

WPR24FA083

OPERATIONAL FACTORS/HUMAN PERFORMANCE

Attachment 4
Simulator Evaluation
November 19, 2024

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SIMULATOR EVALUATION

Location: CAE New Jersey Morristown Training Center, Whippany, NJ
Date: November 19, 2024
Time: 0957 EST¹
Aircraft: Hawker 800 XPi simulator no. 2RXN-712
Airport: KCOS

Overall Objective:

- Documentation of indications and handling characteristics.
- Document procedures for Stalls per Hawker Beechcraft Corp Pilot's Operating Manual.
- Document any control force required to overcome pitching motion using terms such as "lighter," "heavier," "normal," etc.
- Capture the following audible sounds: Stick Shaker, Altitude Alert Tone (C-chord), Autopilot disconnect, "horn" similar to stall warning horn on a Cessna 172

Invited Participants²:

Stephen Stein (IIC)
Katherine Wilson (NTSB, Human Performance)
Shawn Etcher (NTSB, Operational Factors)
Timothy Burtch (NTSB, Performance)³
Patrick Lusch (FAA - AVP-110)
Ricardo Asensio (Textron Aviation)
Kelsey Veer (Textron Aviation - Test Pilot)
Dondi Pangalangan (Clay Lacy)

Initial Simulator Setup for the Test Runs:

- On runway at Colorado Springs (COS), CO
 - Airplane started and checklists completed to the "Before Take-Off Checks"
- Configuration:
 - Weight 23,890 lbs
 - Fuel 7,290 lbs
 - % MAC 24
 - Outside temperature on ground 8°C, Dewpoint -1°C
 - V-speeds associated with above weight V_1 - 110, V_r - 118, V_2 - 128.
- Cloud heights: Scattered at 6,000 ft. agl, overcast 10,000 ft agl tops at 17,000 ft msl.

¹ Eastern standard time

² The group was divided up into two(2) groups and the runs were each done for both groups. The first group consisted of Katherine Wilson, Shawn Etcher, Dondi Pangalangan, with Kelsey Veer as the pilot flying. The second group consisted of Stephen Stein, Patrick Lusch, Ricardo Asensio with Kelsey Veer as the pilot flying.

³ Mr. Burtch was unable to attend.

- Weather:
 - Wind: 260@10
 - Visibility 10 SM
 - Altimeter 29.59
 - Temperature 8°C
 - Dew Point -1°C
 - **KGJT 071853Z 26010KT 10SM FEW060 FEW080 OVC100 08/M01 A2959 RMK AO2 RAE30 SLP994 P0000 T00781006**
- Day
- Fuel freeze to be utilized during the entire simulator evaluation to repetitively simulate the accident flight's weight near the time of the accident.
- All stalls will be started at altitudes noted in the plan and will be recovered as noted in the plan.
- All stalls will be performed from left seat unless noted otherwise.
- All runs will be conducted with motion **on** unless noted otherwise.
- All subsequent runs will be set up in flight as listed in plan; only the first run will begin on the ground at GJT.
- All runs to be repeated as necessary and note attempt number.
- Items to note during runs:
 - Handling characteristics
 - Any secondary stalls
 - Any stalls that require the sim to be stopped

Run 1: Normal Departure with Climb to 18,000 ft

Procedure

- Place aircraft on runway 31.
- Normal departure and climb procedures
 - Allow for acclimation of normal procedures and indications.
 - **NO** turbulence
- Allow airplane and autopilot to stabilize during a normal climb.
- Level at 18,000 ft.
- Note and document, if any, all indications and alerts.
- Reduce thrust to idle and allow airspeed to decrease until onset of stick shaker.
- Note any control forces needed after the autopilot was disconnected and if autopilot automatically disconnected or was manually disconnected.
- Recover airplane and climb to 18,000 ft.

Specific items to note.

- Document the following:

- Max Pitch Attitude 16° nose up
- Airspeed at Stick Shaker 121 kts.
- Pitch attitude during recovery N/A
- Roll Angle 0° left/right
- Altitude when stick shaker activated 18,000 feet
- Lowest altitude before airplane recovered 17,700 feet

Notes

- Aircraft indications noted: Stall Valve 'A' illuminated
- Aircraft indications noted **AFTER** autopilot disengaged: normal barber pole on airspeed indicator with normal stall characteristics to the shaker per the pilot. No abnormal control forces and classified as "normal" forces.

