AFS-600
Regulatory Support Division

DESIGNEE UPDATE
SPECIAL EDITION

Examiner, Designee, and Instructor Community

IN THIS UPDATE

TESTING IN TECHNICALLY ADVANCED AIRCRAFT

The following guidance for conducting practical tests in technically advanced aircraft (TAA) has been coordinated with and approved by the General Aviation and Commercial Division (AFS-800).

Computer technology and modern display media are rapidly encroaching into the aviation community replacing air as the primary source of flight instrument power. Are we, in the certification field, able to keep up the pace? It won't be long before "needle, ball, and airspeed" will be an obsolete term in the aviation community to describe emergencies involving flight instrument malfunctions or "partial panel instrument flying."

The following paragraph (in draft form) will be placed in future revisions of the practical test standards (PTSs) to help explain flight instrument emergencies in aircraft equipped with electronic flight displays.

Modern technology has introduced into aviation a new method of displaying flight instruments, such as Electronic Flight Instrument Systems, Integrated Flight Deck displays, and others. For the purpose of the Practical Test Standards, any flight instrument display that utilizes LED or picture tube like displays will be referred to as "Electronic Flight Instrument Display." In the case of testing in an aircraft equipped with this type of display, partial panel tasks must be tailored to failures that would normally be encountered in the aircraft. If the aircraft is capable, total failure of the electronic flight instrument display, or a supporting component, with access only to the standby instruments could be substituted where a task calls for **"***Performed without the use of the attitude and heading indicators."*

It is the examiner's responsibility to test the applicant's ability to handle both normal and abnormal situations in the aircraft. Some technically advanced aircraft have as many as three or more electronic displays and flight instrument data that can be move to another display if the primary flight instrument display becomes inoperative. They may also have the ability to switch data source to another data display. For instance, if the data source for the pilots display fails the display may be reverted to the co-pilot's data source. Even though this is an abnormal situation that should be tested it does not replace the responsibility for the applicant to be able to fly the aircraft using only standby instruments.

Some instructors strongly recommend that the autopilot be used when experiencing a failure in the data source as the autopilot still has functions that are operable and get some of their data from the global position system (GPS) or flight management system (FMS) systems. Again, the procedure should be accepted as a prudent measure; however, the applicant must still be able to demonstrate the ability to hand fly the aircraft using standby instruments.

Examiners and instructors have asked if it is permissible for the applicant to use the co-pilots instrument for reference if the pilot's primary instruments fail. Another applicant says, "If my side instruments fail I just let the co-pilot fly since we are a two pilot operation." These, just like the autopilot, may be viable options to consider in an emergency, but do not fulfill the requirement for the applicant to demonstrate ability to fly the aircraft solely by reference to standby instruments.

It must be noted that some aircraft do not use a turn indicator as a standby instrument but rather have replaced it with a standby attitude indicator. This standby attitude indicator may have a coordination ball included. Heading information and navigation indication may be supplied by GPS(s). The applicant is required to demonstrate that he/she can fly the aircraft performing a non-precision approach in this configuration without the aid of the autopilot.

It is the examiner's responsibility to have a thorough knowledge of the equipment to be used during the testing. This, combined with the examiners experience, should lead to a comprehensive test of the applicant's ability to fly in the instrument environment and help ensure a competent pilot that can handle abnormal and emergency procedures in a technically advanced aircraft.

The following paragraph is being placed in future PTSs and should answer questions regarding view-limiting device used during testing.

The applicant is required to provide an appropriate view-limiting device that is acceptable to the examiner. This device shall be used during all testing that requires testing "solely by reference to instruments." This device must prevent the applicant from having visual reference outside the aircraft, but not prevent the examiner from having visual reference outside the aircraft. A procedure should be established between the applicant and the examiner as to when and how this device should be donned and removed and this procedure should be briefed before the flight.

Any questions concerning the above policy should be referred to the Airman Testing Standards Branch (AFS-630). The point of contact is Mr. Bob Hlubin at 405-954-6404. E-mail bob.hlubin@faa.gov.

The following paragraphs will provide guidance for testing applicants in an aircraft with a primary flight display (PFD) and autopilot system.

Primary Flight Display Malfunctions & Failures (DPE Guide)

To understand the failure modes of the Avidyne primary flight display (PFD) you must first understand how the PFD works. The following discussions provided by industry should provide information to examiners and inspectors conducting evaluations using this equipment. Note: Failures should never be conducted in actual instrument conditions.

ADAHARS Failure

Air data, attitude heading and reference system (ADAHARS) is the most common failure of the PFD. In a conventional aircraft, this is loosing your vacuum system, which affects the attitude indicator and the directional gyro (DG) (assuming no electrically powered horizontal situation indicator (HSI)). The same instruments are affected with an ADAHARS failure. The failure is visually identified by red X's through the attitude indicator and the HSI. The procedure for simulating an ADAHARS failure in flight is to pull both PFD

circuit breakers and then reset them. In 3-5 minutes the system will come back on-line, but only air-data will be displayed (Airspeed, Altitude, and Vertical Speed).

