

# ADVISORY CIRCULAR



DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Washington, D.C.

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## FAR GUIDANCE MATERIAL

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**Subject:** AIRWORTHINESS AND OPERATIONAL APPROVAL OF AIRBORNE SYSTEMS TO BE USED IN LIEU OF A GROUND PROXIMITY WARNING SYSTEM(S) (GPWS)

1. PURPOSE. This advisory circular provides information and guidance regarding the airworthiness and operational approval of airborne equipment/system(s) in accordance with Federal Aviation Regulations (FAR) § 135.153, paragraphs (b) and (c).

2. RELATED READING MATERIAL.

a. Advisory Circular 25-6, Ground Proximity Warning Systems (GPWS). Copies may be obtained from the U.S. Department of Transportation, Publications Section (M-443.1), Washington, D.C. 20590.

b. Radio Technical Commission for Aeronautics (RTCA) Document No. DO-160, "Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments (current issue)," and RTCA Document No. DO-161A, "Minimum Performance Standards - Airborne Ground Proximity Warning Systems," dated May 27, 1976. Copies of these documents may be obtained from the RTCA Secretariat, Suite 655, 1717 H Street, N.W., Washington, D.C. 20006.

c. Technical Standard Order (TSO), TSO-C92a, Ground Proximity Warning Glide Slope Deviation Alerting Equipment. Copies may be obtained from the Federal Aviation Administration, Systems Branch (AWS-130), Room 334, 800 Independence Avenue, S.W., Washington, D.C. 20591.

3. BACKGROUND. Section 135.153(b) allows the use of alternate equipment in lieu of a Ground Proximity Warning System (GPWS) for certain turbojet operations conducted under FAR Part 135. Section 135.153(b) also requires that the use of any such system must be approved by the Director, Flight Standards Service. Since the Flight Standards Service has reorganized at the Washington level, that approval should now come from the Office of Airworthiness and/or the Office of Flight Operations.

4. GENERAL GUIDELINES. The equipment/system to be used in lieu of a GPWS should perform the same basic functions as the GPWS which is to convey warnings of excessive closure rates with the terrain and excessive deviations below a glide slope.

5. AIRWORTHINESS CONSIDERATIONS. The airborne equipment/systems, which may be under consideration in lieu of a GPWS, should use the same basic performance standards described in RTCA Document No. DO-161A referenced in paragraph 3, as modified by this advisory circular, and permitted by § 135.153, paragraphs (b) and (c).

a. Equipment/System Considerations. The words "equipment/system" as used herein includes all of the components, subsystems, or units necessary to perform its intended function. For example, the equipment/system could include cockpit controls, display, computing unit, aural warning unit, etc. The equipment/system need not include the associated sensors for which other performance standards are applicable (e.g., radio altimeter).

(1) Location of Display and Controls. Displays and controls should be visible to and usable by each pilot while seated at his duty station if the equipment is to be operated by the pilots.

(2) Control(s) Considerations.

(i) Controls which are not normally adjusted in flight need not be readily accessible to the flightcrew.

(ii) Controls should be arranged to provide adequate protection against inadvertent turnoff.

(iii) The operation of controls intended for use during flight, in all possible combinations and sequences, should not result in a condition whose presence or continuation would be detrimental to the continued performance of the equipment/system.

(3) Failure Protection. Any probable failure of the equipment/system should not derogate the normal operation of equipment connected to it nor should normal operation result in failure or degraded performance of interfaced equipment. Likewise, the failure of interfaced equipment should not render the equipment/system inoperative.

(4) Failure Monitoring and/or Self-Test. Failure monitoring and/or a self-test should be used to provide a positive indication of status or conditions.

(5) Unwanted/False Warnings. The equipment/system should be designed to minimize unwanted or false warnings.

(6) Environmental Conditions. The equipment/system should be capable of performing its intended function over the environmental ranges expected to be encountered in actual operation.

