Methods, Techniques and Practices and The Lost Requirement for Criteria

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Outline:

i. Abstract

The privileges of a mechanics certificate to perform maintenance was always limited to applying objective criteria in determining airworthiness, as opposed to using subjective judgements. A given condition was, by definition, either airworthy or not airworthy and that determination should not have varied depending upon who was making the determination. In the United States, the requirement for an objective basis for

airworthiness determinations is “Methods, Techniques and Practices.” This paper will show the regulatory basis for, and definition of, Methods, Techniques and Practices” and from a recent accident show that no criteria was used in previous inspections of the aircraft. It will show the normalized deviation of the lack of criteria for maintenance institutionalized in the Airworthiness Directive resulting from the accident. The paper ends with an appeal to extend future accident investigations to include identifying the failure of the application of criteria in airworthiness determinations, especially during inspections.

The views expressed in this paper do not necessarily represent the views of the United States, the U.S. Department of Transportation (DOT), the Federal Aviation Administration, or any other Federal agency.

I. Introduction:

There are things I was taught in Aircraft Maintenance Technician (AMT) school in in 1971 that no longer seem to be true. One was that there is no such thing as an old aircraft; only airworthy aircraft and unairworthy aircraft. This meant that the airworthiness standards did not lower because they were more difficult to meet as the aircraft aged. Another was that AMTs did not make subjective determinations of airworthiness; they could only apply objective criteria when making airworthiness determinations.

II. The Regulations:

Title 49 of the United States Code (49 U.S.C.) **§ 44701**, General requirements

(a) Promoting Safety.—The Administrator of the Federal Aviation Administration shall promote safe flight of civil aircraft in air commerce by prescribing—

(1) **minimum standards required in the interest of safety** for appliances and for the design, material, construction, quality of work, and performance of aircraft, aircraft engines, and propellers;

(2) **regulations and minimum standards in the interest of safety** for—

(A) inspecting, servicing, and overhauling aircraft, aircraft engines, propellers, and appliances;

(B) equipment and facilities for, and the timing and **manner of, the inspecting**, servicing, and overhauling; and

(C) a qualified private person, instead of an officer or employee of the Administration, to examine and report on the inspecting, servicing, and overhauling;

14 CFR 43 Maintenance Performance Rule, **§ 43.13(a)** Each person performing maintenance… (14 CFR 1: Maintenance means inspection, overhaul, repair and the replacement of parts)… shall use

the **methods, techniques, and practices** prescribed in the current manufacturer's maintenance manual

or Instructions for Continued Airworthiness (ICAs) prepared by its manufacturer *(which are **methods, techniques, and practices**)*,

or other **methods, techniques, and practices** acceptable to the Administrator.

This should require actual existing **methods, techniques, and practices** be followed when performing maintenance, which includes performing inspections.

§ 43.13(b) Each person maintaining or altering, or performing preventive maintenance, shall do that work in such a manner and use materials of such a quality,

that the condition of the aircraft, airframe, aircraft engine, propeller, or appliance worked on will **be at least equal to its original or properly altered condition**

(with regard to aerodynamic function, structural strength, **resistance to vibration and deterioration**, and other qualities affecting airworthiness).

This includes condition inspections. The condition found during inspection should be that which has the same resistance to vibration and deterioration as its original design and condition. This requires criteria as a way of knowing that the condition actually provides this.

FAA Advisory Circular 120-77, MAINTENANCE AND ALTERATION DATA, states concerning § 43.13(b) that its requirements are usually met by following the maintenance manuals. In Section 10. METHODS, TECHNIQUES, AND PRACTICES VERSUS TECHNICAL DATA, AC 120-77 states:

*"The terms "**methods, techniques, and practices**" (AKA "acceptable data") and "technical data" have often been confused. While the concepts are related, each has a distinct meaning. The **methods, techniques, and practices** referenced in section 14 CFR 43.13(a) are the **step-by-step** instructions for performing maintenance (including inspections). These "**how-to**" instructions are normally contained in manufacturers' maintenance manuals and other service documents.*

This Advisory circular clarifies that the **methods, techniques and practices** required by § 43.13(a), **are step-by-step, how to work instructions**. This would include when

performing a condition inspection, how the mechanic would know that a condition is airworthy. That is whether its original resistance to vibration and deterioration, or a level of resistance which is known to be airworthy, exist by substantiation back to its approved design."