Run 2: Stall Clean Configuration with Icing

Procedure

- Place aircraft 18,000 ft on flight freeze.
- Normal climb procedures
 - Allow for acclimation of normal procedures and indications.
 - **NO** turbulence
 - Light icing in clouds
- Allow airplane and autopilot to stabilize during a normal climb prior to releasing the simulator.
- Level at 18,000 ft.
- Note and document, if any, all indications and alerts.
- Reduce thrust to idle and allow airspeed to decrease until onset of stick shaker.
- Note any control forces needed after the autopilot was disconnected and if autopilot automatically disconnected or was manually disconnected.
- Recover airplane and climb to 18,000 ft.
- Stop run when airplane recovered and level at 18,000ft.

Specific items to note.

- Document the following:
 - Max Pitch Attitude 16°nose up
 - Airspeed at Stick Shaker 122 kts.
 - Pitch attitude during recovery 8°nose up
 - Roll Angle 0° left/right
 - Altitude when stick shaker activated 18,000 feet
 - Lowest altitude before airplane recovered 17,800 feet

Notes

c. Aircraft indications noted: issue with developing simulated ice. Simulator maintenance was requested and it was determined to use -16°C with rain instead of the -28°C that was used for previous and other runs. Ice was simulated as "light."

d. Aircraft indications noted **AFTER** autopilot disengaged: after the stick shaker the stall was benign. There were no roll indications throughout the maneuver and the autopilot disconnected at the onset of the stick shaker.

Run 3: Stall Clean Configuration CAE Pusher Demonstration

Procedure

- Place aircraft 18,000 ft on flight freeze.
- Normal climb procedures
 - Allow for acclimation of normal procedures and indications.
 - **NO** turbulence
- Allow airplane and autopilot to stabilize during a normal climb prior to releasing the simulator.
- Level at 18,000 ft.
- Note and document, if any, all indications and alerts.
- Reduce thrust to idle and allow airspeed to decrease until onset of stick shaker.
- Allow airplane to continue to slow until pusher activation and note any other indications
- Note any control forces needed after the autopilot was disconnected and if autopilot automatically disconnected or was manually disconnected.
- Recover airplane and climb to 18,000 ft.
- Stop run when airplane recovered and level at 18,000 ft.

Specific items to note.

- Document the following:
 - Max Pitch Attitude 15° nose up
 - Airspeed at Stick Shaker 121 kts.
 - Pitch attitude during recovery 5° nose down
 - Roll Angle 0° left/right
 - Altitude when stick shaker activated 18,000 feet
 - Lowest altitude before airplane recovered 17,100 feet

Notes

e. Aircraft indications noted: Stall valve A and B illuminated nearly simultaneously.

f. Aircraft indications noted **AFTER** autopilot disengaged: Pilot stopped trimming at 158 kts. Silenced gear horn at 150 kts. The stall occurred with pusher at 115 kts. Typically the airplane would have about a 10° nose down pitching moment per test pilot. The pusher force was appropriate per test pilot.

Run 4: Stall Clean Configuration with Disabled Pusher

Procedure

- Place aircraft 18,000 ft on flight freeze.
- Normal climb procedures
 - Allow for acclimation of normal procedures and indications.
 - **NO** turbulence
 - Press and hold stall identification buttons to disable channels
- Allow airplane and autopilot to stabilize during a normal climb prior to releasing the simulator.
- Level at 18,000 ft.
- Note and document, if any, all indications and alerts.
- Reduce thrust to idle and allow airspeed to decrease until onset of stick shaker.
- Allow airplane to continue to slow until approximate pusher speed and note any other indications
- Note any control forces needed after the autopilot was disconnected and if autopilot automatically disconnected or was manually disconnected.
- Recover airplane and climb to 18,000 ft.
- Stop run when airplane recovered and level at 18,000 ft.

Specific items to note.

