seven three miles from klump turn left heading two six zero maintain two thousand three hundred til established localizer clear i l s approach runway two three.” The flight acknowledged that clearance.

At 2216:02 EST, FDR data showed the engine power levers were reduced to flight idle and both engines torque values declined to minimum thrust. At 2216:07, Buffalo transmitted, “Colgan thirty four zero seven contact tower one two zero point five have a good night.” At 2216:09 EST the crew extended the landing gear and the auto flight system captured the ILS 23 localizer. Three seconds after that the crew moved the engine conditions levers forward to the maximum RPM position, and at the same time, 2216:12 EST, the flight replied, “over to tower you do the same thirty four zero seven.”

According to FDR indications, at 2216:28 the crew moved the flaps to 10°, and two seconds later the stall warning stick shaker activated. The autopilot disconnected at about the same time that the stick shaker activated. The crew added power to approximately 75% torque. The airplane began a sharp pitch up motion, accompanied by a left roll, followed by a right roll, during which the stick pusher activated. During this time, the indicated airspeed continued to decrease to less than 100 kts. Eight seconds after the flaps had been selected to 10°, and at an airspeed of less than 110 kts, the flaps began to retract. Sixteen seconds later the flaps were fully retracted.

Following further pitch and roll excursions the airplane pitched down and entered a steep descent from which it did not recover. The airplane impacted a residential house and was destroyed. All 49 occupants and one person on the ground suffered fatal injuries.

2.0 Personnel Information: Flight Crew

2.1 The Pilot in Command, Marvin Dean Renslow

Year of birth: 1961
Date of Hire with Colgan Air, Inc.: 9/19/2005

Pilot Certificates and Ratings:
- Airline Transport Pilot
  - Airplane Multiengine Land
  - Type Ratings: SF-340, DHC-8
  - Commercial Privileges
  - Airplane Single Engine Land

Airman Certificate Date of Original Issue:

AIRMAN CERTIFICATE	ORIGINAL ISSUE DATE
Private Pilot – Airplane Single Engine Land	6/21/1990
Private Pilot – Instrument Airplane	10/25/1991

Commercial Pilot – Instrument	6/25/2002
Commercial Pilot – Airplane Single Engine Land	6/25/2002
Commercial Pilot – Airplane Multiengine Land	4/29/2004
Airline Transport Pilot – Airplane Multiengine Land	10/18/2007
SF-340 Type Rating	10/18/2007
DHC-8 Type Rating	11/18/2008

Record of FAA Certificate Disapprovals:

Private Pilot – Instrument Airplane	10/01/1991
Commercial Pilot – Single Engine Land	5/14/2002
Commercial Pilot – Multiengine Land	4/09/2004
Airline Transport Pilot – SF-340 Type	10/15/2007

On 10/01/1991, Captain Renslow was disapproved for his initial instrument airplane flight rating. The aircraft was a PA-28-181 and the tasks disapproved were Pilot Operation 3 Task A and B; Pilot Operation 2, Task C; Partial panel VOR Approach, NDB approach and holding. He completed the rating on 10/25/1991.

On 5/14/2002, Captain Renslow was disapproved for his initial commercial single engine land airplane flight certificate. The aircraft was a C-177-RG and the tasks disapproved were takeoffs, landings, go-arounds, and performance maneuvers. He completed the flight check for the certificate on 6/25/2002.

On 4/09/2004, Captain Renslow was disapproved for his initial commercial multiengine land airplane flight certificate. The aircraft was a PA-44-180. He was notified that the entire flight portion of the practical exam would need to be re-accomplished. He completed the flight check for the certificate on 4/29/2004.

On 10/28/2005, Captain Renslow was graded as TP (train to proficiency) on his initial proficiency check in the SF-340 as First Officer. The task area identified was normal/abnormal procedures. The grade identifies one or more items on a check ride that needed to be repeated, but that the overall performance was satisfactory.

On 10/17/2006, Captain Renslow received an unsatisfactory grade on his Recurrent Proficiency Training event at Colgan Air in the SF-340. At the time he was a First Officer. The unsatisfactory tasks were rejected takeoffs, general judgment, landings from a circling approach, oral exam, and non-precision approach. According to company records he attended recurrent training and then completed requalification proficiency training on 11/01/2006.

According to FAA records, on 10/15/2007, Captain Renslow was disapproved for his initial airline transport pilot certificate. The aircraft was a Saab SF-340 and the task disapproved was approach and landing with powerplant failure – multiengine airplane. FAA

records show that Captain Renslow completed his upgrade proficiency check and airline transport pilot certificate on 10/18/2007. However, Colgan Air's records show that the unsatisfactory check ride took place 10/03/2007. Colgan Air records also show upgrade LOFT[5] and simulator training took place on 10/14/2007, additional simulator training took place on 10/15/2007 and that the satisfactory upgrade proficiency check took place on 10/15/2007.

Flight Time based on Colgan Air, Inc. records:

FLIGHT TIME	**HOURS**
Total	3379
Total PIC (Pilot in Command)	1030
Total Turbine	3051
Total time in type (DHC-8)	110.7
Last 24 Hours (not including accident flight)	0
Last 7 days	16:09
Last 30 days	56:11
Last 90 days	116:02

Most Recent Training and Check Completion Dates:

PART 121 TRAINING/CHECKS	**DATE**
Consolidation of Knowledge and Skills	2/10/2009
Transition Line Check (Q400)	12/03/2008
Transition Operating Experience (Q400)	12/03/2008
Transition LOFT	11/19/2008
Transition Proficiency Check	11/18/2008
Transition Ground School	10/31/2008

A check of FAA records showed that no enforcement actions had been taken against Captain Renslow.

2.2 The Second in Command, Rebecca Lynne Shaw

Year of birth: 1984
Date of hire with Colgan Air: 1/16/2008

Pilot Certificates and Ratings:
- Commercial Pilot
  - Airplane Multiengine Land; DHC-8
  - Airplane Single and Multiengine Land
  - Instrument
  - DHC-8 SIC privileges only

[5] Line oriented flight training

Flight Instructor
Airplane Single Engine
Instrument Airplane
Limitation: valid only when accompanied by pilot certificate
Expired 31 Dec 2008.

A review of FAA records indicated that a Notice of Disapproval was issued on May 7, 2006 for an initial Flight Instructor Certificate. She subsequently passed the test and was issued a Temporary Airman Certificate on May 12, 2006.

Airman Certificate Original Date of Issuance:

AIRMAN CERTIFICATE	ORIGINAL ISSUE DATE
Private Pilot – Airplane Single Engine Land	December 3, 2003
Private Pilot – Instrument	September 30, 2004
Commercial Pilot – Airplane Single Engine Land	September 22, 2005
Flight Instructor – Airplane Single Engine Land	May 12, 2006
Commercial Pilot – Airplane Multiengine Land	September 16, 2006
DHC-8 SIC type rating	March 16, 2008

Flight experience according to Colgan Air, Inc. records:

Flight Time	Hours
Total	2244
Pilot In Command	0[6]
Turbine Time	774
Time in Type	774
Last 24 hours (not including accident flight)	0
Last 7 days	15:49
Last 30 days	57:20
Last 90 days	163:21

Most Recent Training and Checks:

PART 121 TRAINING/CHECKS	DATE
Recurrent Ground School	January 15, 2009
Consolidation of Knowledge and Skills	April 29, 2008
Initial Operating Experience	March 22, 2008
Initial Proficiency Check	March 16, 2008

A check of FAA records showed that no enforcement actions had been taken against First Officer Shaw.

[6] See Human Performance Factual Report for PIC time prior to Colgan

3.0 Airplane Information

3.1 Weight and Balance Information:

The following information was obtained from the flight release, the Colgan air load report/worksheet, and Aerodata[7] information for the flight. Passenger weight used by Colgan and Aerodata was 189 lbs, which was not in accordance with the Flight Operations Policies and Procedure Manual (FOPPM) figure of 195 lbs. (winter weights). Baggage weights used by Colgan were in accordance with standard weights of 30 lbs each for both checked and carry-on, as shown in the FOPPM on page C-1-19. However, the total number of bags shown on the air load report/worksheet was 76[8], while the number entered into ACARS[9] by the crew was 65. The reason for these discrepancies could not be determined.

Operations Specification A099, issued to Colgan by FAA, and dated 05/27/2005, is entitled "Large Cabin Aircraft Passenger and Baggage Weight Program." It pertains to aircraft certified for 71 passengers or more. The Dash 8 Q400 is certified to seat 74 passengers. It shows winter passenger weights should be 195 lbs., checked bags should be 30 lbs. and carry-on items should be 16 lbs. It also states that carry-on items are to be included in the average passenger weight.

As computed by Colgan and used by the flight crew:

	Weight
Basic Operating Weight	39,824 lbs.
Passenger Weight (45 x 189 lbs.)	8505 lbs.
Baggage (65 x 30 lbs.)	1,950 lbs.
Freight	73 lbs.
Zero Fuel Weight	50,352 lbs.
Maximum Zero Fuel Weight*	58,000 lbs.
Fuel	8,000 lbs.
Ramp Weight	58,352 lbs.
Taxi Fuel Burn[10]	1,410 lbs.
Takeoff Weight	56,942 lbs.
Maximum Allowable Takeoff Weight*	65,200 lbs.
Maximum Takeoff Weight (Flt Release)	64,576 lbs.
Fuel Burn	2,576 lbs.
Estimated Landing Weight [11]	54,366 lbs
Maximum Allowable Landing Weight*	62,000 lbs.

***** Airplane Flight Manual Limitations

[7] See section 3.2.1 regarding Aerodata
[8] See attachment 4, Colgan Air Load Worksheet. Total checked bags were 54, and carry-on bags were 22.
[9] Aircraft Communications Addressing and Reporting System
[10] The standard taxi fuel burn of 300 lbs. was shown on the release. Actual burn was based on 1hour 34 minutes taxi time, 150 lbs for start and first 10 minutes, and 84 minutes at 15 lbs. per minute. (AOM figures)
[11] Landing weight entered into ACARS by the crew was 54,700 lbs.

Computed in accordance with Ops Spec A099:

	Weight
Basic Operating Weight	39,824 lbs.
Passenger Weight (45 x 195 lbs.)	8,775 lbs.
Baggage (checked) (54 x 30 lbs.)	1,620 lbs.
Freight	73 lbs.
Zero Fuel Weight	50,292 lbs.
Maximum Zero Fuel Weight*	58,000 lbs.
Fuel	8,000 lbs.
Ramp Weight	58,292 lbs.
Taxi Fuel Burn[12]	1,410 lbs.
Takeoff Weight	56,882 lbs.
Maximum Allowable Takeoff Weight*	65,200 lbs.
Maximum Takeoff Weight (Flt Release)	64,576 lbs.
Fuel Burn	2,576 lbs.
Estimated Landing Weight [13]	54,306 lbs
Maximum Allowable Landing Weight*	62,000 lbs.

The takeoff performance report from Aerodata for the flight indicated a takeoff Center of Gravity of 27.8 % MAC[14] and a gross takeoff weight of 58,052 lbs. According to the AOM[15] Volume 1 Limitations Section, the allowable CG range for that weight is 17.7 to 36.0.

