AT THE EDGE

Preventing Loss of Control In-flight (LOC-I) During Post-Maintenance Flights

1st Edition

A Practical Action Guide for Aviation Leaders and Pilots

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APS AVIATION PERFORMANCE SOLUTIONS

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EXECUTIVE SUMMARY

Overview

An aircraft leaving maintenance raises two questions. Was the maintenance done and documented correctly? And is the aircraft ready for its next flight? When a check flight is required, a maintenance signature, a type rating, or an uneventful takeoff cannot answer the second question on its own. WYVERN's *Post-Maintenance Flight Check Guidance* (the WYVERN guidance; Zotter et al., 2026) and the Flight Safety Foundation's *Functional Check Flight Compendium* (the FSF compendium; Flight Safety Foundation [FSF], 2012) set the same expectation: the flight needs a clear purpose, a justified profile, a prepared crew, and a controlled way to judge the results.

The National Transportation Safety Board's January 2026 report describes two fatal accidents during manufacturer-required postmaintenance stall test flights following routine four-year inspections: a Hawker 900XP near Westwater, Utah, on February 7, 2024, and a Hawker 800XP near Bath Township, Michigan, on October 16, 2025. The crews were qualified for normal operation of their aircraft but were unprepared for the adverse stall behavior encountered. The Board called for manufacturer-authorized training and experience criteria and a thorough stall test plan. In its final report on the Utah accident, the NTSB named two causes: the crew's decision to conduct the stall test in an area of icing conditions, and the manufacturer's lack of training and experience requirements to prepare crews to conduct the test safely (National Transportation Safety Board [NTSB], 2025a). The recommendations apply to specified aircraft models; their broader safety lesson is that qualification for normal operations is not proof of competence for every required post-maintenance maneuver (NTSB, 2026, pp. 1–2, 10–14, 17–19).

This guide covers the full return-to-service (RTS) process but focuses on the flight: deciding which checks are required, matching the crew to the task, expecting both normal and abnormal results, and preventing loss of control in flight (LOC-I). It does not suggest flying aircraft toward the edges of the envelope just because they have been in maintenance. The required checks come from the applicable technical instructions and the work actually done (Zotter et al., 2026; FSF, 2012).

Leadership priorities

- Assign one coordinator for the RTS event and name the people who hold maintenance, operational, and flight decisions. Coordination does not transfer legal authority.
- Require a clear link from the maintenance performed to the systems disturbed, the checks required, and the evidence needed to close each item.
- Select crews for the actual test tasks and the abnormal outcomes that could realistically happen, not for seniority, total flight time, or availability.
- Protect the right to postpone the flight, drop an optional check, or stop. A required check stays open until it is completed satisfactorily or resolved through an authorized alternative.

- Keep the aircraft out of line service until the required records, discrepancy decisions, and operational acceptance are complete.

These priorities are this report's implementation recommendations, synthesized from the WYVERN guidance, the FSF compendium, and the NTSB report; they are not additional regulations (Zotter et al., 2026; FSF, 2012; NTSB, 2026).

Pilot priorities

Know what was disturbed, what each check must prove, what a normal result looks like, and what will end the item or the flight. A check flight succeeds when it gives a reliable, well-documented answer about the aircraft's condition, even if not every item on the test card (the written, step-by-step sequence for each in-flight check) gets flown. An abnormal or uncertain result is useful evidence. The WYVERN guidance is direct: discontinue the check and return for maintenance evaluation rather than try again in the air (Zotter et al., 2026, Execution and Appendix A, items 42–44).

Where departure from controlled flight is a realistic hazard, WYVERN recommends making upset prevention and recovery training (UPRT) part of check-pilot qualification, alongside aircraft systems knowledge, test experience, crew coordination, and the relevant procedures. UPRT completion alone does not qualify a pilot for flight testing, and UPRT programs are not equal. How the training is built and how well it is delivered decides how much capability a course actually builds (Zotter et al., 2026; Federal Aviation Administration [FAA], 2017; NTSB, 2026; Ransbury et al., 2026a, 2026b).

Pilots assigned to a post-maintenance flight should start with the Pilot quick start at the beginning of Part 1.

Purpose, Scope, and Use

Audience: aviation leaders, directors of operations and maintenance, chief pilots, safety and quality personnel, maintenance providers, and pilots responsible for planning or conducting post-maintenance flights. Part 1 is the action guide. Part 2 explains the evidence, technical considerations, and implementation logic. Appendices contain adaptable worksheets and a WYVERN crosswalk.

This is a U.S.-centered educational and planning guide, with selected international guidance used for comparison and safety principles. For other jurisdictions, the operator must establish the applicable rules and approvals. EASA SIB 2011-07 has been withdrawn because the topic is addressed by Commission Regulation (EU) No 965/2012; it is cited only for historical terminology. Historical EASA and UK CAA publications are not a statement of current European or UK law (EASA, 2011, publication-status record).

This guide uses RTS for the whole organizational process. For the legal maintenance sign-off, it uses "approval for return to service." Flight authorization, PIC acceptance, technical acceptance of the

results, and return to line operations are separate decisions, even when one person holds more than one role (14 C.F.R. §§ 43.7, 43.9, 91.407, 2026).

How to use the tools

- Pilots assigned to a flight: start with the Pilot quick start, then use Table 6 in Section 6 and Table 7 and Figure 6 in Section 7.
- Use the executive summary and Sections 1–3 to establish leadership responsibilities.
- Use Sections 4–8 and Appendices A–E to prepare and document an individual RTS event.
- Use Part 2 when selecting crews, planning their preparation, assessing demanding profiles, and explaining why a flight is held or escalated.
- Replace every aircraft-specific blank with verified, applicable data. A blank limit, unresolved conflict, or missing procedure is not permission to use a familiar value from another type.
- Have maintenance, flight operations, safety, and relevant aircraft/test specialists review the adapted tools before operational adoption.
- Terms and abbreviations are defined at first use and collected in the Glossary.

Use boundaries

This guide is an educational and planning resource. It is not an approved flight manual, maintenance procedure, test plan, operational authorization, legal opinion, or regulatory qualification standard, and it does not replace qualified instruction. All figures, tables, and templates are original planning aids synthesized for this report; they are not WYVERN forms and do not carry WYVERN, FAA, or Bombardier approval. Criteria drawn from other sources, such as WYVERN's sample checklist items, remain sample criteria unless a rule or approved procedure makes them requirements. Aircraft-specific manuals, approved test procedures, and the operator's authorized processes govern every flight. The report does not promote a training provider. The author leads Aviation Performance Solutions (APS), a UPRT provider named in the WYVERN guidance; Section 12 explains how APS resources are used and why the same evaluation applies to any provider.

Glossary of Terms and Abbreviations

Terms and abbreviations as used in this guide. Each is also defined at first use.

Airplane flight manual (AFM): The approved manual containing the aircraft's operating limitations and procedures.

Angle of attack: The angle between the wing and the oncoming airflow. Exceeding the critical angle of attack stalls the wing; reducing it is the primary response to an impending or full stall (FAA, 2015).

Approval for return to service: The maintenance approval made by a person authorized under 14 C.F.R. § 43.7 and recorded under § 43.9 or § 43.11. It covers the work performed and is separate from flight authorization and operational acceptance.

Check flight: This guide's general term for a post-maintenance flight that verifies aircraft condition or system function. The WYVERN guidance divides check flights into confidence flights, functional check flights, and test flights (Table 5).

Confidence flight: In the WYVERN guidance, a lower-risk shakedown flight confirming that systems operate normally before the aircraft returns to revenue service.

Crew resource management (CRM): The use of all available crewmembers, information, and resources to manage workload, communication, and decisions.

Designated engineering representative (DER): An FAA engineering designee. The role is a designation, not a general qualification standard for check pilots (Section 10).

FSF compendium: The Flight Safety Foundation's *Functional Check Flight Compendium* (FSF, 2012).

Functional check flight: In the WYVERN guidance, a medium-risk flight prescribed by certain maintenance actions to confirm that affected systems function properly. Other sources define the term differently (Table 9).

Loss of control in flight (LOC-I): An unintended departure from controlled flight.

Maintenance documents (AMM, ICA, SRM, STC): Aircraft maintenance manual, instructions for continued airworthiness, structural repair manual, and supplemental type certificate.

NTSB report: National Transportation Safety Board Aviation Investigation Report AIR-26-01 on postmaintenance stall test flights in certain Hawker airplane models (NTSB, 2026).

Operational check: The flight check required by 14 C.F.R. § 91.407(b) before persons other than crewmembers are carried, when maintenance may have appreciably changed flight characteristics or substantially affected operation in flight.

Pilot flying (PF) and pilot monitoring (PM): The PF controls the flightpath. The PM monitors the flightpath and aircraft state, operates systems, and makes calls.

Pilot in command (PIC): The pilot with final authority and responsibility for the operation and safety of the flight.

Return to service (RTS): In this guide, the end-to-end organizational process from planning the maintenance event to returning the aircraft to intended line operations. The legal maintenance step is called approval for return to service.

RTS coordinator: The person who maintains the RTS event record and handoffs. Coordination does not carry signatory authority.

Safety management system (SMS): An organization's formal system for identifying hazards, managing risk, and assuring that safety controls work.

Stall test: A flight check of stall warning, stall protection, or stall characteristics, often required by the manufacturer after specified maintenance. Section 11 distinguishes the different levels of exposure.

Stick shaker and stick pusher: Stall warning and stall protection devices. The shaker vibrates the control column as the wing nears the stall; the pusher moves the column forward to reduce angle of attack.

Stop criterion: A recognizable condition, defined before flight, that ends a test item, together with the expected crew response (Section 13).

Test card: The written, step-by-step sequence for each in-flight check, including entry conditions, expected result, limits, and stop criteria (Appendix C).

Test flight: In the WYVERN guidance, a high-risk flight to test specific systems and confirm that the aircraft performs as designed. It can approach or exceed the normal operating envelope.

Upset: An undesired aircraft state characterized by unintentional divergence from parameters normally experienced in line operations or training (FAA, 2017).

Upset prevention and recovery training (UPRT): Training that builds the knowledge and skill to prevent, recognize, and recover from upsets.

VMC; VMO/MMO: Visual meteorological conditions; maximum operating limit speed and Mach number.

WYVERN guidance: WYVERN's *Post-Maintenance Flight Check Guidance*, Revision 1, June 15, 2026, cited as Zotter et al. (2026). It is this guide's primary integration source (Appendix E).

PART 1 | PRACTICAL ACTION GUIDE

Pilot quick start

If you have been assigned to fly a post-maintenance check, start here. This section gives you three tools: a picture of how fast an adverse stall can develop (Figure 1), a red-flag screen to decide whether the flight is really a test flight (Table 1), and what the NTSB cases teach (Table 2). Then use the brief card in Section 6 (Table 6) and the crew calls and crew composition decision in Section 7 (Table 7 and Figure 6). Leaders and planners can use the same tools to confirm that the assigned crew has what it needs.

How fast it goes wrong

A post-maintenance stall test checks how the aircraft behaves, and the crew cannot fully predict that behavior. Figure 1 uses NTSB data from two events. In the 2024 accident, the airplane stalled at the same moment the stick shaker activated, before the pusher, leaving no warning margin. Full left aileron, full power, and full aft elevator, the natural responses under surprise, made the stall and spin worse. In the 2006 incident, a crew of the manufacturer's own pilots was inverted within 4 seconds and lost about 11,000 ft in 30 seconds before regaining control (NTSB, 2026, pp. 5, 8).

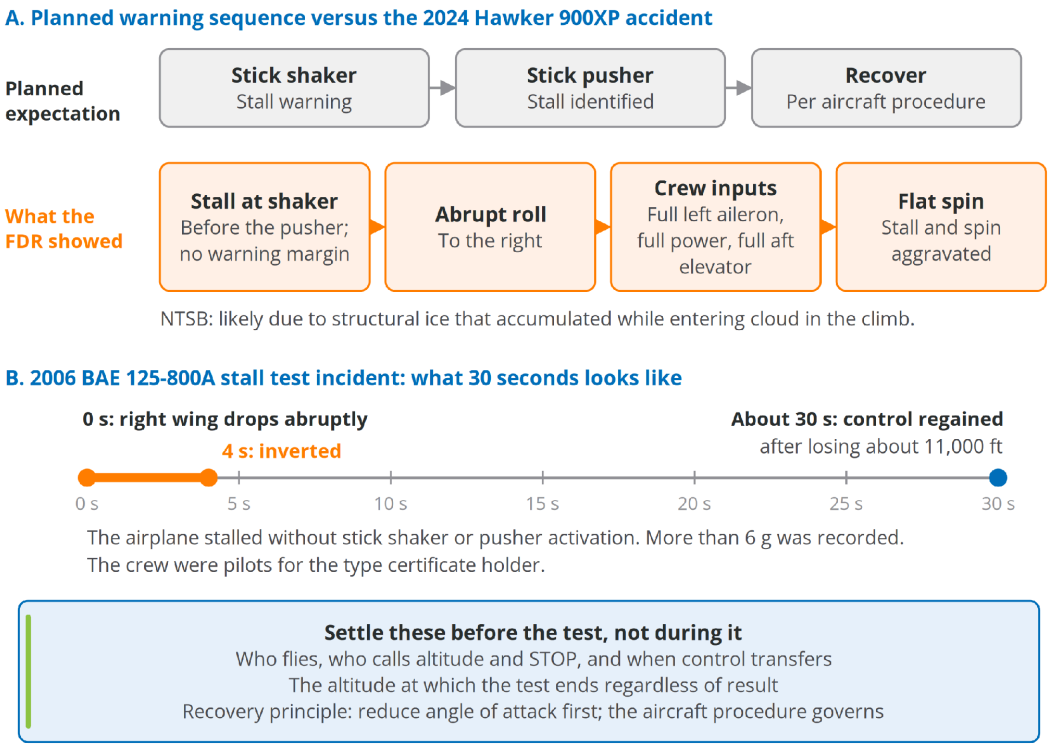


Figure 1. How fast an adverse stall develops.

Original figure from NTSB (2026, pp. 5, 8); recovery principle from FAA (2015). Not a recovery procedure; aircraft-specific procedures govern.

Is this really a test flight?