- Document the following:
 - Max Pitch Attitude 14° nose up
 - Airspeed at Stick Shaker 120 kts.
 - Pitch attitude during recovery 1° nose down
 - Roll Angle 0° left/right
 - Altitude when stick shaker activated 18,000 feet

Notes

- g. Aircraft indications noted **AFTER** autopilot disengaged: although there was no stick shaker and no stick pusher the simulator developed a "rumble" about 106 kts. No aileron input was used. After the nose broke to an airplane nose down attitude the pilot maintained full aft elevator pressure with no adverse reaction. The pilot relaxed back pressure and then reapplied full back pressure and same results occurred. The airplane during the stall was descending at nearly 7,000 feet per minute until the test was complete and recovery was started.

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Run 5: Failure of Signal Summing Unit

Procedure

- Place aircraft 18,000 ft on flight freeze.
- Pull circuit breakers DA-D, B6, B7 to fail shaker motor (reference appendix 3.0 checklists)
- Normal climb procedures
 - Allow for acclimation of normal procedures and indications.
 - **NO** turbulence
- Allow airplane and autopilot to stabilize during a normal climb prior to releasing the simulator.
- Level at 18,000 ft.
- Note and document, if any, all indications and alerts.
- Reduce thrust to idle and allow airspeed to decrease until onset of stick shaker.
- Allow airplane to continue to slow until approximate pusher speed and note any other indications
- Note any control forces needed after the autopilot was disconnected and if autopilot automatically disconnected or was manually disconnected.
- Recover airplane and climb to 18,000 ft.
- Stop run when airplane recovered and leveled at 18,000 ft.

Specific items to note.

- Document the following:
 - Max Pitch Attitude 14° nose up
 - Airspeed at Stick Shaker N/A kts.
 - Roll Angle 0° left/right

Notes

- h. Aircraft indications noted: SSU light illuminated on the captain side when lamp test was accomplished; however, it did not illuminate as it should have with the breakers pulled.
- i. Aircraft indications noted **AFTER** autopilot disengaged: The pilot disconnected the autopilot and silenced the gear horn about 150 kts. Stopped trimming by 144 kts. There was no stick shaker indication approaching a stall other than the checkboard on the airspeed indicator. There was a pusher felt by the pilot which he described as not normal configuration for an SSU failure. The pilot described the control forces as "normal."

Run 6: Rudder Out of Trim

Procedure

- Place aircraft 18,000 ft on flight freeze.
- **NO** turbulence
- Allow airplane and autopilot to stabilize during a normal climb prior to releasing the simulator.
- Adjust Rudder trim so slip/skid indicator shows out of trim (suggestion would be slightly out of trim either left or right but may need to be more aggressive and have rudder trim halfway from center to either full left or right)
- Level at 18,000 ft.
- Note and document, if any, all indications and alerts.
- Reduce thrust to idle and allow airspeed to decrease until onset of stick shaker.
- Allow airplane to continue to slow until approximate pusher speed and note any other indications
- Note any control forces needed after the autopilot was disconnected and if autopilot automatically disconnected or was manually disconnected.
- Recover airplane and climb to 18,000 ft.
- Stop run when airplane recovered and leveled at 18,000 ft.

Specific items to note.

- Document the following:
 - Max Pitch Attitude 17° nose up
 - Airspeed at Stick Shaker 124 kts.

- Pitch attitude during recovery 15 °nose up
- Roll Angle see note below
- Altitude when stick shaker activated 18,000 feet

Notes

j. Aircraft indications noted: the rudder trim was set with 2 out of 3 units to the right. Resulting in about 40% slip/skid indication of left deflection. A rolling tendency was noted with a 0-2° roll to the right. Pilot disconnected the autopilot at 152 kts and cancelled gear horn audible.

k. Aircraft indications noted **AFTER** autopilot disengaged: During the recovery the pilot not no abnormal control force. Subsequently, the pilot conducting the test again and inputted right rudder to place the slip/skid indicator to the right with about 1/3 deflection. During the stall one stall valve opened and was followed by the second stall valve opening shortly thereafter. Recovery was benign with no excessive inputs needed.

NOTE: The test pilot was requested to show a normal clean configuration stall test as he would do flying a test. The stall was started at 18,000 ft and everything leading up to the stall was as listed above in the other tests. The recovery from the stall occurred at 17,480 feet and the aircraft pitch attitude at recovery was about 0 to 1° nose up attitude and recovery was benign.

