

WPR24FA083

OPERATIONAL FACTORS/HUMAN PERFORMANCE

Attachment 2

Memorandum for Record - Gary Grommet

February 11, 2025

11/13/2024

MEMORANDUM FOR RECORD

NTSB Investigators: Stephen Stein, Dr. Katherine Wilson, Shawn Etcher

Contact: Gary Grommet

NTSB #: WPR24FA083

Time: 0901 CST

Subj: Stall Test Procedures and Requirements

When asked approximately how many stall tests have you done in the Hawker, he stated that he was the chief test pilot in factory with flight test. He had done about 100 stall tests at the factory on new aircraft with the bulk of those tests being conduct as a retest following an initial flight test. He typically conducted those tests prior to delivery and verified that the aircraft stall behavior was acceptable. After leaving Hawker he conducted stall tests on a contract basis for operators starting in 2013 and had conducted approximately 350 plus stall tests under contract. So far in 2024 he had just conducted his 45th stall test for the year a few days prior to the interview. He further provided that there had been a similar event in 2006 with a demonstration pilot who he stated was "unqualified" to do that stall test. The stall test appeared similar to what he knew about this event; however, the pilot was able to recover during that event with a 6 G pull up. He felt the requirement in the maintenance manual was "ambiguous" and was "set up that way" by industry standards.

When asked to describe a typical stall test set up from preflight through the maneuver he provided the following: He flew two days ago with a chief pilot from an organization the operated 11 Hawker airplanes. When this accident occurred, that operator had a safety meeting and he had conducted a couple of stall test for them. He stated there were no published procedures for stall tests. The maintenance manual was how the airplane should be maintained once it had received its initial maintenance out of the factory. The stall test must be done after wing maintenance was conducted. The manual did not direct a pilot on how many configurations that must be tested, where an initial stall warning should occur, or that it should coincide with the low side of the speed tape. The manual was written in a way for pilots to determine if acceptable or not. The maintenance manual also described overbalance of the aileron and if it did occur it would be due to a defect of the leading edge. The maintenance manual described a stall maintenance test which was 79 steps to accomplish. It's to make sure the aircraft maintained its performance to its type design. There were regulations in *Code of Federal Regulation (CFR)* Part 23 and 25 for airplanes to demonstrate to the

FAA the airworthiness standards required for aircraft. In *CFR Part 21* when you start to build an airplane with the title "flight test," that regulation stated each airplane had to be test flown to a production flight test procedure. The production flight test procedure was a "massive" test and the checklist had to be approved by the FAA. After which the aircraft would receive its first airworthiness certificate. Once the initial airworthiness certificate was issued the airplane then would have moved from the production stage to the operations stage. The manual stated that the stall procedure must be flown by a pilot that was familiar with the stall characteristics and identifications. He felt other aircraft manufactures required a factory test pilot to conduct the stall tests. The manual stated that during the test the pilot was to trim the airplane to 1.4 Vs and decelerate the airplane at 1 kt per second which was as required in *CFR Part 25*. He stated that what was not in the manual was to demonstrate the stall at flaps at 0 degrees, flaps at 15 degrees, flaps at 25 degrees with the landing gear down, and with the flaps at 45 degrees with the landing gear down. Which were all of the required configurations the test had to accomplish. The production flight procedures give an acceptable criterion to determine airworthiness of the airplane. There were other things like on a swept wing airplane was that trim was so important. If the airplane was not in trim it could result in a roll. In the electronic cockpit it was difficult for a pilot to know what was "in trim" especially when all three slip skids indicators, for instance, disagree. He had done several tests in the Proline 21 and very few slip skid indications agreed. To align the AHRS it required the airplane to be jacked up, leveled, and then an AHRS realignment procedure must be done.

Additionally, the description of what should be considered unacceptable could be the aircraft roll, overbalanced aileron, or aileron snatch. The Hawkers have stall separators near the wing root in order to get the disturbed air near the root and not at the aileron during a stall. If there was airflow separation over the aileron that would cause the control yoke to "snatch" and with only one aileron with undisturbed airflow over it, likely would not be enough to control the airplane before going inverted. In reality the stick shaker and pusher were there so the Hawker never gets to that stage, an aerodynamic stall.