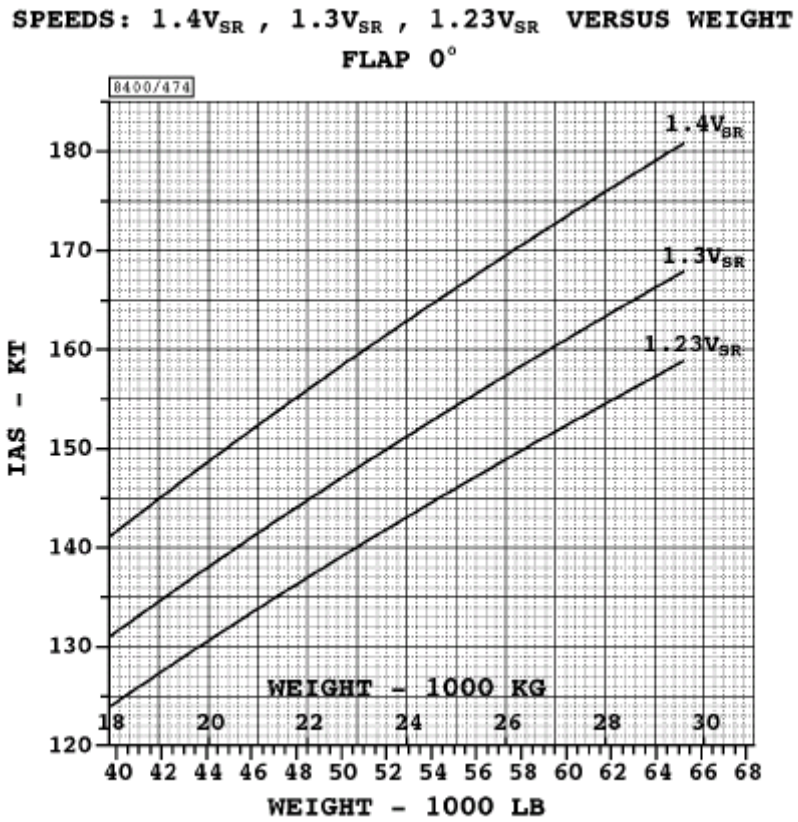
3.2 Approach Speed

Section 5 of the Bombardier Dash 8 Q400 AFM[16] provides approach and reference speeds for various configurations. The following charts provide normal speeds for flaps 0, 5, 10 and 15. Minimum speeds for flight in icing conditions[17] are derived by adding the speed increments shown in Figure 2.

Bombardier information presented below in Figures 1 though 5 are for reference only.

[12] The standard taxi fuel burn of 300 lbs. was shown on the release. Actual burn was based on 1hour 34 minutes taxi time, 150 lbs for start and first 10 minutes, and 84 minutes at 15 lbs. per minute. (AOM figures)
[13] Landing weight entered into ACARS by the crew was 54,700 lbs.
[14] Percent of mean aerodynamic chord
[15] Airplane Operating Manual
[16] Airplane Flight Manual
[17] See section 3.3.1.2 for definition of icing conditions

Figure 1
Flaps 0 – 1.23Vsr
From Figure 5 – 1 – 2 Q400 AFM

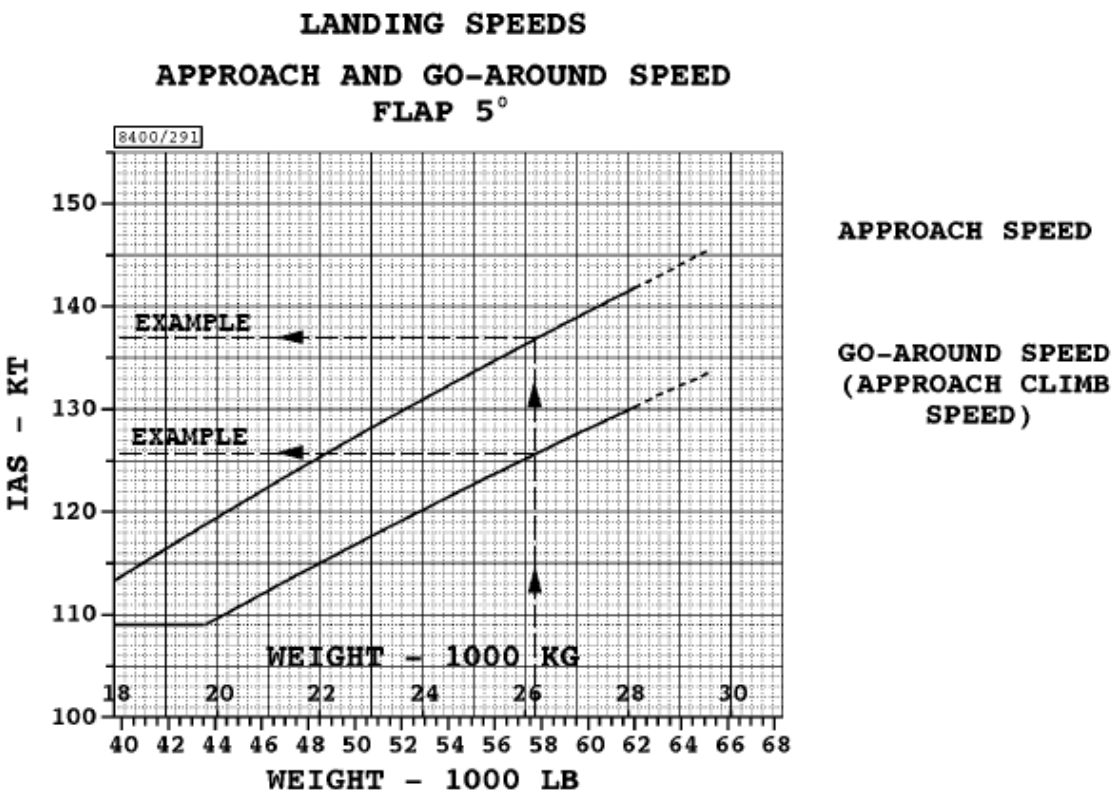


At 54,366 lbs and zero flaps, the 1.23Vsr would be 145 kts. The minimum speed in icing conditions would be 170 kts.

Figure 2
Minimum Airspeeds in Icing Conditions
From Section 4.7.2.4 Q400 AFM

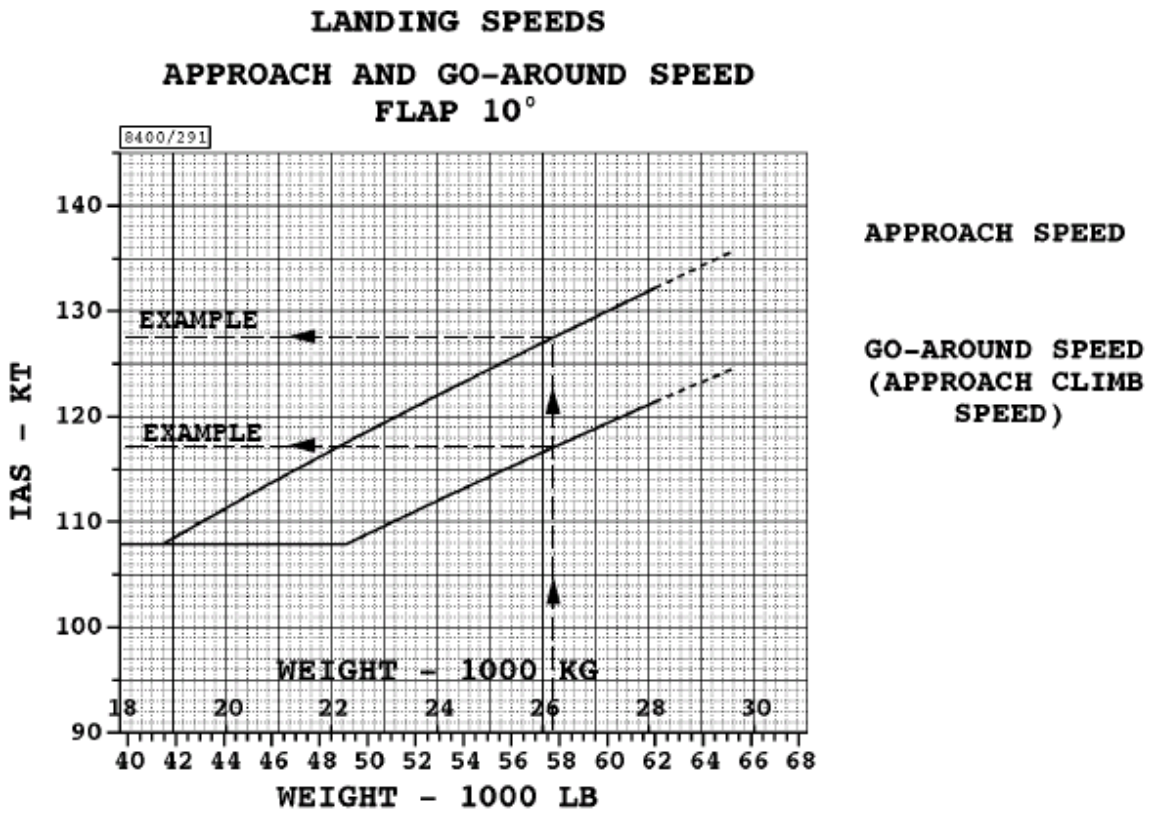
– Minimum holding, 190 kt.
– Approach Speed 1.23 V_{SR} (Figure 5–1–2) flap 0° + 25 kt.
– Approach Speed (Figure 5–8–1) flap 5° + 20 kt.
– Go-around Speed (Figure 5–8–1) flap 5° + 20 kt.
– Approach Speed (Figure 5–8–2) flap 10° + 20 kt.
– Go-around Speed (Figure 5–8–2) flap 10° + 20 kt.
– Approach Speed (Figure 5–8–3) flap 15° + 20 kt.
– Go-around Speed (Figure 5–8–3) flap 15° + 20 kt.
– Landing V_{REF} (Figure 5–8–1) flap 10° + 20 kt.
– Landing V_{REF} (Figure 5–8–2) flap 15° + 20 kt.
– Landing V_{REF} (Figure 5–8–3) flap 35° + 15 kt.

Figure 3
Flaps 5 Approach Speeds
From Figure 5 – 8 – 1 Q400 AFM



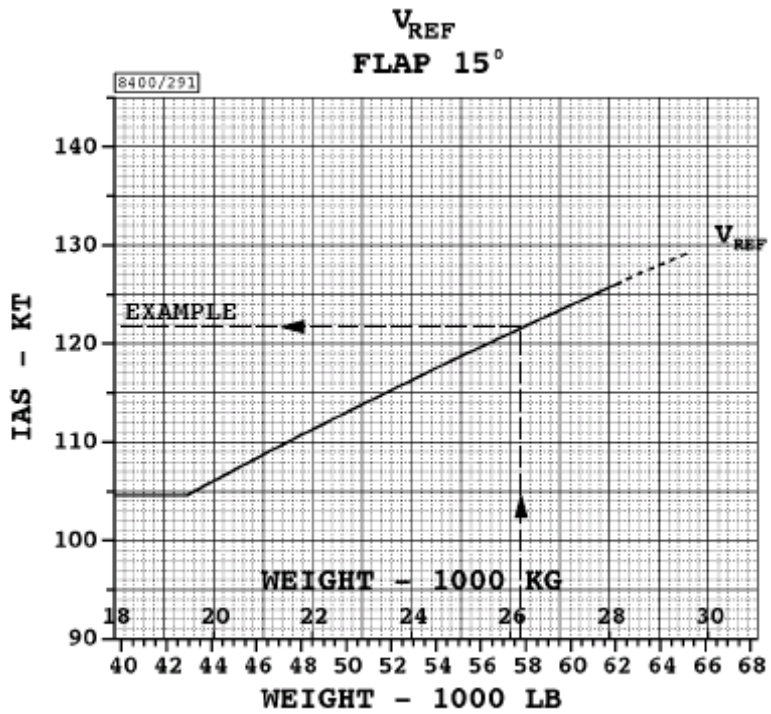
Based on an estimated landing weight of 54,366 lbs, the Flaps 5 approach speed would have been 133 kts, and the minimum speed in icing would have been 153 kts.

