



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

June 10, 2021

Group Chairman's Factual Report

OPERATIONAL FACTORS

DCA20IA014

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A. ACCIDENT

Location: Atlanta, Georgia
Date: November 6, 2019, (November 7, 2019, coordinated universal time (UTC))
Time: 21:15 Eastern Standard Time (EST)
02:15 Universal Time Coordinate (UTC)
Airplane: Embraer ERJ 170-200LR, N117HQ

B. OPERATIONAL FACTORS GROUP

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C. SUMMARY

On November 6, 2019, about 2115 EST, Republic Airways, Inc. flight 4439, an Embraer ERJ-170-200LR, N117HQ, experienced a pitch trim anomaly shortly after takeoff from Hartsfield–Jackson Atlanta International Airport (ATL), Atlanta, Georgia. The flight crew declared an emergency and returned to ATL. None of the 9 passengers and crew onboard were injured and the airplane was not damaged. The airplane was operating under the provisions of Title 14 Code of Federal Regulations Part 121 as regularly scheduled passenger flight and was destined for LaGuardia Airport (LGA), New York, New York.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board (NTSB) investigator on the Operational Factors Group was assigned to the accident on Monday November 11, 2019, and did not travel to the accident scene. The group chairman was briefed by the Investigator in Charge (IIC) on the events surrounding the accident. An Operational Factors Group was formed with a human performance specialist and party members from the FAA, Republic Airways (Operator), and the International Brotherhood of Teamsters (IBT).

¹ Aircrew Program Designee

The Operational Factors Group chairman requested manuals, flight documents, and other various investigative items from the operator and notified the operator that the Operational Factors Group would be interviewing the flight crew.

On Friday November 15, 2019, the Operational Factors Group interviewed the event first officer and event captain, via separate conference calls.

E. FACTUAL INFORMATION

1.0 History of Flight

The flight crew reported for duty on the day of the incident at approximately 1400 at Detroit Metro Wayne County Airport (DTW), Detroit, Michigan. The routing took them from DTW-LGA. LGA-ATL and ATL-LGA (incident flight) which was the third flight of the day for the flight crew.

The captain flew the incident airplane from DTW to LGA. According to the captain, while enroute, an EICAS² message annunciated for Pitch Trim SW 1 Fail. He further stated they referenced the QRH and since the EICAS message was advisory only, they wrote it up in the aircraft logbook to be addressed while they were on the ground in LGA.

On the ground in LGA, the crew was advised by maintenance that they were going to change the pitch trim switch on the captain's yoke to resolve the EICAS message, but it was going to take 20 minutes to get the part. As the captain was in the concourse getting food, the FO called him and said they were ready to start passenger boarding and that maintenance had deferred the trim switch per the MEL³ and placarded it INOP. The captain spoke to maintenance regarding the deferral and was told to use the backup trim switch in lieu of the failed captain's yoke trim switch.

According to the FO⁴, the flight from LGA-ATL was his leg to fly and it was "just a normal leg." The FO also indicated there was no further maintenance in ATL.

The crew stated the incident leg taxi out and the takeoff were normal. The captain was the pilot flying. During takeoff, airplane had a high rate of climb, about 4,000 fpm, and he said this seemed normal since they were very light and only had six passengers on board.

The FO indicated that while waiting to switch over to the departure frequency, the captain said to declare an emergency told him they had runway trim. The FO stated he could see the captain struggling to control the airplane. According to the captain's interview, it took both he and the FO pushing forward on the control column to keep the airplane from pitching up.

They reported to ATC⁵ that they were in a stalling situation. They pressed the button to cutout pitch trim system 1 since that was the system associated with the EICAS message.

² Engine Indicating and Crew Alerting System.

³ A process of deferring maintenance action based on the Minimum Equipment List.

⁴ First Officer.

⁵ Air Traffic Control.

The FO indicated that the airspeed dropped to at least 138 knots before they regained control of the airplane.

When asked about performing the Initial Action Items to stop the runway pitch trim, the captain indicated that he “kept pushing the button” but had to keep both hands on the yoke to control the airplane. The captain also said he had the QRC⁶ in his lap but could not pick it up and read it as all of his efforts were directed toward keeping both hands on the yoke.

The FO stated that once he started flying the airplane about 10,000 feet, and he had System 1 cutout, he was able to trim the airplane nose down and regain some airspeed. They elected to return to ATL and landed uneventfully.

2.0 Flight Crew Information

The captain flew the first leg of the trip on the day of the incident. He flew from Detroit, DTW to New York LaGuardia, LGA. The first officer, FO, then flew from LGA to ATL and the captain was the pilot flying on the incident leg from ATL-LGA.

2.1 Captain

The captain was 32 years old. His date of hire was May 5, 2015, and he held an Airline Transport Pilot (ATP) certificate with a rating for airplane multiengine land with type rating in the ERJ-170 /175⁷. He also held CFI⁹, CFII¹⁰ and MEI¹¹ certificates as well as a FAA Dispatchers License. He upgraded to captain on June 6, 2018.

2.1.1 Captain’s Pilot Certification Record

FAA records of the incident captain indicated the following:

Private Pilot – Airplane Single-Engine Land certificate was issued August 31, 2008.

Private Pilot – Airplane Single-Engine Land; Instrument Airplane certificate was issued January 26, 2009.

⁶ Quick Reference Card

⁷ Embraer Source S.A. (formally known as Yaborã Indústria Aeronáutica S.A.): ERJ 170-100 STD, ERJ 170-100 LR, ERJ 170-100 SU, ERJ 170-100 SE, ERJ 170-200 STD, ERJ 170-200 LR, ERJ 170-200 SU, ERJ 190-100 STD, ERJ 190-100 LR, ERJ 190-100 IGW, ERJ 190-100 ECJ, ERJ 190-200 STD, ERJ 190-200 LR, ERJ 190-200 IGW, ERJ 190-300 FAA Order 8900.1, Figure 5-88.

⁸ The Embraer 170 has a range of 2,150 nautical miles, and the Embraer 175 has a range of 2,200 nautical miles

⁹ Certified Flight Instructor.

¹⁰ Certified Flight Instructor – Instruments.

¹¹ Multi-Engine Instructor.

Commercial Pilot – Airplane Single-Engine Land; Instrument Airplane; Limitation: English Proficient certificate was issued on October 29, 2009.