As a test pilot his job was to make sure, if past the stick pusher and if the aileron rolls, that the airplane could only roll 20 degrees maximum. During one of his stall tests, he had one airplane roll to the right; he was able to use full deflection in the aileron in the opposite direction of the roll. During a stall test, he was looking at the instruments while the airplane is slowing that he is trimmed, reading out airspeeds as the shaker occurred and then as the pusher, if rolling he was looking at how many degrees of roll the airplane went. The roll measurement was only measured after the pusher not before the pusher, and if it was already rolling a few degrees the roll prior to the pusher activation did not factor into the 20 degrees of roll limitation. A stall test pilot should be able to help a technician be able to diagnose the reason for an unacceptable stall test.

One of the first thing he looked at when walking to the airplane was the stall spoilers, looking at an oxidation line to see if it had been moved. The maintenance

manual had the requirement for a test flight. Typically a pilot would conduct the flight, if there was an issue, return to the airport, maintenance will adjust, and then attempt the test again. Most only go out to test stall prevention with zero degree of flap most pilots that he had conversed with state they did not go to the pusher. He stated that the behavior of the airplane should not change from factory settings unless something had been changed. The maintenance manual only allowed the stall spoiler to be adjusted 1/20th of an inch at a time.

At high altitudes, a stall would likely get to buffet boundary where the airplane "rumbles," which was a first characteristic of stall. He had been to Grand Junction about 10-12 times this year and had been there with clouds, moisture and icing on the airplane. He would go to warmer airspace and clear of clouds to clear the airplane prior to conducting the stall test. He had explained to pilots he had flown with on the test that the test was "integrating the regulations." The type design on the Hawker had been sold seven times so it was hard to get the "tribal knowledge" of the stall test rationale. He thought he was the only factory test pilot conducting the stall tests outside of the factory. There were no procedures for conducting this test nor the number of configurations either in the regulations or the manuals. An example he gave was a test could pass at 0 degrees of flaps but fail at 45 degrees. Without testing all configuration it would leave a surprise for another pilot. He questioned why there was a statement in the maintenance manual that referred to procedures and why there were no procedures or standards to hold to? There were only two flight test requirements - one was the stall test and there were no procedures on how to conduct that nor how to determine acceptability. The other was a roll test and occurred when replacing a winglet, aileron, or flap. There were procedures for doing the roll test but it stated trim the airplane to a certain speed, lower gear at a specific speed and it gave the tolerance for that. He felt that the stall test should be done with a factory production test pilot; however, he stated that Textron would only do the test if the repair was done at a Textron facility. He further elaborated that the only procedure was the factory flight test procedures that he was aware of.

When asked about specifics of adjusting the stall spoiler, he stated that the stall spoiler was to be measured from the trailing edge of the TKS panel and maintenance, after repairs were completed, were to return the stall spoiler to the nominal position which was the initial production test flight. He felt that it could have been adjusted for many reasons but returning it to the nominal position might not accommodate for other adjustments that were needed. West Star maintenance has started measuring the dimensions when the airplane first arrived. He also stated that they now did the AHRS realignment process.

When asked if a stall inhibit button was pressed, could it be uninhibited in flight, he stated that if the inhibit button was pressed in flight there was a panel behind the captain's head. When the panel was open, there were "doll's eyes" that show if the SCU had a fault and to reset a button had to be pressed. There was also a button to uninhibit the stall inhibit switch but he felt there would be no reason to reset it in flight.

He was asked in terms of doing a stall test during flight how did he set it up and utilize the second pilot. He had a test card he used from the flight test procedure. They used the customer's normal checklist and that was the SOP. He always filed a block altitude of 14,000 ft to 16,000ft. He likely would not fly up to 16,000 but during the stall test the aircraft would normally climb as it decelerates. He gave the other pilot a clipboard with the test card. Around 15,000 ft he pulled the thrust lever to idle and the airplane starts to decelerate. He had the other pilot write down numbers and circle target airspeeds and weight, prior to and during the test. He would call out the speeds from the captain's instruments. He would trim the airplane until the speed reached 1.4 above V_s which he used the AOA to monitor. The name of the chart, where he got all the numbers on his test card, was called the power off stall speed. Once the shaker activated, he would announce that speed for the other pilot to write down, then when the airplane's stick pusher activated, he would announce that speed for the other pilot to write down. If those speeds were within 3-4 knots of the predetermined speeds he would advance the power. Then he began the next stall test and referred to the flaps 15 column on his task card. He then reconfigured for the 15-degree flap setting. After that completion he would advance to the 25 flap and landing gear down column. After the 25-degree flap test was completed, he would then conduct the 45-degree flap with landing gear down column.