A yes to any item below means the flight is not a routine confidence flight. Raise it with the chief pilot or RTS coordinator and resolve it before you accept the aircraft. One red flag can be enough.

Table 1. Test-flight red flags.

Red flag	What to do
1. The card includes approaching the stall, stick shaker or pusher activation, or stall characteristics.	Treat it as a test flight. Confirm task-qualified crewing and any manufacturer-defined pilot criteria (Table 5).
2. Flight controls, wing leading edges, aerodynamic surfaces, or stall-protection components were removed, repaired, adjusted, or painted.	Get the full work package. Expect changed handling or warning behavior until the check proves otherwise.
3. The only qualification standard is being "familiar with" the aircraft or having "prior experience."	Ask who decides you are qualified and on what evidence. The NTSB found these criteria open to interpretation.
4. You have never performed this check on type, or only took part once, years ago.	Hold and ask for the crew determination: is the task within demonstrated competence, or does it need a test pilot or added flight-test crewmember?
5. Your stall training was a demonstration with no proficiency standard.	Do not count it as test preparation. Arrange preparation that matches the actual task.
6. There is no written test plan with entry conditions, expected results, abort criteria, and recovery roles.	No-go until the plan exists and the crew has briefed it.
7. The card covers only one configuration, or nobody can say which configurations the test requires.	Get the required configurations from the approved procedure or the manufacturer. An aircraft can pass in one configuration and fail in another.
8. Manual references conflict, are missing, or point to the wrong document.	Resolve with the manufacturer or maintenance authority before flight.
9. Ice or wing contamination is possible, including climbing through clouds to the test altitude.	The test assumes a clean wing; the stall protection system cannot compensate for a contaminated one. In the 2024 accident, the NTSB found that even a 2-minute icing encounter could have reduced the stall angle of attack by up to 6°. Reschedule, or re-plan the route and altitude so every test condition is met and all surfaces are confirmed free of ice.
10. A qualified test pilot or specialist was recommended but is not part of the plan.	Revisit that decision with the person who made it before you accept the aircraft.
11. Someone suggests adding a check "while we are up there."	Fly only the reviewed and authorized profile.
12. People who are not needed for the test are planned to be aboard.	Carry only the minimum crew needed to conduct the flight (Figure 6).
13. The aircraft is scheduled for a trip right after the flight.	Separate the test from the trip. The aircraft stays out of service until the results are reviewed and accepted.

Synthesis from NTSB (2025a; 2025c; 2026, pp. 3–5, 10–12), Zotter et al. (2026, Introduction, Execution, and Appendix A, items 14, 33, and 47), FSF (2012), and CAA (2017, para. 6.18).

What the accidents teach

Table 2 lists each NTSB Hawker stall test case, the safety barrier at issue, and the tools in this guide that address it. The October 2025 investigation is still open; the table reports only facts the NTSB has published and implies no cause. Event Boxes 1 to 7 in Part 1 summarize these three cases and four related events, using the reports of the NTSB, the French Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA), and the UK Air Accidents Investigation Branch (AAIB).

Table 2. Lessons from NTSB Hawker cases.

Event	What the NTSB reported	Barrier at issue	Tool in this guide
2006 BAE 125-800A, near Lincoln, Nebraska (incident)	Type certificate holder pilots flew the stall test with the autopilot engaged, as the maintenance test procedure required, although the AFM called for autopilot off. The crew did not meet the stall test condition that the wing be free of ice. The airplane stalled above the calculated speed without shaker or pusher, was inverted within 4 s, and lost about 11,000 ft before recovery. Four technicians were aboard.	Conflicting procedures; aircraft surface condition; even manufacturer crews were surprised.	Table 1 (items 7 and 8); Appendix C test-card template; Section 13 stop criteria.
2024 Hawker 900XP, N900VA, near Westwater, Utah (two fatalities)	Fully qualified line pilots had only simulator exposure to the stall warning system; the PIC had once been SIC on a stall test, the copilot never. The test was flown en route on a positioning flight, after a climb through icing conditions, above the 18,000 ft maximum, and with less than the required cloud clearance. The stall came with the shaker; full left aileron and full aft column aggravated it. The NTSB found the manufacturer's lack of training and experience requirements causal.	Subjective qualification criteria; test combined with a trip; ice-free, cloud clearance, and altitude conditions not met; no POM recovery procedure for adverse stall behavior.	Table 1 (items 3, 4, and 8); Table 5 crew levels; Figure 1; Table 6 recovery roles.
2025 Hawker 800XP, XA-JMR, near Bath Township, Michigan (three fatalities; investigation ongoing)	The operator's primary crew flew the stall test after 7 months of maintenance. Their simulator stall training covered recognition and avoidance and was not graded. The maintenance facility gave them a list of experienced stall test pilots for hire; when one could not be arranged, the crew flew the test themselves. A company maintenance representative was aboard.	Task-specific crew preparation and the choice not to use an offered specialist; the NTSB review of training and experience is ongoing.	Table 1 (items 5, 9, and 11); Section 4 crew determination; Figure 6.

Facts from NTSB (2025a; 2025b; 2026, pp. 3–5, 8–10). The barrier and tool columns are this report's analysis.

Settle roles, minimum altitudes, and recovery actions on the ground. FAA stall guidance makes reducing angle of attack the primary response to an impending or full stall, and the inputs recorded

in the 2024 accident show how hard that can be when a roll arrives without warning (FAA, 2015, pp. 7–10; NTSB, 2026, p. 8). Where departure from controlled flight is a realistic hazard, preparation should include upset recognition and recovery matched to the aircraft class (Section 12).

1. The end-to-end RTS process

Start planning when the maintenance event is scheduled, not when the aircraft is ready to leave the shop. The WYVERN guidance does not cover the pre-maintenance stage in detail, but its recommendations call for early agreement on the work scope, the instructions for continued airworthiness, the expected RTS requirements, and crew preparation (Zotter et al., 2026, Scope and Recommendations). Figure 2 shows the full process.

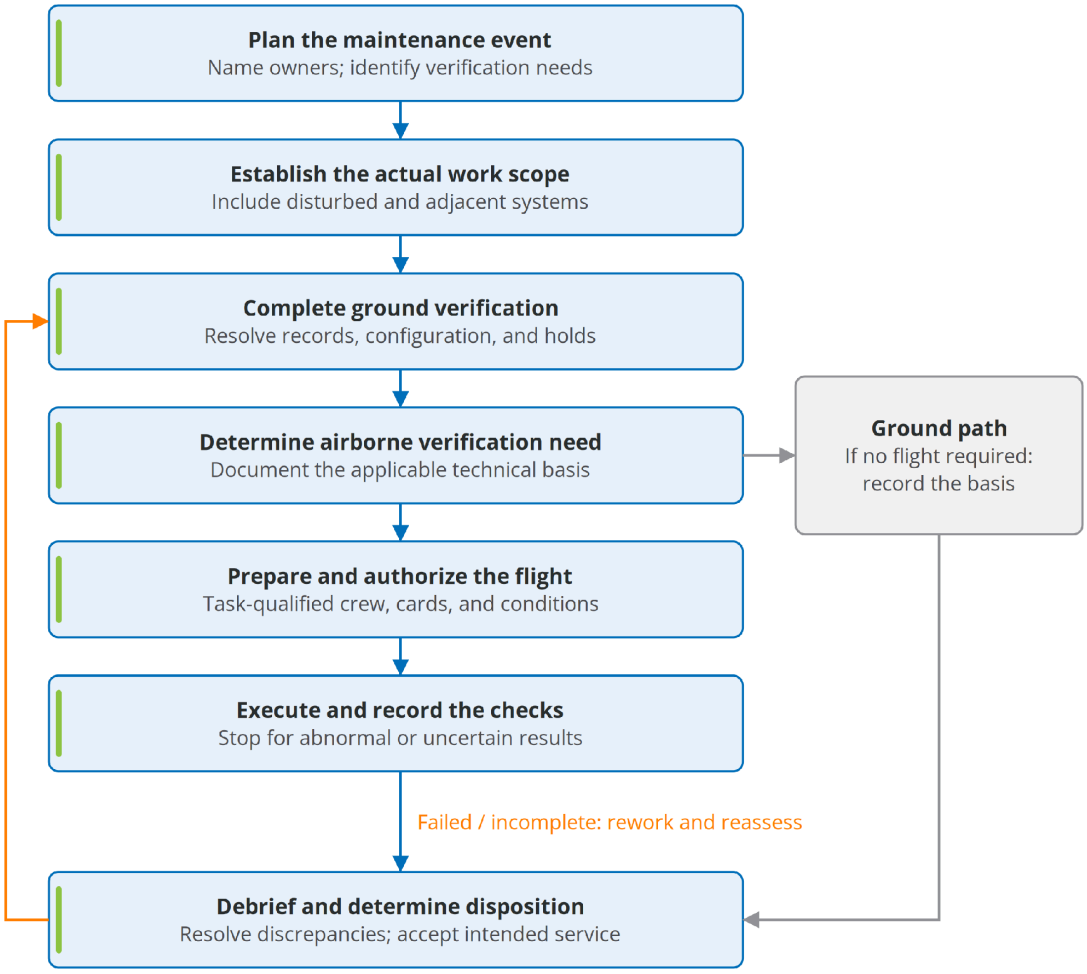


Figure 2. End-to-end RTS process.

Original synthesis from Zotter et al. (2026), FSF (2012), and 14 C.F.R. § 91.407 (2026). Ground verification does not waive a required airborne check without an authorized basis.

Figure 2 shows how the organization works through an event; it does not mean every event needs a check flight. It includes a documented ground-check path. If the applicable instructions require an

airborne check, skipping it needs an authorized resolution, not a management preference (14 C.F.R. § 91.407, 2026; Zotter et al., 2026).

Planning timeline

Post-maintenance flight risk is set long before engine start. WYVERN recommends agreeing on the work scope, the instructions for continued airworthiness, and the expected RTS requirements before the aircraft goes into the shop, and holding the risk discussion well before the planned release date (Zotter et al., 2026, A Practical Example and Recommendations). Figure 3 shows what leaders and the assigned pilots should be doing at each stage.

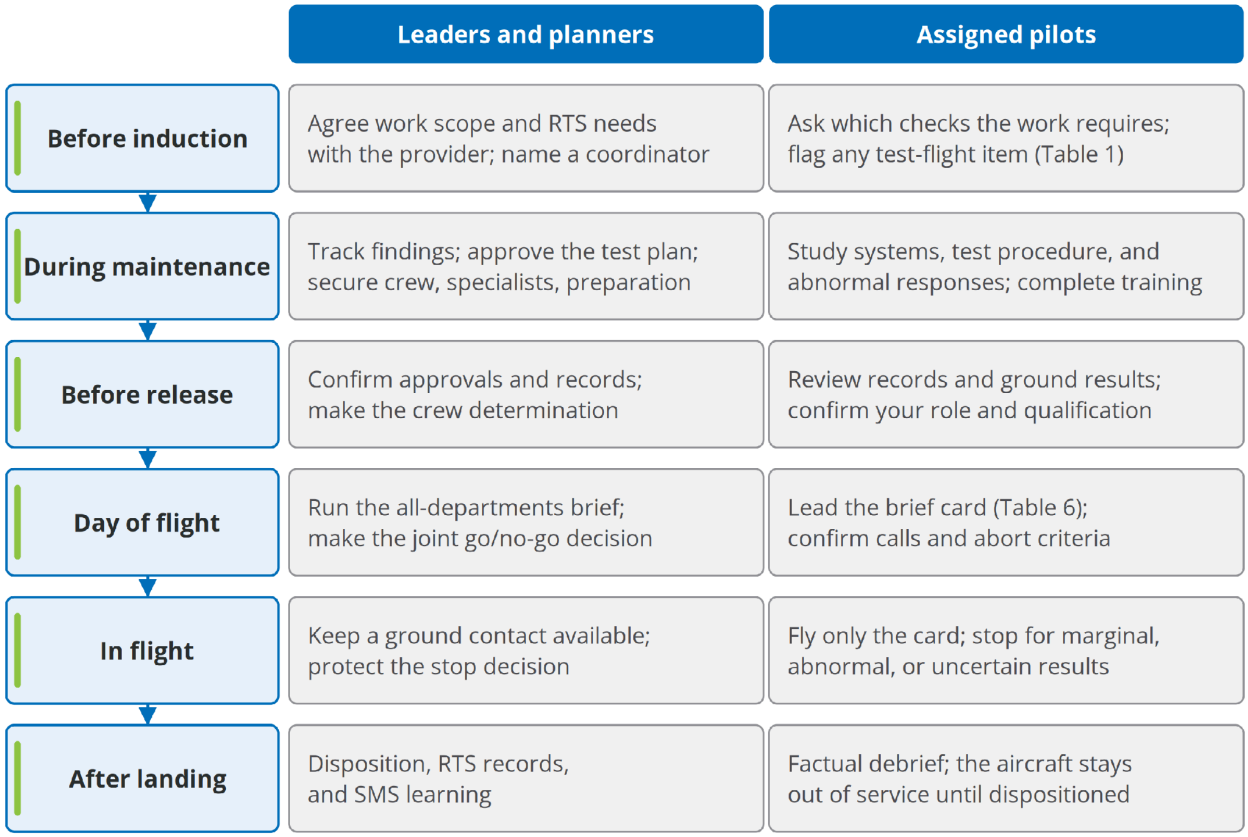


Figure 3. Leader and pilot planning timeline.

Original synthesis from Zotter et al. (2026, Recommendations and Appendix A, Phases A–F) and FSF (2012). Stage timing is illustrative; adapt it to the event.

Define success before departure

For every required check, record the instruction that governs it, the expected result, how it will be measured or observed, the acceptance criteria, and who decides the outcome. Flying a check is not the same as passing it. “Flown” does not mean “passed,” and “no fault noticed” does not mean the item was checked against a defined standard (Zotter et al., 2026, Appendix A, items 42–55; FSF, 2012).

Event Box 1. 2003 Beech 1900D, N233YV, Charlotte, North Carolina.

Why it matters for RTS: The aircraft returned to scheduled service after maintenance with a flight control misrig that the postmaintenance checks did not detect.

Event: January 8, 2003 | Charlotte-Douglas International Airport, North Carolina | Raytheon (Beechcraft) 1900D | 2 flight crewmembers and 19 passengers; all killed. 1 person on the ground received minor injuries.

