Kansas City Flight Standards Office

Airworthiness Facts

Date FY20 1st Quarter

Federal Aviation Administration

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Is the Aircraft you returned to Service Airworthy?

Definition of Airworthy: *Airworthy* means the aircraft conforms to its type design and is in a condition for safe operation

One issue with returning an aircraft to service is the STC compatibility and this is not a new issue.

As you can imagine an aircraft with a special mission can be heavily modified (EMS, or ENG for example, or what about Night Vision) do all the modification play well together or are there some underlying capability issues. How about just an older aircraft that has had several avionics upgrade, have all the older systems removed or are they just capped and stowed? (Analog to Digital problems). Aircraft with Special Missions do have special maintenance needs, and even sometimes the less than special aircraft have had multiple modifications. These modifications no matter how small need to play well together. If they don't, things could not end well.

There were two accidents that brought about three NTSB recommendations, and prompted the FAA to publish an Advisory Circular (AC 20-188).

The First of the Two Accidents:
A Beech Baron, it was modified under an STC that installed vortex generators, which decreased the airplane's air minimum control airspeed (Vmca) from 81 knots to 74 knots. Another subsequent STC modification installed more powerful engines, different propellers, winglets, and modified engine nose cowlings. The engine STC took into account a change to only the original type design and increased the airplane's Vmca to 87 knots; however, the airplane's airspeed indicator remained marked to indicate a Vmca of 74 knots.

The Back Story: The pilot had previously owned the accident airplane about 22 years ago, and it was modified under a supplemental type certificate (STC) that installed vortex generators (VGs), which decreased the airplane's air minimum control airspeed (Vmca) from 81 knots to 74 knots. Another subsequent STC modification, installing more powerful engines, different propellers, winglets, and modified engine nose cowlings. This STC only took into account a change to the original type design and increased the airplane's Vmca to 87 knots; however, the airplane's airspeed indicator remained marked to indicate a Vmca of 74 knots. A representative of the current holder of STC reported that, to his knowledge, no flight testing was performed on the accident airplane or any similar make and model airplane to determine the interrelationship between his company's STC and the previous STC. Therefore, the actual performance data for the accident airplane, including the Vmca, were unknown.

This pilot purchased the airplane 4 days before the accident and performed three full-stop landings 2 days before the accident to get current. An individual familiar with the pilot believed that the pilot had not previously flown a reciprocating-engine-equipped airplane in about 3 years. Due to the pilot's recent purchase, an insurance company broker "suggested" that the pilot obtain a multiengine instrument proficiency checkride; a Federal Aviation Administration (FAA) designated pilot examiner acting as a certified flight instructor (CFI) was on board for the accident flight.

The CFI did not have an exemption from 14 Code of Federal Regulations 91.109(a) to give instruction in an aircraft equipped with a throw-over control yoke.

According to uncorrelated radar data, after departure, the flight proceeded north-northwest and climbed to 3,600 feet where two 360-degree nearly level turns to the left were made, followed by a 360-degree turn to the right. The airplane then proceeded north-northwest and climbed to 4,200 feet briefly with the ground speed decreasing to 127 knots, then it descended to 3,900 feet and remained at that altitude, at which heading changes occurred, and the ground speed decreased to about 71 knots.

Witnesses reported seeing the airplane flying level before it descended in a left spin and impacted a house.

The only major components of the airplane that were not extensively heat damaged consisted of the outer section of the left wing and one cargo door, both of which were found in close proximity to the house. Both engines and their accessories and both propellers were extensively heat damaged. Although the right engine-driven fuel pump drive coupling was found fractured, this likely occurred during post-accident rotation of the crankshaft in order to facilitate removal of the propeller. The extent of the heat and impact damage to the airplane limited the airframe and engine testing that could be performed; however, there was no evidence of pre-impact failure or malfunction on the observed components.

Based on the airplane's decreasing airspeed and nearly level altitude, the pilot was likely performing either imminent stall or simulated loss of engine power airwork before the airplane aerodynamically stalled and then entered a spin. Because the airplane was equipped with only a throw-over control yoke, the CFI had limited ability to assist in the recovery of the airplane. Although it was not possible to determine which low-airspeed maneuver was being demonstrated, one scenario that is consistent with the radar data evidence (and is typically performed during multiengine checkrides) is the Vmca demonstration, which requires a power reduction on one engine (and is consistent with the witnesses' descriptions of "sputtering" engine sounds). If the pilot were performing a Vmca demonstration, it is possible that the airplane began to lose directional control earlier than expected because the actual Vmca of the airplane with multiple STC modifications was unknown, and the airspeed indicator was improperly marked.