APPENDIX

1.0 Checklists - Hawker Beechcraft Corporation

HAWKER 900XP PILOT CHECKLIST

AFTER TAKE-OFF CHECKS

NOTE

The recommended airspeed for flight in turbulent conditions is 230 KIAS/0.70 Mach.

1. LANDING GEAR.....UP
2. MAIN AIR VLVs 1 & 2.....OPEN
3. FLAPSUP
4. Yaw Damper.....ENGAGE
5. THRUST.....SET CLIMB POWER
6. APRDISARM
7. ENG SYNCN₁ OR N₂
8. ANTICE.....AS REQUIRED
9. APU (If Installed).....AS REQUIRED

CLIMB CHECKS

1. Altimeters.....SET AND CHECKED
2. EXTERIOR LIGHTS.....AS REQUIRED
3. Cabin Notices.....AS REQUIRED
4. PressurizationCHECK
5. OXYGENCHECK CONTENTS

CRUISE CHECKS

1. PressurizationCHECK
2. OXYGENCHECK CONTENTS
3. ANTICE.....AS REQUIRED
4. Systems.....CHECK AND MONITOR

NOTE

To extend engine life, engine ITT should not exceed 974° C during cruise operation.

2.0 Stall Identification Checklist

HAWKER 900XP PILOT CHECKLIST

STALL WARNING & IDENTIFICATION

STALL IDENTIFICATION

Operation of the STALL WARNING (stick shake) or STALL IDENTIFICATION (stick push) must be accepted as indicative of a stall. Proceed with normal stall recovery actions.

If stick shake persists:

1. STALL WARN MOTOR L and R
Circuit BreakersPULL (DA-D, B6 & B7)

If stick push persists:

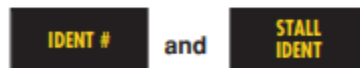
2. STALL IDENT Switches 1 and 2PUSH BOTH TOGETHER –
SYSTEM IS NOW INHIBITED

CAUTION

With stall identification system inhibited or stall warning system disabled, normal stall protection is not available. Continue flight with caution, flying at airspeeds above the low speed cue, except during landing.

STALL IDENTIFICATION SYSTEM

Pilot and Copilot Panel



1. Relevant STALL IDENT SwitchPUSH – RELEVANT INHIB
ANNUNCIATOR ILLUMINATES

CAUTION

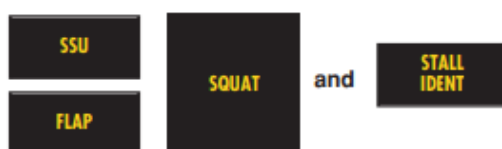
With stall identification system inhibited or stall warning system disabled, normal stall protection is not available. Continue flight with caution, flying at airspeeds above the low speed cue, except during landing.

3.0 Stall Identification Component Malfunction.



STALL IDENTIFICATION COMPONENT MALFUNCTIONS

Pilot Panel Copilot Panel



SSU – Indicates a failure of one or both of the Signal Summing Units. Stall warning and identification may not operate. Continue flight with caution.

FLAP – Indicates a flap asymmetry has been detected. Complete either the FLAPS UP OR 15° APPROACH AND LANDING or FLAPS 25° APPROACH AND LANDING procedure; page A-15, Tab 6, if applicable.

SQUAT – Indicates a landing gear weight on wheels switch asymmetry between the left and right sensors.

If indication occurs during taxi:

1. PITOT/VANE HEAT L & R.....OFF
2. SCREEN HEAT L & R.....OFF
3. MAIN AIR VLVs 1 & 2.....CLOSE
4. APU BLEED AIR (If Installed).....OFF

Thrust reversers may not function.

The fault must be corrected before flight.

If indication occurs in-flight:

1. ICE DETOVRD
2. PRESSN.....OVRD
3. THRUST REVERSERSOFF

Avoid flight in icing conditions as the following systems may not function:

Left and Right "A" Windscreen Heat
Left and Right Static Plate Heat
Left and Right Pitot Heat

Stall Identification and Stall Warning may not be available. Continue flight with caution.

The Landing Gear Handle may not be movable from the down position unless the GEAR OVRD button is pushed.