What happened: The airplane crashed shortly after takeoff on a scheduled Part 121 passenger flight. During the detail six maintenance check, the elevator control system was "incorrectly rigged," which "restricted the airplane's elevator travel to 7º airplane nose down, or about one-half of the downward travel specified by the airplane manufacturer." The mechanic who did the work "had not previously performed it on a Beech 1900D" and was receiving on-the-job training from a quality assurance inspector.

Probable cause (NTSB): "The airplane's loss of pitch control during takeoff. The loss of pitch control resulted from the incorrect rigging of the elevator control system compounded by the airplane's aft center of gravity, which was substantially aft of the certified aft limit."

What the NTSB found: "The postmaintenance checks performed by the quality assurance inspector and the mechanic were not adequate to detect the elevator control system misrig." The changes "were not conspicuous to the flight crew." "A complete functional check at the end of maintenance for critical flight systems or their components would help to ensure their safe operation, but no such check is currently required."

Facts from NTSB (2004, pp. x, 96, 102, 128–129, 131). The "Why it matters" line is this guide's analysis.

2. Ownership and decision authority

Name an RTS coordinator to keep the event record and make sure handoffs happen. Table 3 lists the roles involved and what each is responsible for. Use it as a template; actual titles, required signatures, and legal authority depend on the operation. Maintenance approval must come from a properly authorized person, not just someone with a management title (14 C.F.R. § 43.7, 2026).

WYVERN names the responsible department for each step and requires a clear decision on whether the planned profile is within the crew's demonstrated competence. Adopt that clarity, but do not assume WYVERN's sample staffing structure fits every flight department (Zotter et al., 2026, Appendix A, Phases B–D).

Protect the stop decision

Put a clear statement in the flight authorization: any assigned crewmember can call to stop a check, and the PIC will put safe aircraft control and the applicable abnormal or emergency procedure first. A stop call must never become an argument over rank. Management should back justified delays and conservative decisions (FSF, 2012, pp. 6–9, 12–13; Zotter et al., 2026, Appendix A, item 43). The 2006 BAE 125-800A incident shows why this matters. A mechanic on board saw frost near the wing root, out of the pilots' view, and reported it, but the test went ahead (NTSB, 2026, p. 9). Brief one rule before flight: any report of wing contamination means a hold. That rule turns a report like this into a decision, not a debate.

Table 3. RTS roles and accountabilities.

Role	Accountability in this proposed framework
Accountable operational leader	Resources, schedule protection, risk acceptance within policy, and escalation beyond delegated authority.
RTS coordinator	Maintains scope, decisions, outstanding items, document versions, and handoffs; does not replace signatory authority.
Maintenance lead / authorized signatory	Explains the work and technical requirements; verifies completion and issues applicable maintenance approvals and records.
Quality / compliance	Checks applicable inspection and record requirements; verifies discrepancies and restrictions are addressed.
Chief pilot / operations	Assesses crew suitability, mission planning, operating permissions, and flight authorization.
Safety representative	Facilitates hazard review, challenges assumptions, records mitigations and residual risk, and tracks learning.
Pilot in command	Accepts the aircraft and mission within applicable authority; controls flight conduct and safety decisions.
Other required crewmembers	Perform assigned monitoring, systems, data, or engineering duties; exercise briefed intervention authority.

Event Box 2. 2025 Hawker 800XP, XA-JMR, near Bath Township, Michigan.

Why it matters for RTS: An experienced stall test pilot was offered for hire, and the operator's primary crew flew the test themselves. See Table 2.

Event: October 16, 2025 | near Bath Township, Michigan | Hawker 800XP | 3 aboard: the pilot, the copilot, and a company maintenance representative; all fatally injured. Investigation ongoing.

What happened: The pilot and copilot were "the operator's primary flight crew for the airplane, which had been down for maintenance for the preceding 7 months." Their simulator stall training was "focused on recognizing and avoiding stalls and were not graded." Maintenance facility personnel "provided the flight crew with a list of experienced stall test pilots-for-hire, but the flight crew instead flew the accident stall test flight themselves." The airplane leveled at 15,000 ft, within an approved block altitude of 14,000 to 16,000 ft. At 1727 it began a rapid descent, and a crewmember transmitted, in Spanish, "in a stall, recovering, sorry."

Probable cause: Not determined; the NTSB investigation is ongoing. The NTSB stated that "the descent profile and other aspects of the flight are similar to those identified" in the 2024 Hawker 900XP accident (Event Box 4).

What the NTSB recommended: Pilot training and experience qualification criteria and a stall test plan for postmaintenance stall test flights in certain Hawker airplane models (Safety Recommendations A-26-1 through A-26-7).

Facts from NTSB (2025b; 2026, pp. 3–4, 13–14). No cause is implied. The "Why it matters" line is this guide's analysis.

3. Translate maintenance into verification

Ask for the full work package, including non-routine findings, access work, removed and reinstalled components, software/configuration changes, deferred defects, and ground-test results. The name of the original task can hide the work that matters: a paint job may involve removing flight controls, rebalancing, aerodynamic surfaces, probes, and extensive masking (Zotter et al., 2026, A Practical Example; FSF, 2012, pp. 7–8). Table 4 lists the records to request and the questions each should answer.

Table 4. Maintenance records and questions.

Record	Questions to resolve
Work actually performed	What was removed, opened, adjusted, repaired, replaced, rebalanced, reprogrammed, or reconnected?
Affected and adjacent systems	Which interfaces, sensors, wiring, plumbing, controls, protections, or configurations were disturbed?
Technical basis	Which current AMM, SRM, ICA, STC, AFM, or other applicable instruction controls the verification?
Ground evidence	Which checks and inspections were completed, by whom, and with what results?
Airborne requirement	What cannot be established on the ground, and what explicit requirement or justified objective remains?
Acceptance and closure	What evidence constitutes a pass, who evaluates it, and what happens after an incomplete or failed item?

Ground checks first

Complete the applicable ground checks before flight. This reduces unnecessary time in the air, but it cannot replace a required flight check without an authorized technical basis. Under § 91.407(c), skipping the paragraph (b) flight requires conclusive ground-test or inspection results, not just a belief that the flight is unlikely to find a problem (14 C.F.R. § 91.407, 2026; FSF, 2012, p. 8).

Hold the flight if any of these apply

- The maintenance scope or configuration cannot be established.
- The required test instruction is missing, contradictory, outdated, or not applicable to the aircraft.
- A discrepancy, ground-test failure, or restriction has not been resolved for the intended flight.
- The flight's legal basis or required maintenance record is uncertain.

These hold conditions are recommendations. Resolve each one with the right maintenance, manufacturer, operations, or regulatory authority before departure. Do not try to resolve technical uncertainty by adding exploratory maneuvers in flight.

Event Box 3. 2006 BAE 125-800A, near Lincoln, Nebraska.

Why it matters for RTS: The manufacturer's maintenance test procedure conflicted with its AFM, and a reported wing contamination did not stop the test. See Table 2.

Event: May 4, 2006 | near Lincoln, Nebraska | BAE 125-800A | 6 aboard: the pilot, the copilot, and four technicians; minor injuries. Incident.

What happened: During a stall test flight, the airplane "entered a stall without the expected stick shaker and stick pusher activation and rolled uncommanded through 360°." It "became inverted 4 seconds after the initial upset and lost about 11,000 ft of altitude within 30 seconds before the pilot regained control of it." The downward acceleration force "exceeded 6 g." The flight crewmembers were pilots for the airplane type certificate holder at the time.

What the NTSB found: "The AFM stated that intentional stalls were to be performed with the autopilot off. However, the Raytheon maintenance test flight procedures required it be engaged." "Contrary to the guidance specified in the AFM, the flight crew initiated the stall test with ice contamination on the wings and . . . this contamination resulted in the airplane's adverse stall behavior." A mechanic on board saw frost on the wing near the root, "out of the pilots' field of view," and reported it to the flight crew, "but they continued to perform the stall test." Raytheon later issued a stall training syllabus but added it "only to its internal Production Flight Test Procedure" and not to any AFM or pilot's operating manual (POM).

Facts from NTSB (2026, pp. 8–9). The "Why it matters" line is this guide's analysis.

4. Classify the task and crew

WYVERN sorts check flights into three categories: confidence flights, functional check flights, and test flights. Table 5 describes each and adds the crew level this guide suggests considering. The categories are useful planning labels, not legal classes. Choose the category from what will actually be flown and the risk that remains, not from the label on the work order. The crew-level column is this guide's planning recommendation, not a regulatory qualification standard (Zotter et al., 2026, Scope and Planning and Preparation; NTSB, 2026, pp. 11–12).

WYVERN describes the highest consequence category, Test Flight, in Table 5 as potentially approaching or exceeding the normal operating envelope. That wording is not permission to exceed AFM limitations. Proposed activity outside the ordinary authorized basis must be separately resolved with appropriate specialists and authorities. Category labels do not confer permission.

A defined standard already exists for at least one manufacturer. The NTSB pointed to a stall flight operations manual, developed by Bombardier Aerospace for specified Learjet models, that specifies ground and flight training for manufacturer-authorized pilots, along with stall test procedures and checklists, recovery techniques, and safety precautions (NTSB, 2026, pp. 11–12). Where a required test has no equivalent standard, the crew determination in Figure 4 (Crew-to-task suitability decision) has to supply that rigor.

Table 5. Check-flight categories and crew levels.

WYVERN category	What it means	Crew level to consider
Confidence flight	Lower-risk shakedown flight to confirm that all aircraft systems operate normally before the aircraft returns to revenue service.	A pilot properly certificated, current, and qualified on type. WYVERN notes that after a low-risk component replacement, an experienced line pilot with strong familiarity with normal system function may validate performance. Confirm that the actual tasks and credible abnormal outcomes are within demonstrated competence.
Functional check flight	Medium-risk flight prescribed by certain maintenance actions to confirm that the affected systems function properly.	The same baseline plus task-specific preparation: systems and abnormal-procedure review, simulator practice of unfamiliar procedures, and a formal check-pilot qualification. Ordinary recurrent training may not cover the intended tasks. Where departure from controlled flight is a credible hazard, add recent UPRT at an architecture level suited to the aircraft and mission, from a provider whose delivery quality has been assessed. A dedicated test pilot may not be required if checks stay within the normal envelope and ground testing has been extensive and successful.
Test flight	High-risk flight to test specific systems and confirm that the aircraft performs as designed. It can approach or exceed the normal operating envelope.	An appropriately qualified flight-test pilot with aircraft-specific expertise, not merely a pilot familiar with the expected characteristics. Where the manufacturer defines pilot training and experience criteria, as the NTSB recommended for Hawker stall tests, use pilots who meet them. Independently confirm the operational and technical authority for the planned profile.

Sources: Zotter et al. (2026, Scope; Planning and Preparation; Recommendations); NTSB (2026, pp. 11–12, 17); Ransbury et al. (2026a, 2026b).

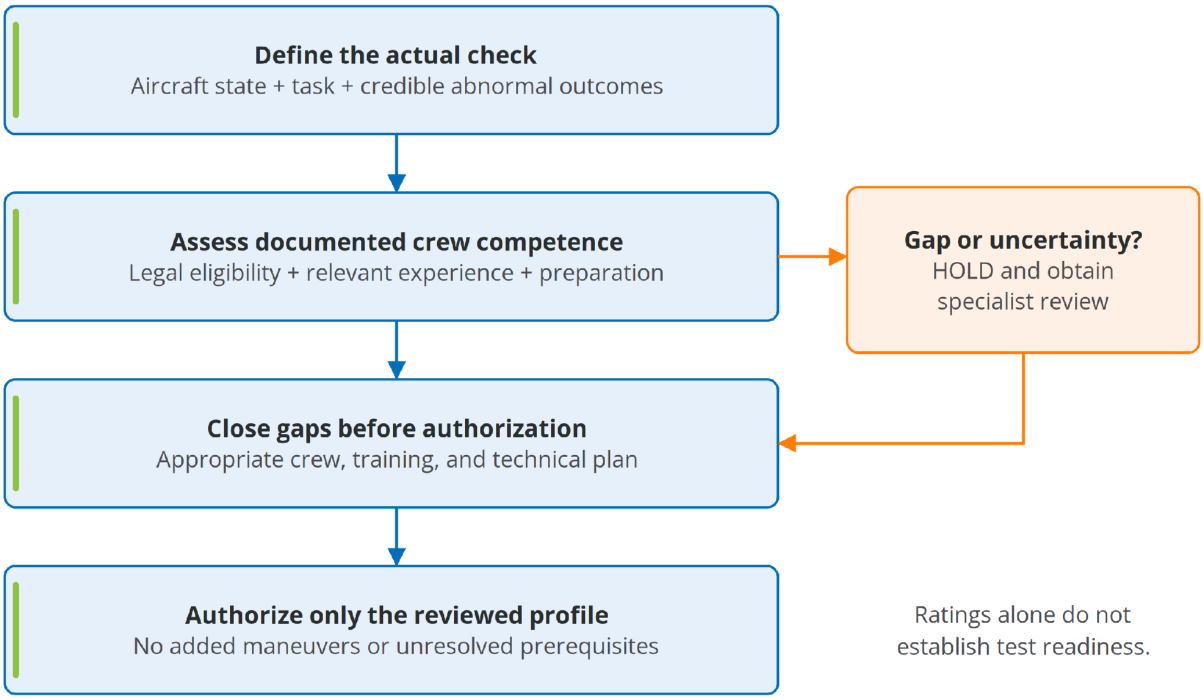


Figure 4. Crew-to-task suitability decision.

Original planning framework informed by Zotter et al. (2026), FSF (2012), and NTSB (2026).

Evidence of crew readiness

Document the crew's experience on the aircraft and with the actual check, recent practice, understanding of the affected systems, ability to handle abnormal responses, monitoring skills, and ability to explain the stop criteria. Assess both pilots and any required technical crewmember. A type rating, seniority, or total flight hours alone do not show readiness for demanding checks (FSF, 2012, pp. 5–9; NTSB, 2026, pp. 10–12).

If the required profile is beyond what the available crew has shown it can do, change the crew, arrange suitable preparation, or postpone. Cutting the scope is an option only for checks that are truly optional, or through an authorized alternative for required work. Do not leave a required check unresolved and call the aircraft accepted.