Although the limitations and conditions section of the STC stated that the installer must determine that the relationship between that STC modification and any other previously approved modifications "will not produce an adverse effect upon the airworthiness of that airplane," the investigation found that the FAA does not provide any guidance to an installer to help determine the interrelationship between multiple STCs.

As a result of this accident, on December 29, 2011, the FAA issued Airworthiness Directive (AD) 2011-27-04 that requires an inspection for airplanes equipped with this STC and that specifies corrective action, if applicable, to ensure that the airplanes have the correct Vmca marking on the airspeed indicator, taking into

consideration other STC modifications. AD 2011-27-04 is available from the FAA's website at.

The second example:
A Cessna 337, the most obvious alteration is the wing tip, but it was modified under 22 different supplemental type certificates (STCs), which included separate STCs for a short field take-off and landing (STOL) kit, an extended wingtip fuel tank, and winglets. The investigation found evidence that the combined effects of the multiple STC modifications on the accident airplane may have adversely affected the airplane's wing structure because the combined effects of the STCs were not taken into account.

The Back Story: One of the pilots announced over Unicom his intention to perform a low pass over the runway, and witnesses observed the airplane fly about 50 feet above the runway with the landing gear retracted. Global positioning system data recovered from the wreckage indicated that the airplane's ground speed at that time was about 160 knots (kts) (184 mph). Witnesses observed the airplane's nose pitch up just before the outboard 6-foot section of the right wing separated, and the airplane descended uncontrollably and impacted the ground.

Although the pilot/owner seated in the left front seat was not rated to operate a multi-engine land airplane, he was known to perform ostentatious maneuvers in the accident airplane on previous occasions. The pilot seated in the right front seat was rated to operate a multi-engine land airplane. A placard above the airspeed indicator indicated, "Maneuvering --- 135 KTS (155 MPH)"; therefore, the pilot's low pass and subsequent pitch up maneuver, consistent with an ostentatious display, was performed at an airspeed that exceeded this operating limitation.

Post-accident metallurgical examination of airplane's structure revealed that the right wing forward spar upper cap failed in compressive buckling. Although the left wing did not fail in flight, it showed buckling characteristics similar to the right wing, indicating that both wings were overloaded in upward bending. The airplane was modified under 22 different supplemental type certificates (STCs), which included separate STCs for a short field take-off and landing (STOL) kit, an extended wingtip fuel tank, and winglets.

The investigation found evidence that the combined effects of the multiple STC modifications on the accident airplane may have adversely affected the airplane's wing structure because the combined effects of the STCs were not accounted for. For example, although not a factor in the in-flight breakup, skin fatigue cracks were observed at certain stations on the wing, which indicate that the airplane was subjected to vibratory stresses. Therefore, although each individual STC modification did not pose a concern, the combination of STCs on the accident airplane created wing loads that were not initially evaluated.

As a result of this accident investigation, the Federal Aviation Administration (FAA) reevaluated the STCs and determined that revised operating limitations should be disseminated and implemented for this airplane; the FAA issued airworthiness directives (ADs) 2010-21-18 and 2011-15-11 to help address these issues. These ADs are available from the FAA's website at. In addition, concurrent with this investigation, the NTSB investigated another accident (NTSB identification ERA10FA404) involving an airplane with multiple STCs installed and discovered that the FAA does not provide any guidance to an STC installer to help the installer determine the interrelationship between multiple STC modifications.

The NTSB issued three Safety Recommendations.

They are:

- Develop specific guidance and/or a checklist to help installers performing supplemental type certificate (STC) modifications determine the compatibility and interaction between a new STC and any previously installed STCs …
- Instruct installers to document in the Description of Work Accomplished block of Federal Aviation Administration Form 337 how the installer determined the compatibility and interaction between the new supplemental type certificate (STC) and previously installed STCs…
- Educate:
  - •Educate owners and operators of all aircraft with multiple STCs about the potential hazards of incompatible STCs;
  - •Encourage them to have their aircraft evaluated to determine if the multiple STCs adversely affect the aircraft's structural strength, performance, or flight characteristics
  - •Document any evaluation in FAA Form 337 for that aircraft.

One of FAA responses was to release an AC that explained a method to ensure compatibility of modifications. In December 2016 FAA released AC 20-188, It is titled, "Compatibility of Changes to Type Design Installed on Aircraft". It states "The installer must determine whether this design change is compatible with previously approved modifications." By compatibility we mean ensuring that changes to type design approved separately do not create a safety issue if installed together.