When asked approximately how long it takes to conduct the test, he estimated that 99% of the time done the test was accomplished within 30 minutes. He had done it in 15 minutes but normally less than 30 minutes.

When asked which seat he sits in while conducting the test, he stated he would sit in the left seat for the procedure. They would review the stall test while on the ground before the flight. He further briefed the other pilot that the speed will be the slowest they would normally be and there would be "more grass in the windscreen" than they are used to.

When asked what would happen if the stall test was done above FL180, he stated that the stall speed would increase due to the density of the air, which could get outside the measurements/parameters required for the test to be acceptable.

When asked if doing a stall in the simulator would ever indicate an unacceptable condition, he stated that it would not.

When asked how he learned to do the stall test, he stated he learned while flying with other test pilots from the factory. Currently the test pilots at the factory still learn from chief pilots and other pilots that were in the flight test group. There were no schools to conduct this type of training except very expensive ones. He felt that flight test was learning about judgment. Using one's judgement to take the regulations and matching it with what the airplane did to know if that was an acceptable test.

When asked if he could describe what an aircraft "rumble" was, he stated it was buffet boundary and that was when the airflow was "smacking the wing at angles it shouldn't." As the airplane slowed into the airspeed range it's a lot like driving on a

gravel road. Pilots typically do not operate at those speeds at altitude, and very few have experience of operating there and experiencing "rumble."

When asked if he had encountered a difference in airspeed between the captain's and co-pilots' airspeeds, he stated he had had that occur on rare occasions where the air data computers disagree but not to the point of a fault being generated. He thought that a fault would be generated if there was more than a one or two knot difference. Prior to a stall test he would look into the documents of the airplane and figure out the weight of an empty aircraft. But normally in the FMS they had the BOW which would be different and account for various galley and lavatory items. The target speed for each weight would increase a half a knot per 200 lbs.

When asked what a normal stall speed was, he stated, he always asked for the same fuel load 3,000 lbs. per wing tank. His goal was to have the weight below the landing weight. If he has to hunt for clear weather he would add 1,000 lbs. of fuel. Normally he burned about 800 lbs. of fuel when conducting a stall test. Normally the test was conducted within about 40 flight miles. He further stated that the numbers were based on the shaker setting and the pusher was 7 to 9% different. The shaker column on his test card was based on the target speed for the pusher plus 7%. Typically for a stall when the airplane weighed 22,200 lbs. it would have a target airspeed of 119 knots and 111 knots for the pusher.

When asked what weight would they have to be at to obtain a 105-knot stall speed he stated that with 3,300 lbs. of fuel a test flight would activate the shaker at 105 kts. Although, he felt this would not have been the speed for the accident flight as the flight was anticipating, after a successful stall test, to continue on to Washington state and that amount of fuel would not have allowed for them to reach their intended destination.

When asked if ice could build up on the wing when using TKS, he stated that ice could build up on the wing because between the TKS panels there was unprotected surfaces. He further elaborated the TKS did not remove ice from a wing but helped prevent it from accumulating within the protected areas.

When asked if he had ever done a stall test above a layer of clouds, he stated that after the 2006 accident the manufacturer put a requirement that you had be at least 10,000 feet above a cloud layer when conducting the stall test. He was always looking at temperatures when flying through clouds and there had been days that it was a challenge to get the 10,000 feet above clouds.

When asked what a typical altitude loss was when conducting a stall test, he stated he didn't think he had ever lost more than 800-900 feet. Sometimes he might lose only a few hundred feet but never more than 900 feet that he could recall.

When asked about how quickly the airplane may roll during a stall, he stated it was usually due to asymmetrical stall of the wings. If it started to roll it felt "like it is rolling off" and as a test pilot it was instinctive to put in the opposite aileron. He had never measured roll rate though.

When asked if he had ever had the airplane roll beyond the 20-degrees of roll, he stated that in the last 10 years he had about 5-6 airplanes that went beyond the 20 degrees of roll during a test flight. Additionally, he had one occur during a production test flight. On the production test flight it went to approximately 110 degrees but during the recovery it started to roll back upright.

When asked if he considered rolling the airplane once at the 110 degrees, he stated that his upset training always taught him to go back to the nearest horizon so he never had a thought to roll it all the way over to recover. The airplane did roll "pretty quickly" and when it rolled it indicated asymmetrical stalled wings.

When asked if he had ever experience icing during a stall test, he explained he was conducting a test flight in Georgia and the airplane entered a cloud for "a flash." The airplane picked up enough ice that the airplane began to "rumble" well before the onset of a stall.