Figure 4
Approach Speeds for Flaps 10
From Figure 5 – 8 -2 Q400 AFM



Based on an estimated landing weight of 54,366 lbs, the flaps 10 approach speed would have been 124 kts, and the minimum speed for flaps 10 in icing conditions would have been 144 kts.

Figure 5
Charted Vref for Flaps 15
From Figure 5 – 8 - 2 Q400 AFM



Based on the airplane's estimated landing weight of 54,366 lbs, the Vref for the planned flaps 15 landing would have been 118 kts. This is consistent with the 118 kt Vref provided to the crew during the flight from Aerodata. As long as icing conditions prevailed, the 20 kt additive would have resulted in a target speed of 138 kts.

3.2.1 Use of ACARS and Aerodata for performance data

The Colgan Air Q400 operation does not use traditional paper charts for the calculation of takeoff and landing performance data or for weight and balance.

The Colgan Air FOPPM states on page C-1-64:

"Colgan Air has contracted with AeroData to provide a weight and balance system, including weight and balance engineering for the Q400. The source documents which encompass and substantiate AeroData are:

- *AeroData letter dated 12/26/07*
- *Aerospace Performance Inc. letter dated 12/26/07*
- *Colgan Air Bombardier Dash-8 Series 400 Weight and Balance Engineering Report AP-COL1207.*

Through Aerodata, Colgan Air will have Compute Server System Access and ACARS Performance and Weight and Balance system, including weight and balance engineering services applicable for the DHC-8-402 PW150A fleet.

Aerodata will provide Colgan Air access to the AeroData Compute Server System for all calculations the AFM allows. Calculations include, but are not limited to, reduced torque calculations, optimized flaps, inoperative components, weight and balance, and continuous airport database access. For SOC[18], this recognizes the benefits of real-time takeoff, enroute, and landing performance data which is contained within the Takeoff and Landing Report (TLR). The TLR generated by SOC will be attached to associated flight release. For the flight crew, real time calculations for takeoff, landing and weight and balance performance is requested by ACARS."

The Colgan Air CFM describes how crews will use the ACARS system to transmit and receive performance information. Takeoff and landing data requests are made by the crew using the Universal Unilink PERF/W&B page. After the crew enters required items, such as temperature, altimeter setting, runway, and airplane gross weight, the Compute Server System (CSS) returns required performance data within 10 to 30 seconds. According to the CFM, the information that must be entered by the crew for a Landing Data Request is airport, runway, and actual gross weight. Optional entries include a second runway, flap setting and wind. The system will provide an optimal flap setting if not specified, and winds are assumed calm unless an entry is made. Optional keywords which may be entered include "icing" and "eice." The system then returns a message which displays Vref, Vga, Vfri, and Vcl,[19] as well as maximum allowable landing weight and landing distance.

A Colgan check airman said in an interview that use of "icing" would cause the Vref speed provided by the system to increase by 20 knots for a flaps 15 landing and by 15 knots for a flaps 35 landing. He said "eice" introduced a 90 lb weight penalty.

3.3 Equipment and Systems

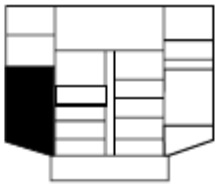
The following systems information is taken from the Bombardier Q400 AOM.

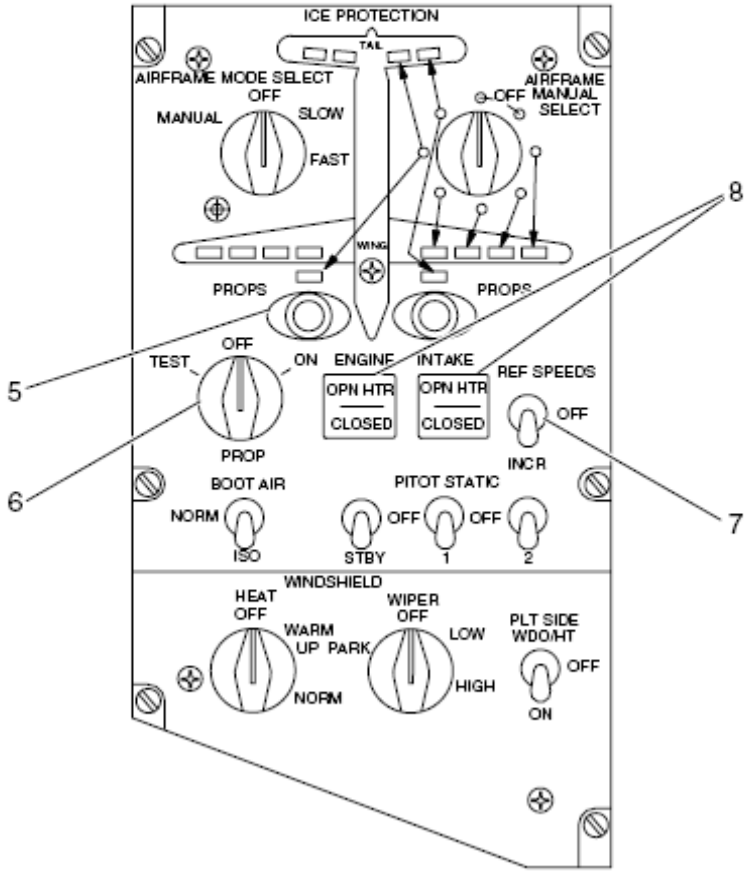
3.3.1 Ice Protection Panel

The ice protection panel is located on the overhead panel on the captain's side of the cockpit. The following figure is taken from the Bombardier Q400 AOM, page 12-11-8. The "REF SPEEDS" switch is listed as item 7. The AOM states that placing the switch to INCR causes the Stall Protection System (SPS) to adjust stall margin for icing conditions.

[18] System Operations Control
[19] Landing reference speed, go-around speed, flap retract speed, and climb speed.

Figure 6
Ice Protection Panel





3.3.1.1 Procedures for Use of Ice Protection Panel

The Bombardier Q400 AFM provided procedures for the use of the Ice Protection Panel in Section 4, “Normal and Abnormal Procedures,” paragraph 4.7, “Operation in Icing Conditions.”

For takeoff into icing conditions (paragraph 4.7.2.1), the procedure is to turn on the engine intake door de-ice, the windshield heat, and the prop de-ice before takeoff, and after takeoff to place the REF Speeds switch to INCR at 400’ AGL. There is a bold print

"Caution" which states, "If airspeed is not increased before REF SPEEDS switch is selected to INCR, stall warning may occur." When airframe ice is detected, de-ice boots are to be operated in "fast."

For flight before encountering icing conditions or when ice is first detected or when flashing "Ice Detected" advisory appear on the Engine Display (paragraph 4.7.2.2), the procedure is to place the REF SPEEDS switch to INCR. This is to be done at the same time as the engine intake door switches, the prop selector, and the windshield heat are placed on; the pilot's side window heat switches are to be turned on if ice is forming on the pilot's side window.

For climb, cruise and descent in icing conditions (paragraph 4.7.2.3), the AFM procedure is to maintain at least minimum airspeed (climb, Vfto + 20 kts; descent 1.23 Vsr for 0 flaps + 25 kts); to operate the de-ice boots, and to monitor wing and tail advisory lights for normal operation. When the aircraft is aerodynamically clean, the procedure is to turn off the de-ice boots and the REF SPEEDS switch. Minimum airspeeds then revert to normal. A note states "The aircraft is aerodynamically clean when all ice is removed from the visible leading edges and wing tips."

For holding, approach and landing in icing conditions (paragraph 4.7.2.4), minimum airspeeds in acing apply, the de-ice boots must be operated in "fast," and a performance penalty must be applied. There is a note which states, "When holding in icing conditions flaps must be at 0°." Minimum airspeeds are shown in Figure 2.

When the aircraft is no longer in icing conditions (paragraph 4.7.2.5), the procedure is to continue the use of de-ice boots on "fast" until all ice is removed from the visible leading edges. Once the aircraft is aerodynamically clean, the procedure is to turn the de-ice boots and the REF SPEEDS switch off and resume normal airspeeds.

3.3.1.2 Colgan Limitations on Ice Protection

The Colgan CFM, section 2, Limitations, states under paragraph 2.6.6, Ice Protection:

"Engine: Engine intake by-pass doors must be open for engine operation in icing conditions. ***NOTE:*** *Icing conditions exist when the SAT on the ground and for takeoff is 10°C or below, or SAT in flight is 5°C or below, and visible moisture is present in any form (such as clouds, fog with visibility of one mile or less, rain, snow, sleet or ice crystals. Icing conditions also exist when the SAT on the ground and for takeoff is 10°C or below when operating on ramps, taxiways or runways where surface snow, standing water, or slush may be ingested by the engines or freeze on engines, nacelles or engine sensor probes."*

"Airframe: When ice is detected, the AIRFRAME MODE SELECT selector must be positioned at FAST or SLOW. See paragraph 4.7, OPERATION IN ICING CONDITIONS."

3.3.1.3 Colgan 24 Hour System Ice Protection Check

The Colgan CFM, section 5, Expanded Checklist, provides for 24 hour system checks on certain systems. They are autofeather, fire detection, APU[20], baggage smoke warning, stall warning, ADC's[21], and ice protection. These daily system checks are to be accomplished once each calendar flight day and recorded in the maintenance log. The normal order of preference for accomplishment of these checks is first flight of the day, after parking at the first arrival at a maintenance base, before start at the first departure from a maintenance base, and at any station. A Colgan Check Airman said in an interview that the ice protection check is performed in the air, whereas the other checks are done on the ground.

On the ice protection check the following items are checked:

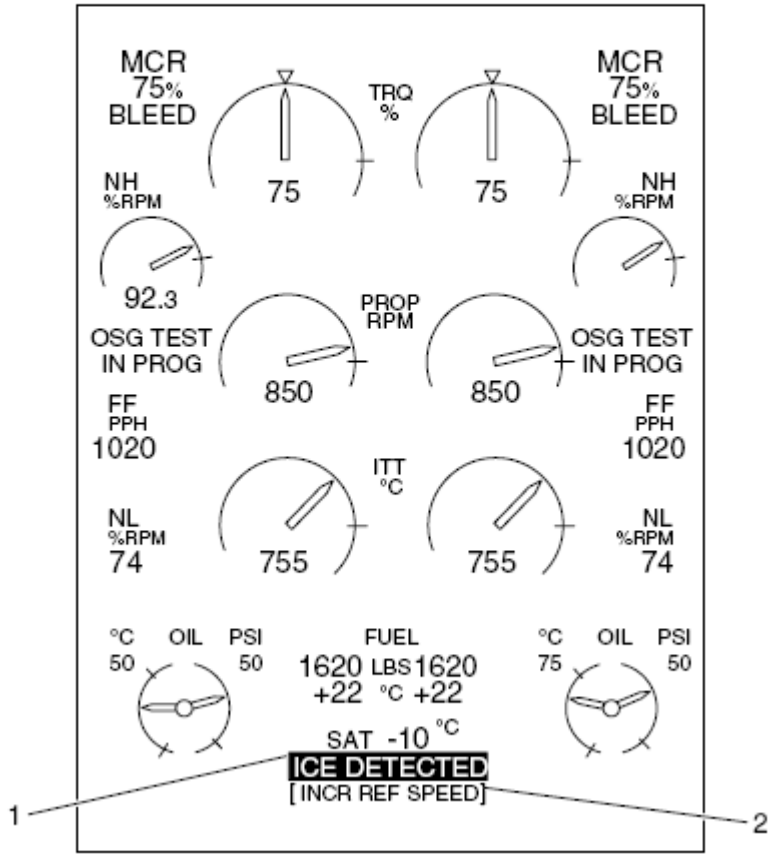
- Airframe deice pressure indicator for adequate pressure (18 psi +/- 3)
- Airframe Mode Select Switch in "Fast" (one complete cycle)
- Airframe manual select switch in all positions
- Propeller selector (one full cycle)
- Ref Speeds switch (check proper indication on the ED[22])
- Engine intake doors for proper operation
- Windshield heat for proper operation
- Stall Protection for operation with REF Speeds INCR

3.3.2 Ice Detected Message on Engine Display

The Q400 Engine Display (ED) shows a message, "ICE DETECTED," when one or both ice detector probes have detected more than 0.5 mm of ice. This is depicted by item one of Figure 7. The message will flash in yellow reverse video for five seconds, and if the REF SPEEDS switch is not set to the INCR position, the message continues in normal video. When the airplane is in icing conditions with the REF SPEEDS switch set to INCR, the message is in white normal video, not flashing. Item two of figure 7 depicts the "INCR REF SPEED" message, which displays when the REF SPEEDS switch is set to INCR.