Notice of Disapproval – Commercial Pilot Airplane Multiengine Land was issued on October 29, 2009. Areas for Reexamination: Area of Operation VIII, Task C and Area of Operation X Task (D) Not Tested.

Commercial Pilot – Airplane Single- and Multiengine Land; Instrument Airplane; Limitation: English Proficient certificate was issued on November 17, 2009.

Aircraft Dispatcher certificate issued June 4, 2011.

Flight Instructor – Instrument Airplane; Limitation: Valid Only When Accompanied By Pilot Certificate No. 3365934; Expires February 28, 2015 certificate was issued February 25, 2013.

Flight Instructor – Airplane Single Engine; Instrument Airplane; Limitation: Valid Only When Accompanied By Pilot Certificate No. 3365934; Expires June 30, 2015 certificate was issued June 1, 2013.

Flight Instructor – Airplane Single-Engine; Airplane Multiengine; Instrument Airplane Limitation: Valid Only When Accompanied By pilot Certificate No. 3365934; Expires May 31, 2016 certificate was issued on May 11, 2014. Renewed on May 19, 2016 again on April 10, 2018 and renewed again on May 3, 2020.

Notice of Disapproval – Airline Transport Pilot certificate was issued on June 27, 2015. Areas for Reexamination: All areas of Operation¹²; Oral completed on June 6, 2015.

Airline Transport Pilot – Airplane Multiengine Land; ERJ-170; ERJ-190; Commercial Pilot Privileges; Airplane Single-Engine Land; Limitations: Engine Proficient; ATP Circling Approach VMC Only; ERJ-170, ERJ-190, Circling Approach – VMC Only; ERJ-170 ERJ-190 Circling Approach – VMC Only; Restricted in Accordance with 14 CFR 61.167 certificate was issued on July 18, 2015.

Airline Transport Pilot – Airplane Multiengine Land; ERJ-170; ERJ-190; Commercial Pilot Privileges; Airplane Single-Engine Land; Limitations: ERJ-170, ERJ-190, Circling Approach – VMC Only; ATP Circle Approach – VMC Only. certificate was issued on April 7, 2016.

2.1.2 Captain's Certificates and Ratings Held at the Time of the Incident

Airline Transport Pilot (issued April 7, 2016)

Airplane Multiengine Land

Type ratings in the ERJ-170, ERJ-190

¹² In an FAA Memorandum dated August 3, 2015, the Inspector / Examiner indicated reason for the “Disapproval of Airline Transport Pilot application dated June 27, 2015 was, “Verify the date (year) of the medical in section I box N3.”

Commercial Pilot (issued November 17, 2009)
Airplane Single-Engine and Multiengine Land

Flight Instructor (renewed May 3, 2020)
Airplane Single-Engine
Airplane Multiengine
Instrument Airplane

Aircraft Dispatcher (issued June 4, 2011)

Medical Certificate – First Class (issued November 21, 2018)
Limitations: None

2.1.3 Captain’s Training and Proficiency Checks Completed

A synopsis of the4 captain’s recent training at Republic Airways is as follows¹³

Captain Upgrade	May 16, 2018
QCQ – Quarterly Continuing Qualification	September 18, 2018
LC – Route Line Check	November 26, 2018
LOE – Simulator	May 25, 2019
MV/SIM – Maneuvers Validation	May 24, 2019

2.1.4 Captain’s Flight Time

The captain’s flight times based on pilot’s interview transcript and Republic Airways provided documentation:

Total flying experience	4,500
Total flying experience ERJ 170/175	3,135
Total PIC incident make/model	750
Total flying the preceding 24 hours	7
Total flying time last 7 days	25
Total flying time last 30 days	69
Total flying time last 90 days	703

¹³ Source: Republic Airways for further information see Operational Factors Group – Attachment 3 Flight Crew Training and recent Flight Records.

2.2 First Officer

The first officer, FO, was 30 years old. His date of hire was July 24, 2018, and he held an Airline Transport Pilot (ATP) certificate with a rating for airplane multiengine land with type rating in the ERJ-170 /175¹⁴. He also held CFI¹⁵, CFII¹⁶ and MEI¹⁷ certificates.

2.2.1 First Officer's Pilot Certification Record

FAA records of the first officer indicated the following:

Private Pilot – Airplane Single-Engine Land; Limitation: English Proficient certificate was issued June 30, 2016.

Private Pilot – Airplane Single- and Multiengine Land; Limitation: English Proficient certificate was issued on July 15, 2016.

Private Pilot – Airplane Single- and Multiengine Land; Instrument Airplane; Limitation: English Proficient certificate was issued on September 12, 2016.

Commercial Pilot – Instrument Airplane; Airplane Multiengine Land; Private Pilot Privileges: Airplane Single Engine Land; Limitation: English Proficient certificate was issued on October 25, 2016.

Flight Instructor – Airplane Multiengine; Limitation: Valid Only When Accompted by Pilot Certificate No. 3883543; Expires December 31, 2018 certificate was issued on December 4, 2016.

Commercial Pilot – Airplane Single & Multiengine Land; Instrument Airplane; Limitation: English Proficient; certificate was issued on December 11, 2016.

Flight Instructor –Airplane Single-Engine; Airplane Multiengine; Limitation: Valid only when Accompted By Pilot Certificate No. 3883243. Expires December 31, 2018. certificate was issued on December 21, 2016.

Flight Instructor –Airplane Single-Engine; Airplane Multiengine; Instrument Airplane Limitation: Valid Only When Accompted By pilot Certificate No. 3883243; Expires December 31, 2018 certificate was issued on December 22, 2016.

¹⁴ Embraer Source S.A. (formally known as Yaborã Indústria Aeronáutica S.A.): ERJ 170-100 STD, ERJ 170-100 LR, ERJ 170-100 SU, ERJ 170-100 SE, ERJ 170-200 STD, ERJ 170-200 LR, ERJ 170-200 SU, ERJ 190-100 STD, ERJ 190-100 LR, ERJ 190-100 IGW, ERJ 190-100 ECJ, ERJ 190-200 STD, ERJ 190-200 LR, ERJ 190-200 IGW, ERJ 190-300 FAA Order 8900.1, Figure 5-88.

¹⁵ Certified Flight Instructor.

¹⁶ Certified Flight Instructor – Instruments.

¹⁷ Multi-Engine Instructor.