The Regulations further require in 14 CFR 65 Subpart D – Mechanics, **§ 65.81 General privileges and limitations**, (b) that a certificated mechanic may not exercise the privileges of his certificate and rating **unless he understands the current instructions** of the manufacturer, and the maintenance manuals, for the specific operation concerned. The AMT cannot blindly follow work instructions. This also implies that the privileges of the mechanic certificate does not extend beyond following work instructions which are ultimately substantiated and known to ensure the aircraft is airworthy.
So when performing maintenance, which includes inspections, the AMT must be following "**step-by-step, how to**" work instructions, called in the rule "**methods, techniques and practices**," that they understand. There is no regulatory authorization to make airworthiness determinations without such instructions or criteria. There is no regulatory authorization to use subject judgement in making airworthiness determinations!

III. The Problem

Title 49 of the United States Code (49 U.S.C.) § 44701 intends that the regulation, 14 CFR 43 Maintenance Performance Rule, provide the minimum standard for the performance of maintenance. § 43.13(a) requires the use of methods, techniques and practices known to ensure meeting the requirement of § 43.13(b) so that its condition will be at least equal to its original or properly altered condition. These two requirements constitute the definition of airworthy. One source of this definition is FAA (AC) 120-77, in which airworthy is defined as:

(1) The aircraft must conform to its Type Certificate (TC). Conformity to type design is considered attained when the aircraft configuration and the components installed are consistent with the drawings, specifications, and other data that are part of the TC and would include any Supplemental Type Certificate (STC) and field approved alterations incorporated into the aircraft.
{Which § 43.13(a) requires}

(2) The aircraft must be in a condition for safe operation. The condition of the aircraft relative to wear and deterioration (e.g., skin corrosion, window delamination/crazing, fluid leaks, tire wear, etc.) must be acceptable.
{Which § 43.13(b) requires}

For all this to work there must actually be methods, techniques and practices that exist and that are being used! **The problem today is that this minimum standard of safety, needed to ensure airworthiness, is no longer enforceable.** The existence of methods, techniques and practices is no longer required. Hence, the objective basis for

airworthiness determinations originally intended by the regulations to ensure a minimum level of safety, required by 49 U.S.C. § 44701, is no longer required.

FAA legal interpretations say that the Administrator must show that what was done was "unacceptable" by proving the adverse impact on the level of safety that the aircraft's conformity to its type design is intended to ensure. [1] This is different from being required to actually use methods, techniques and practices known to return the aircraft to its original or properly altered condition. The basis for this is a court case in 1986, Administrator v. Calavaero, Inc., NTSB Order No. EA-2321. That case held that not "every scratch, dent, 'pinhole'" of corrosion, missing screw, or other defect, no matter how minor or where located on the aircraft, dictates the conclusion that the aircraft's design, construction, or performance has been impaired by the defect to a degree that the aircraft no longer conforms to its type certificate."

The effect of this interpretation on condition inspections can become very much like the drift into normalized deviation at NASA associated with the Challenger accident. That is changing the basic philosophy from proving that it is safe to fly ***(airworthy),*** to proving that it is not safe ***(unairworthy)***. [2] [3] Without the actual requirement for methods, techniques and practices, AMTs performing condition inspections are put into the situation of having to use subjective judgements when making airworthiness determinations. The effect of this interpretation on the performance of non-inspection maintenance can grant license to deviate from the procedures (step-by-step, how to work instructions) in the maintenance manuals. This volitional "failure to follow procedures" is found in most accidents where maintenance was the cause. [4] [5]

IV. The Normalized Deviation

Historically, aircraft manufacturers of General Aviation aircraft did not prescribe methods, techniques and practices for standard technologies like structures, cables, hydraulics, wiring, etc., because the FAA provided methods, techniques and practices for them in Advisory Circular 43.13-1. The knowledge of these standard practices and of the requirement for their use in the absence of manufacturer provided methods, techniques and practices, is no longer the norm today. The norm today is the belief that subjective judgment can be used, instead of such objective criteria. The legal interpretation makes the enforceable regulatory standard, knowing that it is unsafe. The regulations have never intended this responsibility for the AMT. The result can be catastrophic.