[20] Auxiliary power unit
[21] Air data computers
[22] Engine display

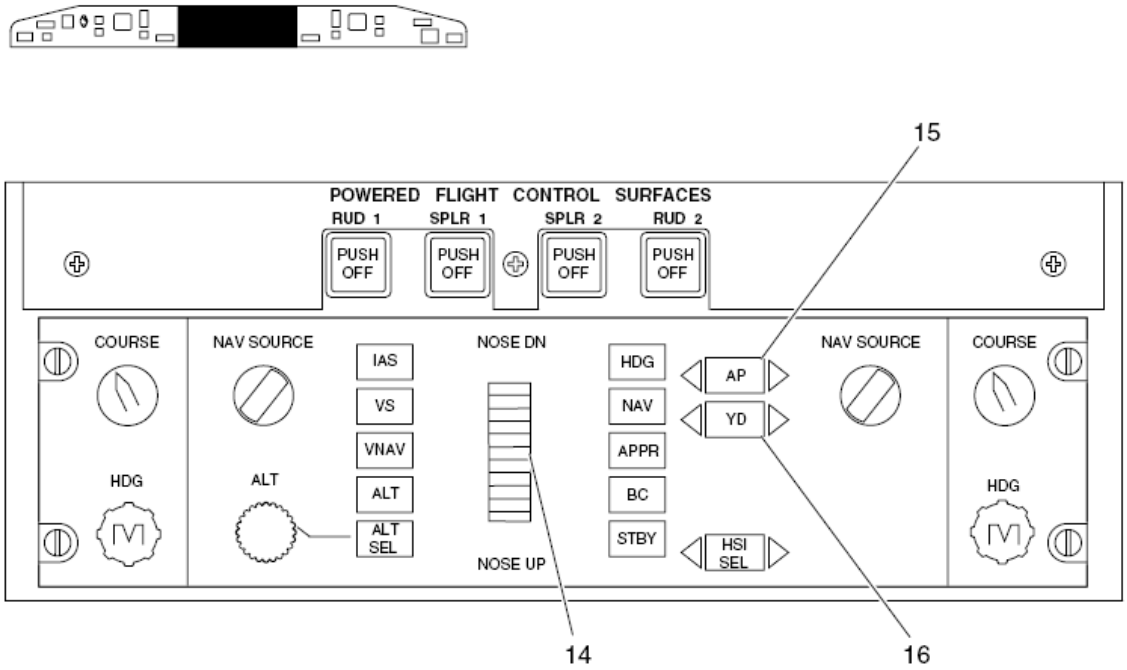
Figure 7
Engine Display with Ice Detected Message



3.3.3 Automatic Flight Control System (AFCS)

The automatic flight guidance control panel is mounted on the glare shield directly in front of the pilots. The following figure is from the Bombardier Q400 AOM. The autopilot (AP) and yaw damper (YD) engage buttons are depicted as items 15 and 16.

Figure 8
AFCS Control Panel



3.3.3.1 Autopilot Disengagement

The autopilot can be disengaged manually or automatically. According to The Q400 AOM Section 12.3.7.1, the autopilot disengages automatically when it receives a stall warning signal from Stall protection Module 1 or 2.

3.3.3.2 Limitations on Use of Autopilot

The Colgan CFM Limitations Section states that autopilot must be disengaged in severe icing.

3.3.3.3 Autopilot Pitch Trim

The Q400 AOM states in section 12.3.8.1:

"When the autopilot is engaged, the AFCS commands pitch trim to reduce the mistrim control column force held by the AP pitch servo, ensuring that the pitch transient at AP disengagement is minimal. The AFCS measures the torque applied to the controls by the AP pitch servo to determine when to trim. The AP Pitch Trim function is disabled when TCS[23] is active. The AP Pitch Trim function operates at two speeds:

1. *Trim high speed for Calibrated Airspeed (CAS) below 180 knots*
2. *Trim low speed for CAS above 180 knots*

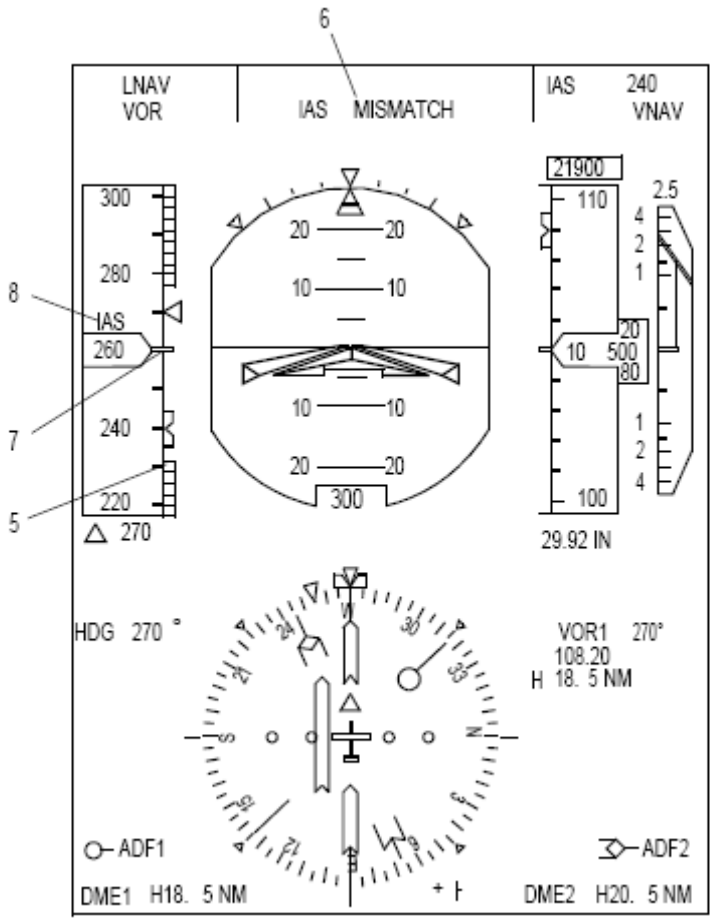
[23] Tactile control steering

The high speed trim provides the AP with adequate controllability during flaps extension/retraction, landing gear extension/retraction, accelerations and decelerations, or combinations of the above. The low speed trim provides the AP with sufficient precision for when small trim motion has a large effect.

3.3.4 Airspeed Indication, Speed Bug and Low Speed Cue

The primary airspeed indications are on the left and right Primary Flight Displays (PFD). The Q400 AOM Section 12.12 describes the aircraft airspeed indication systems. The following figure is from the Q400 AOM.

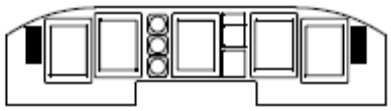
Figure 9
Primary Flight Display (PFD)

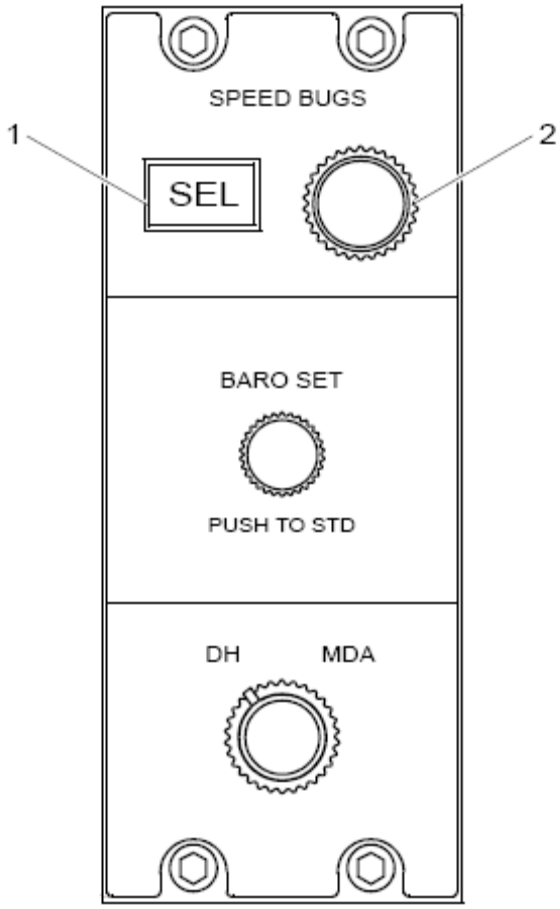


Indicated airspeed (IAS) is displayed on the upper left side of the instrument. The vertical scale shows the aircraft's current indicated airspeed as a rolling drum indication

with marks every ten knots. The tape displays +/- 42 KIAS[24] around the actual aircraft speed. A digital display shows the IAS from 30 KIAS up to 500 KIAS. The number seven (7) shows the current airspeed. The hollow triangle is the desired (bugged) airspeed, and the low speed cue is depicted by the number five (5). The vertical bar below the low speed cue is red. When IAS is less than or equal to the low speed warning, the digital IAS displays changes to red.

Figure 10
Speed Bug Index Control Panel





The select speed bug index pushbutton, item one in figure 10, is a momentary action

[24] Knots indicated airspeed

pushbutton which allows to the pilot to select two bug speeds while in flight. The first push sets bug #1, which is displayed as a solid cyan colored triangle. The second push sets bug #2, which is a hollow cyan colored triangle. If no bug is set within five seconds of the button push, selection is cancelled. When the index bugs are set outside the airspeed indication tape, they are not shown. The speed bug rotary knob, item two in figure 10, adjusts the bug value displayed on the Primary flight Display (PFD) airspeed indication.