(7) Aircraft Electrical Power Source. The equipment/system should be installed so that it receives electrical power from a bus that provides maximum reliability of operation without jeopardizing essential or emergency loads assigned to that bus.

b. Demonstration of Performance. An applicant for approval of the equipment/system installation should show that performance can be demonstrated by a combination of ground and flight evaluations:

(1) Ground Evaluation. After installation, an operational/functional check should be performed to demonstrate compatibility between the equipment/system and the aircraft electrical/electronic systems, all normal operating functions are exercised, and any emergency/failure conditions expected may be observed.

(2) Flight Evaluation. The equipment should be flight evaluated to determine that the design and installation criteria are met. All modes of operation should be functionally checked and verified. Airplane Flight Manual procedures should be evaluated, including abnormal and emergency procedures if applicable.

c. Airplane Flight Manual. The Airplane Flight Manual should contain the following information (see § 135.153, paragraphs (c)(1) and (2) for requirements):

(1) Normal procedures for operating the equipment.

(2) Equipment operating limitations.

(3) Emergency/abnormal operating procedures.

d. Airworthiness Approval. Applications for approval will be coordinated with the Office of Airworthiness.

6. OPERATIONAL CONSIDERATIONS. Section 135.153(b) requires that a system used in lieu of a GPWS be capable of conveying warnings of excessive closure rates with terrain, and any deviations below glide slope by visual and aural means. Those requirements are basic. It is anticipated that the equipment/system submitted for approval for use under § 135.153(b) may also combine several other functions within the submitted systems (e.g., aural callouts of altitude below 1000 feet, landing-gear-not-down warnings, etc.). Consideration of these other warnings and indications is important but the basic requirements of § 135.153(b) should not be compromised. The operational evaluation of a system should determine that it will reliably and consistently perform the minimum basic functions. Factors to consider

vary in accordance with the equipment/system under review but should include the following concepts:

a. Flightcrew Information. The equipment/system should provide the flightcrew with audible and visual information which will alert the flightcrew to take the proper action to prevent inadvertent collision with the terrain caused by: unintentional close proximity to ground, excessive closure rates to terrain, negative climb rate after takeoff, and excessive downward deviation from an Instrument Landing System Glide Slope.

(1) Aural/Visual Information. Distinctive aural and/or visual information should be provided to warn of each condition in paragraph 7.a. The aural warning should consist of words or sounds to command the attention of the flightcrew to the situation in time to avoid inadvertent collision with the terrain. The equipment/system should be designed to minimize distracting audible signals where no threat to inadvertent ground hazard exists. The visual warning should be distinctive under all normal lighting conditions and commensurate with other cockpit warnings. Aural/visual warning methods should be compatible with the user's flight procedures.

(2) Deactivation Capability. Means to deactivate the warning indications may be provided for flightcrew use in planned abnormal and emergency conditions.

(3) Glide Slope Alert. An alert should be given at least by the time the aircraft is 1.5 dots below glide slope. A system that gives an alert when an aircraft is less than 1.5 dots below a glide slope is not acceptable. Where a decision height is used as a parameter, the glide slope alert may be inhibited when below decision height.

(i) If glide slope alerting is deactivated, it should be automatically reactivated for the next approach.

(ii) The glide slope deviation alert should consist of the aural annunciation "Glide Slope" (or other acceptable annunciation). An aural warning related to altitude should take precedence over this alert.

b. Flight Summary Report. A review of a summary of any flight experience that could provide data on the operational reliability and accuracy should be conducted. Pilot comments should be reviewed, if available.

c. Inflight Evaluation. An inflight evaluation of the equipment/system should be conducted to observe performance of the equipment in the four modes mentioned in paragraph 7.a. Such an evaluation should include observation of the system at other than optimum conditions (i.e., rough terrain on final approach, performance during circling approaches, etc.).

d. Operations Manual Evaluation. The operational evaluation should include a review of proposed Operations Manual revisions encompassing equipment/system description and operation. Proposed revisions to the Minimum Equipment List should also be considered, if appropriate.

7. DISCUSSION.

a. Requests for approval of an equipment/system should be sent directly to the appropriate regional office for evaluation.

b. Approval of the equipment/systems are granted by letter, from the Office of Airworthiness and the Office of Flight Operations, based on the region's evaluation report and recommendations.



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