Aircraft accident NTSB # WPR16FA153 illustrates this problem; evidences its systemic nature; and demonstrates the lack of criteria norm normalized in an Airworthiness Directive. It involved a Piper PA-31T aircraft in a Part 135 Aeromedical Flight, which broke up in flight shortly after the pilot reported smoke in the cockpit, resulting in four fatalities. There had been previous PA-31T inflight fires, the cause of which could not be determined because the aircraft completely burnt up at the accident site. The aircraft in WPR16FA153 broke up in flight, extinguishing the fire and allowing the source of the fire to be determined. The fire was found to have been caused by chafing between

hydraulic lines and the electrical wires in an unpressurized section of the aircraft below the floor between the pilots' seats. This area had been inspect 22.4 flight hours prior to the accident. The wires were main power feed wires going to the Bus Tie circuit breakers.

Six exemplar Piper PA-31T maintained by various individuals/operators, all had electrical lines and hydraulic lines found in direct contact with electric wires. This shows a systemic failure of the aircraft inspection program to ensure airworthiness. See example in figure 1 below.

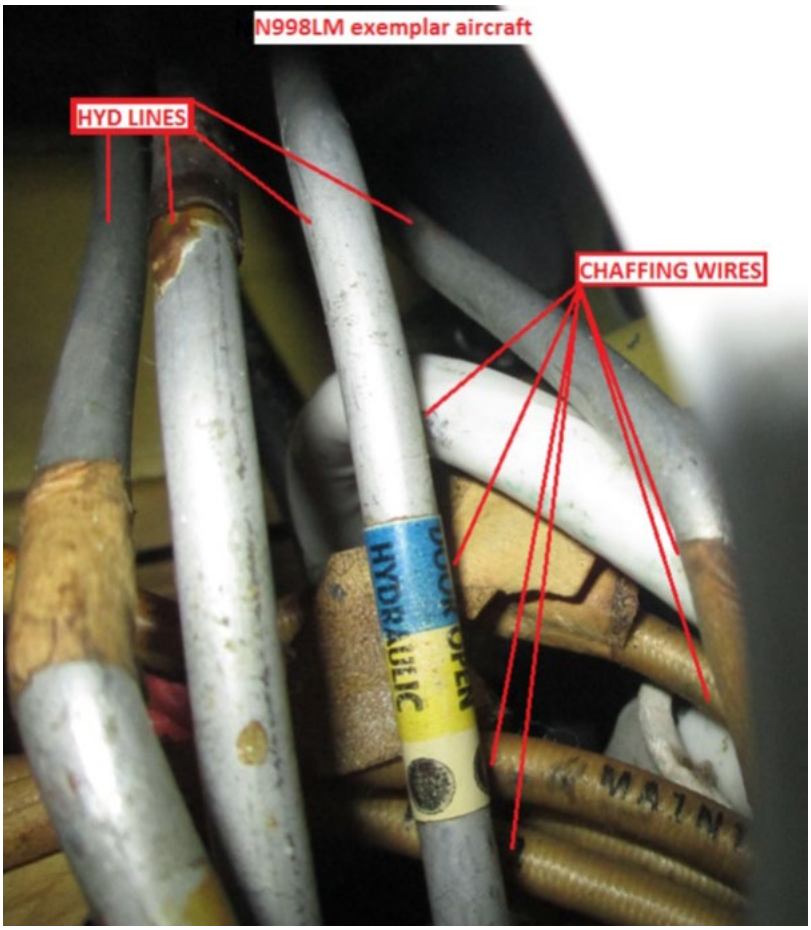

Figure 1, Chaffing Contact Found on all Exemplar Aircraft

§ 91.409 Inspections, Sections (e) and (f) (3) requires…"turbopropeller-powered multiengine airplanes" use current inspection program recommended by the manufacturer. The PA-31T's, a turbopropeller-powered multiengine aircraft, Inspection Program defined "Inspections" as examinations performed only by certified mechanics, using **acceptable methods, techniques, and practices** to determine physical condition and detect defects." It is dependent upon the detail in AC 43.13-1B to be used during inspection. Historically this was the regulatory norm.