Event Box 4. 2024 Hawker 900XP, N900VA, near Westwater, Utah.

Why it matters for RTS: The crew was qualified for normal operations but not prepared for the adverse stall behavior a stall test can expose. See Table 2.

Event: February 7, 2024 | near Westwater, Utah | Hawker 900XP | 2 aboard: the pilot and copilot; both fatally injured.

What happened: The crewmembers were the operator's line pilots, on a Part 91 positioning flight from Grand Junction, Colorado. Their simulator training covered the stall warning and identification system and was "focused on recognizing and avoiding stalls." The PIC had flown one stall test flight 4 years earlier as second in command (SIC); the copilot had never flown one. The airplane "entered the stall at the same time the stick shaker activated and before the stick pusher activated," which the NTSB attributed "likely" to "structural ice that accumulated as the airplane entered the clouds during part of its climb." The airplane rolled right, and the crew "responded with full left-wing-down aileron control input, full power, and full aft . . . elevator control input, which aggravated the aerodynamic stall and spin."

Probable cause (NTSB): "The flight crew's decision to conduct a post-maintenance stall test in an area of icing conditions, which resulted in wing contamination that significantly decreased the airplane's critical angle of attack. Also causal was the airplane manufacturer's lack of training and experience requirements for the flight crew to safely conduct the stall test, which resulted in an attempted remedial action that aggravated the aerodynamic stall and led to a loss of control from which they were unable to recover. Contributing to the accident was the flight crew's failure to follow the test conditions regarding cloud clearance, altitude limit, visual meteorological conditions, and ensuring all external surfaces were free from ice."

What the NTSB concluded: The crew was "properly trained and qualified for normal operations," but "their training, experience, and the procedures available in the applicable airplane manual were inadequate to prepare them to safely respond to the adverse stall behavior they encountered."

Facts from NTSB (2025a, p. 3; 2026, pp. 4–5, 8, 11). The "Why it matters" line is this guide's analysis.

5. Build the flight plan

Write an event-specific plan before the day-of-flight brief. It should show the flight's purpose, technical basis, crew roles, sequence, acceptance criteria, and contingencies in one place. FSF stresses justifying the flight, understanding the aircraft's condition, suitable crewing, weather and airspace, and test cards that keep warnings and tolerances next to each task (FSF, 2012, pp. 7–13). The plan should cover:

- Mission identity: aircraft registration/serial number, maintenance event, configuration, date, plan revision, and controlling documents.
- Scope: required versus optional checks, excluded activities, acceptance criteria, and dependencies between items.
- Aircraft readiness: maintenance approvals, records, ground results, deferred items, equipment, fuel, mass and balance, and special configurations.

- Crew: legal eligibility, task-specific competence, preparation, fitness, role allocation, and technical support.
- Environment: suitable departure/recovery airports, runway conditions, terrain, weather, airspace, ATC coordination, and emergency services.
- Execution: test cards, entry prerequisites, monitoring assignments, result capture, stop criteria, and restoration steps.
- Contingencies: incomplete tests, abnormal indications, loss of a required parameter, inability to restore configuration, and changed conditions.
- Closure: post-flight debrief, discrepancy disposition, required records, technical acceptance, and operational acceptance.

Event Box 5. 2008 Airbus A320, D-AXLA, off Canet-Plage, France.

Why it matters for RTS: The planned checks could not be flown as written. The programme was adapted in flight, and a low-speed check was improvised at low height.

Event: November 27, 2008 | off the coast of Canet-Plage, France | Airbus A320-232 | 7 aboard: 2 flight crew and 5 passengers; all fatally injured.

What happened: The flight was a "flight at end of leasing agreement," before the aeroplane was returned to its owner. "The programme of planned checks could not be performed in general air traffic, so the flight was shortened." In level flight at FL320, "angle of attack sensors 1 and 2 stopped moving." Three days before the flight, the aeroplane had been rinsed with water without protection of the angle of attack (AOA) sensors. Near the initial approach fix, the crew "decided, without preparation, and in particular without a call-out of the theoretical minimum speeds indicated in the OFC [operational flight check programme], to undertake the check of the low speed protections at an altitude of about 4,000 ft." The operating crew "did not follow any specific training for this flight."

Causes (BEA): "The accident was caused by the loss of control of the aeroplane by the crew following the improvised demonstration of the functioning of the angle of attack protections, while the blockage of the angle of attack sensors made it impossible for these protections to trigger. The crew was not aware of the blockage of the angle of attack sensors. They did not take into account the speeds mentioned in the programme of checks available to them and consequently did not stop the demonstration before the stall." Contributing factors included "the decision to carry out the demonstration at a low height," "the decision to use a flight programme developed for crews trained for test flights, which led the crew to undertake checks without knowing their aim," "the absence of a regulatory framework in relation to non-revenue flights," and the absence of AOA sensor protection during rinsing.

What the BEA recommended: That non-revenue flights "be described precisely in the approved parts of the operations manual," including "their preparation, programme and operational framework as well as the qualifications and training of crews."

Facts from BEA (2010, pp. 11, 75, 96, 98–99). The "Why it matters" line is this guide's analysis.

Weather and recovery space

Set weather limits from the maneuver and the space needed to recover, not from "basic VFR" alone. WYVERN recommends normally flying checks in daytime visual conditions (VMC) unless an approved

procedure requires otherwise, not flying through possible icing to reach VMC, and having plenty of clear air below any maneuver that may need altitude to recover (Zotter et al., 2026, Planning and Preparation).

Take entry and stop conditions from the applicable aircraft and test data. Do not use this guide to set a generic stall-test altitude, airspeed, bank angle, or margin. Coordinate the test area and altitudes with ATC, but an ATC clearance is not technical authorization or proof of enough recovery space (Zotter et al., 2026; FSF, 2012, p. 10).

Check how the items depend on each other

Sequence the checks so the crew can always recover and land after each one. Identify systems that are temporarily disabled or reconfigured, how they affect later checks, and how their restoration will be verified. A safe sequence matters more than efficiency. If the profile is reordered or shortened, review those links again; renumbering the cards is not enough (FSF, 2012, pp. 11–13).

6. Brief, authorize, and stop

The all-departments brief should confirm a plan that already exists, not build one beside the aircraft. WYVERN's Phase C checklist brings maintenance, both crew members, operations, quality assurance, and safety together and treats any unresolved question as a hold on departure (Zotter et al., 2026, Appendix A, Phase C; FSF, 2012, pp. 11–12).

Briefing checklist

- Confirm work scope, affected systems, known anomalies, and current aircraft configuration.
- Review every check's objective, sequence, expected response, and applicable limits.
- Name the pilot flying, pilot monitoring, systems operator, and data recorder for each phase; combine roles only where workload allows.
- State the abort call, immediate response responsibilities, control-transfer convention, and communication priorities, using the operator's standard phraseology where it exists.
- Review weather, terrain, airspace, usable recovery airports, and fuel/time constraints.
- Discuss significant unexpected behavior, misleading indications, protection non-activation, and configuration-restoration failure where relevant.
- Confirm how incomplete, failed, marginal, or invalid results will be recorded.
- Ask each crewmember to identify unresolved concerns; record and resolve holds.

Pilot pre-test brief card

After the all-departments brief, the crew briefs together. Table 6 is a card for leading that crew brief; keep it on the flight deck. Fill in every field from the approved test plan and aircraft manuals. A blank field means hold. The card condenses the briefing checklist above and WYVERN's Phase C and D

items into the questions the crew must answer together (Zotter et al., 2026, Appendix A, items 21–37).

Table 6. Pilot pre-test brief card.

Brief item	Crew answer (from the approved test plan)
Purpose	Maintenance performed; what each check must prove; governing instruction and revision: _____
Go/no-go status	Maintenance approval and records, ground results, crew determination, weather (no icing on the test path), airspace: _____
Roles	Pilot flying: _____ Pilot monitoring: _____ Observer/recorder: _____ Who switches and who confirms: _____
Area and floors	Test area and block altitude: _____ Minimum altitude to begin each item: _____ Altitude at which the test ends regardless: _____
Entry gates	Configuration, weight and center of gravity, speed and energy, prerequisite results: _____
Validity checks	Weight basis for target speeds; airspeed source; slip reference if indicators disagree: _____
Expected response	What a normal result looks like, the tolerance, and how it will be recorded: _____
Stop triggers	Marginal, abnormal, unexpected, or uncertain result; any crewmember call; listed card limits: _____
If it departs	First actions per the aircraft procedure, starting with reducing angle of attack before expecting normal roll control; who flies; who calls altitude; when control transfers; non-flying pilot's seat aft and knees clear of the controls: _____
After a stop	Restore configuration as appropriate; no repeat to get a different result; return plan and alternate: _____
Ground contact	Name, frequency, and availability window: _____
Readiness	Each crewmember states fit, prepared, and no unresolved concern. Any concern is a hold.

Synthesis from Zotter et al. (2026, Execution and Appendix A, items 21–47), FSF (2012, pp. 11–13), FAA (2015), and NTSB (2025a, 2025c).

Final release check

Before release, confirm that maintenance status, crew suitability, weather and environment, records, and test cards all support this flight. This organizational sign-off does not replace the PIC's responsibilities or the required maintenance approval. WYVERN's sample matrix requires every go/no-go element to be satisfactory before final organizational authorization (Zotter et al., 2026, Appendix A, Phase D).

Required does not mean continue

A required test means the operator must get an acceptable result through a proper process. It does not mean the crew must keep going when a safety limit is reached. If the planned safety limits prevent completion, record the item as incomplete and get a technical review. The fix is a revised authorized plan, a corrected aircraft, a suitable crew, or an acceptable alternative, never moving the limit in flight (Zotter et al., 2026, Appendix A, items 42–45; NTSB, 2026). In the 2006 incident in Event Box 3, a mechanic reported frost on the wing, and the crew continued the stall test (NTSB, 2026, p. 9).

7. Execute the check flight

Keep the pilot flying focused on flying the aircraft while the pilot monitoring, and any additional crewmember, handles switching, recording, and monitoring. Brief each demanding item again just before flying it: configuration, prerequisites, limits, expected result, who monitors what, and how the item ends. Do not let recording, switching, or discussion of the system under test absorb the whole crew (FSF, 2012, pp. 11–13). Figure 5 shows the flow for each test point.

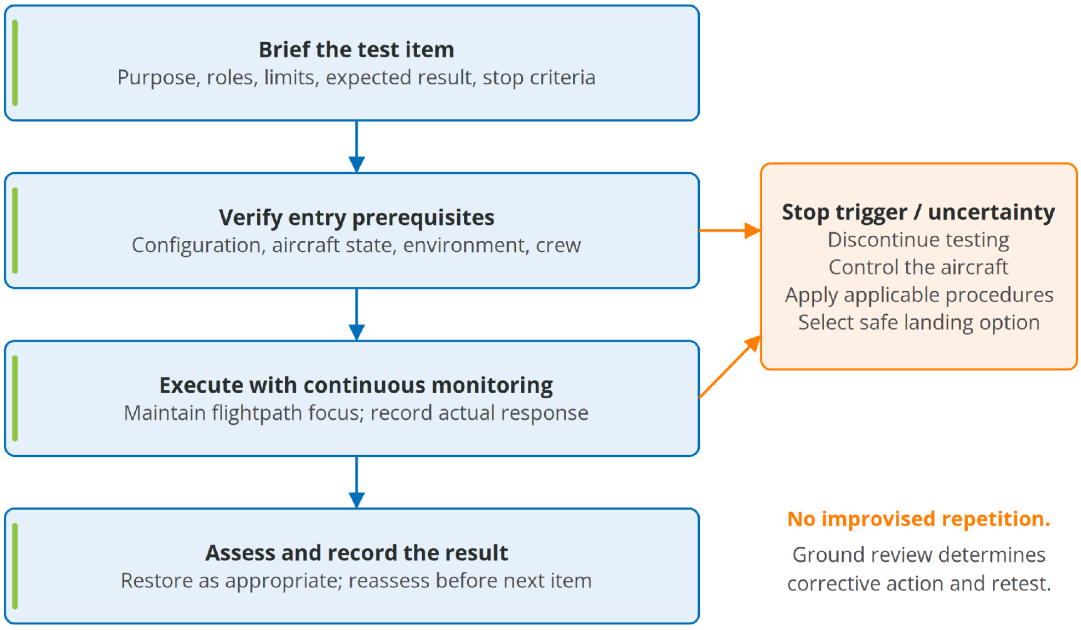


Figure 5. Test-point execution and discontinuation.

Original synthesis from Zotter et al. (2026), Appendix A, Phase E, and FSF (2012). Aircraft-specific procedures govern immediate response and configuration changes.

Standard crew calls

Brief the calls in Table 7 so everyone knows each one and its response. Any crewmember may make any call. Keep the calls few and simple, because under stress people fall back on basic words. STOP,

ABORT and TERMINATE mean the same thing. If anyone is overloaded or has lost the picture, call STOP, recover to a safe, stable condition, then discuss.

Table 7. Standard crew calls.

Call	Meaning	Required response
STOP (ABORT and TERMINATE mean the same)	A stop trigger is met, something is not understood, or a crewmember is overloaded or has lost the picture.	Discontinue the item. The pilot flying controls the flightpath, recovers to a safe, stable condition, applies the aircraft procedure, and restores configuration as appropriate. Then the crew discusses.
"I'm not happy"	A crewmember is uncomfortable with the test progression.	The active pilot recovers to stable flight immediately; the crew reviews before any continuation.
"Confirm [switch]"	A switch or system selection is about to be made.	One person points, the other verifies, then the selection is made. One check at a time.
Silence after a callout	A required call or reply is missing.	Treat it as a possible concern; the pilot flying asks and pauses the item.

Synthesis from FSF (2012, pp. 12–13) and Zotter et al. (2026, Appendix A, items 29 and 43).

Decide the crew composition

In a two-pilot aircraft, normal pilot flying and pilot monitoring procedures apply. The minimum crew is set by the AFM and applicable operating rules, and the guidance reviewed for this report does not require a third pilot for test-profile oversight. It does differ on whether to add a crewmember. FSF describes a third crewmember in the jump seat who records data, monitors the pilots, and holds a right of intervention, and it strongly recommends a third check-qualified crewmember for this work (FSF, 2012, pp. 12–13). The UK CAA strongly recommends at least one extra person to record results and help maintain a lookout, but does not require it (CAA, 2017, para. 6.4). WYVERN advises that only the minimum required crew necessary to conduct the flight be aboard (Zotter et al., 2026, Execution). Decide explicitly whether an additional crewmember is necessary to conduct the flight safely. If so, assign and brief that person's duties and authority to call a stop, and carry no one else. Figure 6 (Crew composition decision) shows the decision.