Note: Even though air-data is restored the startup dialog box will overlay the airspeed and altimeter. This does not mean the failure cannot be simulated, but it is not 100 per cent like an actual failure. In an actual failure, the startup dialog box will not block part of the airspeed or altimeter. Consideration to this should be given when evaluating the applicant.

The applicant is evaluated on their ability to identify the failure, determine what equipment is affected (integration), and select the most suitable course of action based on flight conditions.

Recommended Course of Action (applicant): With a ADAHARS failure, the multiple function display (MFD) will no longer display heading information. The S-Tec 55X lateral navigation (heading and navigation) will not operate. The pilot has two basic courses of action:

1. Fly traditional partial panel using the backup instruments, compass, and the NAV 1 page on the Garmin GPS for lateral navigation. (The problem is the scan pattern is so large spatial disorientation is a concern.)
2. The recommended course of action is to utilize the GPS Steer (GPSS) function on the autopilot. Lateral navigation for the autopilot is then taken directly from the GPS. Altitude and vertical speed modes are not affected.

NOTE: Precision approaches are not possible with an ADAHARS failure. The applicant's safest course of action is to select an approach procedure that will auto-sequence all the way to the visual descent point (VDP) or missed approach point. The standard "T" shaped GPS approach is a perfect example of this.

Air-Data Failure
Red X's indicates an air data failure where the airspeed, altimeter, and VSI are located. This failure is representative of a failure of the system to convert the actual air data to a digital representation. If the pitot-static system is compromised, traditional indications representative of the failure will be shown on the PFD & no red X's are present. There is no way of duplicating this in the airplane.

The best way to test understanding of this failure is through oral quizzing.

Applicant's Knowledge: The applicant should identify and understand what the red X's mean. In the event the pitot-static system is providing erroneous information, the applicant should be able to determine the best course of action using traditional methods (i.e. alternate static-source). There is no VSI to break on a PFD equipped aircraft.

Full Failure with indications
Red X's displays a full failure with indications where instrument indications would normally be located. (airspeed, attitude indicator, vertical speed indicator, and turn coordinator are co-located with the electronic horizontal situation indicator (EHSI). There is no way of duplicating this in the airplane. Since no useful information would be displayed on the PFD it should be taken off line by pulling the circuit breakers and utilizing the backup instruments and utilizing the autopilot.

The best way to test understanding of this failure is through oral quizzing.

The same procedure explained in the ADAHARS failure should be used with one exception. The PFD circuit breakers should be pulled to enable the pilot to use the vertical speed (VS) directly from the autopilot. This is different because normally all VS changes are made through the PFD. The aircraft will not level off on its own; the pilot must select altitude hold when the desired altitude is reached.

Power Failure
Power failure is just that, there is no power going to the unit. This would have to be caused by a critical failure in the unit itself. Back instruments and autopilot should be utilized. The circuit breakers should also be pulled to ensure predictable autopilot use.

The procedure for testing this in flight is to pull both PFD circuit breakers.

The applicant is evaluated on their ability to identify the failure, determine what equipment is affected (integration), and select the most suitable course of action based on flight conditions.

Recommended Course of Action (Applicant): Pull both PFD circuit breakers (note: the instructor or examiner will have already pulled these, but the applicant should advise them they would perform this action). Use the GPSS function for lateral navigation. Select an auto-sequencing approach that which will allow descent down to the VDP. To descend use the VS function directly on the autopilot.

Lamp / LCD Failure
This failure is caused by one of two events. One or both set of lamps (light bulbs) has burnt out or the LCD panel has been damaged. The PFD will be black and the keys will be lit, unlike the power failure in which the keys will no longer be lit. At this point the unit may be operating, but no useful information is presented.

The procedure for testing this in flight is to dim the PFD panel.

The applicant is evaluated on their ability to identify the failure, determine what equipment is affected (integration), and select the most suitable course of action based on flight conditions.

Recommended Course of Action (applicant): Both PFD circuit breakers should be pulled. The recommended course of action under power failure should be followed.

Scenario
The best scenario is to dim the PFD panel to simulate a lamp / LCD Failure. The applicant should then correlate that no usable information is available. The applicant should then pull circuit breakers on the main and essential bus to take the unit off line. This will give predictable autopilot use and make it possible to complete a GPS approach using the GPSS function.

Autopilot should be utilized as much as possible to minimize head movement that may result in special disorientation. Speed should also be reduced to allow time to determine a proper course of action or place to divert. This is an emergency situation and should be reported to air traffic control (ATC) as such. A standard "T" pattern GPS approach works best because this will limit the amount of hand flying one has to do. GPSS will sequence through the approach, and the pilot must utilize the VS function on the autopilot for vertical guidance.

Final Notes
Understanding the autopilot is part of understanding how the PFD works. If the weather is IMC and the autopilot is inoperative it is recommended that the flight be delayed until the weather improves or the autopilot is fixed. Having the autopilot if the PFD were to malfunction will greatly reduce the likelihood of disorientation. It is important to remember that the applicant is required to demonstrate knowledge and skill using all of the technology. However, in order to ensure that the applicant can operate the aircraft in the worse case scenario he/she will be required to demonstrate a partial panel, non-precision approach without the use of the autopilot.