

AC NO: 25-6

DATE: 12/31/74



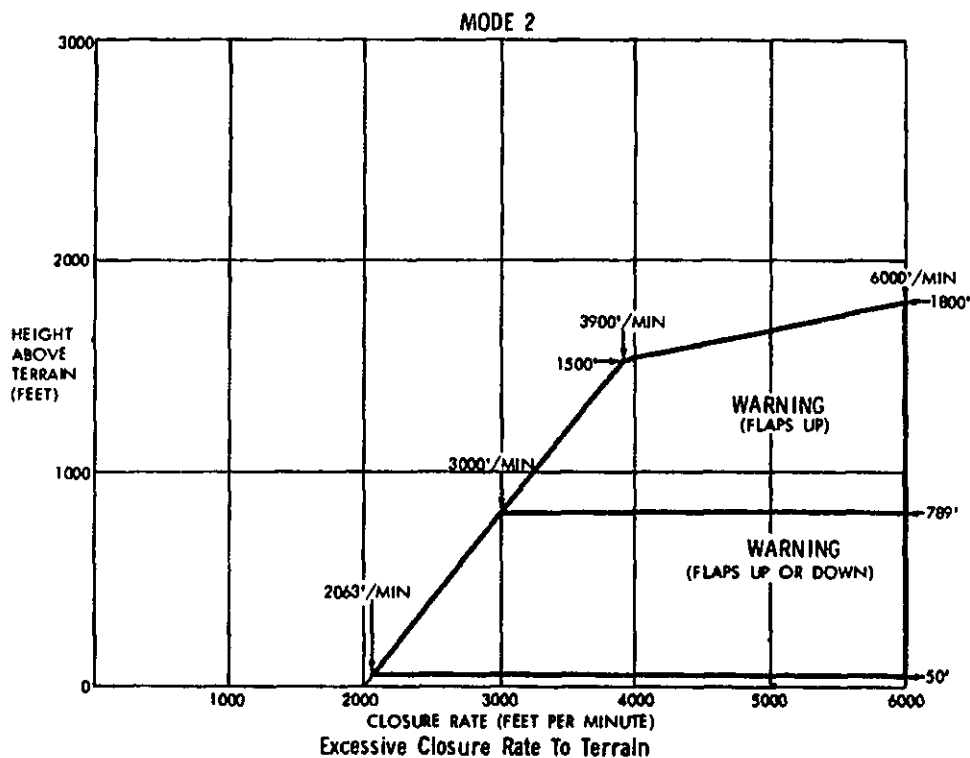
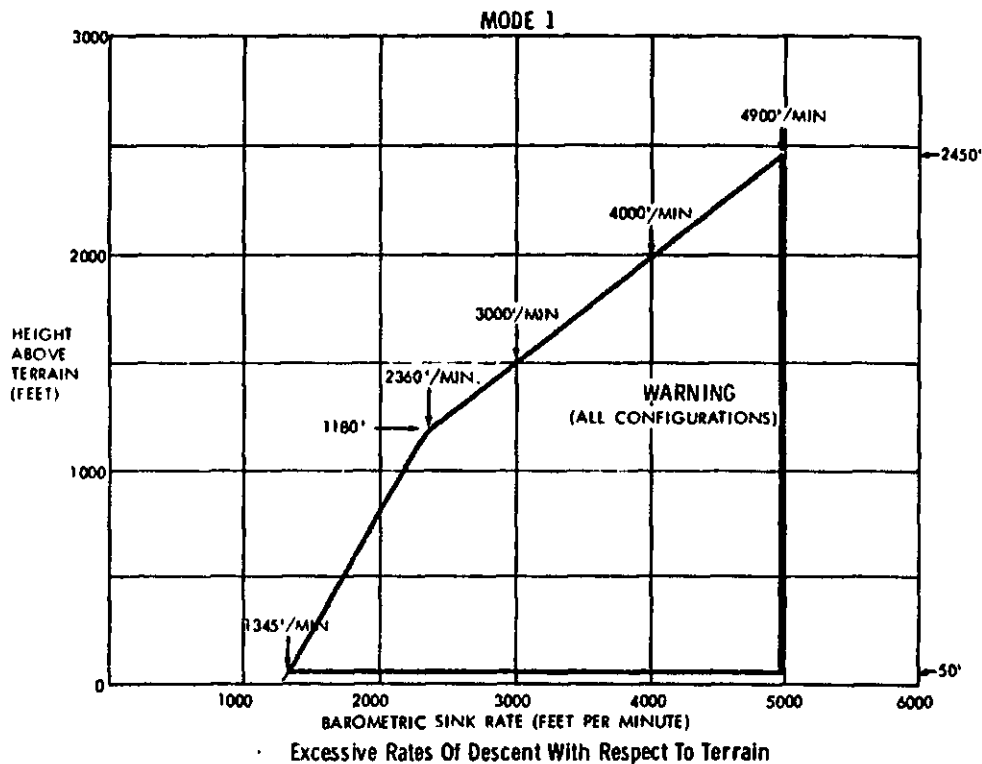
ADVISORY CIRCULAR