Concluded at 1235 CST

11/30/2024

To: Stephen Stein, Dr. Katherine Wilson, Shawn Etcher, NTSB Investigators

From: Gary Grommet

Subject: Comments on Memorandum for Record dated 11/13/2024 regarding Stall Test Procedures and Requirements

While looking over your notes I was reminded of a Francis Bacon quote, “Reading makes a full man; conference a ready man; and writing an exact man.” To that I would add, for me, speaking tends to make a rambling man. I hope my comments can bring more clarity to the questions you were interested in. Please feel free to ask any follow up for clarification.

1. Lines 10-20: In my career, to date, I have completed around 360 stall tests on Hawkers. I performed 100 of those in the factory, the bulk of which were after the initial tests and adjustments. Most of those 100 would have been on the current model at the time. I have performed 260 tests on contract since I left the factory on HS-125 & BAE-125 models from the 700 through the 1000. By the time I complete these notes I will have completed my 48th stall test in 2024.
2. Line 18: I mentioned a similar incident to this investigation which occurred in May 2006. This is in the NTSB record (CHI06IA127). I was a Chief Test Pilot at the factory at the time and personally familiar with both pilots. That incident aircraft was flown by a factory demo pilot, he was not a test pilot with training in the stall test. The pilot was attempting to use PFTP procedures but he did not interpret “all surfaces clear of ice” properly.
3. Line 21 & 22 I intended to say that the statement mandating the test in the Hawker Maintenance Manual was ambiguous, that it can be interpreted in two different ways, that its wording is biased toward the qualification that any pilot with experience performing stalls in the Hawker may perform the stall test which I do NOT believe is industry standard. By the inclusion of a test in a manual intended to ensure continuing airworthiness I view the test as a test of airworthiness. A pilot would then need procedures, tolerances and training to determine stall characteristics airworthy – the FAA defines airworthiness as meets type design and in a safe condition for flight. Information on the airworthiness of an airplane IN-FLIGHT would only be found in the Airworthiness Standards, part 25, or the Production Flight Test Procedures required by 21.127, the only document developed to prove the Hawker’s airworthiness IN-FLIGHT.

4. Line 27: I made the statement that there are no procedures published for the stall test in the Hawker. By that I mean there are no procedures that are available to the public that a line pilot performing a stall test has access to.
5. Line 18-22: Following the factory incident in 2006 the ambiguous statement in the Maintenance Manual concerning the qualifications of the pilot who should perform the test was leaned further toward the interpretation that any pilot with experience performing stalls in the Hawker could do the test by revisions to the Hawker Flight Manuals consonant with the language in the Maintenance Manual. If the experience qualification were true the remaining statement would require this pilot have experience in stalls in all the models referenced.

I argue for an alternate reading, which would be a pilot who understands how the Hawker should perform to the original prototype for airworthiness. Other manufacturers require a “factory test pilot,” which would qualify.

Here are some further justifications for my alternate interpretation:

- a. As previously mentioned, a factory test pilot appears to be the qualification in other transport category aircraft of this vintage.
- b. The Maintenance Manual that mandates the stall test is part of the 25.1529 requirement for Instructions for Continued Airworthiness. It is very rare to have a flight test in these manuals but when they are they are about airworthiness. Airworthiness is NOT determined by a pilot’s experience, it is determined by procedural means to a standard.
- c. The ONLY procedures developed to determine the airworthy behavior of the Hawker during activation of the stall prevention system are contained in the Production Flight Test Procedures (PFTP) required to meet 21.127 for manufacturers. These procedures “establish that the production aircraft has the same range and degree of control as the prototype aircraft.” (21.127 (1))
- d. These PFTPs are not available outside the factory and are only used by factory test pilots. There may even be very little experience performing the Hawker PFTP in the current factory of the type certificate holder as they came into ownership post-production on the Hawker.
- e. Familiarity with the “stall characteristics” could mean the heading in UK CAR10 and CAR4b (the original certification bases for the Hawker) under which the airworthiness standards for stall demonstrations, behavior and warnings are grouped. In CAR4b this heading is “Stalling Characteristics”, in FAR 25 they are grouped under the heading “Stalls”