After a stop call

When anyone calls stop, end the test activity, fly the aircraft first, and apply the aircraft-specific abnormal or emergency procedure. Restore configuration only when it is safe and suits the actual condition. Choose the safest suitable landing option; a generic "return to base" checklist item does not require flying back to the departure airport when another option is safer. This guide authorizes no improvised repeats, further envelope exploration, or troubleshooting in the air.

A diagnostic check planned before flight is different from experimenting after a significant surprise. Its purpose and limits must be set before takeoff. After an unexpected result, preserve observations and data for a technical assessment on the ground rather than looking for a more reassuring result in the air (FSF, 2012). As the WYVERN guidance puts it, "do not repeat a test simply in the hope of obtaining a different result" (Zotter et al., 2026, Execution).

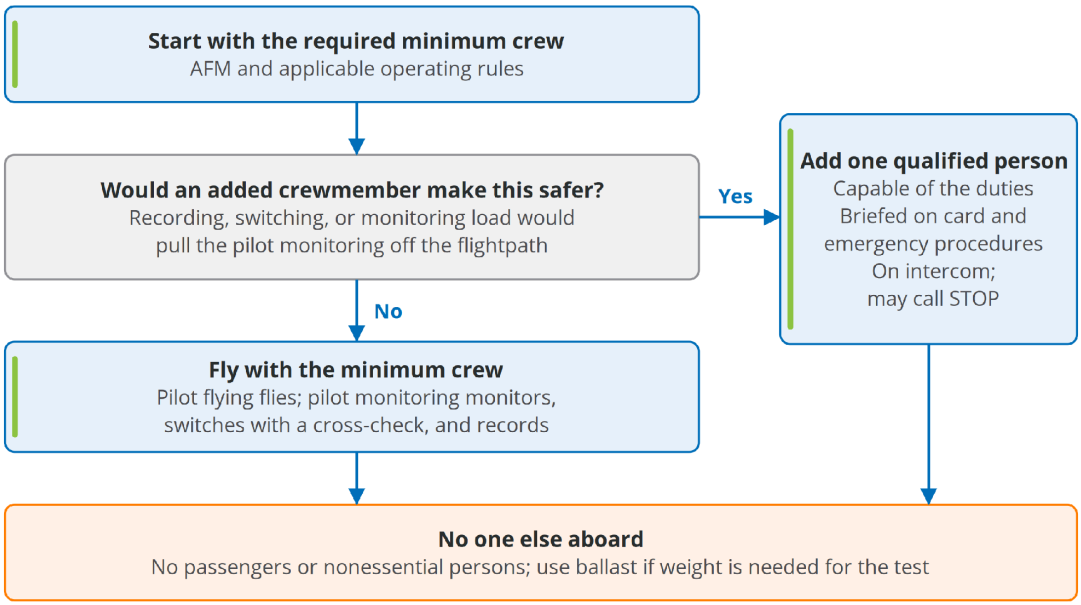


Figure 6. Crew composition decision.

Original synthesis from FSF (2012, pp. 12–13), CAA (2017, paras. 6.4, 6.15, 6.18), and Zotter et al. (2026, Execution).

Record each result in one of five states

Record every check result in one of the five states in Table 8, so that "flown" is never mistaken for "passed."

Table 8. Proposed five-state result record.

Result	Meaning and disposition
Pass	Applicable prerequisites and acceptance criteria met; evidence recorded.
Fail	A valid check shows a result outside the acceptance criteria; refer it for technical review and decision.
Marginal / uncertain	Crew cannot confidently establish an acceptable result. Discontinue under the conservative policy in this guide; obtain technical review.
Incomplete / aborted	Not completed because a stop condition, interruption, or changed situation prevented completion. Not a pass.
Invalid	Data or execution did not satisfy prerequisites; cannot support acceptance. Do not automatically repeat; assess why validity was lost.

Table 8 is an original recordkeeping aid. WYVERN calls for ending the check flight after any marginal, abnormal, unexpected, or uncertain result and for recording incomplete or aborted items (Zotter et al., 2026, Appendix A, items 42–45).

Event Box 6. 1996 Douglas DC-8-63, N827AX, near Narrows, Virginia.

Why it matters for RTS: Neither pilot had handled the controls in an actual stall in the type, the revised stall recovery procedure agreed in 1991 had not been institutionalized, and the stall series was flown without a natural horizon.

Event: December 22, 1996 | near Narrows, Virginia | Douglas DC-8-63 | 6 aboard: 3 flightcrew members and 3 maintenance/avionics technicians; all fatally injured.

What happened: The airplane impacted mountainous terrain "while on a post-modification functional evaluation flight" (FEF) from Greensboro, North Carolina, under Part 91. The pilot flying, in the left seat, was serving as second in command and "receiving instruction in functional evaluation flight maneuvers, including the clean stall maneuver." The pilot flying "applied inappropriate control column back pressure during the stall recovery attempt." The stick shaker was inoperative.

Probable causes (NTSB): "The inappropriate control inputs applied by the flying pilot during a stall recovery attempt, the failure of the nonflying pilot-in-command to recognize, address, and correct these inappropriate control inputs, and the failure of ABX to establish a formal functional evaluation flight program that included adequate program guidelines, requirements and pilot training for performance of these flights." Contributing: "the inoperative stick shaker stall warning system and the ABX DC-8 flight training simulator's inadequate fidelity in reproducing the airplane's stall characteristics."

What the NTSB found: The program's informality "permitted the inappropriate pairing of two pilots for a functional evaluation flight, neither of whom had handled the flight controls during an actual stall in the DC-8." The operator's "failure to require completion of a functional evaluation flight by sundown or to establish adequate limitations on ambient lighting and weather conditions led the flightcrew to attempt the stall series in the absence of a natural horizon." "The accident could have been prevented if ABX had institutionalized and the flightcrew had used the revised functional evaluation flight stall recovery procedure agreed upon by ABX in 1991."

Facts from NTSB (1997, pp. v, 48–49, 51). The "Why it matters" line is this guide's analysis.

8. Debrief and close the event

Landing ends the flight, not the RTS process. Compare every item with its acceptance criteria, note any deviations and limits of the evidence, and keep "completed" separate from "accepted." WYVERN's final phase brings flight, maintenance, quality, and safety together and records any further maintenance or checks needed (Zotter et al., 2026, Appendix A, Phase F). After landing:

- Preserve the executed card revision, flight log, recorded observations, and available aircraft data.
- Conduct a factual crew debrief before recollections diverge: what was commanded, what occurred, and what was recorded?

- Record all anomalies, marginal results, procedural deviations, configuration issues, and safety concerns.
- Have the appropriate technical personnel determine corrective action, acceptance, or the need for another check.
- After rework, identify which earlier results remain valid and which checks must be repeated under a reviewed plan.
- Complete legally required entries through authorized personnel; retain additional supporting records under applicable policy.
- Obtain operational acceptance for the intended service and communicate any remaining restrictions.
- Forward lessons and follow-up actions into the SMS process with an owner and closure date.

WYVERN's sample Phase F calls for debrief within two hours. Treat this as a sample process target, not a universal legal deadline. Preserve timely observations and make the required technical and operational decisions before intended line service (Zotter et al., 2026).

Make results usable by maintenance

An unacceptable result helps only if maintenance can act on it. Record what was observed in terms that match the manufacturer's descriptions of unacceptable behavior: configuration, speeds at warning and protection activation, direction and amount of roll, and anything unexpected. A former Hawker factory test pilot told the NTSB that the stall test pilot should report discrepancies that closely match the unacceptable conditions in the structural repair manual to guide the technician's adjustments, then re-fly after each adjustment until the behavior is acceptable. Each re-fly is a new planned event after a maintenance action, not a repeat flown in hope of a different result (see Do not normalize a failed check). He also described repair facilities that could not fix an airplane a stall test pilot had called unacceptable (NTSB, 2025c).

Keep sign-offs clear

A pilot's record entry for the § 91.407(b) operational check does not approve maintenance beyond that pilot's authority. Likewise, § 43.9(a)(4) states that the maintenance signature approves return to service only for the work performed. Keep clear links between maintenance entries, flight results, technical decisions, and the aircraft's operational status (14 C.F.R. §§ 43.7, 43.9, 91.407, 2026).

Recommended leadership measures

Track the share of events with traceable check requirements, documented crew-task assessments, complete test cards, resolved holds, and closed discrepancies. Review repeat anomalies and the quality of rework decisions. Do not treat a low abort rate or fast release as proof of a good program; those numbers can reward pressure to finish. These are suggested management measures, not regulatory reporting requirements.

Event Box 7. 2009 Boeing 737-700, G-EZJK, west of Norwich, United Kingdom.

Why it matters for RTS: An earlier check result was not recorded in the technical log, the customer request form then gave the trim direction the wrong way round, and there was no formal debrief or controlled record to catch the error.

Event: January 12, 2009 | west of Norwich, Norfolk, United Kingdom | Boeing 737-73V | 4 aboard: 2 crew and 2 engineer observers; no injuries. Serious incident.

What happened: "A flight control manual reversion check was being conducted as part of a post-maintenance check flight. During the check, the aircraft pitched rapidly nose-down, descending approximately 9,000 ft before control was recovered." The rate of descent peaked at 20,000 ft/min, and 429 kt (Mach 0.719) was recorded during the recovery. The previous month, on the flight that delivered the aircraft to maintenance, the commander had found that "11.5 turns of nose-up trim were required to trim the aircraft for level flight in the test configuration." Under the operator's policy of not including "for information" items in the technical log, he did not record the result.

What the AAIB found: "The sequence of events leading to the in-flight incident can be directly attributed to the wording of the customer request form, which recorded the aircraft was out of trim in the nose-down direction rather than the nose-up direction identified by the pilot." "No formal mechanism or controlled paperwork existed for recording test results or significant information during the flight, there was no requirement or procedure for formally debriefing the crew with key maintenance personnel present and no procedure for storage of test results in a controlled manner for future reference." The check flight processes "appear to have been conducted on a largely informal basis."

What the AAIB recommended: Safety Recommendation 2010-073 asks that operators "have, and comply with, a detailed procedure and a controlled test schedule and record of findings for briefing, conducting and debriefing check flights that assess or demonstrate the serviceability or airworthiness of an aircraft."

Facts from AAIB (2010, pp. 1–3, 5, 15, 22, 30). The "Why it matters" line is this guide's analysis.

PART 2 | EVIDENCE AND APPLICATION

9. Why this problem matters

A post-maintenance check exists to find out whether the aircraft or system behaves as expected after the work. The expected result is something to confirm, not something to rely on. The FSF compendium stresses that the aircraft is under examination and that the crew needs relevant knowledge, observation, judgment, and integrity (FSF, 2012, pp. 5–9).

The NTSB report matters because the maintenance was routine but the flight that followed was not. It points to sensitive aerodynamic surfaces, possible adverse stall behavior, gaps in pilot qualification criteria, and conflicting manual references. It supports treating the technical instructions and the crew's readiness as linked safeguards, not separate paperwork (NTSB, 2026, pp. 1–3, 10–15). Gary Grommet, a former Hawker Beechcraft chief test pilot who has flown hundreds of Hawker stall tests in the factory and under contract, told NTSB investigators that the maintenance manual's stall test requirement was "ambiguous" and that no published procedure available to a line pilot defined how the test should be flown or how many configurations it must cover. In his written comments to investigators, he added: "Airworthiness is NOT determined by a pilot's experience, it is determined by procedural means to a standard" (NTSB, 2025c). WYVERN recommends his memorandum as required reading for any designated post-maintenance check pilot (Zotter et al., 2026, Recommendations).

The problem is wider than one airplane family. An APS review of U.S. NTSB accident data for 2016–2025 found 139 fixed-wing accidents on flights the NTSB report describes as a post-maintenance test, check or functional flight. Of those, 32 were fatal, and 42 people died. System or component failure in the powerplant was the most frequent defining event, in 49 of the 139 accidents (35.3%). Loss of control in flight was the most severe: it accounts for 15 of the 32 fatal accidents (46.9%) and 20 of the 42 fatalities (47.6%), as Figures 7 to 9 show (Aviation Performance Solutions [APS], 2026a).

Read these numbers with care. Only 67 of the 139 fixed-wing accidents were coded Flight test in the NTSB data; the rest were found by reading the reports. The figures are counts, not rates, because no flight-hour data exist for these flights, and every total is a minimum. Defining events are NTSB classifications, not root causes. The analysis is APS's own and has not been reviewed or endorsed by the NTSB (APS, 2026a).

Figure 7 ranks the three defining events by fatalities. Loss of control in flight leads with 20 of the 42 fatalities (47.6%), ahead of powerplant system or component failure (10) and fuel-related events (6).

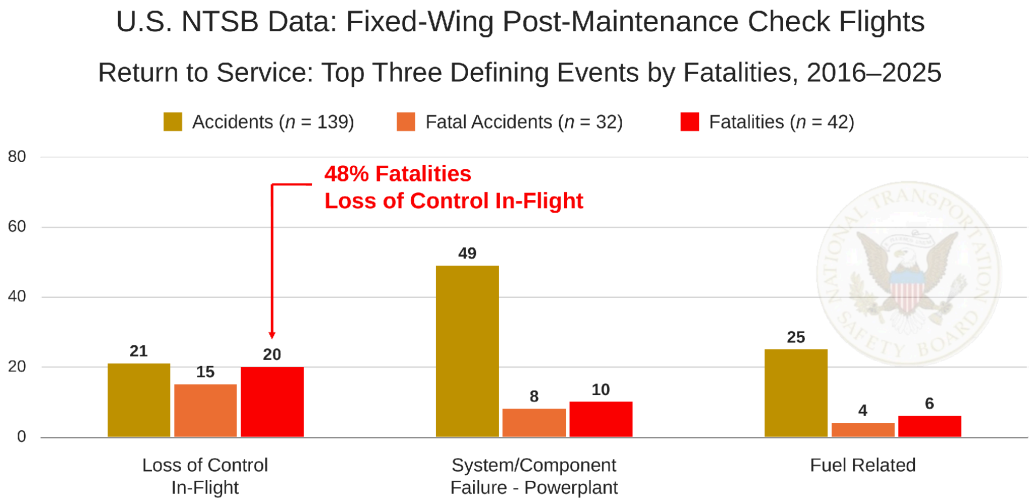


Figure 7. Top three defining events by fatalities, 2016–2025.