4.0 Hawker Beechcraft Corporation - Pilot's Operating Manual Technique for Stalls



Hawker Beechcraft Corporation Pilot's Operating Manual

STALLS

Conditions For Stalls

When intentional stalls are carried out the following conditions apply:

1. The altitude must be above 10,000 ft AGL, 10,000 ft above clouds and below 18,000 ft MSL.
2. Stalls must be conducted during day VMC with good visual horizon.
3. The autopilot must be disengaged.
4. The Stall Identification System must be operative.
5. All the external surfaces must be free from ice.
6. The ventral fuel tank must be empty.
7. The weather radar must be at standby.

Stalls may be demonstrated with the yaw damper switched on or off. To limit the altitude loss, to maintain acceptable stalling characteristics and to prevent structural abuse, it is strongly recommended that the procedure given below should be followed.

Technique For Stalls

The stalling technique is as follows:

1. All stalls are to be made in straight (wings level) flight.
2. Stalls with flaps retracted and in the take-off configuration should be carried out at idle thrust. To reduce altitude loss with approach or landing flaps, thrust should be adjusted not to exceed 77% N_1 .

Once thrust is set it should not be reduced during the approach to the stall and recovery.

3. The airplane should be trimmed at an airspeed of approximately $1.4 V_{S1}$ in the appropriate configuration after setting the required thrust.
4. The airspeed should be reduced at not more than one knot per second. Rapid or violent movements of any control during the approach to the stall should be avoided, particularly at air speeds below the operation of the stick shaker.

With the yaw damper off, any tendency to yaw during the approach to the stall should be corrected by normal use of the rudder.

5. The stall is identified by a short forward movement of the control column provided by the Stall Identification System. The red STALL VLV OPEN annunciators will illuminate. The airplane should be allowed to pitch nose down until the stick push has cancelled, and should then be recovered to normal controlled flight. Any tendency to roll should be corrected by use of ailerons.

Do not attempt to hold the airplane in the stall.

Stall Characteristics

CAUTION: A FREQUENT REASON FOR UNACCEPTABLE STALL CHARACTERISTICS IS A TENDENCY TO ROLL AT THE STALL. IT IS ACCEPTABLE FOR A MODERATE ROLL TO OCCUR, PROVIDED THAT NORMAL USE OF AILERONS CAN LIMIT THE ROLL ANGLE TO NO MORE THAN 20°.

AILERON SNATCH MAY OCCUR AT OR PRIOR TO STALL AND IS NOT ACCEPTABLE. THE AILERON SNATCH MAY BE STRONG ENOUGH TO AFFECT RECOVERY USING AILERON INPUT, IN WHICH CASE THE ELEVATOR CONTROL MUST BE MOVED FORWARD TO DECREASE THE ANGLE OF ATTACK AND ALLOW THE RETURN OF NORMAL AILERON CONTROL. IN SUCH AN EVENT THE PILOT MUST BE PREPARED TO RECOVER FROM AN UNUSUAL ATTITUDE.

PILOTS CONDUCTING STALL CHECKS SHOULD HAVE PRIOR EXPERIENCE IN PERFORMING STALLS IN THE HAWKER AND MUST BE PREPARED FOR UNACCEPTABLE STALL BEHAVIOR AT ANY POINT LEADING UP TO AND THROUGHOUT THE MANEUVER.

There is no natural stall warning or aerodynamic buffet prior to the stall.

Stall warning is provided by a stick shaker which is set to operate at an indicated airspeed of 7% to 9% above the stalling speed.

It is acceptable for stick pusher operation to be coincident with the natural stall, provided that any rolling tendency can be restrained to within 20° of bank angle by normal use of ailerons. Some aerodynamic buffet may occur briefly at the point of stall.

Power-off stalling speeds in terms of indicated air speed (IAS) are given for various configurations in the Airplane Flight Manual, Section 5 - PERFORMANCE, Sub-section 5.05 - GENERAL. These airspeeds apply to an altitude of 15,000 feet and are the stall identification speeds at forward CG and therefore differ from the values shown in the AFM Figure 5.10.4 which are based on the minimum airspeed obtained during the stall.

The above was taken from Hawker Beechcraft Corporation, Pilot's Operating Manual, 900XP, Section V, sub-section 1 "Normal Handling" ppg 1-16 and 1-17, originally issued in August 2007.

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