- f. The words that were added to the Stall Test Requirements paragraph in the Hawker 125 Series SRM 57-41-00 in 2006 were “In accordance with the Flight Manual procedures” the airplane must be test flown . . .
 - i. There are no procedures in these manuals.
 - ii. There are three descriptive paragraphs: Conditions for Stalls; Techniques for Stalls and Stall Characteristics. These are NOT procedures to determine airworthy behavior.
 - iii. The descriptive paragraphs in the Hawker Flight Manuals DO NOT provide:
 - a. Required configurations (any likely combination of positions approved for operation)(FAR 25.201 b.1.)
 - b. Weight and Balance (FAR 25.201 b.2.)
 - c. Required adjustments to reference speed tables
 - d. Requirement that all stalls be performed power off (FAR 25.201a.1)
 - e. No suggestion of using a block altitude range so no concern for altitude loss.
 - f. No airworthiness tolerances regarding target and actual speeds for the shaker and pusher activation.
 - g. No description of appropriate stall identification activation relative to additional impending stall instrumentation.
 - h. The top altitude in the Flight Manual is 18,000’ MSL. The PFTP top altitude is 17,000’ MSL
- g. These missing items in the Hawker Flight Manuals are contained in the PFTP for the Hawker.
- h. Please Note – the bias of the interpretation of the test flight requirement in the Hawker Maintenance Manual (57-41-00) is accompanied by companion language in the Hawker Flight Manual. These were made compatible during changes in 2006. The Maintenance Manual statement starts “In accordance with the Flight Manual procedures” and then in the Flight Manual we read in a CAUTION: “Pilots conducting stall checks (inconsistent language but interpreted to be “tests”) 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.”
- i. There are terms describing unairworthy behavior of the Hawker in the Flight Manual and maintenance Manual, “aileron snatch” and “overbalance aileron” that are not defined and are not typically known to a line pilot.
- j. There are disordered, incomplete procedures in the Maintenance Manual. These manuals are typically not accessible to pilots. By disordered I mean that the suggested configurations, recording of results and description of behavior are suggested AFTER the pilot flies the aircraft to determine if the behavior is

acceptable and they are suggested to be performed only if the behavior is deemed unacceptable.

- k. Conspicuously missing from both the Flight Manual and the initial test flight in the Maintenance Manual is the required configurations for the stall test. From experience a Hawker can have acceptable stall characteristics at some configurations and unacceptable characteristics at another. This is anticipated by the suggested maintenance corrections in the manual. I have a number of anecdotes from line pilots who have performed the stall test in a single configuration.

- 6. Line 28: While an aircraft is in production it's maintenance is ordered around factory quality instructions. Once the aircraft completes the Production Test Flight Procedure and all discrepancies corrected and verified it is awarded its Initial Airworthiness Certificate. At that point it's maintenance is ordered by Instructions for Continued Airworthiness.

Line 5 of the Standard Airworthiness Certificate, the "basis for issuance" states, and I paraphrase, that the airworthiness certificate certifies that the aircraft has been inspected and found to *conform to its applicable type certificate* having been shown to *meet the requirements of the applicable comprehensive and detailed airworthiness code*.

Line 6 of the Standard Airworthiness Certificate, the Terms and Conditions clause states "Unless sooner surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator, *this airworthiness certificate is effective* as long as the maintenance, preventive maintenance, and alterations are performed in accordance with Parts 21, 43, and 91 of the Federal Aviation Regulations, as appropriate, and the aircraft is registered in the United States.

- 7. Line 34: SRM 57-41-00 2. states "Before undertaking the test flight the stall identification system should be checked-out on the ground in accordance with the requirements of the AMM (Refer to Chapter 27, Stall Warning and Identification System – Adjustment/Test)." This test cannot be performed by a pilot as it requires special equipment. It incorporates approximately 69 steps. Pilots perform a preflight test in the overhead panel which looks at circuitry only.
- 8. Line 36: As mentioned, all inspections and maintenance are performed to maintain "airworthiness". As defined by the FAA. See para. 3 above.

