



# Federal Aviation Administration

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## Memorandum

Date: May 14, 2014

To: Manager, Transport Standards Staff, International Branch, ANM-116

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Douglas Bryant, ANM-112

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for Use of a Digital-Only Presentation of High Pressure Rotor Speed (N2) on the Airbus Single Aisle New Engine Option Model Airplanes (FAA Project Number AT00949IB-T)

ELOS Memo#: AT00949IB-T-P-11

Reg. Ref.: §§ 25.1305, 25.1549

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This memorandum informs the certificate management aircraft certification office of an evaluation made by the Transport Airplane Directorate (TAD) on the establishment of an equivalent level of safety (ELOS) finding for the Airbus Single Aisle (SA) New Engine Option (NEO) Model airplanes.

### Background

Title 14, Code of Federal Regulations (14 CFR) 25.1549, "Powerplant and auxiliary power unit instruments" in part requires each maximum and, if applicable, minimum safe operating limit must be marked with a red radial or a red line, and each takeoff and precautionary range must be marked with a yell arc or a yellow line.

The primary engine displays on turbine engine powered transport aircraft have traditionally displayed the required engine rotor speeds, oil temperature, oil pressure and fuel flow required by § 25.1305 in an analog-only or an analog and digital format. Standby Engine Indicators (SEIs), when provided, have typically displayed these parameters in either analog-only or digital-only format. An increasing demand to conserve primary display space has led to digital-only primary displays for various engine parameters including those rotor speeds not normally used for power setting. This situation may result in a small, cluttered, low-resolution primary display.

The FAA generally considers that digital-only displays are less effective than conventional analog displays at providing the crew with discernible indication of the parameter during a rapid transient, and quick intuitive indication of the parameters approximate level, direction and rate of change, proximity to limits, and relationship to other parameters on the same engine or the same parameter on other engines. Therefore, Advisory Circular (AC) 20-88A, paragraph 4(c), states that “digital indicators are most valuable when integrated with an analog display.”

While many of the rules do not require an analog format, § 25.1549 actually does require instrument markings which presumes an analog type display format. Therefore, the FAA considers that features of the digital format must at least provide a level of safety equivalent to that intended by compliance with § 25.1549.

### **Applicable regulation(s)**

§§ 21.21(b)(1), 25.1305 and 25.1549

### **Regulation(s) requiring an ELOS finding**

§ 25.1549(a), (b) and (c)

### **Description of compensating design features or alternative standards which allow the granting of the ELOS finding (including design changes, limitations or equipment need for equivalency)**

The Airbus SA NEO model airplanes are equipped with either CFM International CFM Leap-1A engines or Pratt and Whitney PW1100G-JM engines that are controlled by a Full Authority Digital Engine Control (FADEC) system. The N2 speeds are secondary engine parameters not used in the thrust setting process. The N2 speeds are mainly monitored to detect engine abnormalities during the engine starting sequence.

Automatic FADEC monitoring of N2 is provided to prevent any gradual exceedance of the redline limit during normal engine operation. Continuous monitoring of N2 by the FADEC ensures a prompt fuel flow cutback if the limits are reached.

If, for any reason, the N2 speed is allowed to reach or exceed the redline limit, the N2 digital indication for the affected engine will be framed with an amber attention getting box and the digits will turn red, providing limit exceedance information to the crew. In addition a dedicated ECAM warning “ENGx N2 OVERLIMIT” will be displayed associated with master light on and an aural chime. This warning and the associated procedure direct the crew to reduce thrust on the affected engine, monitor the affected parameter and shut down the engine if the parameter does not reduce below the limit.

If, for any reason, the flightcrew does not intervene, the engine rotor integrity is protected by overspeed protection. This fully automated control logic in the engine FADEC will cut back fuel supply if the shaft speed reaches overspeed conditions. This level is set below the rotor integrity limit level in order to protect the engine from exceeding it but is higher than the red line. There

is no expectation for flightcrew intervention in order to prevent the engine shaft speeds to exceed the rotor integrity limit level.

**Explanation of how design features or alternative standards provide an ELOS to that intended by the regulation**

Section 25.1549 is intended to ensure engine limits are not exceeded and to ensure that engine abnormalities that could lead to engine failure or other undesirable engine behaviors are identified by the flightcrew and addressed in a timely manner. At the time this rule was promulgated, the available technology primarily relied on flightcrew awareness and direct action to respond to engine abnormalities. Analog instrumentation was required to provide appropriate flightcrew awareness. Since that time, the development of FADEC systems has relieved the flightcrew of much of the burden of monitoring engine indications, particularly for secondary engine parameters not directly used for power setting.

Although noncompliant with the § 25.1549(a), (b) and (c), the FADEC continuous monitoring in-flight of the operating condition of the engine high pressure rotor speeds (N2), automatic generation of warnings to the cockpit, with associated flightcrew procedures, and engine automatic shutdown if a limit is exceeded are considered to provide an ELOS as that established by providing analog displays.

**FAA approval and documentation of the ELOS finding**

The FAA has approved the aforementioned ELOS finding in the SA NEO model airplanes project issue paper P-11, titled “Digital Only Display of Engine High Pressure Rotor Speed (N2).” This memorandum provides standardized documentation of the ELOS finding that is non-proprietary and can be made available to the public. The TAD has assigned a unique ELOS memorandum number (see front page) to facilitate archiving and retrieval of this ELOS finding. This ELOS memorandum number should be listed in the type certificate data sheet under the Certification Basis section in accordance with the statement below:

The FAA has made an ELOS Findings for the following regulation(s):  
 14 CFR 25.1549(a), (b) and (c), Powerplant and auxiliary power unit instruments  
 (documented in TAD ELOS Memo AT00949IB-T-P-11)

*Original signed by Victor Wicklund*  
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 Transport Airplane Directorate,  
 Aircraft Certification Service

*May 14, 2014*  
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 Date

ELOS Originated by Transport Standards Staff: Propulsion and Mechanical Systems Branch	Project Engineer Douglas Bryant	Routing Symbol ANM-112
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