3.3.5 Stall Protection System

According to the Q400 AOM, Section 12.8.8, the aircraft has two Stall Protection Modules (SPM), SPM1 and SPM2. Each SPM uses the following parameters to calculate when the airplane is near a stall condition:

- Angle of Attack data
- Flap position
- Mach number
- Engine torque
- Icing status

The modules use the following to calculate stick pusher operating angle:

- Angle of attack
- Flap position
- Mach number
- Power lever angle
- Condition lever angle
- Icing status

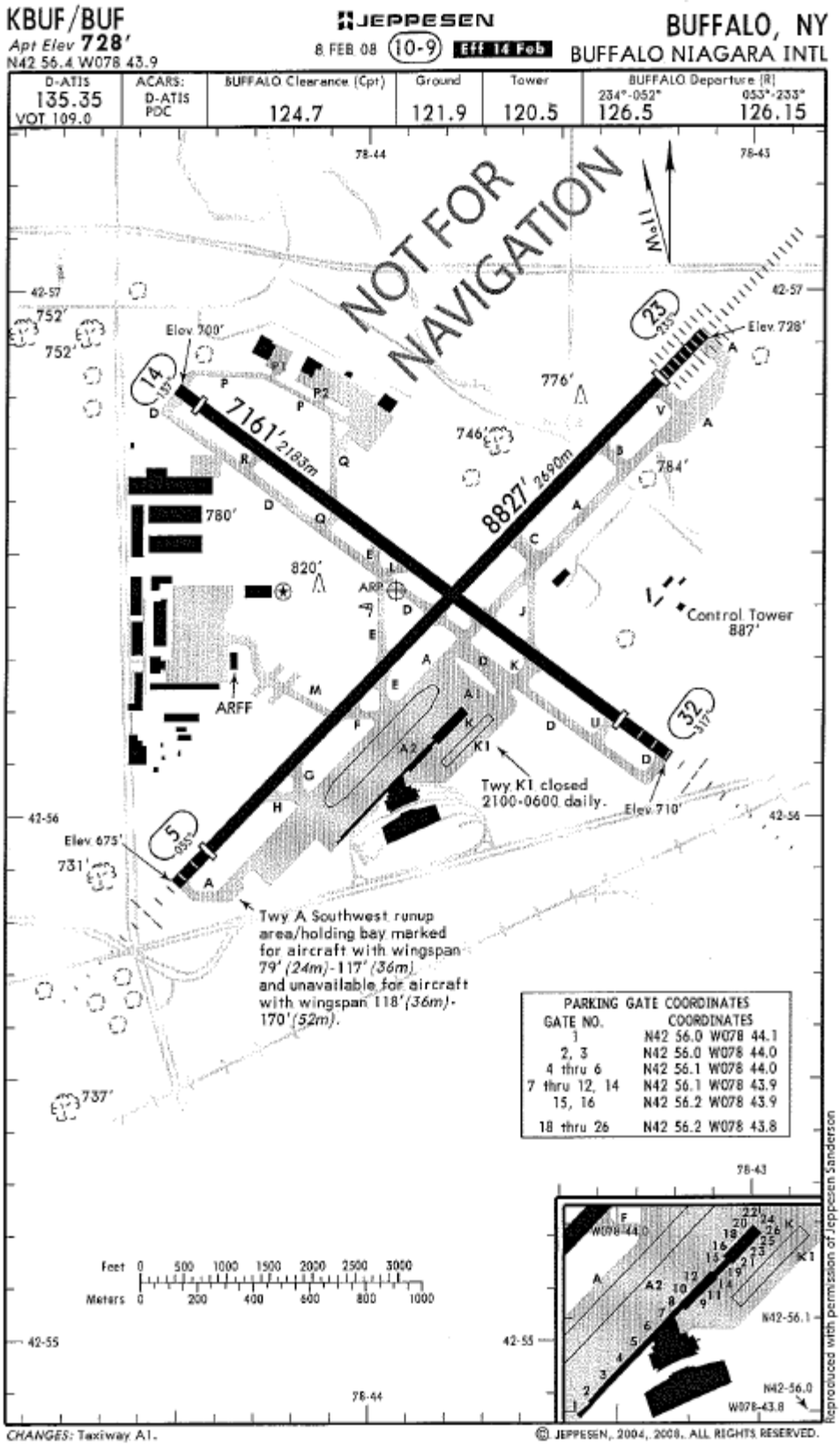
The AOM goes on to say that when the Stall Protection modules operate their related stick shakers, a signal to the AFCS disengages the autopilot, and a signal to the Ground Proximity Warning System (GPWS) prevents the PULL UP audible alerts.

4.0 Airport Information

4.1 Buffalo Niagara International Airport

The Buffalo Niagara International Airport is located 5 miles east of Buffalo, NY, and operates 110 commercial flights a day. It has two lighted, asphalt, grooved runways, 5/23, which is 8827’ long, and 14/32, which is 7161’ long. Runways 5, 23 and 32 have published ILS instrument approach procedures.

Figure 11
Buffalo Niagara Airport Diagram and ILS Runway 23


KBUF/BUF
Apt Elev 728'
N42 56.4 W078 43.9
JEPPESEN
8 FEB 08 10-9 Eff 14 Feb
BUFFALO, NY
BUFFALO NIAGARA INTL
D-ATIS 135.35 VOT 109.0
ACARS: D-ATIS PDC
BUFFALO Clearance (Cpt) 124.7
Ground 121.9
Tower 120.5
BUFFALO Departure (R) 234°-052° 126.5 053°-233° 126.15
NOT FOR NAVIGATION
Elev 700'
Elev 728'
7161' 2183m
8827' 2690m
Control Tower 887'
ARFF
Twy K1 closed 2100-0600 daily.
Elev 710'
Elev 675'
Twy A Southwest runup area/holding bay marked for aircraft with wingspan 79' (24m)-117' (36m) and unavailable for aircraft with wingspan 118' (36m)-170' (52m).
PARKING GATE COORDINATES
GATE NO. COORDINATES
1 N42 56.0 W078 44.1
2, 3 N42 56.0 W078 44.0
4 thru 6 N42 56.1 W078 44.0
7 thru 12, 14 N42 56.1 W078 43.9
15, 16 N42 56.2 W078 43.9
18 thru 26 N42 56.2 W078 43.8
Feet 0 500 1000 1500 2000 2500 3000
Meters 0 200 400 600 800 1000
CHANGES: Taxiway A1.
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KBUF/BUF
BUFFALO NIAGARA INTL

JEPPESEN
20 APR 07 (11-2)

BUFFALO, NY
ILS or LOC Rwy 23

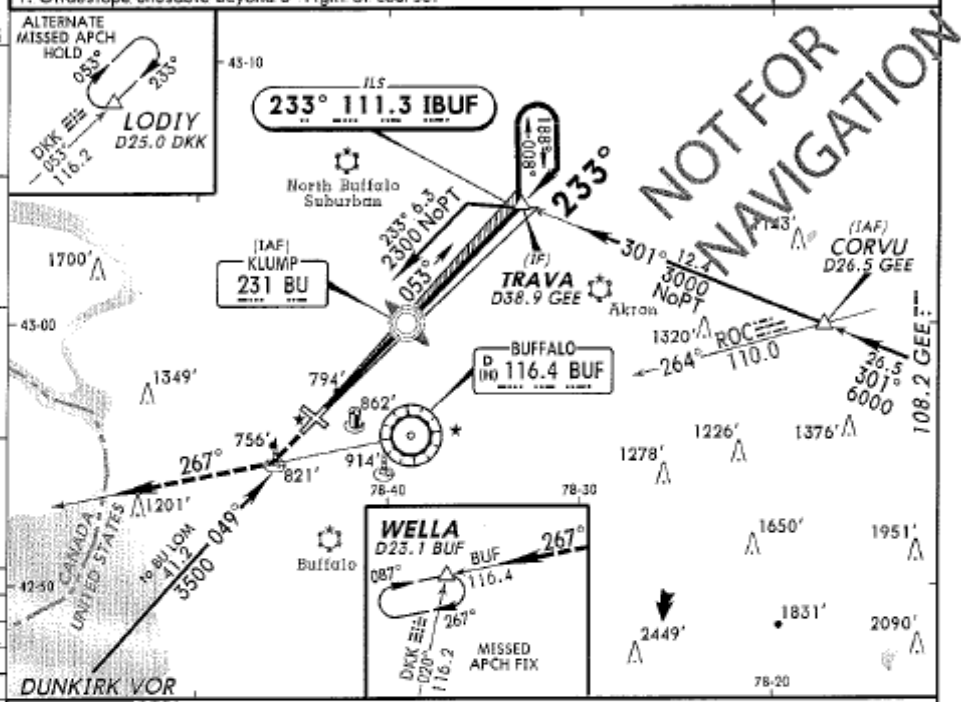
D-ATIS	BUFFALO Approach (R)	BUFFALO Tower	Ground
135.35	126.15	120.5	121.9

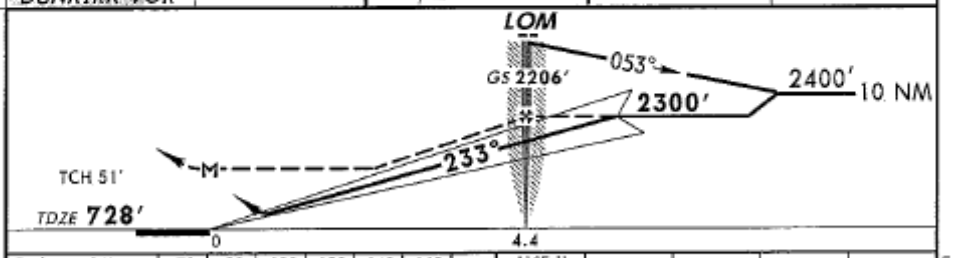
LOC IBUF	Final Apch Crs	GS LOM	ILS DA(H)	Apt Elev 728'
111.3	233°	2206'(1478')	928'(200')	TDZE 728'

MISSED APCH: Climb to 2300', then climbing RIGHT turn to 3000' via 300° heading and outbound on BUF VOR R-267 to WELLA INT/D23.1 BUF and hold.

Alt Set: INCHES Trans level: FL 180 Trans alt: 18000'
1. Glideslope unusable beyond 5° right of course.

MSA BU LOM: 2700' (090°–270°), 3900'





Gnd speed-Kts	70	90	100	120	140	160
GS 3.00°	377	484	538	646	753	861
LOM to MAP 4.4	3:46	2:56	2:38	2:12	1:53	1:39

ALSF-II | 2300' | 3000' via RT | 300° hdg | and BUF 116.4 R-267

STRAIGHT-IN LANDING RWY 23

	ILS DA(H) 928'(200')			LOC (GS out) MDA(H) 1060'(332')	
	FULL	TDZ or CL out	ALS out		ALS out
A	RVR 18 or ½	RVR 24 or ½	RVR 40 or ¾	RVR 24 or ½	RVR 50 or 1
B					
C					
D				RVR 40 or ¾	

CIRCLE-TO-LAND

Max Kts	MDA(H)
90	1200'(472') - 1
120	
140	1200'(472') - 1½
165	1280'(552') - 2

TERPS

CHANGES: IM decommissioned.

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4.2 ILS Runway 23 Glide Slope Anomaly

The ILS Runway 23 approach plate has a note which indicates that the glideslope is unusable beyond 5° right of course. One airline reported that some of their aircraft had observed that when attempting to intercept the runway 23 ILS from a right downwind, the glide slope indicated that the aircraft was well above glide slope. Just prior to intercepting the localizer, the glide slope then moved upward to the proper glide slope interception indication. Aircraft which had autopilot and flight director engaged could capture the glide slope as it moved up, resulting in a climb and loss of airspeed. That airline directed its crews to avoid right-hand pattern intercepts to runway 23.

Colgan 3407 intercepted the ILS from the left side.