9. Lines 43, 44: I often refer to the four stages in an aircraft's life – The Prototype Stage ends with the issuance of a Type Certificate (Part 25); The Production Stage ends with the issuance of a Production Certificate (Part 21); The Airworthiness Stage ends with the issuance of an Initial Airworthiness Certificate (Part 21); and the Operations Stage doesn't end until an aircraft is deemed permanently unairworthy, it continues with the maintenance of the aircraft to Parts 21, 43 and 91. My division of this and discussion is usually to point out that almost all pilots and maintainers meet the aircraft and are trained in the Operations Stage. They have no knowledge of what happens in the previous stages. There are no schools to learn about what happens in the first three stages. Those who work in these early stages, the engineers, the technical writers, pilots and maintainers, the FAA, even vendors to these stages must learn ON THE JOB.
10. Line 54: I mentioned the importance of trim during the stall test on a swept wing aircraft. The digital slip/skid indicators migrate over time, losing their zero position. The process to correct this involves jacking the aircraft, leveling it in all axes, and performing the AHRS (Attitude Heading Reference System) realignment procedure. West Star in Grand Junction is now routinely performing this procedure prior to a stall test in the Proline Hawker. When I perform a stall test in a Proline with slip/skid indicators that do not agree I will often use the standby instrument's slip/skid indication.
11. Line 60: The manuals state that the most frequent reason for stall behavior being unacceptable in the Hawker is a tendency to roll at the stall. A "moderate" roll is acceptable provided the roll can be limited to 20 degrees with normal use of aileron. In my experience, if a Hawker begins to roll at the stall identification (the pusher) full deflection of the aileron, to the stop, is required and then the angle of the roll must be noted. Part 25 states this should be measured from the point of the identification through the recovery. This is a test procedure, not a normally suggested practice for a stall recovery taught at a training facility. The AMM also mentions aileron snatch and aileron "overbalance", I have never experienced either and contend that these behaviors are uncommon because the manual suggests that if they occur a defect will be found in the leading edge. Again, on some aircraft there may be no roll at several of the flap configurations and unacceptable roll at another. Adjustment to the stall spoilers may correct the unacceptable roll at the failing configuration and promote a roll at the configurations that had none previously. On most Hawker aircraft it is not possible to achieve the ideal, only the airworthy.

12. Line 62: The Hawker leading edge incorporates triangular-shaped stall spoilers to encourage airflow separation at the wing root. These spoilers are located on the second TKS panel just inboard of the landing light. Unacceptable stall characteristics are remediated by adjustment of these spoilers. They can only be moved .020 an inch per adjustment. This is important: These spoilers are adjusted as needed during the production flight test. If the airplane is maintained properly after the production setting the stall characteristics should never change. Improper fillet sealing, a bent vortex generator, the addition of winglets, may however change the behavior. I have had to counsel adjustments on 5 of the last 260 stall tests.

The maintenance manual requires these spoiler locations to be measured prior to removal so that they can be reinstalled in the same orientation. This still requires a stall test. The manual requires the spoiler to be installed at the nominal position if the spoiler is replaced or the TKS panel underlying the spoiler is replaced. In this case this reverts the aircraft's stall characteristics back to the original factory flight. THERE ARE FEW PILOTS WHO WOULD KNOW HOW TO COUNSEL ADJUSTMENTS BACK TO AIRWORTHY CHARACTERISTICS in this case. Experienced Hawker maintainers ignore this requirement and replace the spoiler to the measured location. This could be changed in the maintenance manual. The location from where the measurement is made should be changed and the requirement to install to nominal should be dropped and replaced with a procedure to reinstall at the measured orientation.

13. Line 66: I often ask copilots if they know the reason we have a stall shaker and a stall pusher on the Hawker. The answer is that the natural stalling characteristics of the Hawker are not certifiable. So we must have a system on the Hawker that would not allow us to ever get to the aerodynamic stall.

14. Line 76. A stall test pilot should not just be experienced performing stalls in the Hawker. The stall test pilot in the Hawker must be able to determine the airworthy characteristics of the Hawker during the activation and operation of its stall prevention system. AND, if it is deemed unacceptable the stall test pilot must create discrepancies that closely match the unacceptable conditions described in SRM 51-47-00 in order to guide the technician on adjustments. The stall test pilot must then re-fly and advise until acceptable behavior is achieved. I have a number of anecdotes where I received a call from a repair facility who reported that a stall test pilot called the Hawker unacceptable but they could not fix it. This must be deeply frustrating for maintainers.

15. Lines 88ff: Some years ago the FAA added a requirement during training that the facility “demonstrate” high altitude stalls. This requirement came after the certification of the simulators for the Hawker so there is no modeling for a high altitude stall in these simulators. My experience has been, during training that instructors bring the simulator to a high altitude and slow the aircraft to the shaker for the sluggish recovery that follows. It is not likely that a swept wing aircraft will get to shaker at high altitude. It is more likely the aircraft will exhibit “buffet boundary” before the speed for the shaker is obtained. I have experience reaching buffet boundary in the Hawker with a slight, imperceptible, frosting of ice on the wing. The aircraft will “rumble” and then start buffeting. At high altitude or with ice on the wings, this will be the first indication of an impending stall.