Airline Transport Pilot – Airplane Multiengine Land; ERJ-170¹⁸; ERJ-190; Commercial Pilot Privileges; Airplane Single-Engine Land; Limitations: Engine Proficient; The ERJ 170/190 Type Rating Is Subject To The Pilot In Command Limitations: ATP Circling Approach VMC Only; ERJ-170, ERJ-190 Circling Approach – VMC Only; certificate was issued on October 20, 2018.

2.2.2 First Officer’s Certificates and Ratings Held at the Time of the Incident

Airline Transport Pilot (issued October 20, 2018)

Airplane Multiengine Land

Type ratings in the ERJ-170, ERJ-190

Limitations: ATP/ ERJ-170, ERJ-190 circle approach in VMC only.

Commercial Pilot (issued December 11, 2016)

Airplane Single-Engine and Multiengine Land

Flight Instructor (issued December 22, 2016)

Airplane Single-Engine

Airplane Multiengine

Instrument Airplane

Medical Certificate – First Class (issued March 10, 2017)

Limitations: None

2.2.3 First Officer’s Training and Proficiency Checks

INDOC – Initial Indoctrination	August 3, 2018
LOE – Line Oriented Evaluation	November 1, 2018
MV – Maneuvers Validation	October 20, 2018
PV – Procedure Evaluation (Simulator)	October 20, 2018
SV -System Evaluation (Online)	October 7, 2018

2.2.4 First Officer’s Flight Time

Total flying experience at Republic	677
Total flying experience ERJ 170/175	677
Total SIC incident make/model	677
Total flying the preceding 24 hours	7
Total flying time last 7 days	17
Total flying time last 30 days	71
Total flying time last 90 days	189

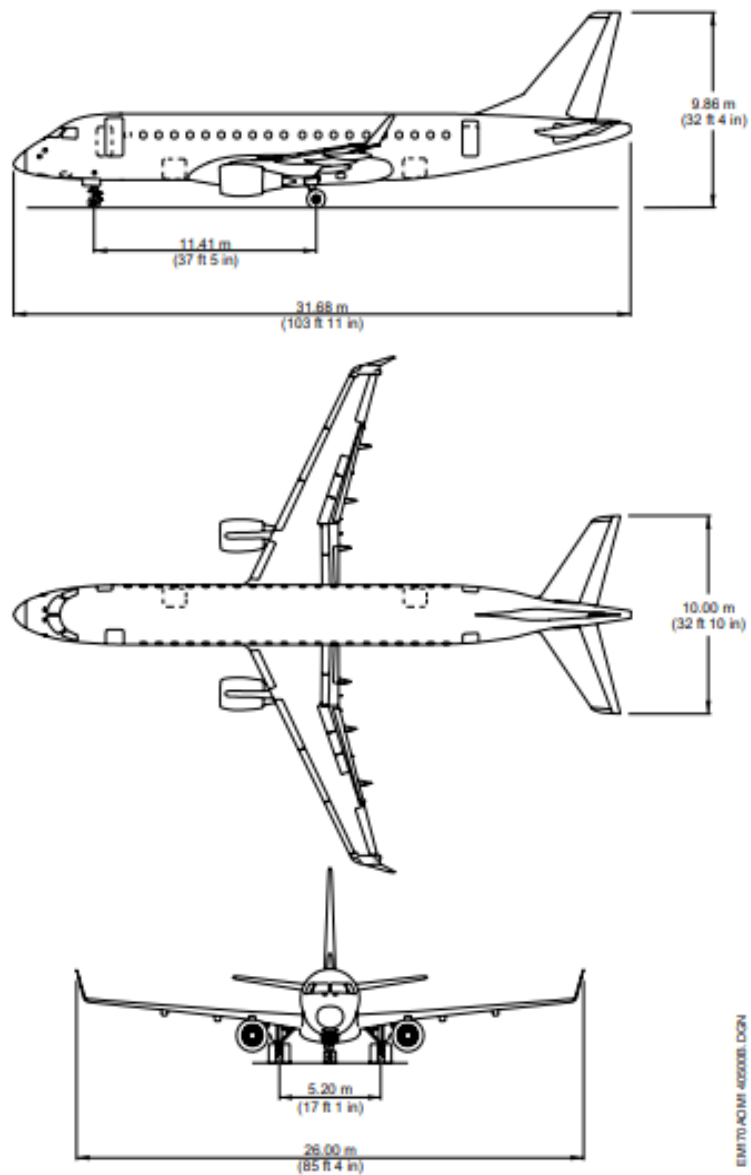
¹⁸ Embraer S.A. ERJ-170-100 STD, ERJ 170-100 LR, ERJ 170-100 SU, ERJ 170-100 SE, ERJ 170-200 STD, ERJ 170-200 LR, ERJ 170-200 SU, ERJ 190-100 STD, ERJ 190-100 LR, ERJ 190-100 IGW, ERJ 190-100 ECJ, ERJ 190-200 STD, ERJ 190-200 LR, ERJ 190-200 IGW. Source: FAA Order 8900.1 Figure 5-88.

3.0 Airplane Information

The incident airplane (Registration N117HQ, Serial No. 17000184) was an-Embraer-Empresa Brasileira de Aeronáutica ERJ-170-200 LR. The airplane was built in 2007, registered to Republic Airways, Inc. and held a transport category airworthiness certificated dated September 26, 2007. The airplane was powered by 2 GE CF34-8E5 turbo fan engines, and each were rated at 14,510 pounds of takeoff thrust. The airplane was configured with 2 pilot seats, one cockpit observer seat, 1 forward flight attendant jumpseat, 1 aft flight attendant jumpseat, and 70 passenger seats.