5.0 Organizational and Management Information

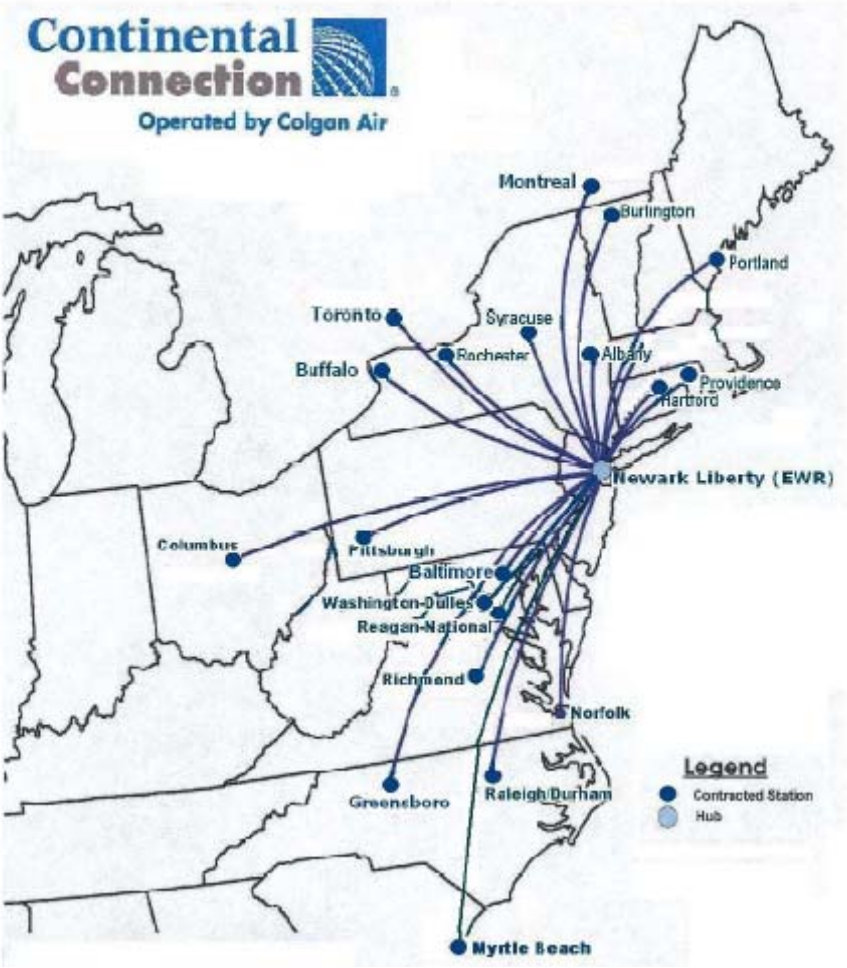
5.1 Colgan Air, Inc.

According to its website, Colgan Air, Inc.**,** a wholly owned subsidiary of Pinnacle Airlines Corp., is a regional airline headquartered in Manassas, Virginia. Colgan Air operates as Continental Connection, United Express and US Airways Express. Launched in 1991, Colgan Air offers more than 350 daily flights to 53 cities in 15 states & Canada. Colgan operates 34 Saab 340 and 14 Q400 regional airliners, and has hub operations in Boston, Houston, New York, Pittsburgh and Washington, D.C. Colgan Air has approximately 1,300 employees.

Charles Colgan and his son, Michael J., started service under the name National Capital on a Washington/Dulles - Binghamton, NY route on December 1, 1991. Service was provided with Beechcraft 1900C equipment. This route was later dropped and the name Colgan Air adapted. On July 1, 1997**,** Colgan Air became a Continental Connection through a marketing alliance-code share agreement with Continental Airlines. On December 11, 1999**,** Colgan Air started operating under a code-share and service agreement as a US Airways Express Carrier. Colgan reintroduced Continental Connection service in March 2005 and it acquired additional Saab 340 aircraft for service out of Houston. On October 4, 2005 Colgan Air started providing flights for United Express flights out of Washington's Dulles International airport.

On January 17, 2007**,** Colgan Air was acquired by the Pinnacle Airlines Corp., the parent company of Pinnacle Airlines, Inc. a regional airline doing business as Northwest Airlink. The acquisition of Colgan Air provided the company access to three more of the eight major carriers in the United States. Combined, Pinnacle Airlines Corp., provided service as a Continental Connection, United Express, Northwest Airlink and US Airways Express. On February 5, 2007, it was announced that Colgan Air would provide service for Continental Airlines out of Newark Liberty International Airport starting in early 2008. Colgan acquired 15 Bombardier Q400 aircraft for that service.

Figure 12
Colgan Air Bombardier Q400 Routes



5.1.1 Operations Management Organization

According to the Colgan Air Flight Operations Policies and Procedures manual (FOPPM), page 2-3, the Vice President, Flight Operations is the executive manager in charge of operations. Reporting to him are the Director of Inflight, Director of Flight Standards, Director of Crewmember and Dispatcher Training, Director of System Operations Control and Scheduling, Director of Flight Operations, and Director of Crewmember Resources.

Reporting to the Director of Flight Standards are the Manager of Inflight Standards, the Manager of Flight Standards, the Saab Fleet Manger, the Q400 Fleet Manager, and the APD's[25] and Check Airmen.

[25] Aircrew program designees

Reporting to the Director of Crewmember and Dispatcher Training are the Manager of Crewmember and Dispatcher Training, the Manager of Inflight Training, and a clerk and an assistant.

Reporting to the Director of Operations is the Chief Pilot, who in turn supervises the two Regional Chief Pilots in EWR and IAH.

5.1.2 Selection of Pilots

The Colgan Vice President, Administration explained the pilot selection and hiring process to the Operations Group. She said they exclusively use a company called Airline Apps, which is an online application service, to identify and screen pilot applicants. Airline Apps has an extensive application process that asks things like hours, past history, accidents, incidents, violations, and DUI's. About 60 percent of those that apply online receive a phone screening by either the manager of recruiting or one of the pilot recruiters. In the phone screening, they're asked basic questions concerning such areas as accidents, incidents, violations, and what type of flying they've been doing, such as Part 121, Part 135, military, or anything in their background that would disqualify them.

Applicants who make it through that process are invited to LaGuardia where they take a 50 question written test. The test parallels the ATP written. If they pass the written test, they then move on to the next phase, which is an interview with either the manager of recruiting or one of the senior pilot interviewers. The applicant's logbooks are reviewed at that time. Following the interview, they go to a full motion sim at Flight Safety in LaGuardia, and at that point, they're evaluated by either an instructor or a check airman. Each of three to four individuals involved independently rate the pilot. She said the sim check was very important.

The manager of recruiting reviews the applicant one final time and gives his okay, and then it goes to either the VP Administration or the Human Resources Manager. They do a final review of the paperwork, just to make sure there's nothing that recruiting missed, and that all the PRIA[26] paperwork is filled out completely. Applicants are told that we have to have their PRIA records and background check clear before they'll officially be a pilot with Colgan Air. The PRIA records are handled by HR and done in house.

The PRIA records go back five years for pilots for accidents, incidents, violations and drug and alcohol issues if they worked for 121, 135 or 125 operators. A lot of the pilots they hire don't have pilot records from other airlines. They check the NDR, the national driving record, as well.

The VP Administration said that their minimum education requirement for pilots is a high school education or GED. The company's internal policy for minimum pilot flight time is 600 hours total flight time with 100 hours multiengine

[26] Pilot Records Improvement Act

time. They look at the quality of the time the pilot has; a pilot with 600 hours where 250 or 300 hours of that is in a 121 operation is much more valuable than someone who flew 1500 hours in a Cessna 152 just to build up their time. Someone from a bridge program, such as those provided by Purdue, San Jose State, and Regional Airline Academy are regarded as being of higher quality. They primarily use Gulf Stream in Florida.

The VP Administration said Colgan began a pilot development program in 2008. The purpose of the program was to have a longer interview process for pilots who were coming in with lower flight time. They put applicants though a week-long ground school and did familiarization flights with them, and based on that, would offer them an interview for a position. The company made a big investment in that program, but discontinued it after two or three classes because of drastic changes in the industry. They began to receive applications from much more highly qualified pilots, and realized that the development program wasn't necessary.

5.1.3 Company Flight Operations Policies and Procedures

5.1.3.1 Standard Operating Procedures

The Colgan Air FOPPM[27] addresses standardization, cockpit decorum, sterile cockpit concept, and airplane control on pages 5-23 to 5-25. It states, "The captain is to maintain at all times a businesslike environment in the cockpit that is conducive to the safe and proper conduct of the flight." It makes reference to 14 CFR 121.542, which states:

"Flight crewmember duties.

(a) No certificate holder shall require, nor may any flight crewmember perform, any duties during a critical phase of flight except those duties required for the safe operation of the aircraft. Duties such as company required calls made for such nonsafety related purposes as ordering galley supplies and confirming passenger connections, announcements made to passengers promoting the air carrier or pointing out sights of interest, and filling out company payroll and related records are not required for the safe operation of the aircraft.
(b) No flight crewmember may engage in, nor may any pilot in command permit, any activity during a critical phase of flight which could distract any flight crewmember from the performance of his or her duties or which could interfere in any way with the proper conduct of those duties. Activities such as eating meals, engaging in nonessential conversations within the cockpit and nonessential communications between the cabin and cockpit crews, and reading publications not related to the proper conduct of the flight are not required for the safe operation of the aircraft.
(c) For the purposes of this section, critical phases of flight includes all ground operations involving taxi, takeoff and landing, and all other flight operations conducted below 10,000 feet, except cruise flight."

Note: Taxi is defined as "movement of an airplane under its own power on the surface of an

[27] Flight Operations Policy and Procedure Manual

airport."

5.1.3.2 Checklists

The Colgan FOPPM states on page 5-34 that "the checklist is designed to be performed in the challenge-response manner or as otherwise directed by the CFM or POH." It says "the pilot not performing the action called for by the checklist item shall monitor and double check that the proper action was taken." It says "additional checklist philosophy relating to Colgan Air policies and procedures are located in the aircraft CFM.'

The Colgan Q400 CFM does not contain a statement of checklist philosophy. In its expanded checklist there are statements in the Climb checklist and in the After Landing checklist which indicate those checklists are to be performed silently.

The Q400 CFM states in Section Five, "normally, the PF[28] calls for the DESCENT checklist when descending through 18,000' or at the top of descent if cruise altitude is below 18,000'. It also states, "The PF calls for the APPROACH checklist with sufficient time for completion of the checklist prior to crossing the initial approach fix or transitioning to the initial approach phase during an instrument approach, or, before turning base leg on a visual approach. Upon completion of the flows the PM[29] reads the checklist. Whenever possible, tune all radios to their final selection before crossing the initial approach fix or transitioning to the initial approach phase." A note in the CFM approach profile section says the BEFORE LANDING checklist should be completed one nm[30] before the final approach fix (FAF).

5.1.3.3 Altitude and Approach Callouts

The Colgan FOPPM provides altitude callouts to be made by crews on page 5-42. It says:

- The PF will call out 1,000 feet above or below the assigned altitude.
- The PF will call out 10,000 feet when climbing or descending.
- The PF will call out "FL 180" or transition altitude and "29.92" or appropriate altimeter setting when passing transition altitude/level.
- Approach – in the CFM.

The Colgan Q400 CFM., Section Ten, shows approach callouts. It states:

- PM will advise PF of deviations greater than ½ dot GS or course, and +/- 10 KIAS.
- VNAV approach: "minimums" will be called at 50 feet above MDA.
- PM can call "runway in sight" at any time during an approach. When PF responds "landing" no further callouts are needed except deviations.

[28] Pilot flying
[29] Pilot monitoring
[30] Nautical mile

- PM will advise “localizer alive”, “glide slope alive” or “course alive” when appropriate.

5.1.3.4 Approach Briefings

The Colgan FOPPM describes the required approach briefing on page 5-46. The following items are required:

- Approach name and runway
- Approach chart date (the most recent EFFECTIVE chart will be used)
- Primary navaids frequency
- Final approach course
- FAF altitude (see NOTE)
- DA(H), MDA, or HAA (see NOTE)
- TDZE or Airport elevation, as appropriate
- Highest MSA
- Required visibility (see NOTE)
- Missed Approach (see NOTE) point, initial heading and altitude for missed approach procedure
- Any applicable special considerations to include, unique airport advisory approach information, noise abatement procedures, engine failure during missed approach, significant terrain or obstacles in the terminal area relative to approach routing, weather conditions, any other known risks and intentions.