APS analysis of NTSB accident data, extract of September 21, 2026 (APS, 2026a); not reviewed or endorsed by the NTSB. Minimum count: only flights the NTSB report describes as a post-maintenance test, check or functional flight, under any type of operation. Excludes first flights after maintenance with no check purpose stated, new builds and Phase I flights, and manufacturer testing. Accidents and fatal accidents count events; fatalities count persons. Shares use the full fixed-wing total, including Unknown and Other (not ranked). Totals are small.

Figure 8 ranks the same events by fatal accidents, and the order holds. Loss of control in flight accounts for 15 of the 32 fatal accidents (46.9%); powerplant system or component failure accounts for 8 and fuel-related events for 4.

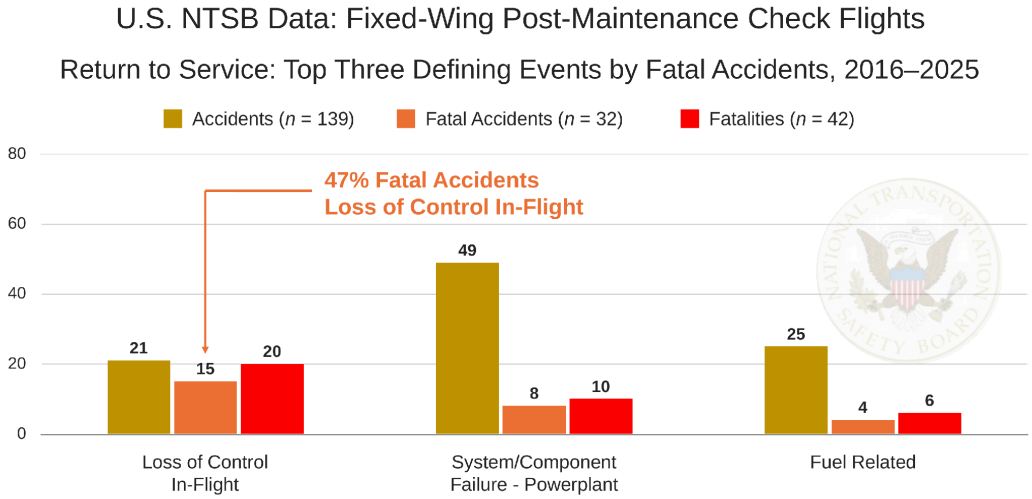


Figure 8. Top three defining events by fatal accidents, 2016–2025.

APS analysis of NTSB accident data, extract of September 21, 2026 (APS, 2026a); not reviewed or endorsed by the NTSB. Same scope and counting rules as Figure 7.

Figure 9 ranks them by accidents, and the order changes. Powerplant system or component failure is the most frequent defining event, in 49 of the 139 accidents (35.3%), followed by fuel-related events (25) and loss of control in flight (21). The same three events lead on all three measures; only the order differs. Loss of control is the least frequent of the three, but 15 of its 21 accidents were fatal (APS, 2026a).

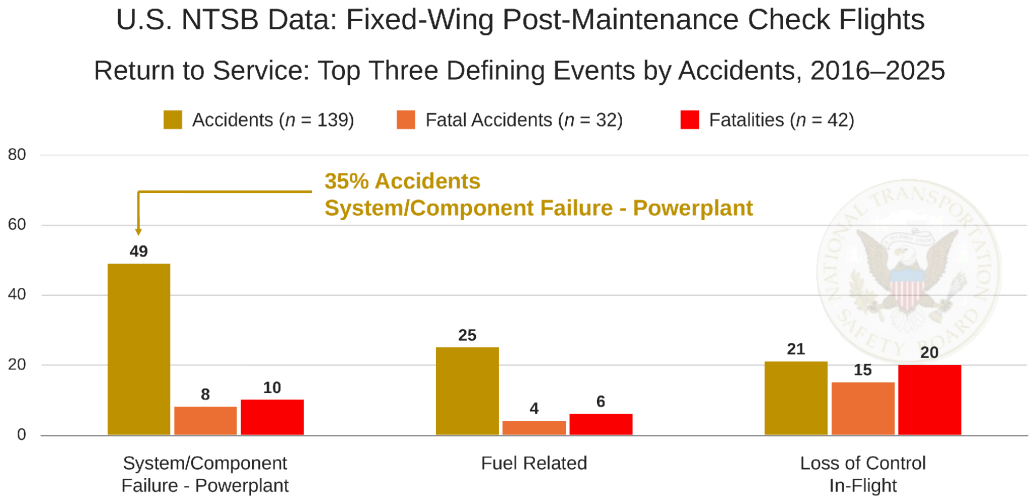


Figure 9. Top three defining events by accidents, 2016–2025.

APS analysis of NTSB accident data, extract of September 21, 2026 (APS, 2026a); not reviewed or endorsed by the NTSB. Same scope and counting rules as Figure 7.

Use the evidence without overstating it

The NTSB report combines information from completed investigations, ongoing investigations, and previous events. It is a safety recommendation report, not a final probable-cause finding for every accident discussed. In particular, its discussion of the October 2025 accident was preliminary. This guide does not attribute a final cause to that accident or repeat later summaries as if they were established findings (NTSB, 2026, pp. 3–4).

The worked scenarios and planning tools remain manufacturer-neutral. The NTSB accidents are identified by aircraft model, date, and location because those facts are on the public record, and source titles retain accurate aircraft-model names because changing them would misrepresent the evidence. A model-specific investigation can support a general planning lesson without transferring its exact speeds, limitations, recovery procedures, or regulatory treatment to another aircraft.

Maintenance size is not flight risk

Maintenance complexity and flight-test risk are related but not the same. A routine inspection can lead to a demanding check in the air, and extensive maintenance may be verified mostly on the ground. Judge the risk by the remaining airborne task, the protections affected, the configurations expected, and the abnormal outcomes that could realistically occur, not by the cost or length of the shop visit (Zotter et al., 2026; NTSB, 2026).

10. Regulatory and terminology boundaries

This section explains what the regulations require after maintenance and how the terms in this guide relate to other common terms.

Read § 91.407 as a sequence

Paragraph (a) requires approval for return to service by a person authorized under § 43.7 and the applicable maintenance record entry under § 43.9 or § 43.11 before operation. Paragraph (b) prohibits carriage of persons other than crewmembers until the specified operational check is flown and logged when maintenance may have appreciably changed flight characteristics or substantially affected operation in flight. Paragraph (c) provides a ground-test/inspection exception when its conditions are conclusively met (14 C.F.R. § 91.407, 2026).

The phrase “appropriately rated pilot with at least a private pilot certificate” in paragraph (b) is not a complete crew-qualification standard for every operation. Other applicable pilot, aircraft, operating, and authorization requirements still matter. It also does not establish proficiency for a high-risk test profile. The NTSB’s concern is precisely the gap between normal operational qualification and the specific competence demanded by stall testing (NTSB, 2026, pp. 10–12).

When manufacturer instructions require an in-flight test after maintenance, the test reaches back to standards most operators never see. For the Hawker, the procedures that established acceptable stall behavior in production were the factory production flight test procedures required by 14 C.F.R. § 21.127, which are not available outside the factory (NTSB, 2025c). Most of the affected airplanes are no longer in production, so there are no production test pilots for them (NTSB, 2026, p. 11). Treat a required in-flight airworthiness test as specialist work unless the manufacturer provides the procedure, tolerances, and pilot criteria. Where a manufacturer-authorized pilot is not available, confirm any candidate’s recent experience in the specific type and maneuver, and use the WYVERN guidance’s recommendations on required reading and test pilot school short courses as a starting point (Zotter et al., 2026, Recommendations).

This guide deliberately sets no DER flight-test experience minimums as universal hiring criteria. A designee benchmark, a Part 135 check airman role, a company post-maintenance designation, and proven competence for a specific test are different things. Where formal approval is needed, get it for the actual mission from the relevant authority rather than assuming it from a job title.

Terms that are often confused

Several terms in post-maintenance work sound alike but mean different things. Table 9 explains each one and where it stops applying.

Table 9. Related-activity terms and boundaries.

Term or concept	Use and boundary
Operational check under § 91.407	A specific regulatory context. Describe the actual check and record obligation rather than treating the phrase as a universal low-risk category.
WYVERN's three categories	A guidance framework for varying risk and qualification expectations, not FAA certification or licensing classes.
Functional check flight	Usage varies by source. The withdrawn EASA SIB 2011-07 used a broad non-revenue serviceability definition; identify which source definition is being used.
Certification / experimental testing	A separate context. Do not import certification test points into an in-service check flight or assume all post-maintenance flights fall under Part 21 testing provisions.
Special flight permit	A specific authorization for eligible purposes, not a generic workaround for unresolved airworthiness or a high-risk test. § 21.197 requires capability for safe flight.

Table 9 sources: 14 C.F.R. §§ 21.197 and 91.407 (2026); European Aviation Safety Agency [EASA] (2011); Civil Aviation Authority [CAA] (2017, Introduction); Zotter et al. (2026).

11. Demanding flight profiles

Table 10 (Demanding-profile planning matrix) lists demanding profiles, the evidence each should produce, and the unexpected behavior to plan for. It is for planning and specialist review, not maneuver instruction. None of these checks is automatically required after maintenance; include only those the applicable technical basis and authorized mission call for. The FSF compendium separates low-speed, high-speed, flight-control, air-data, engine, electrical, and other checks, which shows why a generic "test flight" label is not enough (FSF, 2012).

Low-speed work

Checking a stall indication, approaching the stall, activating a protection system, and testing actual stall characteristics are different tasks. They may not need the same exposure or preparation. The NTSB documents cases in specific aircraft where the stall came before the expected warning or protection, so relying on the system being tested is not a safety plan on its own (NTSB, 2026, pp. 2–3, 10–15). Defects too small to see can change stall behavior. In a 2005 Hawker 800XP stall test, the airplane stalled without shaker or pusher and rolled three times, losing about 3,000 ft; deformed vortex generators were found afterward. The NTSB notes that light ice can have the same effect (NTSB, 2026, pp. 9, 15).

Table 10. Demanding-profile planning matrix.

Profile	Expected evidence	Unexpected behavior / planning issue
Normal-envelope verification	Affected systems function to the applicable standard in the specified configuration.	Misleading indications, automation masking a control issue, or a defect revealed only under flight loads.
Low-speed awareness / indications	Required cues and displayed information conform to the specific check procedure.	Cue absent, late, inconsistent, or not representative of actual aerodynamic condition.
Stall warning / protection / stall checks	Precisely defined warning, protection, and handling acceptance criteria from applicable data.	Adverse roll, unexpected stall before protection, unusual control forces, or inadequate recovery preparation.
High-speed verification	Required data or behavior at explicitly authorized speed/Mach and configuration.	Unexpected vibration, buffet, trim/force change, or rapidly reducing margin; specialist termination/recovery plan needed.
Flight controls / degraded modes	Specified response, trim, indication, and backup function.	Unexpected pitch/roll/yaw, switch error, changed handling, or inability to restore a normal mode.
Engine / system reconfiguration	Specified parameters, transitions, or required backup function.	Failure to restore function, coupled system consequences, or reduced landing options.

Synthesis from FSF (2012); Zotter et al. (2026); NTSB (2026). These are hazard prompts, not predictions for every aircraft.

Why a swept wing stalls at the tips first

A swept wing built for high-speed cruise pays for it at low speed. Its effective lift is proportional to the speed of the airflow perpendicular to the leading edge (FAA, 2021, p. 16-6). Compared with a straight wing, it also builds lift more gradually as angle of attack increases, with a less well-defined maximum, so the loss of lift past that point may be less dramatic. Those high-lift conditions come with high drag, which may result in a high rate of descent (FAA, 2021, p. 16-7).

At high angle of attack, the boundary layer tends to flow spanwise toward the tips, so an unmodified swept wing tends to stall at the tips first (Figure 10). Two things follow for the pilot. The ailerons sit near the tips, so roll control weakens early. And because the tips are behind the root, a tip stall moves the center of lift forward and adds a nose-up pitching tendency at the moment the nose needs to come down. The FAA notes that the tendency is greatest when sweep and taper are combined, and that manufacturers modify the wing spanwise with twist, changes in airfoil section, vortex generators, or a combination, which helps a pilot retain roll control initially (APS, 2026b; FAA, 2021, p. 16-7). Some T-tail configurations are also prone to deep stalls, in which the tail can become immersed in the wing wake at very high angles of attack and lose effectiveness (FAA, 2021, p. 16-8).

Those design fixes work only if the wing keeps its shape, which is why small maintenance defects matter. On the Hawker, when a wing leading edge is reinstalled, the gap between the leading-edge skin and the wing skin must be between 0.02 and 0.15 in., and the profile must be between −0.01 and +0.02 in. The manufacturer requires a stall test flight after certain work on the leading-edge assemblies, deicing distribution panels, or stall trigger assemblies (NTSB, 2026, p. 2).