Photo 1: ERJ-170-200LR , Actual Airplane (Photo credit: Colin Brown)



THREE VIEW DRAWING

Photo 2: Embraer Model 175 General Dimensiones¹⁹

¹⁹ Source: Embraer 170/175 Airplane Operating Manual Volume 2, page 2/10

3.1 Estimated Weight and Balance

Aircraft Basic Operating Weight (BOW) ²⁰	49,941
Total Passenger Weight ²¹	1,140
Total Cargo Weight	1,085
Maximum Zero Weight	69,887
Zero Fuel Weight	52,166
Fuel Weight	12,300
Estimated Taxi Fuel	700
Ramp Weight	63,766
Maximum Ramp Weight	85,870
Maximum Takeoff Weight (Structural)	85,517
Maximum Allowable Takeoff Weight ²²	74,957
Actual Takeoff Weight	63,766
Estimated Fuel Burn	7,396
Maximum Landing Weight	74,957
Estimated Landing Weight	56,370
Takeoff Center of Gravity (CG)	17.5% MAC
CG Limits (per Airplane Flight Manual)	10.1-27.0%
V _{REF} ²³ Flaps Full	132 knots

²⁰ The Aircraft BOW is the weight of the structure, powerplant, instruments, flight controls, hydraulic, electronic, electrical, air conditioning, oxygen, anti-icing and pressurization systems, interior furnishings, portable and emergency equipment and other items of equipment that are an integral part of the aircraft configuration. It also includes unusable fuel, total engine and APU oil, total hydraulic fluid, toilet fluid and water, potable water, crew and crew baggage, navigation kit (manuals, charts), catering (beverages and food) and removable service equipment for the galley as determined by the maintenance department and includes the following weights: Aircraft configures with 20 first class seats and 172 cabin class seats, 2 pilots with flight kits and bags, 4 flight attendants and bags, Galley cart and supplies, domestic level catering. Source Embraer 175 Airport Planning Manual.

https://www.flyembraer.com/irj/go/km/docs/download_center/Anonymous/Ergonomia/Home%20Page/Documents/APM_175.pdf

²¹ Estimate based on a 190- pound average weight per passenger.

²² This was limited by aircraft performance.

²³ V_{REF} was defined as 1.3 times the stalling speed in the stated landing configuration and at the prevailing aircraft weight. This is the speed required as the landing runway threshold is crossed at a height of 50 feet in landing configuration if the calculated aircraft performance is to be achieved. FAR 97.3 Aircraft approach category, also recognizes that V_{ref} may not be 1.3V_{so}. Source: [https://www.skybrary.aero/index.php/Reference_Speed_\(Vref\)](https://www.skybrary.aero/index.php/Reference_Speed_(Vref))

3.2 Maximum Recommended Crosswind Limitation

The Republic Airways E170/175 Operations Manual “Limitations – Operating Limitations,” pg. 3-4, indicated the Embraer aerodynamic analysis have resulted in the following maximum recommended crosswinds for takeoff and landing.

RCC	Braking Action	Maximum Recommended Crosswind (kt)
6	-	38
5	Good	31
4	Good to Medium	20
3	Medium	15
2	Medium to Poor	12
1	Poor	08

Figure 1: Republic Airways Crosswind Limitation

4.0 Meteorological Information

Airport weather observations for ATL were obtained from the National Weather Service. Airport weather information found in the METAR²⁴ for ATL originated from an Automated Surface Observing System (ASOS). The following METARs were issued for ATL for the time period surrounding the accident:

[2052 EDT] METAR KATL 070152Z 12005KT 10SM BKN250 16/08 A3031 RMK AO2 SLP 262 T01560083=

[2152 EDT] METAR KATL 070252Z 10005KT 10SM SCT250 14/08 A3031 RMK AO2 SLP 263 T01440083 51005=

The decoded METAR for ATL at 2052:

Atlanta weather observation at 2052 EST, wind from 120° at 5 knots, visibility 10 miles or more, ceiling broken at 25,000 ft agl²⁵, temperature 16° Celsius (C), dew point 8° C, altimeter 30.31 inches. Remarks: automated station with a precipitation discriminator, sea-level pressure 1026.2-hPa²⁶, temperature 15.6° C, dew point 8.3° C.

5.0 Airport Information

Hartsfield- Jackson Atlanta International Airport (ATL) was the main commercial airport for the city of Atlanta, Georgia. It is located about 7 miles to the south of downtown Atlanta at 33°38.20N by 84°25.67W. The airport elevation was 1,026 feet msl²⁷ and had five paved runway surfaces. The runways were all oriented in an east and west direction.

²⁴ Meteorological Aerodrome Report.

²⁵ Above Ground Level

²⁶ Hectopascal (unit of pressure)

²⁷ mean sea level.

According to FAA records, the airport was owned by the City of Atlanta. The airport had an operating FAA air traffic control tower (ATCT) that operated continuously and was in operation at the time of the incident.