It goes on to say, “for a visual approach, the briefing shall always include at least the following:

- Airport elevation
- Pattern altitude
- Navigation facilities or aids available
- Review of any conditions which might affect how the approach and landing will be conducted.”

This paragraph is followed by a note:

“NOTE: See also Expanded Checklist Procedures Section for “Monitoring Responsibility” in the Aircraft Company Flight manual.”

An examination of the Q400 CFM did not reveal a paragraph or statement entitled “Monitoring Responsibility.”

5.1.3.5 Approach Profile

The Colgan Q400 CFM, Section Ten, provides a profile depiction entitled “Approaches with Vertical Guidance.” Under “Notes,” it states:

- Select flaps 5 upon entering terminal area when a/s allows
- Before landing checklist should be complete 1 nm before FAF
- No checklists inside FAF
- PM will advise "localizer alive", "glide slope alive", or "course alive" when appropriate.

The order of events depicted are as follows:

1. "gear down" (PF)
2. gear down landing flow (PM)
3. "flaps 15/35, before landing checklist" (PF)
4. "before landing checklist complete" (PM)
5. "1000 above" (PM)
6. "100 above" (PM)
7. "minimums" "no contact" "approach lights in sight" (ILS only) "runway in sight (PM)
8. "missed approach" "continue" "landing" (PF)

Also included are the following notes:

- PM will advise PF of deviations greater than ½ dot GS or course, and +/- 10 KIAS.
- VNAV approach: "minimums" will be called at 50 feet above MDA.
- PM can call "runway in sight" at any time during an approach. When PF responds "landing" no further callouts are needed except deviations.
- PM will advise "localizer alive", "glide slope alive" or "course alive" when appropriate.

5.1.3.6 Stabilized Approach

The Colgan Air Dash 8 Q400 Company Flight Manual (CFM) provides an illustrated profile of normal approaches with and without vertical guidance in Section Ten. A target approach speed is not discussed in these profiles, although there is a note which says "PM will advise PF of deviations greater than ½ dot of course, and +/- 10 KIAS."

The FOPPM, pages 5-44 and 5-45, describes the company's stabilized approach criteria. It states, in part, that below 1,000 feet (IMC) or 500 feet (VMC) AFE, the aircraft is to be at a speed no less than Vref and not greater than Vref + 20 as applicable to flight conditions, wind gust, etc. The manual does not describe specific speed additives for steady or gusting wind components.

Interviews with Colgan crews indicated that crews flew final approach at approach speeds above Vref, but that a specific speed was not required. The FAA APM[31] stated that the training calls for flying final at Vref plus 10 kts. However, that figure was not found in

[31] Aircrew program manager

the Colgan FOPPM or CFM. One Colgan captain interviewed said it was his practice to fly the final approach at Vref plus 20 kts. Other pilots interviewed were not specific as to approach speed flown.

The Operations Group asked the FAA APM to discuss the effects of the air traffic environment in the northeastern U.S. on speeds flown by Colgan crews during final approach. He said that it was difficult to maintain Vref plus ten knots when it is 130 kts. He said "approach control flying into Newark has you screaming in. They want you a hundred and eighty knots to the marker." "the guys do a good job of getting it slowed down to the ref plus 10, but I do see that they're right on the edge and they tend to fly it a little bit faster than I would like to see it. But I think that is possibly a function of the environment that they're operating in."

He went on to say, "coming up on the terminal area, generally -- 200 knots, the guy's calling for flaps five, it's slowing down, what, roughly 180. Maintaining 180, a typical vector is going to put you on the localizer and as the glide slope starts coming in, as you start dirtying up[32], it, you know, naturally starts decreasing the speed." "They bring the condition levers to max. That adds a lot of drag there. And then you get your flaps setting in. But typically (you) make a power adjustment on the order of down 25 percent and once they start down the glide slope… adjustments back in the high teens and I've seen it down in the low teens."

Asked about the need to maintain higher speed at airports other than Newark, the APM stated, "I've also seen instances where AT[33] will slam dunk[34] them and it's virtually impossible to descend the amounts they want them to descend and slow down at the same time. Buffalo, I've noted that. Buffalo, they've been doing it like that since I've been flying up there and that was more than 10 years ago. Why they need to do it, I don't know."

Regarding the use of the condition levers to slow the airplane rapidly, the FAA APM said, "well, it increases it (drag). It's noticeable. If I were flying the airplane, I would probably do that. Rather than play around with the power and wait an extended period, I might be inclined to bring the condition levers up, take advantage of the drag and you know, if I get a little bit more noise, oh well. That's technique."

5.1.3.7 Approach and Landing in Icing Conditions

The Colgan Air FOPPM, page 7-36, states "Do not attempt to takeoff, make an approach or land in freezing rain, sleet or drizzle or wet snow conditions that are beyond the performance limits of the aircraft."

5.1.4 Training

The Colgan Air training program is governed by its "Crewmember and Dispatcher

[32] Adding drag by configuring the airplane for landing
[33] Air Traffic Control
[34] ATC clearance for a rapid descent

Training Program" (Training) manual. The manual contains instructions and information for the Training Department to conduct operations in accordance with company policies, procedures, Federal Air Regulations and Operations Specifications. The policies, procedures and processes in the manual are the responsibility of the Director, Crewmember and Dispatcher Training.

According to the Training manual, page 1-7, one of the responsibilities of the Director, Crewmember and Dispatcher Training is to track the failure rate of airmen in training to ensure compliance with FAR 121.401 (e). Another responsibility is to ensure that all pilots are trained to the standards directed by the current ATP Practical Test Standard. He also must ensure the adequacy of the forms and procedures of the record keeping function, continuously review the training program to ensure its adequacy and completeness, and generate and forward all required personnel paperwork as necessary.

5.1.4.1 Outsourced Training

Under Operations Specification A031, Colgan Air is authorized to make arrangements with specified training centers listed in order to conduct instruction and/or evaluations. The following Part 142 Training Centers are permitted to conduct Initial, Transition and Upgrade training:

- Flight Safety International St. Louis, MO Dash 8 Q400/ SF-340
- Flight Safety International Seattle, WA Dash 8 Q400
- Flight Safety International Ontario, Canada Dash 8 Q400

5.1.4.2 Standards of Performance

The Training Manual sets out details of performance standards on page 2-2 and following pages. It says:

"Flight crewmembers will be required to receive a satisfactory grade on all flight maneuvers, procedures and duties. A satisfactory grade is obtained ONLY when the student demonstrates the ability to operate the aircraft/simulator in a manner that shows he/she is obviously the master of the aircraft, and with successful outcome of each maneuver never in doubt on a scale of 1 through 4, as indicated below in the Simulator Grading Legend.

Flight/Simulator Training Grading Legend:

1. Trainee understands maneuver and completes it successfully. No further training is necessary.
2. Trainee understands maneuver and completes it successfully. Further training for retention is necessary.
3. Trainee understands maneuver but is unable to complete the maneuver with the degree of accuracy necessary for flight check purposes. Further training is necessary and will be considered unsatisfactory performance.
4. Trainee does not understand maneuver and is unable to complete it successfully.

He/she needs further instruction and explanation prior to further flight or simulator training and will be considered unsatisfactory performance.

Additionally, all maneuvers must be accomplished in accordance with the applicable completion standards as set forth in this program. Unsatisfactory grades indicate the requirement of additional training. The standards set forth in the ATP Practical Test Standard as revised are the completion standards for all proficiency checks."

Initial Simulator and Flight Training standards are stated on page 2-2 as follows:

"*During initial flight training, flight crewmembers will be expected to progress through the training within the normal programmed hours. If the check airman/flight instructor feels that the person is not progressing as expected, he/she will discontinue the flight training and forward his recommendation to the Director, Crewmember and Dispatcher Training. The general policy will be to grant additional training as determined by the individual's attitude and within a reasonable time period as determined by the company. Every consideration will be given to those factors which could have adversely affected the person's performance. In deciding whether to grant additional training, the Director, Crewmember and Dispatcher Training or his designee may conduct an evaluation check ride. When additional training is granted, the Director, Crewmember and Dispatcher Training will coordinate with the Director, Flight Standards and will provide an outline of the additional training. If, after this additional training, the pilot is unable to satisfactorily complete the initial flight training, he/she will be dismissed from the training."*

Upgrade, Recurrent, Re-qualification and Transition standards are stated on page 2-3 and are essentially the same as the above, except that it states that the Director of Crewmember and Dispatcher Training will forward his recommendation to the Director of Flight Operations.

Proficiency check standards are covered on pages 2-3 as follows:

"*If a pilot being checked fails any of the required maneuvers, the check airman may suspend the check and give additional training on the failed item. In no case will more than two (2) items be retrained during the course of a proficiency check.*

After additional training is completed, the check airman will resume the check. In addition to repeating the maneuvers failed, the check airman giving the proficiency check may require the pilot being checked to repeat any other maneuvers he/she feels finds necessary to determine the pilot's proficiency. (Reference 121.441(e))

If, after this additional training, the proficiency check is still unsatisfactory, the check airman will discontinue the proficiency check, document the check as being unsatisfactory and forward his recommendation to the Director, Flight Standards, who will notify the Director, Crewmember and Dispatcher Training and notify the Principal Operations Inspector (POI) of the failure.

The airman must be removed from line operations until he/she satisfactorily completes the training or check.

In the event the additional training is given as provided in this paragraph and the airman is found to be proficient, the check airman must document the items originally failed and generate a training form for the training conducted. He/she may then certify the airman's proficiency as satisfactory if all maneuvers and procedures are performed satisfactorily.

In order to maintain objectivity in the training and evaluation program, checking and evaluations will not be performed by the same individual who conducted the training. Checking and evaluations will be performed without interference or influence from company management."

5.1.4.3 Stall Training Q400

The Colgan Air DHC-8 Q400 Series Simulation Training is described in Appendix F in the Training Manual, pages F-1 to F-13. The training described is for Q400 initial, transition, upgrade, recurrent and requalification pilot simulator training. Flight training events are described in detail for eight flight simulator training modules, the last of which is a check ride.

Stall training in the Q400 simulator training is conducted in lessons 1, 4 and 7 and stalls are evaluated on the proficiency check. The following training for stalls is programmed:

- Lesson One - Approach to Stall – takeoff, enroute, and landing configuration
- Lesson Four – Approach to Stall – takeoff and landing configuration
- Lesson Seven – Approach to Stall – landing configuration

5.1.4.4 Stall Profiles

Illustrations of the three stall profiles to be flown are depicted in the CFM, section ten, revision 1, pages 7-9.

The clean stall, which refers to a stall performed with gear and flaps retracted, is entered from an airspeed of 180 kts, at a minimum altitude of 5000' AGL, and with power at flight idle. The pilot flying (PF) calls out "stall," advances power to the rating detent, and states "check power." The profile says that during the stall the PF is to maintain heading and altitude. Power should be adjusted to maintain 180 kts to exit the maneuver.

The takeoff stall is entered at 180 kts, at a minimum altitude of 5000' AGL, with flaps set to 15°, gear down, and power at flight idle. The PF is to maintain heading and altitude during the maneuver and begin a 20° bank turn at 120 kts. The PF calls out "stall," advances power to the rating detent, rolls wings level, and states "check power." The PM calls out "positive rate," the PF calls "gear up," the PM calls "Vfri," and the PF calls "flaps

0." Power should be adjusted to maintain 180 kts to exit the maneuver.

The landing stall is entered at 180 kts, at a minimum altitude of 5000' AGL, with flaps set to 35°, gear down, and power at flight idle. The PF is to maintain heading and altitude during the maneuver. The PF calls out "stall," advances power to the rating detent, and states "check power, flaps 15." The pilot monitoring (PM) calls out "positive rate," the PF calls "gear up," the PM calls "Vfri," and the PF calls "flaps 0." Power should be adjusted to maintain 180 kts to exit the maneuver.