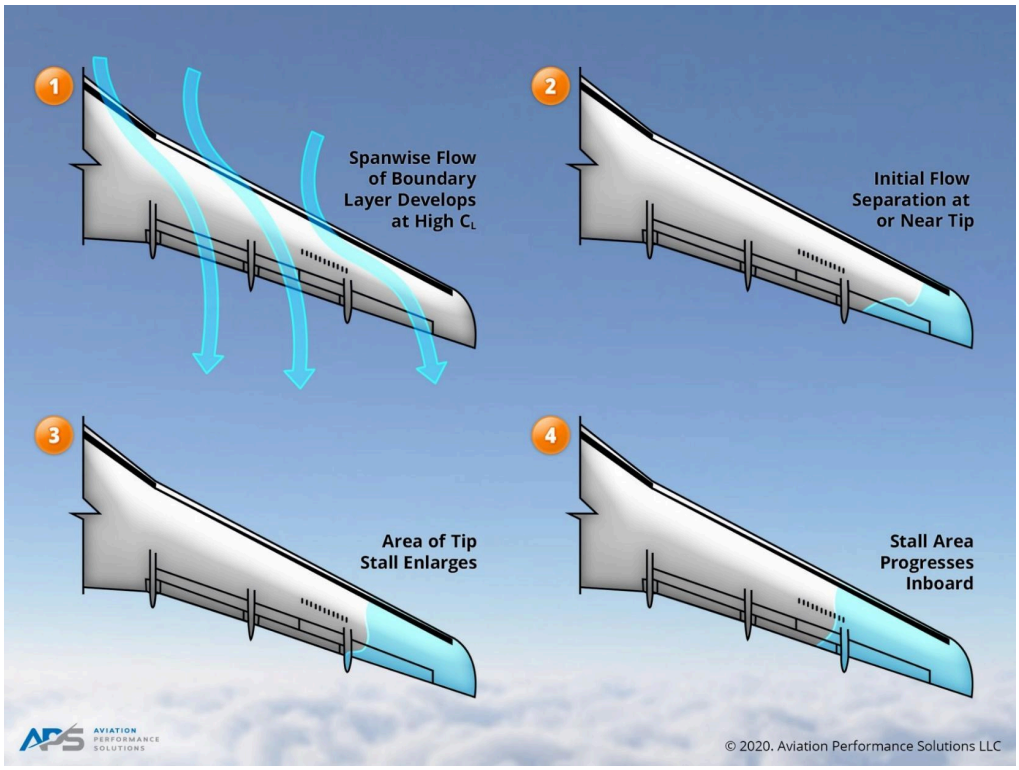


Figure 10. Spanwise flow and tip stall on a swept wing.

Graphic © 2020 Aviation Performance Solutions LLC (APS, 2026b), based on FAA (2021, pp. 16-7 to 16-8).

Recognize a stall by what the airplane does

Airspeed alone does not tell a crew whether the wing is stalled. The FAA Airplane Upset Recovery Training Aid explains that a wing can be stalled at any airspeed and in any attitude, because the angle of attack determines whether the wing is stalled. It describes the stall by what the airplane does (Figure 11): “A stall is characterized by any or a combination of the following: a. Buffeting, which could be heavy. b. Lack of pitch authority. c. Lack of roll control. d. Inability to arrest descent rate.” These characteristics are usually accompanied by a continuous stall warning (FAA, 2008, p. 2.20).

The published stall speed is defined for specific conditions: trim at 1.3 V_S, forward center of gravity, low altitude, a deceleration rate of 1 kn/s, wings level, and approximately 1 g. In other conditions, the speed at the stall is not the same as the published stall speed (FAA, 2008, p. 2.20). A planned stall check is flown close to those conditions; an unexpected departure usually is not. Section 12 covers the first response if a departure occurs.

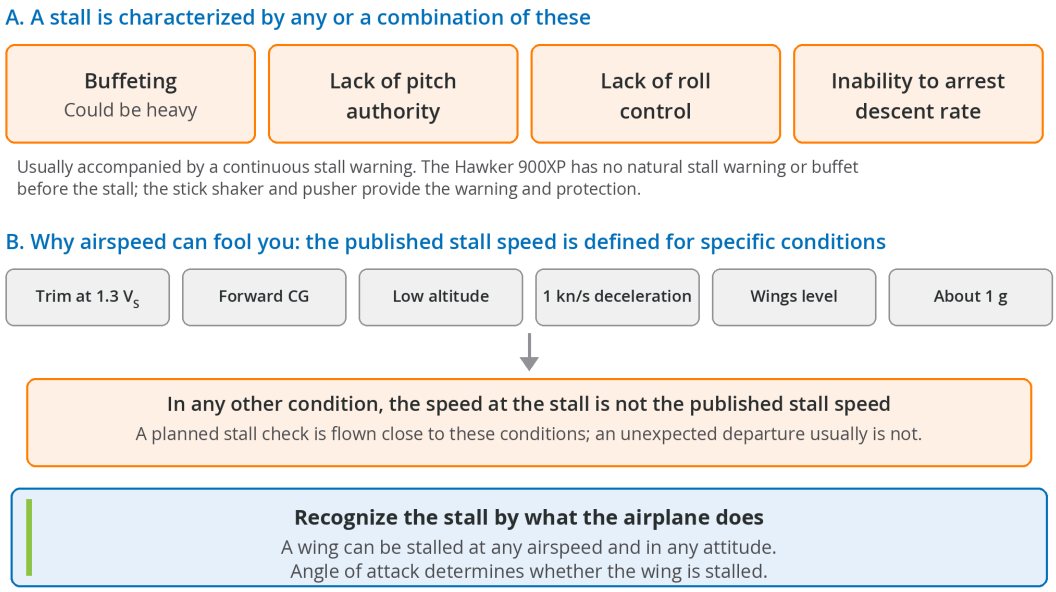


Figure 11. Recognizing a stall.

Original figure from FAA (2008, p. 2.20) and NTSB (2025a).

The protection system is set for the wing as certificated. The Hawker 900XP POM warns that there is no natural stall warning or buffet before the stall, and the system derives angle of attack from two vanes on the fuselage. In the 2024 accident, the shaker and pusher activated at appropriate speeds, yet the airplane stalled as the shaker activated. An icing study for the NTSB found that even a 2-minute icing encounter on a similar airfoil could have reduced the stall angle of attack by up to 6° and maximum lift by up to 40% (NTSB, 2025a). A former Hawker factory test pilot put it plainly: “The Hawker is not protected by a stall prevention system with ice on the aircraft, it is protected procedurally.” He described buffet well before the expected warning with only a slight frosting on the wing, and after a brief cloud entry (NTSB, 2025c). Where the type has no natural pre-stall buffet, list unexpected buffet before the warning as a stop trigger.

The certification standard shows why a post-maintenance stall check differs from line flying. For transport-category airplanes, 14 C.F.R. § 25.203 requires that it be possible to recover from a stall by normal use of the controls and that roll in a wings-level stall not exceed approximately 20 degrees. A post-maintenance stall test checks, in effect, whether an aircraft whose wing surfaces or stall-protection system have been disturbed still behaves as certificated. When it does not, the departure can be abrupt. In the February 2024 accident, the airplane entered a flat spin and rolled through 360 degrees multiple times. In a 2006 BAE 125-800A stall test incident, the airplane became inverted 4 seconds after the initial upset and lost about 11,000 ft within 30 seconds, with forces exceeding 6 g, before the pilot regained control (14 C.F.R. § 25.203, 2026; NTSB, 2026, pp. 5, 8).

FAA flight-test guidance quoted by the NTSB states that, “since operational pilots may not be required, or trained, to fly an angle of attack beyond that for stall warning, any exposure to the behavior of the airplane in an actual stall would be both unexpected and unfamiliar.” The NTSB also

reported that no schools provide training on performing stall test flights and that no production test pilots remain for the affected airplanes because those models are no longer in production (NTSB, 2026, p. 11). Where a required test calls for specialist competence that is not available, hold the test rather than substitute familiarity.

High-speed work

Do not treat VMO/MMO as a routine target, and do not confuse a high-speed check with deliberately exploring buffet or flutter. The exact requirement, permitted configuration, monitoring, and stop criteria need aircraft-specific technical authority. This guide gives no speed margins or methods for exciting the flight controls; that detail belongs in specialist-reviewed procedures (FSF, 2012, High Speeds; CAA, 2017, Introduction).

Unusual attitudes

Unusual-attitude recovery is something to be ready for, not a maneuver to add to the card. The check flight is not the place to practice recovery skills. Build that readiness in an appropriate training environment before the flight (FAA, 2017; NTSB, 2026).

12. Prepare for the unexpected

Choosing a crew takes more than checking eligibility. FSF lists knowledge, skills, aptitude, and relevant experience, including observation, interpretation, communication, judgment, patience, and integrity. Being willing to call a result unsatisfactory and accept the operational consequences is part of competence, not an obstacle to getting the job done (FSF, 2012, pp. 5–9).

Build a task-specific preparation plan

- Review the system under test and its dependencies, including how maintenance could affect indications or protections.
- Review the actual test procedure, expected behavior, aircraft-specific abnormal responses, and known adverse characteristics.
- Practice task allocation, calls, configuration changes, data capture, and discontinuation decisions.
- Select simulator scenarios that address relevant recognition and response needs within the device's validated capability.
- Assess skill gaps explicitly and assign training or specialist crewing; record what evidence closes each gap.

These preparation steps synthesize WYVERN and FAA training guidance (Zotter et al., 2026; FAA, 2017).

UPRT without promotion

WYVERN recommends recent UPRT as one way to reduce risk when departure from controlled flight is an identified hazard, and recommends making it part of pilot qualification for those checks. This guide carries that safety point forward without promoting any provider. Preparation must stay tied to the aircraft, the task, and the failure that could realistically occur (Zotter et al., 2026, A Practical Example and Recommendations).

FAA Advisory Circular 120-111 stresses prevention, recognizing when the flightpath is diverging, manual handling, CRM, and appropriate recovery. It also warns that simulator limits can teach the wrong response (negative transfer of training). A simulator that responds normally does not show how an aircraft with an aerodynamic or system defect will respond. Use qualified instructors and a device suited to the training goal (FAA, 2017).

Not all UPRT is equivalent, and completing a course is not, by itself, evidence of the capability a demanding check may require. One way to apply that distinction is the Four-Level UPRT Delivery Architecture. It distinguishes underlying pilot certification (Level 1), which it states "is not, on its own, a UPRT risk control," from advanced simulation UPRT (Level 2), all-attitude on-aircraft UPRT (Level 3), and integrated UPRT that combines both (Level 4) (Ransbury et al., 2026b, pp. 2, 50). Its companion volume adds that architecture establishes a program's maximum risk-mitigation potential, while delivery excellence "determines how much of that potential is realized" (Ransbury et al., 2026a, p. 2). For check-pilot qualification, record the architecture level, recency, and evidence of delivery quality rather than a completion certificate alone. The author leads Aviation Performance Solutions (APS), which publishes both resources and is named by WYVERN as one recommended UPRT provider; apply the same evaluation to any provider.

FAA stall guidance makes reducing angle of attack the first response to an impending or full stall, ahead of minimizing altitude loss. That is why a promise to hold altitude cannot replace recovery preparation. Aircraft-specific procedures and qualified instruction are still required; this guide does not provide a recovery checklist (FAA, 2015, pp. 7–10, 14).

The manufacturer's own guidance sets the order. For aileron snatch, the POM advises moving the elevator control forward to decrease angle of attack and allow the return of normal aileron control. In the 2024 accident, the airplane rolled right beyond 45° at more than 40° per second, and the crew applied and held full left aileron and full aft column (NTSB, 2025a). Simulator experience does not close this gap. The crew's stall training covered the shaker and pusher; one instructor said of the pusher demonstration, "There's no proficiency required for that." In the NTSB's simulator runs with light simulated ice, the stall response was subtle and showed no roll (NTSB, 2025a).

Startle, surprise, and workload

FAA separates startle, a reflex, from surprise, which disrupts thinking. Prepare crews to recognize divergence and act, rather than wait for a familiar set of cues. Training should progress from knowledge and maneuver skills to realistic scenarios. It should never try to surprise an unprepared crew on the actual post-maintenance flight (FAA, 2017, pp. 3, 9, 11–13).

Captain Tom Huff, U.S. Navy (Retired), a former commanding officer of the U.S. Naval Test Pilot School and a co-author of the WYVERN guidance, offers a simple first step for the moment a departure catches a crew by surprise.

A starting point if the airplane departs

"Consider a simple starting point. Departure from controlled flight varies from type to type, but simply neutralizing or releasing the controls is often enough to start the recovery. It helps keep startle and surprise from adding incorrect control inputs. In a statically stable aircraft, the result is usually seen almost at once."

Captain Tom Huff, U.S. Navy (Retired), personal communication, November 6, 2026

This is not a substitute for a qualified crew, the aircraft procedure, or qualified recovery training. It is a first step for any crew caught in a departure, line pilots or test pilots, in any of the three WYVERN categories in Table 5 (Check-flight categories and crew levels): operational check flight, functional check flight, or test flight.

13. Stop criteria and incomplete profiles

A stop criterion names a condition the crew can recognize and the response that follows. "Stop if unsafe" is not enough as the only instruction on a test card. Define entry conditions, success criteria, stop criteria, and the safe response separately, and keep the relevant warnings with the item (FSF, 2012, pp. 11–13; Zotter et al., 2026). Table 11 lists the kinds of conditions each card should cover.

Table 11. Stop-criterion condition classes.

Condition class	Card must establish
Aircraft condition	Which indications, configuration, ground evidence, and protection availability are prerequisites.
Environment	Required weather, clear airspace, terrain/recovery margin, and suitable landing options.
Aircraft response	Acceptable behavior and tolerances; what observation demands immediate test termination.
Crew performance	Monitoring, communication, workload, or understanding conditions that require a stop.
Plan validity	What interruptions, lost measurements, or configuration deviations invalidate the result.
Post-termination	Aircraft-specific response reference, crew duties, and landing/disposition decision.

Table 11 deliberately contains no universal numbers. A limit copied from another model, a training profile, or an old handbook may be wrong for this aircraft. If an authorized required check conflicts with the operator's proposed safety margin, resolve it before flight with the responsible technical specialists. Do not just pick the more convenient number.

Do not normalize a failed check

A failure that seems minor is not automatically safe to carry into a more demanding item. The dependency review should show what a failed prerequisite rules out. Flying the check again after a maintenance fix is a new planned event; repeating an unexplained anomaly in the air to get a pass is not a substitute for diagnosis (Zotter et al., 2026, Execution and Phase F).

Four questions after a stop

- What action is needed now to maintain or regain safe flight?
- Which test activities must stop, and what system configuration remains?
- What is the safest suitable landing plan given the aircraft's actual condition?
- What evidence and technical work are needed before any further attempt?

WYVERN's sample checklist calls for stopping and returning for evaluation after any marginal, abnormal, unexpected, or uncertain result. This guide adopts that conservative approach and makes clear that safe control and the applicable emergency procedures decide the immediate response and where to land (Zotter et al., 2026, Appendix A, items 42–44).