5.1 Airport Diagram

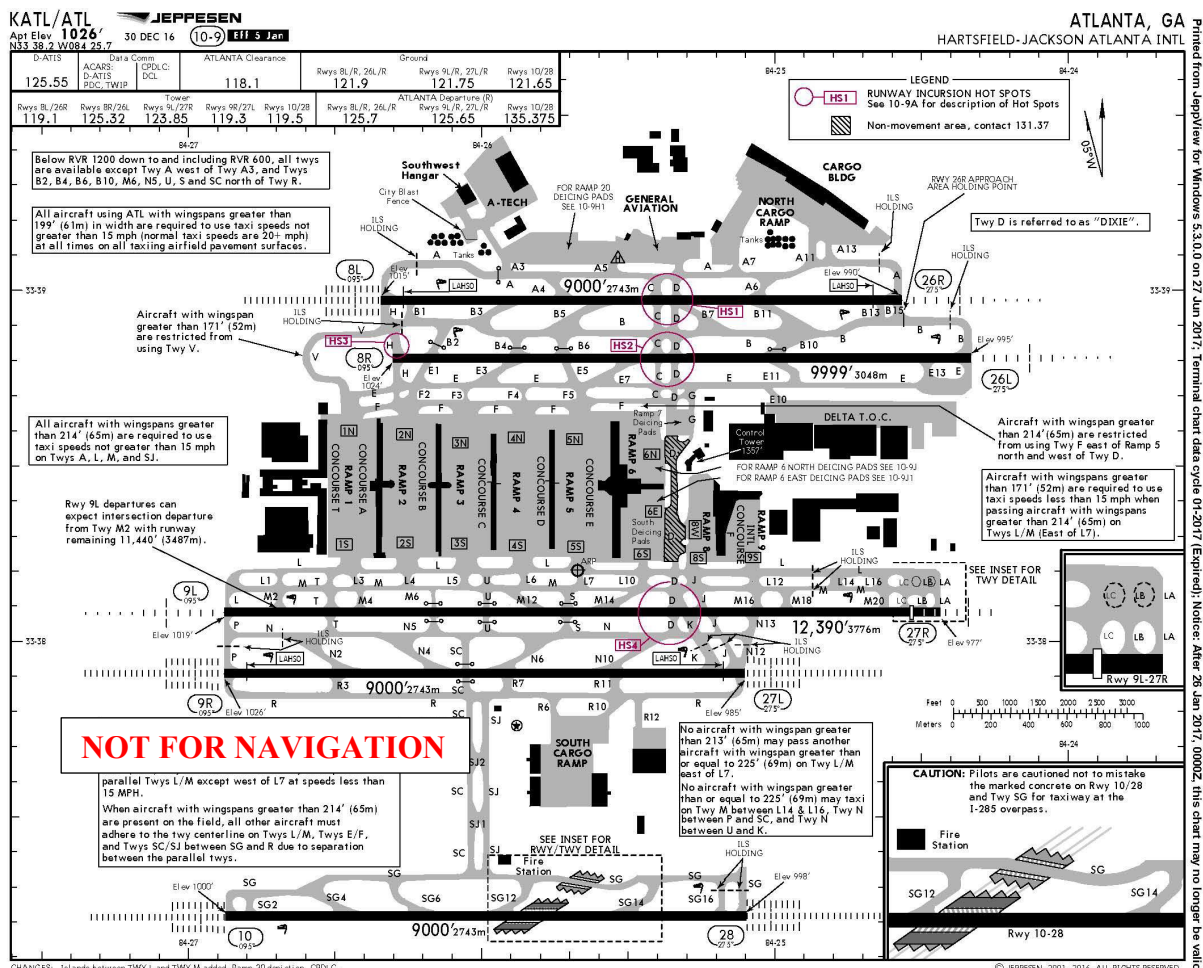


Figure 2: Jeppesen Airport Diagram of Hartsfield-Jackson Atlanta International Airport

5.2 Runway Information

Runway 10/28 was 9,000 feet long and 150 feet wide and was grooved concrete. Runway 10 had 9,000 feet available for landing. Runway 10 was equipped with ALSF2²⁸ approach lighting system and had a 4-light Precision Approach Path Indicator (PAPI), with a charted 3.00° glide path, located on the right side of the runway.

According to the Aeronautical Information Manual Pilot/Controller Glossary, the precision approach path indicator (PAPI) was an airport lighting system, similar to a VASI, providing vertical approach slope guidance to aircraft during approach to landing. PAPIs consisted of a single row of either two or four lights, normally installed on the left side of the runway, and had an

²⁸ High Intensity Approach Lighting System With Sequenced Flashing Lights.

effective visual range of about 5 miles during the day and up to 20 miles at night. PAPIs radiated a directional pattern of high intensity red and white focused light beams which indicated that the flight is "on path" if the pilot sees an equal number of white lights and red lights, with white to the left of the red; "above path" if the pilot sees more white than red lights; and "below path" if the pilot sees more red than white lights.

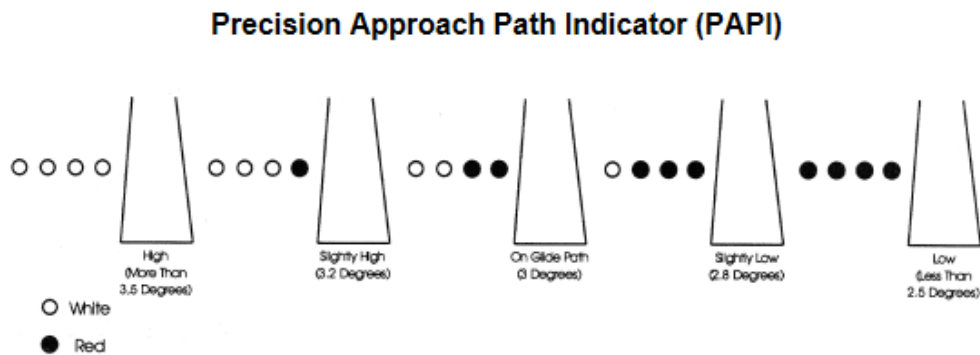


Figure 3: Precision Approach Path Indicator²⁹

5.3 Charts

According to crew interview statements, they used the ILS³⁰ approach to back up their visual approach clearance to runway 10. The ILS 10 was equipped with a 3.00° glide slope and DME³¹.

²⁹ Aeronautical Information Manual Chapter 2 Figure 2-1-5.

³⁰ Instrument Landing System

³¹ Distance Measuring Equipment.

the Caribbean and Central America according to their website. Republic Airways, Inc. operates flight daily through fixed-fee agreements under airline partner brands, including American Eagle, Delta Connection, and United Express. Republic had over 5,500 employees at the end of 2020 and had approximately 2,400 pilots in ten pilot bases.

The pilot bases are Boston, MA, Louisville, KY, Columbus, OH, Washington, DC, Newark, NJ, Indianapolis, IN, LaGuardia NY, Chicago, IL, Philadelphia, PA and Pittsburg, PA.

7.0 Relevant Airplane Systems

7.1 Pitch Control

The Embraer 170/175 Airplane Operations Manual, AOM, revision 24, page 1/8 described the pitch trim system as follows:

Pitch axis control is by means of electro-hydraulic commanded elevators and an electro-mechanical horizontal stabilizer.

7.2 Elevator Control System

Pilot's inputs to the elevators are through the cockpit control columns in normal or direct mode. The elevators can be automatically controlled through the FCM via the autopilot.

7.2.1 Elevator Control System Components

A total of four P-ACE channels are used to independently control each of the four PCUs, providing the analog elevator control functions implemented in the P-ACE units.

Four independent FCM units, located in the MAU 1 and 3, provide high-level system augmentation to the P-ACE units, such as gain scheduling as a function of airspeed, elevator thrust compensation and AOA limiting.

7.2.2 Elevator Control Operation Mode

Normal Mode: With the elevator control system operating in normal mode, the elevator moves according to gain scheduling as a function of airspeed, reducing elevator movement with increasing airspeeds. In the event of loss of airspeed information, the FCM is removed from the control loop, and the associated P-ACE reverts to direct mode. FCM functions and AOA limiting are then no longer available.

Direct Mode: When the FCM is removed from the control loop the elevator system is reverted to direct mode automatically and the operation is defaulted to fixed control laws configuration.

Elevator high level functions as well as the auto pilot are no longer available.

7.2.3 Power Control Units

The elevator surfaces are hydraulically actuated through the PCU units.