The methods, techniques and practices for inspection of the wiring in AC 43-13-1B, section 11-96 are:

> *(a) Wiring must be visually inspected for the following requirements: supported by suitable clamps, grommets, etc, and be securely held in place without damage to the insulation, with no interference with other wires, etc.* ***Ensuring that chafing will not occur*** *against the airframe or other components.*

Special Airworthiness Information Bulletin (SAIB) CE-17-05 issued in response to WPR16FA153 recommended best practices for securing high electrical current wires in the aircraft to ensure proper hydraulic line and wire clearance is maintained. It said to use AC 43.13-1B as guidance. The SAIB is not mandatory and the AC 43.13-1B is not mandatory in and of itself, but some acceptable methods, techniques and practices is required to meet the intent of § 43.13(a). Since "nothing" cannot be a method, technique or practice, something applicable must be! AC 43.13-1B, historically, and by it's own purpose statement, is meant to be that acceptable source of methods, techniques and practices in this case. It states:

> *"1. PURPOSE. This advisory circular (AC) contains* ***methods, techniques, and practices acceptable to the Administrator for the inspection*** *and repair of nonpressurized areas of civil aircraft, only when there are no manufacturer repair or maintenance instructions.*

SAIB Provided Excerpt from AC 43.13-1B"11-126. FLAMMABLE FLUIDS AND GASES:

> *An arcing fault between an electrical wire and a metallic flammable fluid line may puncture the line and result in a fire. Every effort must be made to avoid this hazard by* ***physical separation of the wire from lines*** *and equipment containing oxygen, oil, fuel, hydraulic fluid, or alcohol…Wiring must be routed so that it does not run parallel to the fluid lines. A* ***minimum of 2 inches*** *must be maintained between wiring and such lines and equipment, except when the wiring is positively clamped to maintain at least* ***1/2-inch separation****, or when it must be connected directly to the fluid-carrying equipment.*

The Service Bulletin 1301 and Emergency Airworthiness Directive AD 2017-02-06 issued in response to the accident demonstrates the loss of the requirement for AMTs to use criteria when making airworthiness determinations. The AD requires repetitive inspection of the area shown in figure 1, to be conducted as per Service Bulletin 1301, which had only the subjective requirement of:

> *"Inspect the routing of all wiring. Reroute or rework as necessary to* ***minimize the likelihood of chafing contact*** *between adjacent components such as fluid carrying lines, airframe structure, and other wiring.*

"Minimize the likelihood of chafing" is not criteria! It does not provide an objective standard for the aircraft mechanic to apply. It is not a method, technique or practice as

intended by § 43.13(a) to enable the AMT to work within the privileges provided by the mechanic certificate. It puts the AMTs in the position of using their subjective judgement in making the airworthiness determination.

Of equal concern is that the accident report for WPR16FA153 did not mention the failure of the inspection program to ensure airworthiness of the aircraft. Failure of the inspection program to ensure airworthiness was evident on multiple aircraft with different maintainers. The failure of the inspection program was systemic and normative. This universal underlying cause of the accident remains unaddressed. All General Aviation aircraft inspection programs are subject to the erroneous belief that unless the manufacturer provided specific condition criteria, that the aircraft mechanics are allowed to and expected to use their individual subjective judgement in determining airworthiness.

AD 2017-02-06 addressed a critical safety problem by requiring what an inspection program should already been ensuring. If the failure of inspection programs is a consequence of believing that no criteria are applicable unless explicitly prescribed by the manufacturer, the AD normalized and institutionalized the problem when it did not provide some specific criteria. If the standard separations are not attainable, the instructions could have been to maximize the separation and ensure some minimal separation, such as 1/8 of an inch. Instead it allowed subjective judgements by the aircraft mechanics to be used in determining what would “minimize the likelihood of chafing,” rather than requiring that objective criteria be used. This shifts a responsibility from the regulator and the holder of the Type Design, to the AMT.

VI. The Challenge

If the AC 43.13-1B had been applied to the six exemplar aircraft, they would not have been found with electrical wires in contact with hydraulic lines. If the intended standards are systemically not being applied in this particular General Aviation aircraft inspection, there is no reason to expect that the correct and intended inspection standards are being applied in other areas of General Aviation. The only way to have this problem corrected is for the accident database to identify it. To find all the contributing causes, the investigation needs to go several “why” questions deep. The accident report for WPR16FA153 stopped at the first why, the chaffing of the electrical wire on the hydraulic lines. It did not ask or answer the further why questions concerning why all six exemplar aircraft, maintained by different maintainers, all had the same condition. Some of the difficulties in preventing the chaffing could be from design or alteration, but the fault of the actual chaffing condition existing, is the failure of the inspection program.

Therefore aircraft accident investigations should go further into why the unairworthy condition existed and when “failure of inspection program to ensure airworthiness” was a factor, they should be identified as such. A taxonomy category to code such accidents should be used, like CFIT. Maybe FIP

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XI. Bibliography / End Notes:

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