14. Worked planning scenarios

These three scenarios show how the planning steps in this guide lead to different decisions. Each is illustrative, not a plan for a real aircraft.

Scenario A: A simple, limited check

Assumptions for this example: a component has been replaced, the ground checks are satisfactory, the instruction calls for an airborne observation within the normal envelope, and no handling-limit maneuver is required. Confirm these facts for the real aircraft rather than borrowing them from the example.

The team records the affected system, applicable instruction, expected indication, measurement method, and pass criterion. Operations confirms that the assigned crew understands both normal response and the relevant abnormal procedures. The card restricts the flight to the specified observation. A discrepancy remains a discrepancy even if the aircraft otherwise appears to fly normally.

Decision: a prepared company crew may be suitable if its demonstrated competence covers the actual tasks and contingencies. That conclusion is conditional on the verified scope and aircraft state; it is not permission for any line crew to perform every "confidence flight" (Zotter et al., 2026).

Scenario B: Post-paint control concerns

Illustrative assumptions, adapted from WYVERN: control surfaces and aerodynamic components were removed and reinstalled during painting. The team must establish the applicable rigging, balancing, inspection, configuration, and test requirements. It must not infer that a cosmetic work order creates a low-risk flight. The WYVERN guidance builds its practical example around this same post-paint case (Zotter et al., 2026, A Practical Example).

The plan uses the maintenance-to-verification matrix (Appendix A, Table 13) to link every disturbed part or system to its required check. Any higher-risk handling check triggers a specialist review of the crew. In WYVERN's example, an uncommanded roll and unusual trim demand are reason enough for a precautionary return instead of more testing. The lesson: treat an observed abnormality as evidence, and do not keep expanding the profile until the cause becomes obvious (Zotter et al., 2026, Execution).

Scenario C: Required low-speed testing

Assumptions for this example: the technical instructions require a specific low-speed or stall-system check after maintenance. The available crew is type-rated and current but has no demonstrated experience with this test or the adverse behavior it may reveal.

Decision: hold the demanding portion and arrange appropriate technical planning and task-qualified crewing. Do not substitute an informal familiarization flight for missing competence, and do not delete a required test merely to enable release. The NTSB calls for manufacturer-authorized preparation and a clear test plan in the specific aircraft context it investigated (NTSB, 2026, pp. 10–14).

The scenarios contrast decisions and the evidence needed, not maneuver techniques.

15. Integrate the process into SMS

WYVERN recommends referencing its guidance in the SMS and in flight and ground procedures, with open cooperation between the operator and its maintenance providers. Implementation should link planning, operational decisions, and feedback, not just add a checklist to the manual (Zotter et al., 2026, Recommendations).

A proposed implementation sequence

- Establish policy: define RTS event triggers, coordinator responsibilities, records, risk authority, and crew-task assessment.
- Map existing practices: compare maintenance handoffs, flight authorization, cards, and debriefs against the WYVERN crosswalk.
- Select a representative event: adapt the templates with maintenance, operations, safety, and aircraft/test specialists.

- Run a tabletop rehearsal: test missing information, unavailable crew, marginal weather, abnormal results, and incomplete verification.
- Revise and authorize: close gaps, review regulatory applicability, and approve operator-specific procedures through the appropriate process.
- Monitor actual use: review holds, deviations, recurring defects, record quality, and whether schedule pressure affected decisions.

Small departments

A small department may combine roles, but every decision still needs a named owner. Where expertise or independence is missing, get outside technical review or qualified checking support. The team needs enough competence and capacity for the task, not a committee for show. FSF notes that a management role or extensive line-flying experience does not guarantee specialized checking expertise (FSF, 2012, pp. 7–9).

Management questions before release

- Can we show why each airborne item is necessary?
- Can each crewmember explain what would stop the test?
- Do we have evidence of competence for the task, not just certificates?
- Is the aircraft state supported by the records and ground checks?
- Would we make the same decision without the next passenger trip on the schedule?
- Can another reviewer reconstruct our disposition from the retained records?

APPENDICES

Appendix A | Event planning worksheet

Use Table 12 to plan one return-to-service event through closure, have a qualified reviewer check it, and pair it with the WYVERN guidance's Appendix A checklist (Zotter et al., 2026; FSF, 2012).

Table 12. Event planning worksheet.

Field	Entry / evidence
Event identity	Aircraft / serial / registration: _____ Maintenance event: _____
Document control	Plan ID / revision / date: _____ Coordinator: _____
Operating basis	Jurisdiction / operating rules / authorization: _____
Work scope	Work package reference and revision: _____ Non-routine findings: _____
Disturbed interfaces	Systems / controls / sensors / software / adjacent areas: _____
Technical instructions	Applicable instruction IDs, revisions, effectivity, and required checks: _____
Ground verification	Results and inspection references: _____ Outstanding items: _____
Airborne justification	Requirement or objective not satisfied on the ground: _____
Profile and exclusions	Planned items / dependencies: _____ Prohibited additions: _____
Crew and preparation	Names / assigned roles / task evidence / preparation records: _____
Risk and constraints	Hazards / mitigations / residual risk / accepting authority: _____
Environment	Airports / weather / airspace / ATC / recovery provisions: _____
Release and records	Maintenance approval / entry reference / operating restrictions: _____
Authorization	Operational authorization: _____ PIC acceptance: _____
Closure	Debrief / discrepancies / technical disposition / operational status: _____

Use Table 13 to link each piece of work to its source, ground evidence, airborne check, and acceptance.

Table 13. Maintenance-to-verification matrix.

Work / interface	Source + revision	Ground evidence	Airborne item	Acceptance / closure
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Mark each row required or optional, name who resolves a failed item, and explain any N/A.

Appendix B | Crew readiness assessment

Use this assessment to decide whether a specific crew is ready for a specific check flight. Table 14 applies to this aircraft, this maintenance state, and this profile only; it is not a permanent endorsement of the crew. It answers the core question in WYVERN's sample checklist: is the profile within the crew's demonstrated competence, or does it need a test pilot or an additional flight-test-qualified crewmember (Zotter et al., 2026, Appendix A, item 14)?

Table 14. Crew readiness assessment.

Assessment area	Evidence to record	Gap / disposition
Legal eligibility	Certificates, ratings, applicable currency and medical requirements.	_____
Relevant experience	Specific aircraft, check tasks, complexity, and recent experience.	_____
Systems knowledge	Affected systems, dependencies, configuration changes, expected behavior.	_____
Handling readiness	Applicable test technique and credible abnormal/recovery demands.	_____
Monitoring / CRM	Detection of divergence, callouts, switching discipline, and intervention.	_____
Training suitability	Instructor qualifications, objectives, device capability, and completion evidence. Where departure from controlled flight is a credible hazard: UPRT recency, architecture level, and evidence of provider delivery quality.	_____
Fitness / capacity	Fatigue, workload, preparation time, and ability to decline.	_____
Specialist determination	Whether aircraft/test expertise, manufacturer-defined pilot criteria, or an additional crewmember (for example, a safety observer) is required.	_____

Assessment: suitable / suitable after documented gap closure / not suitable for proposed profile.
Assessor: _____ Reviewer: _____ Date: _____ Mission limitations: _____

WYVERN's sample checklist includes equivalent simulator training within the preceding 90 days for a stall series or another demanding profile. This is a specific sample guidance criterion, not a universal FAA requirement. Adoption needs an appropriate training objective and a simulator capable of supporting it; attendance alone does not establish competence (Zotter et al., 2026, Appendix A, item 15; FAA, 2017).

Preparation completion record

Required competency: _____ Training/rehearsal method: _____ Applicable aircraft procedure: _____ Instructor/assessor: _____ Simulator validation limitations discussed: _____ Completion evidence: _____ Remaining restrictions: _____

Appendix C | Test-card planning template

Use this template to build the test card for each in-flight check. Table 15 lists what every card must contain. It is a planning tool, not a cockpit-ready card, until it is filled in, checked, and authorized for the specific aircraft and flight. Keep each task with its warnings and limits, and do not split a safety-critical sequence across pages (FSF, 2012, p. 11).

Table 15. Test-card planning template.

Card field	Required content
Identification	Card ID / revision / aircraft / maintenance event / test item / sequence.
Purpose and authority	What this check proves; exact applicable source, revision, effectivity, and required/elective status.
Prerequisites	Ground evidence, preceding accepted checks, configuration, mass/CG, equipment, and crew readiness.
Environment	Applicable altitude/terrain/cloud recovery provisions, airspace, weather, and landing options.
Roles	PF / PM / systems operator / recorder; who monitors each safety-critical parameter.
Procedure	Reference the applicable procedure; include reviewed steps only within the authorized scope.
Expected result	Required observation/measurement, tolerances, units, and acceptance standard.
Warnings and limits	Item-specific cautions and hard limits; no unverified generic numbers.
Termination	Recognizable stop triggers; aircraft-specific response reference; call and control-transfer duties.
Restoration	Safe restoration method and verification; response if normal configuration cannot be restored.
Result	Pass / fail / marginal-uncertain / incomplete-aborted / invalid; actual observations and data reference.
Disposition	Continuation eligibility or required stop; maintenance/debrief reference and reviewer.

Illustrative non-numerical card logic

Purpose: verify the specified function following identified maintenance. Entry: only when all prerequisites in the applicable instruction are met. Expected result: response within that instruction's stated criteria. Termination: abnormal behavior, lost prerequisite, uncertain indication, crew stop call, or an item-specific boundary. Result: record what actually occurred. This logic does not define a maneuver or authorize any particular flight condition.

Abort response details must reflect the aircraft's actual condition. A generic instruction to restore all systems immediately can be inappropriate during an emergency; the reviewed card and aircraft-specific procedures must address that possibility.

Appendix D | Go/no-go and debrief

Appendix D holds two records: a go/no-go record for the decision before departure (Table 16) and a debrief record for the results and disposition after landing (Table 17).

Pre-departure decision record

Use Table 16 on the day of flight to confirm that the aircraft, crew, and plan are ready. For each item, record GO, HOLD, or a justified N/A, with the supporting evidence, the decision owner, and the time. The format adapts the idea behind WYVERN's Phase D go/no-go review rather than reproducing it (Zotter et al., 2026).

Table 16. Pre-departure decision record.

Decision item	Status / evidence / owner
Maintenance approval and applicable records	_____
Ground checks and inspection results	_____
Required/elective scope and applicable instructions	_____
Crew competence, preparation, and fitness	_____
Aircraft configuration, fuel, mass and balance	_____
Weather, airspace, airports, and recovery provisions	_____
Cards, acceptance criteria, and abort plan	_____
Outstanding questions / holds closed	_____
Operational authorization and PIC acceptance	_____

Post-flight disposition record

After landing, use Table 17 to record the results, any open issues, and who decides the aircraft's status before it returns to service.

Table 17. Post-flight disposition record.

Debrief item	Entry
Flight identity / flown card revision	_____
Item results and supporting data	_____
Unexpected or marginal observations	_____
Deviations / invalid or incomplete checks	_____
Crew concerns and configuration status	_____
Required maintenance and authorized owner	_____
Retest scope and plan review required	_____
Maintenance record and signatory reference	_____
Operational acceptance / remaining restriction	_____
Safety actions / owner / closure date	_____

Appendix E | WYVERN integration crosswalk

Table 18 shows where each section of WYVERN's guidance is used in this guide and how it was adapted. The primary integration source for this guide is WYVERN's *Post-Maintenance Flight Check Guidance*, Revision 1, June 15, 2026 (Zotter et al., 2026). Page references in Table 18 follow that document's table of contents. This report paraphrases WYVERN's 55-item sample checklist and develops original tools rather than republishing it.

Table 18. WYVERN integration crosswalk.

WYVERN section	Report integration	Adaptation boundary
Scope, p. 2	Section 4; Figure 4	Three categories identified as guidance labels, not universal legal categories; Table 5 adds a plain-language crew level for each.
Planning and Preparation, pp. 4–6	Sections 1–5, 12	Adds explicit maintenance-to-verification traceability and named decision owners. Figure 3 adds a planning timeline for leaders and pilots.
Practical Example, p. 7	Section 14, Scenario B	Manufacturer-neutral educational example; no generic maneuver or CG prescription.
Execution, p. 8	Sections 7 and 13; Figures 1, 5, and 6	Conservative stop discipline; aircraft-specific response and safest landing option take priority. Minimum-crew guidance compared with FSF and CAA in Section 7.
Recommendations, p. 9	Sections 1, 12, 15	Early planning, targeted preparation, UPRT where relevant (architecture and delivery quality in Section 12), and SMS integration; no provider promotion.
Phase A, pp. 11–12	Sections 2–3, 8; Appendix A	Separates preflight maintenance approval from later result disposition; preserves authorized signatory roles.
Phase B, p. 13; items 11–20	Section 4; Appendix B	Task-specific assessment; distinguishes sample recency criteria from legal requirements.
Phase C, p. 14; items 21–30	Section 6	All-departments briefing; unresolved issues hold departure. Pilot brief card in Table 6; crew calls in Table 7 (Section 7).
Phase D, p. 15; items 31–38	Section 6; Appendix D	Explicit go/no-go evidence and owners; no numeric risk score overrides a hard hold.
Phase E, p. 16; items 39–47	Section 7; Appendix C	Prerequisites, monitoring, abort authority, result states, and safe configuration restoration.
Phase F, p. 17; items 48–55	Section 8; Appendix D	Disposition, rework/retest loop, recordkeeping, and organizational learning.

A sequencing clarification: in WYVERN's sample Phase A, test-flight completion appears before the final release item. This guide shows legal preflight status separately from final closure after the check, so that an ordinary check flight is not read as departing without the approval and records required by § 91.407(a). Operators must settle the actual legal and technical sequence for their aircraft (14 C.F.R. § 91.407, 2026; Zotter et al., 2026).

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This guide grew out of his workshop, *At the Edge: Preventing LOC-I During Post-Maintenance Flights*, at the 2026 Bombardier Safety Standdown, where he serves on the Advisory Council. It reflects the core work of APS: training professional pilots to prevent and recover from stalls and upsets, in aircraft and in simulators, and helping operators build the training and safety-management controls that reduce LOC-I risk.

Disclosure: APS provides UPRT, and WYVERN's guidance names APS among recommended providers (Zotter et al., 2026). Section 12 notes this affiliation where the guide cites APS publications.