No reference is made to use of the autopilot.

It was stated in several interviews, that during the stall recovery exercises for initial simulator training, the candidates were instructed to maintain an assigned altitude and complete the recovery procedures while not deviating more than 100' above or below the assigned altitude, as this was the practical test standards (PTS) for the check ride.

5.1.4.5 Stall Recovery Evaluation

The basic pilot proficiency check is detailed on pages 6-2 to 6-5. Both PIC's and SIC's must perform approaches to stalls. Regarding approaches to stalls (page 6-4), the manual states:

"Check airmen shall evaluate the applicant's ability to recognize and recover from an approach to a stall in three separate airplane configurations. The three configurations are the clean configuration, the takeoff configuration, and the landing configuration. Check airmen may waive all but one of the stalls and the one stall must be performed while in a turn with a bank angle between 15 and 30 degrees. This waiver authority should be used when an applicant's performance in other events indicates a high degree of proficiency."

During interviews, some of the Colgan air check airmen stated that the PTS standard for stall recovery was to maintain altitude with an allowable deviation of +/- 100 feet, and that this was a hard limit. Any deviation outside of this would constitute a failed check ride. Other check airmen stated that the PTS altitude limitation for stall recovery was a minimum acceptable loss of altitude.

The FAA Airline Transport Pilot and Aircraft Type Rating Practical Test Standards (PTS) FAA-S-8081-5F outline the PTS standards for approach to stalls. They are as follows:

B. TASK: APPROACHES TO STALLS

REFERENCES: 14 CFR part 61; FAA-H-8083-3; FSB Report; POH/ AFM.

THREE approaches to stall are required, as follows (unless otherwise specified by the FSB Report):

1. One in the takeoff configuration (except where the airplane uses only zero-flap takeoff configuration) or approach (partial) flap configuration.
2. One in a clean cruise configuration.
3. One in a landing configuration (landing gear and landing flaps set).

CAUTION: Avoid deep stalls which are termed as "virtually unrecoverable" in airplanes, and "tip stalls" in swept wing airplanes.
One of these approaches to a stall must be accomplished while in a turn using a bank angle of 15 to 30°.

Objective. *To determine that the applicant:*

1. In actual or simulated instrument conditions exhibits satisfactory knowledge of the factors, which influence stall characteristics, including the use of various drag configurations, power settings, pitch attitudes, weights, and bank angles. Also, exhibits adequate knowledge of the proper procedure for resuming normal flight.

2. Selects an entry altitude that is in accordance with the AFM or POH, but in no case lower than an altitude that will allow recovery to be safely completed at a minimum of 3,000 feet AGL. When accomplished in an FTD or flight simulator, the entry altitude should be consistent with expected operational environment for the stall configuration.

3. Observes the area is clear of other aircraft prior to accomplishing an approach to a stall.

4. While maintaining altitude, slowly establishes the pitch attitude (using trim or elevator/stabilizer), bank angle, and power setting that will induce a stall.

5. Announces the first indication of an impending stall (such as buffeting, stick shaker, decay of control effectiveness, and any other cues related to the specific airplane design characteristics) and initiates recovery (using maximum power or as directed by the examiner).

6. Recovers to a reference airspeed, altitude and heading with minimal loss of altitude, airspeed, and heading deviation.

7. Demonstrates smooth, positive control during entry, approach to a stall, and recovery.

5.1.4.6 Pusher Training

Only a few of the pilots interviewed had received a pusher demonstration or instruction in the Q400. Some had asked for a demonstration, while others had received the demonstration while being trained on another aircraft type. One Q400 check airmen stated that he demonstrates the pusher during initial simulator training. A Saab 340 check pilot/trainer indicated that the pusher was part of the training syllabus for the Saab 340. According to the trainers and Q400 check pilots interviewed, demonstration or instruction of the aircraft pusher system is not part of the training syllabus for initial or re-current training

on the Q400.

5.1.4.7 Flight Crew Winter Operations Training

The Flight Crew Winter Operations / Anti-ice / De-ice training course outline is shown on pages 4A-64 to 69 of the Training Manual. The subject areas are:

- The use of holdover times
- Aircraft deicing/anti-icing procedures, checks and responsibilities
- Aircraft surface contamination, critical area identification and effect on performance and handling characteristics
- Types, purpose, characteristics, and effectiveness of deicing and anti-icing fluids
- Deicing/anti-icing fluids handling/performance implications

5.1.4.8 Tail Stall Video

According to crewmember and Colgan management interviews, a NASA[35] produced training video entitled "Icing for Regional & Corporate Pilots" is shown during initial and recurrent ground school as well as during winter operations training.

According to Colgan Air training records, Captain Renslow completed transition winter operations anti-ice / de-ice training on October 31, 2008 during his transition training for the Q400. Training records also showed the FO Shaw had last completed recurrent winter operations anti-ice / de-ice training on January 15, 2009.

The Colgan Air Q400 ground school instructor who taught this course to the two accident crewmembers stated that he had shown the video during these classes.

The video discusses the latest information from NASA and the FAA about icing. The purpose of the video, as stated in its introduction, is:

- To review fundamentals of aircraft icing
- To enhance the pilots ability to assess hazardous icing conditions
- To enhance the pilots understanding of icing effects on stability and control of the aircraft
- To present strategies that pilots can use to exit a hazardous icing encounter
- To discuss super cooled large droplets (SLD)

One subject the video also discusses is the possibility of horizontal stabilizer icing and associated tail stall. It explains differences between conventional wing stall and tail stall.

It states, in part, that in the event of a wing stall, recovery requires reduction of the angle of attack, which is accomplished by

[35] National Aeronautics and Space Administration

- Lowering the nose
- Adding power
- Lowering flaps one notch

It also states that pilots should be alert to the warning signs of tail stall. These include:

- Lightening of the controls
- Pitch excursions
- Difficulty in trimming pitch
- Buffeting of the controls
- Sudden nose down pitch

The video states that to recover from a tail stall, a pilot must:

- Pull back on the yoke
- Reduce flaps
- Reduce power (some aircraft)

The video states that, first, the pilot must properly diagnose the problem. It states that airspeed awareness is absolutely critical. It states that although the differences between wing stall and tail stall can be subtle, the recovery techniques are quite different.

No references to tail stall or tail stall recovery techniques could be found in the Colgan Training Manual. The Director of Flight Standards stated that "Colgan doesn't teach the pilots tail stall recovery techniques."

In interviews, no Colgan manager could recall when the video was introduced to training or who originally made the decision to include it in training classes.

5.1.4.9 Training Records

The Colgan Training Manual, page 2-6, states:

"A Computer Training Record System will be utilized to maintain individual training records for each crewmember, dispatcher, instructor and check airman. All training is documented on the appropriate training for job aids and tracked as described in Chapter 8. The Director, Crewmember and Dispatcher Training is responsible for all training records and record keeping. The record keeping system known as CrewQual has been approved and is the official record keeping system."

5.1.4.10 Forms

The training forms to be used for Colgan Air Q400 pilots are shown in the Training Manual, pages 9-33 to 9-40. The Q400 Pilot Training Form depicted on page 9-34 provides a grid for event grading on simulator training events, and includes a box for "approaches to

stalls."

No such completed forms could be found for Captain Renslow or FO Shaw. According to the Director of Crewmember and Dispatcher Training, it is the practice of Colgan Air to dispose of such forms once a pilot has completed the training course and course completion has been entered into the CrewQual computer record system. He stated, "Once they've satisfactorily completed the complete course, everything's done, records are entered, and once they're transferred electronic, they're destroyed, as per our manual."

5.1.5 Introduction of Q400

Colgan Air introduced the planned introduction of the Q400 into service in February 2007. Initial training of crews took place at Flight Safety Canada's facility in Toronto, Canada as part of entitlement training to be provided by Bombardier. This was part of the purchase agreement between Bombardier and Pinnacle Airlines. Flight Safety Canada maintained a Part 142 Training Center program for the Q400. The first classes of Colgan pilots to go through training did so in October and November of 2007.

5.2 FAA Oversight

Colgan Air, Inc. is a certificated domestic 14 CFR Part 121 airline, FAA certificate number NVSA519S. The certificate is managed by the Washington Flight Standards District Office (FSDO). FAA operational oversight of Colgan Air is conducted by a Principal Operations Inspector (POI) and Aircrew Program Managers (APM) for the Q400 and the Saab 340. The POI and Saab APM are based at the Herndon, Virginia, FSDO, and the Q400 APM is based at the Teterboro, New Jersey, FSDO.

6.0 Additional Information

6.1 Remedial Training

The Colgan Air Director of Flight Standards stated that Colgan's training program regarded pilots as either satisfactory or unsatisfactory. He stated that if a pilot retrained after a failure and was found to be satisfactory that there was no further follow-up. He said that in the event that a pilot had multiple unsatisfactory check rides that he or the Manager of Flight Standards would coordinate with the Director of Training to assign additional training. He said, "If he's unable to receive additional training and pass a second check ride, he may be terminated." He did not recall having a consultation regarding Captain Renslow at any time during his tenure at Colgan and was not tracking him in terms of his performance.

The Colgan Air Chief Pilot said that if a crew member was marginal, through a complaint or proficiency item, that he would ask the standards department to have a check airman observe him to be sure he was performing satisfactorily. He said there was no formal program geared towards someone who was weak. He stated that he was aware that Captain Renslow had failed his initial upgrade training and had to get retrained and take the check ride again. He did not think that one error was a disqualifying event, but that he had told

Captain Renslow that his next PC needed to be "right on."

The FAA published a Safety Alert for Operators (SAFO) 06015 on 10/27/2006 entitled "Remedial Training for Part 121 Pilots." Its purpose was to promote voluntary implementation of remedial training for pilots with persistent performance deficiencies.

6.2 Post Accident Procedural Changes

In an interview, the POI stated that Colgan was initiating five immediate changes to training and procedures.

- Issuance of CFM Bulletin 09-001 – Speed Bugs for Landing, Icing Definitions, and Ice Equipment Operation. This emphasized the importance of setting the proper Vref bugs, reiterated proper icing terminology when using the Unilink ACARS system, and introduced three levels of icing conditions. It also created a prohibition against using the REF SPEEDS switch in INCR for takeoff below 1000' AGL, and a prohibition against changing the position of the REF SPEEDS switch below 1000' AGL when landing.
- Conduct a mandatory briefing for Q400 pilots on Bulletin 09-001
- Issuance of CFM Bulletin 09-003 – REF SPEEDS Switch and Speed Guidance. This set specific target speeds for airspeeds during the approach phase.
    - 180 kts minimum prior to gear extension
    - 160 knots minimum prior to final approach fix
    - Vref plus 10/ minus 0 on final approach

  This also created a wind correction to approach speed.

- Planning for an enhanced maneuver package – The plan calls for doing three stalls on proficiency checks, non-waiverable, which include autopilot induced stall conditions.
- Complete review of the descent profile – The plan is to review all elements for both the Saab and Q400 fleet descent profiles, including checklists, workloads and monitoring.

E. List of Attachments

Attachment 1: Interview Summaries

Attachment 2: ACARS Report

Attachment 3: AeroData Report

Attachment 4: Colgan Air Load Report Worksheet

Attachment 5: Normal Checklist

Attachment 6: Normal Landing Profile

Attachment 7: Stall Series Profiles

Attachment 8: Captain and FO Training Records

Attachment 9: Colgan 24 Hour Ice Protection Test

*** see Weather Group Chairman's Report for Flight Dispatch Release**