The hydraulic systems responsible for powering the actuators are:

- Hydraulic System 1: left outboard actuator.*
- Hydraulic System 2: left & right inboard actuators.*
- Hydraulic System 3: right outboard actuator.*

Since the actuators on each surface operate on active/standby mode, the P-ACE automatically alternates the active actuator every time the elevator system is powered up. The loss of hydraulic supply forces the standby PCU to become active.

7.3 Elevator Jam

If a jam in one of the elevator actuators is detected, the respective elevator surface will remain fixed at the position where the jam occurred. The pilot will be able to control the airplane using the remaining elevator.

7.3.1 Elevator Flight Control Panel Button

A dedicated button on the Flight Control Mode panel provides the capability to the pilots to reset the elevator system to Normal Mode in case of the system defaulting to Direct Mode, or to manually default the elevator system to Direct Mode.

When the flight control panel elevator button is pushed in, it commands all four elevator channels to change from Normal to Direct mode. In addition, pushing the button also results in the active elevator channels transitioning to the standby state, and the channels that were previously in standby would become active. This feature is also included to allow the system to transition away from the present controlling channels.

When the flight control panel elevator button is pushed out, the system reverts to the Normal Mode.

7.3.2 Disconnect Mechanism (Jammed Column)

A disconnect mechanism is provided to allow separation of the First Officer and Captain's control columns. In the event of a jam in one of the control columns, the disconnect mechanism can be actuated by the pilots through the disconnect handle in the cockpit.

Following a disconnection, the pilot of the non-jammed side retains pitch control by means of the on-side elevator. The system will remain disconnected for the remainder of the flight and ground maintenance is required to reset the disconnected unit.

7.4 Horizontal Stabilizer Control System

Control of the horizontal stabilizer is by means of an electromechanical system commanded by either:

- The manual selection of the Captain or First Officer's wheel main trim switches or pedestal mounted backup trim switches which directly control an electrical servo motor coupled to the Horizontal Stabilizer Actuator (HSA).
- Or the Flight Control Module (FCM) for autopilot trim and speed brake auto trim which actuate the electrical servo-motor coupled to the Horizontal Stabilizer Actuator (HSA).

7.4.1 Horizontal Stabilizer Control Components

Horizontal Stabilizer Actuator Control Electronics (HS-ACE) and one Horizontal Stabilizer Actuator (HSA) are used to move the control surface.

7.4.2 Horizontal Stabilizer Actuator

The HSA is a single electrical-mechanical actuator. Two DC motors drive the actuator in an active/standby configuration. Stabilizer position is provided to the HS-ACE and is used for monitoring and EICAS indication.

7.5 Stabilizer Trim

The Embraer 170, 175 Airplane Operations Manual, revision 25, page 4/16, Flight Controls, System Description has the following information about the Trim panel:

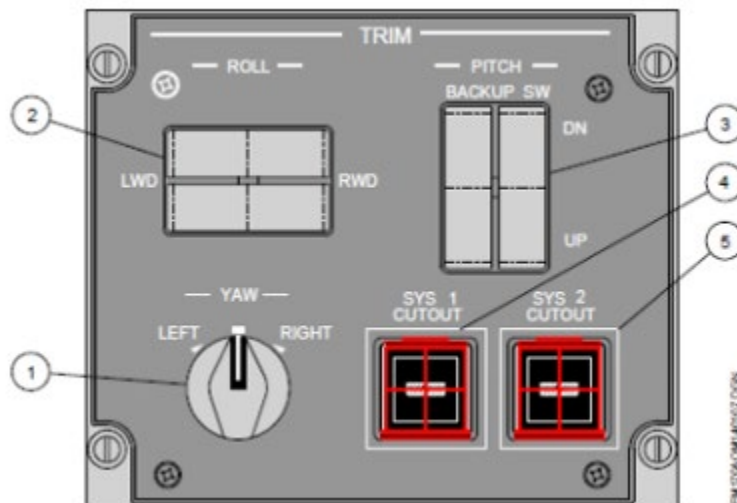


Photo 3: Trim Panel and Description

- 1 - YAW TRIM KNOB (SPRING-LOADED TO NEUTRAL)
 - Actuates the yaw trim to left or right.
 - Manual pilot trim commands are limited to 3 s.
- 2 - ROLL TRIM SWITCH (SPRING-LOADED TO NEUTRAL)
 - Actuates the roll trim to left or right.
 - Manual pilot trim commands are limited to 3 s.
- 3 - PITCH TRIM BACK-UP SWITCH (SPRING-LOADED TO NEUTRAL)
 - Operation of the switch while the autopilot is engaged causes the autopilot to disengage.
 - Manual pilot trim commands are limited to 3 s.
- 4 - PITCH TRIM SYS 1 CUTOUT BUTTON (GUARDED)

PUSH IN:	disables the HS-ACE channel 1.
PUSH OUT:	enables the HS-ACE channel 1.
- 5 - PITCH TRIM SYS 2 CUTOUT BUTTON (GUARDED)

PUSH IN:	disables the HS-ACE channel 2.
PUSH OUT:	enables the HS-ACE channel 2.

7.5.1 Manual Trim

The Embraer 170/175 Airplane Operations Manual, AOM, revision 24 dated August 14, 2015, described the manual system as follows:

The manual trim is commanded through switches installed on the control columns or a backup switch located on the main pedestal. Signals from either the control columns switches, or the backup switch controls the electric trim motor.

The backup trim switches, and the control wheel trim switches are dual split switches which have a 7 second time limitation when actuated separately. If only one half of the switch is actuated for more than 7 seconds, that switch is automatically deactivated. The aural warning “TRIM” triggers for 7 seconds when the control wheel trim or backup trim switches have failed or when only half of the switch is pressed. If the failure persists for more than 7 seconds, the aural message is deactivated, and the applicable advisory pitch trim switch fail message is displayed on EICAS.

In order to avoid a possible pitch trim runaway condition, manual pilot trim commands are limited to 3 seconds. After the control wheel trim or backup trim switches have both been halves pressed for more than 3 seconds, the trim stops the horizontal stabilizer control surface movement and if the switch remains pressed, the aural warning “TRIM” triggers. When the

switch is no more pressed, the aural warning stops. In case of a stick shaker activation, the HS-ACE is prevented from responding to any pitch trim commands by a stick shaker signal from the AFCS.