On many occasions in cold weather I have launched into ice to go out to perform the stall test. Before I depart I have determined where I can find an airport with warmer temperatures and an area of VMC. If I get any indication of icing during the flight I will seek warmer air temperatures to clear all surfaces of ice. I will remain VMC to achieve the flight condition requirements for the test, complete the test and return to the airport of origin. I rarely conduct the stall test during a reposition mission on a Hawker.

I mentioned that there is an example of a procedural test in the 900XP POM. It is a Roll Test described on the page following the Stalls in that manual. Any pilot could perform this test as it has procedures and tolerances.

I did not mention a flight test that was included in a wing patch repair scheme issued by Textron in this year for a rectangular wing skin patch below and aft of the leading edge. The flight test pilot requirement was for a “pilot familiar with the high speed characteristics of the Hawker.” The test procedure provided was close to the Production Flight Test Procedure but it was not one that a normal pilot would have experience with and, as far as I know a factory pilot was not offered. This procedure was on Textron drawing number FR-HA-0003-12406.

16. Lines 110 – 117: I have covered in earlier paragraphs.

17. Lines 118 – 122: There is a Stall Ident Diagnostic Panel located behind the Captains head on the bulkhead. This panel is not included in a pilot’s normal preflight. On the right side of the panel are two dolls eye indicators that show Signal Summing Unit faults, these usually occur during maintenance. I usually check and reset these indicators prior to a stall test. There are Pusher Inhibit controls on the panel on both Pilot and Copilot instrument panels. The inhibiting of a pusher in-flight would only be done as an abnormal procedure as directed by a checklist. The Inhibit Reset

button would not be actuated after an in-flight pusher inhibit. This Reset button is also in the Stall Ident Diagnostic Panel on the left side. I demonstrate pusher inhibit and inhibit reset to all of my copilots on each test – IN CASE – we were to need that abnormal procedure, the inhibit, not the reset, during the stall test. I have never had a need to inhibit a pusher operationally in-flight.

18. Lines 123-149: I explain to all my copilots that the stall test is a normal flight. The Stalls section of the POM is in the Normal Procedures section of the manual. I advise we use normal Hawker SOP during the flight as taught by FSI or CAE. I advise I will flow with them on whatever checklist they have approved to use in their operation. I also inform them that when we reach and are cleared into our block altitude of 14,000'-16,000' that our test card becomes our SOP. I brief the test card and how we will use it and any changes to normal SOP. Usually the copilot is busy navigating, communicating and looking up and writing down indications I am calling out. I usually take over aircraft configurations during the test and ask for them to verify our configurations for the tests we are doing. I advise them to put their seats aft and tuck their knees in and to remain clear of the controls in case I need abrupt, full, aileron movement. I brief what they will experience during the test, possible buffet, system expectations, I brief on the expected attitude for recovery. At the normal test weight in the block of 22,200# we are slowing to 98 knots for the pusher. This is slower than most of them have been in the Hawker. During the recovery the pitch down attitude will show them more "grass in the windshield" than they would normally see. I'm trying to reduce their nervousness by describing what they will experience. They are typically grateful.

19. Line 153: Simulators have no digital modeling for unacceptable stall behavior. They are modeled for pretty gentle "normal" behavior. Those digital models are approved to train pilots to identify the impending stall and execute the proper recovery. Not the test procedure. In the FSI Flight Training Maneuvers and Procedures Manual for the HS-125 Series, page 1, Rev 28 Jan 2021 it states: The objective of this training is to provide pilots with the knowledge and skills necessary to prevent, recognize, and recover from unexpected stall events. It also states: The primary key to all stall recoveries is to reduce the angle of attack (AOA). Of equal importance is the ability to recognize the first indications of an impending stall with the autopilot off, such as decaying airspeed or stall protection system activation, in sufficient time to *prevent a full aerodynamic stall*, (emphases mine) and to understand the negative effects that angle of bank and G-loading have on being able to recover from stall conditions. Another key is to determine that the pilot recovers in accordance with procedures set forth in the AFM and to the desired flightpath. During this training pilots will

become familiar with all stall protection systems installed on the aircraft. This includes stall warning horns, stick shakers, stick pushers, etc. as applicable to the actual aircraft model being trained.

NOTE: There are no stall warning horns on the Hawker. At Zero Flap and at 15 degree flap configurations during a stall test the Gear Warning Horn will activate around 150 kts. This can be silenced by a push-button on the left throttle knob.