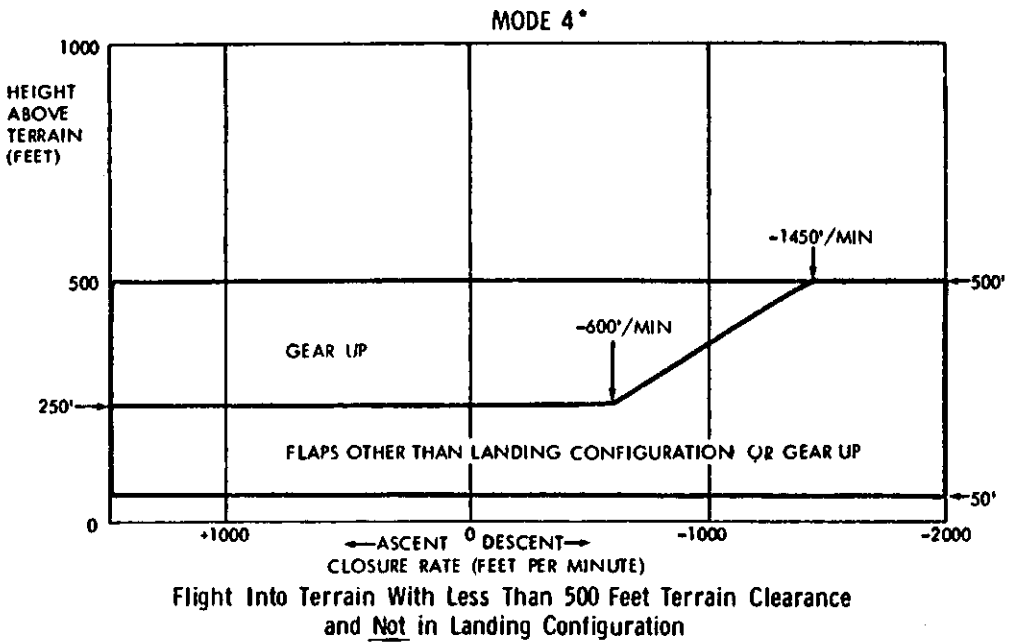
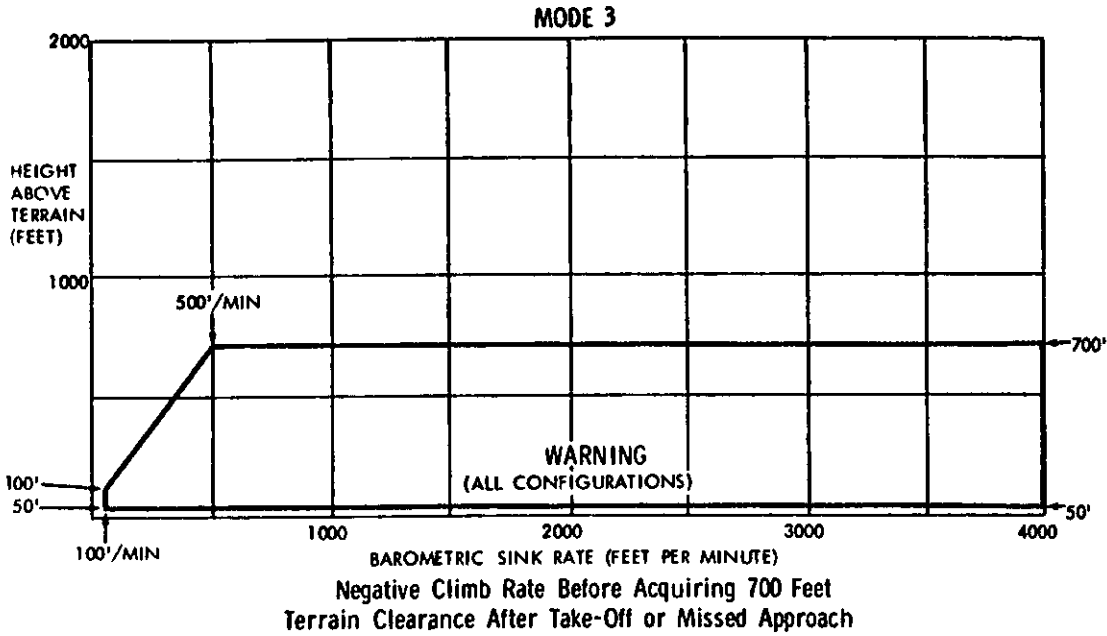
DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION

SUBJECT: GROUND PROXIMITY WARNING SYSTEMS (GPWS)

1. **PURPOSE.** This circular outlines acceptable ground proximity warning system performance. System performance, other than that described, may also be acceptable when adequately substantiated.
 2. **REFERENCES.** Federal Aviation Regulations 121.360 (effective January 23, 1975), 25.1301, 25.1309, 25.1431, and 25.1581.
 3. **BACKGROUND.** Recent air carrier accidents, involving large turbine-powered airplanes and caused by inadvertent contact with the ground, prompted the Federal Aviation Administration to initiate rulemaking action which now requires an approved ground proximity warning system on large turbine-powered airplanes after December 1, 1975. The criteria contained in this circular are directed toward the unique features of GPWS installations and a means of demonstrating compliance with the applicable rules.
 4. **SYSTEM PERFORMANCE.** Ground proximity warning systems are required to provide warning of dangerous flight paths, due to excessive descent rate, excessive terrain closure rate, significant descent after takeoff and insufficient clearance when not in appropriate configuration. The following curves—Mode 1 (descent rate), Mode 2 (terrain closure rate), Mode 3 (descent after takeoff), and Mode 4 (terrain clearance closure rate)—outline the nominal system performance expected. It is recognized that minor variations may be allowed due to particular airplane/system characteristics. A Mode 5 (glide slope deviation) has been installed by some operators. This is not a requirement in the present rule, however, the FAA is studying the necessity for glide path deviation indication, and, when appropriate, may propose a rule change.
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Initiated by: AFS-130





*MODE 4 LOCKS OUT MODE 3. TRANSITION FROM MODE 4 TO MODE 3 IS DELAYED IN THE ORDER OF 2-3 SECONDS.

5. WARNING INDICATION. Distinctive aural and visual warning of dangerous flight path must be provided.
 - a. Aural Warning. The aural warning consists of the sound "Whoop-Whoop," followed by a command, either "Pull-up" or "Terrain" (or other acceptable annunciation) repeated continuously until the hazardous condition no longer exists. "Whoop-Whoop" is described as a tone sweep from 400Hz to 800Hz at a period of 0.3 seconds and with increasing amplitude of 9db. The complete cycle of two tone sweeps plus voice command should take approximately 1.4 seconds, with the cycle repeated immediately. The gain may be automatically reduced after three complete warning cycles to a lower, but discernable, level. Acceptable gain level is to be established and fixed for each aircraft/system during initial approval.
 - b. Visual Warning. The visual warning is to be red and include, in distinctive letters, the word "Pull-up" or "Terrain" (or other acceptable word), whichever is compatible with Paragraph 5.a. The warning size and intensity is to be distinctive under all normal lighting conditions, and commensurate with other cockpit warnings.
 - c. Means to deactivate the warning may be provided to the flight crew for use in planned abnormal or emergency conditions, in the form of a properly-guarded and safetied switch.
6. FALSE WARNINGS. To enhance pilot confidence, the system should be designed to avoid false warnings. In this regard, approval of the system is to include testing for at least the following:
 - a. normal operating and ATC procedures and practices.
 - b. overflight of other aircraft enroute or in holding patterns.
 - c. loss or reapplication of electrical power during switching, etc.
 - d. operation of sensor system self-test.
7. SELF-TEST AND FAILURE MONITORING. Failure monitoring and/or self-test should be highly reliable and provide indication of system conditions. If adequate monitoring or self-test is not provided, acceptable procedures for inspection and test should be established.

8. AIRPLANE FLIGHT MANUAL. The Airplane Flight Manual is to include appropriate procedures for use, proper crew action, and deactivation for planned abnormal or emergency conditions. The flight manual should also outline all input sources which must be operating. This Airplane Flight Manual revision/supplement must be approved by the cognizant FAA office.



Director,
Flight Standards Service