7.6 Stabilizer Trim priority logic

The HS-ACE responds to all trim commands with the following priority:

- 1. Backup switches.*
- 2. Captain.*
- 3. First Officer.*
- 4. FCM (auto-trim) commands.*

7.7 Autopilot Trim

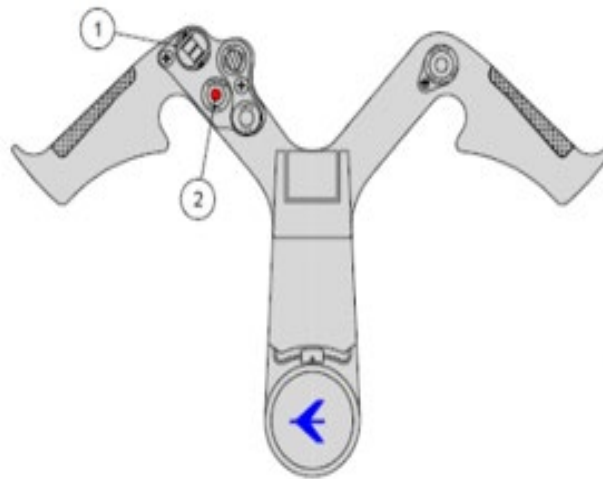
The autopilot can directly operate the electric trim motor when the autopilot is engaged. If the autopilot trim function is inoperative, the autopilot cannot be engaged. If this function is lost during autopilot operation, the autopilot will disengage.

Autopilot trim function will be active only if:

- Autopilot is engaged.*
- Configuration trim is operational.*
- Manual electric trim is not active.*
- On-side autopilot channel is priority.*

NOTE: In case of an electrical failure, followed by RAT deployment, the trim function will work at half speed operation, for either manual trim or autopilot trim.

7.8 Control Wheel



1 - PITCH TRIM SWITCH (SPRING-LOADED TO NEUTRAL)

- Trims the airplane when the autopilot is not engaged.
- If only half of the switch is actuated for more than 7 s, the switch will be automatically deactivated.
- Manual pilot trim commands are limited to 3 s.

NOTE: Captain's pitch trim switch actuation has priority over the first officer's.

2 - AP/TRIM DISCONNECT BUTTON

Trim

- Disables both HS-ACE channels when the switches remain pressed, thus disconnecting the autopilot and stopping any active trim command.
- Releasing the button will activate the channel again.

Autopilot

- Refer to Automatic Flight.

8.0 Stall Warning Systems

8.1 Stalls

According to page 5-25 in the FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B), an aircraft stall results from a rapid decrease in lift caused by the separation of airflow from the wing's surface brought on by exceeding the critical Angle of Attack (AOA). The AOA is the angle at which relative wind meets an airfoil and is formed by the chord of the airfoil and the direction of the relative wind or between the chord line and the flight path. The AOA changes during a flight as the pilot changes the direction of the aircraft and is related to the amount of lift being produced. A stall can occur at any pitch attitude or airspeed.

According to 14 CFR 1.2 – Abbreviations and symbols, VS is the stalling speed, or the minimum steady flight speed obtained in a specific configuration.

8.2 Stall Protection System

The Embraer 170/175 AOM, revision 25, Systems Description, Warning System, page 1/2 describes the ERJ 170-200LR stall system as follows:

The stall protection system provides warning to the pilot when the airplane's speed is approaching stall speed. It is provided by the Auto Flight Control System (AFCS) by activating the stick shaker motor on the control column. The Flight Control Module (FCM) provides stall protection by means of angle-of-attack (AOA) limiting function.

8.3 Stall Protection Activation

Once the stick shaker is activated by the AFCS, the AOA limiting function reduces control column authority in the nose up direction gradually until the control column reaches the aft stop, thereby limiting the angle of attack. The FCM computes AOA limiting command using angle of attack data, control column position and inertial feedback.

If one or more sensors required performing the AOA limiting fails, the function is no longer available, and the respective message is displayed on the EICAS.

9.0 Republic Airways Checklist Information, Policy and Guidance

The Republic Airways Flight Operations Manual dated October 01, 2019, section 19.3.2, contained the following checklist information:

9.1 Read and Do Checklist

Read and Do Checklists are directly referred to when accomplishing and will contain all items necessary to accomplish the task it was designed for (for example configuring the aircraft for application of electrical power/air conditioning and for power down).

9.2 Non-Normal Operations (QRC/QRH³³)

9.2.1 Design

- A. Non-Normal checklist are used to accomplish and verify each step of a single emergency or non-normal procedure and must be performed in the sequence, one item at a time.*
- B. All non-normal procedures are FAA approved.*
- C. Non-normal procedures originate with the manufacturer and may be modified by the Company where necessary for safety, clarification, or standardization.*
- D. The Company has determined an equivalent or greater level of safety is provided by these modified procedures.*

9.2.2 Policy

- A. Flight crewmembers will follow the non-normal procedures located in the aircraft-specific Quick Reference Card (QRC), Quick Reference Handbook (QRH), or Standard Operating Procedures (SOP) to contain non-normal situations.*
- B. Non-normal checklists cannot be created for all conceivable situations. The PIC has the authority to deviate from non-normal procedures when an emergency situation requires him to do so in the interest of safety.*
- C. All actions must be coordinated under the PIC's supervision and performed in a deliberate, systematic manner.*
- D. Crewmembers must be thoroughly familiar with non-normal procedures and the location and use of emergency equipment.*
- E. Any flight crewmember should be able to handle the non-normal duties of any other flight crewmember.*
- F. Multiple failure situations may require crews to prioritize checklist usage.*

9.2.3 Definitions

9.2.3.1 Memory Item

- 1) A memory item is a non-normal procedure that must be accomplished immediately from memory by the PM after either crewmember recognizes the non-normal.*

³³ Quick Reference Card/Quick Reference Handbook

- 2) *Memory items are located on the QRC within a black bordered box in black capital letters.*

9.2.3.2 Immediate Action Item

- 1) *An immediate action item is a non-normal procedure that must be accomplished as soon as possible after the PF or PM recognizes the non-normal.*
- 2) *Immediate action items are located on the QRC and are in capital black letters, but not inside a black bordered box.*

9.2.3.3 Quick Reference Card (QRC)

- 1) *The QRC is located in a holder located on top of the glare shield directly underneath the standby magnetic compass. If other documents are placed in the glare shield document holder, the QRC must always be on top for immediate access.*
- 2) *The QRC will be the primary reference for any non-normal procedure that contains an immediate action item*

9.2.3.4 Quick Reference Handbook (QRH)

- 1) *A QRH must be readily available. One will be stored in the ship's library (the bin on the aircraft left side of the flight deck) and the other will be stored in the bin on the center pedestal.*
- 2) *The QRH will be the primary reference for any non-normal procedure that does not contain a memory item or an immediate action item.*

9.2.3.4 Land at the Nearest Suitable Airport

- 1) *Whenever this statement is included in a non-normal checklist, the captain should ensure that an emergency is declared with Air Traffic Control and turn the aircraft without delay towards the nearest suitable airport.*
- 2) *If this statement is not included in a non-normal checklist, it is the captain's decision to declare an emergency.*

9.2.3.5 Establish and Communicate a Plan

The PF and PM must establish and communicate a plan of action. Communicate this information to the Flight Attendants (NTSB items), Air Traffic Control, System Operation Control, and the Passengers.

