



U.S. Department  
of Transportation

**Federal Aviation  
Administration**

# Memorandum

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Subject: Equivalent Level of Safety (ELOS) Finding for Boeing Puget Sound Ground Fault Interrupter Relays on Models 707, 727, 737CL, 737NG, 747CL, 747-400, 757, 767, and 777  
Project Number PS05-0123

Date: 3/12/07

Reg Ref: § 25.981(a)(3)

From: Manager, Transport Airplane Directorate, ANM-100

Reply to Attn of: Katherine Rask, ANM-140S; Tony Castillos, ANM-130S

To: Manager, Seattle ACO, ANM-100S

ELOS Memo #: PS-05-0123-P-1

The purpose of this memorandum is to inform the certificate management aircraft certification office of an evaluation made by the Transport Airplane Directorate on the establishment of an equivalent level of safety finding for the Boeing Puget Sound ground fault interrupter relay design on Boeing 707, 727, 737CL, 737NG, 747CL, 747-400, 757, 767, and 777 models.

## Background

Boeing Puget Sound has applied for amendment to their Type Certificates to modify models 707, 727, 737CL, 737NG, 747CL, 747-400, 757, 767, and 777 by installing a ground fault interrupter relay (GFI).

In this application, Boeing Puget Sound has proposed the use of a GFI which does not meet some of the requirements of § 25.981 (a)(3) at amendment 102. Boeing Puget Sound has proposed that compensating features of the design exist to provide an equivalent level of safety.

The applicable parts of Amendment (25-102) of § 25.981 (a)(3) state:

“... (a) No ignition source may be present ... This must be shown by ...  
(3) ... Demonstrating that an ignition source could not result from each single failure, from each single failure in combination with each latent failure condition not shown to be extremely remote, and ...

The Boeing GFI design addresses the § 25.981(a)(3) single failure requirement only. However the probability of the GFI having a latent failure condition which would prevent it from detecting a fault current and removing power from the fuel pump is not shown to be extremely remote. The GFI does not have the ability to verify that fault protection is operational prior to application of power to the pump. Potential latent failures in the GFI function will be detected via a manual BIT test which will be performed by operators at minimum 4,000 flight-hour maintenance intervals. Boeing notes that the failure rate for loss of fault current detection is 2.26E-07. The

FAA has therefore concluded that Boeing has not shown the GFI design, in combination with a minimum 4,000 flight-hour maintenance interval inspection, meets the § 25.981(a)(3), amendment 25-102, requirement that for each single failure in combination with each latent failure condition not shown to be extremely remote.

However, the FAA accepts Boeing's position that incorporation of this GFI provides an increased level of protection over those aircraft without the GFI installed. There are compensating features that together provide an equivalent level of safety to that which would be provided if the aircraft was directly compliant to § 25.981(a)(3), amendment 25-102.

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

§ 25.981(a)(3)

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

§ 25.981 (a)(3)

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

Boeing Puget Sound's proposed GFI has the following compensating design features:

1. The extensive service history on the Boeing 707, 727, 737CL, 737NG, 747CL, 747-400, 757, 767, and 777 series airplanes includes 478,123,000 hours of electric motor fuel pump operation that show limited exposure to pump failure modes that could result in an ignition source. Failure rates associated with potential ignition source problems of fuel pump phase-to-phase and phase-to-ground shorts are relatively low.
2. Service experience has resulted in design improvements to prevent certain failures so there are limited numbers of foreseeable failures for which the GFI would be needed to provide additional protection. On-going design improvements in the affected fuel pump housing electrical connectors further reduce the ignition source risk.
3. Periodic inspections will be performed to check functionality of the GFI. Due to the potential latent failures of the GFI functions, a maximum 4,000 flight-hour maintenance interval for checking the functionality of the GFI is required. The 737NG airplanes will be inspected annually, not to exceed 4,000 flight- hours, as required by Section 9 of the 737NG Maintenance Procedures Document. This inspection interval corresponds to the inspection interval for the 737NG fuel pump auto-shutoff and power-on relays. GFIs that fail a functional check must be replaced prior to further flight or the affected fuel pump(s) deactivated per the MMEL. The GFI is an Airworthiness Limitation, Critical Design Configuration Control Limitation (CDCCL) item, and must be checked accordingly, as an airworthiness limitation item in the SCI document.

**Explanation of how design features or alternative standards provide an equivalent level of safety to the level of safety intended by the regulation**

For new airplanes, designed after the promulgation of § 25.981(a)(3), amendment 25-102, the designs should meet §25.981(a)(3) using a numerical probabilistic approach.

The compensating design features described in the previous section constitute a design that meet the level of safety intended by the regulation.

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

The FAA has approved the aforementioned Equivalent Level of Safety Finding in issue paper P-1. This memorandum provides standardized documentation of the ELOS that is non-proprietary and can be made available to the public. The Transport Directorate has assigned a unique ELOS Memorandum number (see front page) to facilitate archiving and retrieval of this ELOS. This ELOS Memorandum number should be listed in the Type Certificate Data Sheet under the Certification Basis section (TC's & ATC's) or in the Limitations and Conditions Section of the STC Certificate. An example of an appropriate statement is provided below.

Equivalent Level of Safety Findings have been made for the following regulation(s):  
§ 25.783 Doors (documented in TAD ELOS Memo SA8293AT-T- S-1)]

*Original signed by Neil D. Schalekamp*

Transport Airplane Directorate,  
Aircraft Certification Service

*3/12/07*

Date

ELOS Originated by: Seattle ACO	Project Engineer: Katherine Rask and Tony Castillo	Routing Symbol: ANM-140S & ANM-130S
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