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Back to Basics: Testing in Aircraft with Electronic Flight Instrument Displays

Excerpt from FAA October 2007 Designee Update newsletter at:
<http://tinyurl.com/2hpesb>

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In June 2003, AFS-600 published a Designee Update Special Edition and placed it on AFS-600's website. The update advocated opening circuit breakers to simulate instrument failures during practical tests in aircraft with electronic flight instrument displays. AFS-600 now advocates adherence to the aircraft/avionics manufacturer's simulated instrument failure procedures. (For the purpose of the Practical Test Standards (PTS), any flight instrument display that utilizes LCD or picture-tube like displays will be referred to as Electronic Flight Instrument Display. FAA-S-8081-4D, Instrument PTS, page 7.) Currently there is no guidance in FAA Order 8710.3E, Designated Pilots and Flight Engineer Examiners Handbook, or Flight Standards policy on opening circuit breakers to simulate instrument failure during practical tests of applicants. The FAA does provide guidance on the proper use of circuit breakers and the circuit breaker's design function. This policy raised concerns in the pilot examiner community since it is contrary to guidance contained in several Advisory Circulars (ACs) listed below.

AC 23-17B, System and Equipment Guide for Certification of Part 23 Airplanes, (Amendment 23-49 and Subsequent) For part 23 applications, the definitions of a switch and a circuit breaker are as follows: 1) A switch is a device for opening and closing or for changing the connection of a circuit; 2) A circuit breaker is a device designed to open and close a circuit by non-automatic means and to open the circuit automatically at a predetermined overload of current, without injury to itself when properly applied within its rating. Thus, circuit breakers used for operational functions are not acceptable because they are not performing their intended function, which is protection against overloads. Circuit breakers, **even those suitable for frequent operation**, should not be used as a switch to perform procedural functions.

RN: This puts a whole new twist on "acceptable tools" available to flight instructors and check pilots for the purpose enhancing the flight training experience. Let us constrain our thoughts to the realm of light aircraft. Indeed, references to Part 23 in the

newsletter suggests that the writer's main concern is for operations in smaller aircraft.

I'm mystified as to the concerns for inducing wear on a breaker by operating it manually. Virtually all breakers we find on TC aircraft are rated by the manufacturer to meet design specifications after thousands of cycles. In fact, the ratings say that the breaker should do thousands of operations under fault conditions which may involve breaking a current that is 10 to 100 times the breaker's nameplate rating. Obviously, this places a high degree of electrical stress on the breaker IN ADDITION to mechanical wear.

Using the breaker as a switch for the occasional, purposeful opening of a circuit under normal operating conditions places no great stress on the breaker's contacts. Only the mechanism is subject to life-limiting wear . . . and that is rated in thousands of cycles.

AC 43.13-1B/2A, Aircraft Inspection, Repair & Alterations, (Page 11-15, Paragraph 11-51, Circuit Breaker Usage) Circuit breakers are designed as circuit protection for the wire. Circuit Breakers are not for protection of black boxes or components, and are not recommended for use as switches. Use of a circuit breaker as a switch will decrease the life of the circuit breaker.

True. But the question to be asked and answered is to what degree? If the airplane is an 8-hour a day training machine where a breaker might see hundreds of operations per year, then breaker service life does become a maintenance issue . . . but is it a safety issue? Let us continue.

AC 120-80, In flight Fires, (Paragraph 11, What is the FAA's Policy About Resetting Tripped (Popped) Circuit Breakers (CB) in Flight?)
Note: This guidance specifically relates to CBs that tripped due to a system malfunction rather than being opened to simulate an instrument failure. However, the guidance in the last sentence of the second paragraph will guide our decision to open CBs during the practical test.

The FAA Reiterates Its Concern About Resetting Circuit Breakers During Flight

Crewmembers may create a potentially hazardous situation if they reset a circuit breaker without knowing what caused it to trip. A tripped circuit breaker should not be reset in flight unless doing so is consistent with explicit procedures specified in the approved operating manual used by the flight crew or unless, in the judgment of the captain, resetting the circuit breaker is necessary for the safe completion of the flight. A detailed entry in the aircraft's maintenance log is a proven safety practice for tracking purposes, and may provide maintenance personnel with key information to enable prompt trouble shooting and effective corrective action on the ground.