10.0 Emergency and Abnormal Procedures

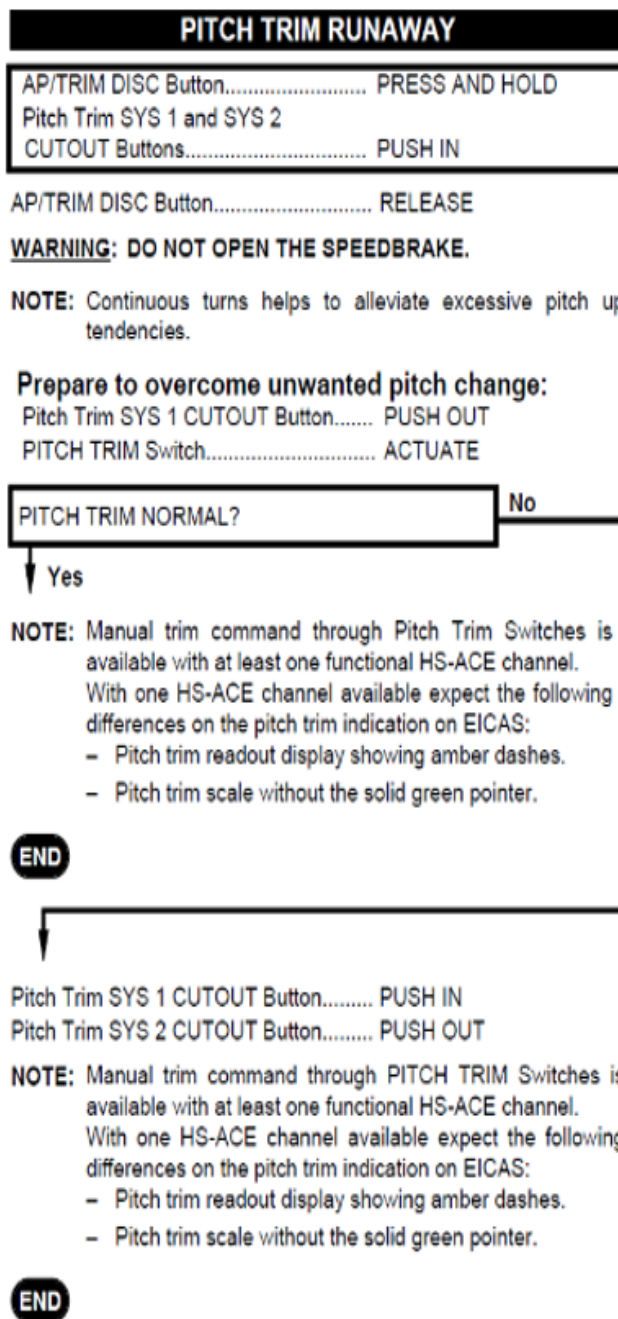
10.1 Pitch Trim Runway –Procedure

The Embraer 170/175 Airplane Operations Manual, AOM, revision 22 NAP1-15 has the following non-Annunciated procedure for a Pitch Trim Runway. The Embraer Pitch Trim Runway procedure includes two steps in the Initial Action Items or Memory Items. The Auto Pilot/Trim Disconnect Button has to be pressed in and held and the Cutout Buttons have to be pushed in.

The Republic Airways Quick Reference Handbook, QRH, E170/175 revision 11, dated June 11, 2019, has one Initial Action Item or Memory Item for a Pitch Trim Runway. The Republic procedure only requires the Auto Pilot/Trim Disconnect Button to be pressed in and held.

Both respective procedures are depicted below.

10.2 Pitch Trim Runway – Embraer Procedure



10.3 Pitch Trim Runaway – Republic Procedure



Quick Reference Handbook E170/175

Flight Controls

PITCH TRIM RUNAWAY

AP/TRIM DISC BUTTON.....PRESS & HOLD

PITCH TRIM SYS 1 & 2

CUTOUT BUTTONS PUSH IN

AP/TRIM Disc ButtonRELEASE

WARNING!

Do not open the speedbrake.

DECLARE AN EMERGENCY

LAND AT THE NEAREST SUITABLE AIRPORT

NOTE: Continuous turns help to alleviate excessive pitch up tendencies.

WARNING!

Due to possibility of a subsequent runaway while actuating Pitch Trim System 1, be prepared to intervene with the AP/TRIM Disc Button.

Pitch Trim System 1

Cutout Button.....PUSH OUT

Pitch Trim Switch.....ACTUATE

PITCH TRIM NORMAL?

No

Yes

NOTE: Manual trim command through Pitch Trim Switches is available with at least one functional HS-ACE channel. With one HS-ACE channel available expect the following differences on the pitch trim indication on EICAS:

- Pitch trim readout display showing amber dashes.
- Pitch trim scale without the solid green pointer.

ESTABLISH AND COMMUNICATE A PLAN

- Contact FAs using EMER Call Button
- Make a PA to the passengers
- Notify Dispatch

END

Pitch Trim System 1

Cutout Button PUSH IN

F. LIST OF ATTACHMENTS

Attachment 1 - Flight Crew Interview Transcripts
Attachment 2 - Embraer 175 Airport Planning Manual
Attachment 3 - Flight Crew Training
Attachment 4 - Republic Quick Reference Card
Attachment 5 - Embraer AOM Pitch Trim {Excerpts}
Attachment 6 - Embraer Pitch Trim Runway Checklist
Attachment 7 – Republic Pitch Trim Runway Checklist

Submitted by:
Warren Abrams
Air Safety Investigator

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