•AC 20-188

- Promotes awareness and Provides "examples" of potentially non compatible STCs to help installers.
- Promotes owners to review aircraft history.
- Provides recommendations for sources of information. This includes the design approval holders and designees.
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This AC focuses on STC; but could apply to alterations.

FAA addresses follow on installations through the Limitations Section of STCs. The "installer" is responsible for determining compatibility. This is typically the authorized repair station or an Inspection Authorization (IA) who approves the aircraft for the return to service. We also require the STC holder to give written permission to use the STC. This can open communication between the STC holder and the installer if there are issues.

On the back of the Major Repair & Alteration Form 337, just above the Description of Work Accomplished the FAA Form 337 includes a notice that reminds the installer of their responsibility.

So spread the word, EVERYONE needs to know of the hazards of layering STCs. The engineers at AIR are also asking for your feedback. If you have a suggestion as to how to improve the AC please submit the suggestion in the AC feedback form.

"The installer must determine whether this design change is compatible with previously approved modifications." How can you do that? Perhaps you are an engineer, and a test pilot, but most of us are not. You will need to get professional help. If you will search the words, "FAA Consultant DER Directory", you will find a list of people who can help.

Note: Your interest here shows that you are vital members of our General Aviation Safety Community. The high standards you keep and the examples you set are a great credit to you and to GA.

Special Flight Permits (ferry permit):

Need a Ferry Permit, and the Local Flight Standards Office is closed? You can reach out and request the service from a Designed Airworthiness Representative (DAR).
How do you find a DAR?
Follow this link:

https://www.faa.gov/about/office_org/field_offices/fsdo/mci/local_more/media/dar.pdf

Notice of Proposed Rules Airworthiness Directives:

Notice of Proposed Rule Making is your chance to make a difference. If you go through the process you can make a difference.

This link is for Proposed Rules Airworthiness Directives;

http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgADNPRM.nsf/MainFrame?OpenFrameSet

New Airworthiness Directives:

This link is for Airworthiness Directives, for all aircraft engines, airframes, and appliances.

http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAD.nsf/MainFrame?OpenFrameSet

Service Difficulty Program:

When a system, component or part of an aircraft (powerplants, propellers, or appliances) functions badly or fails to operate in the normal or usual manner, it has malfunctioned and should be reported. Also, if a system, component, or part has a flaw or imperfection which impairs function or which may impair future function, it is defective and should be reported. While at first sight it appears this will generate numerous insignificant reports, the Service Difficulty Program is designed to detect trends. Any report can be very constructive in evaluating design or maintenance reliability.

The reports can be filed electronically or by paper. For electronic go to:
https://av-info.faa.gov/sdrx/Default.aspx
For paper submission the form can be downloaded:
https://www.faa.gov/forms/index.cfm/go/document.information/documentID/186275
You may have to cut and paste this Link into your browser.

Special Airworthiness Information Bulletins:

A Special Airworthiness Information Bulletin (SAIB) is an information tool that alerts, educates, and makes recommendations to the aviation community. SAIBs contain non-regulatory information and guidance that does not meet the criteria for an Airworthiness Directive (AD).

http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgSAIB.nsf/Frameset?OpenPage

ADS-B out, the clock is still ticking.
By January 1, 2020, ADS-B Out will be required to fly in most controlled airspace. Federal Regulations 14 CFR 91.225 and 14 CFR 91.227 contain the details.

Has the ADS-B system been tested? The FAA has a web site to get a free report on the operation of an installed system.
This information can be found using this link:

https://adsbperformance.faa.gov/PAPRRequest.aspx

Kansas City Flight Standards Office Information

Have you ever used an FAA Designee?
Designees are individuals and organizations in the aviation industry authorized to conduct examinations, perform tests, and issue approvals and certificates on behalf of the FAA.
For information on the local Designees,

Designated Airworthiness Representatives (DAR),

Designated Mechanic Examiners (DME),

Designated Parachute Rigger Examiners (DPRE)

Use this link:

https://www.faa.gov/about/office_org/field_offices/fsdo/mci/

The Article titled "Is the Aircraft you returned to Service Airworthy?" is taken from a FAASTeam PowerPoint titled "Frankenplane" 2018/10-10-139(I)PP Original Author: (Edward Garino) (07/24/2018); POC (Guy Minor), AFS-920 (Airworthiness Lead), Office (707-704-3530); Revision: 1

Airworthiness Facts are published on a quarterly basics and available via email only. If you would like to receive Airworthiness Facts or be removed from the mailing list, contact the Kansas City FSDO FAASTeam
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