Air Carrier manuals and training programs should contain company policies and explicit procedures regarding resetting tripped circuit breakers, both during flight and on the ground. The procedures shown in

the manuals used by the air carrier's crewmembers, maintenance personnel, and airplane ground servicing personnel should be consistent with the airplane manufacturer's guidance. Crewmembers should be reminded that a circuit breaker should not be used as a switch to perform procedural functions unless doing so is specified in approved company procedures or manufacturer's operating procedures. Responsibility of the Designated Examiner

Correct. We've discussed this many times over the past 20 years. In fact, prudent protocols for dealing with electrical system faults in flight are what drove the idea of 'digressing' back to fuses. They're less expensive, lighter, easier to install, faster in terms of operating speed and should not be messed with in flight. However, this is a separate issue that does not go to the concerns about using breakers for the occasional switching function.

As indicated previously in this article, examiners should refrain from using circuit breakers as a switch during a practical test, unless specifically authorized to do so by the aircraft/avionics equipment manufacturer. Review the Pilot's Operating Handbook, Flight Manual, and the appropriate supplements for the correct procedures to employ in the aircraft used for the practical test.

The complexity and variety of electronic flight instrument displays places an additional training and proficiency burden on the pilot examiner. Before accepting an application for a practical test, you must be both knowledgeable and proficient in the use of the avionics equipment installed in the aircraft used for the test. Bottom line: If you don't know how to use the avionics, you should not be testing an applicant on its use.

Consult the following manufacturer's websites to get the latest information on their avionics products:

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It's a certainty that this article will be dutifully digested and faithfully observed by lots of folk most of whom are unaware of underlying issues namely:

(1) Stuff that goes into airplanes is (or should be) DO-160 qualified for power interruption tests that require any accessory demonstrate graceful recovery to normal operation after a power interruption. We've all heard the stories about various equipment items both certified and non-certified with demonstrable, undesirable responses to power brownouts and/or interruptions. On the production lines at any aircraft plant I've worked, power gets turned on and off dozens of times either for the whole aircraft or selected systems. I've NEVER seen an edict that told line mechanics and electricians to be aware of the special needs of any piece of equipment for managing removal or application of power.

These specific departures from traditional design goals are well known and the victims of manufacturer's short-sightedness may either (a) modify their architecture and operational

protocols to accommodate the shortfall or (b) ditch the equipment in favor of a more robust product. It's called a *FREE MARKET DECISION*.

(2) An instructor's first duty is to the student. The artful instructor crafts as many realistic and practical scenarios as they can muster to provide the student with the richest possible learning experience. The airplane is a tool of that activity. The notion that some piece of that tool should NOT be exercised for the purpose of extending *SERVICE LIFE* is counter-productive to the instructor's task. This is especially true when cost of ownership effects of the proposed simulation are insignificant.

An instructor will soon become aware of devices that *DO NOT COMPLY* with *DO-160*. If I discovered that some piece of equipment wanders off into the mud after a power interruption, I would delete the exercise of that system's power as part of my training protocols. I would also complain to the owner/operator of the aircraft about the sub-standard performance of that particular system.

Once the problem children are identified, the instructor should be free to use any of the exercises in his/her bag of tricks to hold up their end of the bargain for the flight training experience.

Nuckolls' first law of systems design is "Things Break" . . . they wear out too. If a breaker wears, its trip current goes down. This means that the aircraft subjected to training exercises of breakers is vulnerable to nuisance trips. These are then dutifully noted on the ship's maintenance squawks and the breaker gets replaced. The fact that the breaker required replacement early in the normal life-cycle of breakers is no big deal. It's a maintenance issue that offers no greater safety implications than any other failure in the equipment powered by that breaker. The fact that the breaker needs replacement every 1000 hours of operation while other breakers never need replacing is a *COST OF OWNERSHP* issue for the individual who owns the aircraft.

This article is a classic example of how individuals with leadership duties craft blanket edicts that replace experience and common sense with policy and procedure. These individuals have lost sight of (or perhaps never embraced) goals for:

- Producing failure tolerant,
- low cost-of-ownership aircraft
- maintained by knowledgeable mechanics and
- flown by competent pilots.

I will suggest that this missive (while factually correct in quoting other policies and procedures) is counter-productive to

doing the best we know how to do. Fortunately, the OBAM aircraft community is free to explore the real capabilities of the equipment we install and craft our own limitations on how it is used.