NOTE: Training objectives emphasize RECOVERY, not ever TEST. FSI and CAE never discuss or teach test procedures nor acceptable or unacceptable airworthy stall behavior of the Hawker.

20. Lines 155-160: Proper flight test airworthiness testing is learned by experience in the environment where it is practiced. There is no ongoing factory flight test for production Hawkers at Textron. There are a few pilots remaining there in Production Flight Test who were trained under men of my vintage while the Hawker was still in production. Production ended 12 years ago. Even if a test pilot has been to one of the premier military schools or the National Test Pilot school the only place to learn airworthy behavior of a Hawker is in the Hawker with the proper procedure, tolerances and someone experienced to train you.

21. Lines 166-173: There can be slight differences between Pilot's and Copilot's airspeed indicators. This can be because of differences in Air Data Computers but it can also occur if the aircraft's main static plates are not kept at the accepted measurement above the skin surface (and any paint). The test procedure requires speeds to be read from the Captain's PFD/ASI.

Weight is important as the target speed charts adjust for weight. It is important to establish whether the operator is using a good Basic Operating Weight in his FMS. Some operators do not understand BOW and have the Empty Weight in their FMS. The speed on the test card is the computed speed for a weight from the Power Off Stalling Speeds chart in the AFM. These speeds are adjusted down 2 knots by the Production Test Flight Procedure and instructions in the AMM. (SRM 57-41-00)

22. Lines 174-182: My normal flight test fuel load is a total of 6000#, this is 3000# per side and an empty ventral fuel tank. This is to ensure a gross takeoff weight that is below the landing weight of the Hawker in case an immediate return is necessary. It also allows a weight in the middle of my test card table. If I need to fly to acceptable weather for the test I add 1000#. I brief all of this with the copilot. At this fuel load and no delays from ATC we usually arrive in the test block at 22,200#. At this weight the computation for target speeds for the 900XP are 119 shake, 111 push at zero flap; 110.5 shake, 103 push at 15 degrees flap; 108 shake, 101.5 push at flap 25 and

gear down, 105.5 shake, 98 push at flap 45 and gear down. As mentioned these speeds are charted linearly $\frac{1}{2}$ knot per 200 pounds either way. The tolerances are within three knots for the pusher. The shaker values on the test card are 7% higher than the pusher speeds. The flight manual says these are 7-9% higher. The tolerance for the shaker is within 4 knots. Usually I am more interested in handling than speeds. If the speeds are slightly out and consistent I presume I don't have an accurate weight.

23. Lines 189-192: There are six stainless steel TKS panels on each wing along with a titanium micro drilled TKS leading edge at the tip. There are seams between each panel and during icing conditions ice can develop on these seams. This is normal and the aircraft can be flown with normal approach speeds. However, the stall test procedure calls for all surfaces to be clear of ice. The Hawker is not protected by a stall prevention system with ice on the aircraft, it is protected procedurally. If the pilot looks out and sees ice developing on the unprotected surfaces (this would include a protected surface that wasn't being anti-iced properly) he is to add speed to his approach speed and increase his landing distance.

24. Additional notes:

- a. The Hawker type certificate has changed hands a number of times since 1961. I think about 7 times. Each time the certificate holder loses some tribal knowledge. When I first communicated with Stephen I said it would be important to know what the original engineers meant in the early 1960's when they wrote that the Hawker needed to be test flown by a pilot "familiar with" the stall characteristics of the Hawker. I believe similar statements by other manufacturers of swept wing business jets of similar vintage is instructive. As I have mentioned the current certificate holder has not produced one Hawker since ownership hence they have little to no experience with the PFTP for the Hawker.
- b. The "biased ambiguity" of the flight test requirement has a hazard multiplier during markets when Hawkers change owners. New owners, new pilots, new maintenance facilities, many with no experience with the Hawker. On several occasions I have been called to complete a stall test on a Hawker after it had flown numerous revenue flights. Often owners and maintenance facilities burden line pilots with the stall test just prior to delivery and many go out with no experience or knowledge and do whatever they think needs doing. I believe many of these pilots so pressured have also been lucky to have good weather days for the test.

- c. I may have mentioned and it possibly did not get in the notes. IF there are no procedures published to determine the airworthiness of the Hawker stall characteristics after maintenance AND this test is a requirement (the paragraph that mandates the test is titled Stall Test Requirements) THEN the FAA likely needs to ask how we know any Hawker meets the terms and conditions for a valid airworthiness certificate.

END