



U.S. Department
of Transportation

**Federal Aviation
Administration**

Memorandum

Subject: **ACTION:** Equivalent Level of Safety
Beech Model 1900D; Landing Gear
Warning Devices; Finding No.
ACE-94-1

Date:

DEC 7 1993

From: Manager, Airplane Certification
Office, ACE-115W

Reply to
Attn. of: LFoster

To: Manager, Small Airplane Directorate,
Aircraft Certification Service,
ACE-100

Background:

The Beech Model 1900D airplane has a landing gear warning system to show compliance with § 23.729(f)(1). The system consists of a warning horn and warning light(s) that activate when one or both power levers are retarded below 84% - 86% N_1 (gas generator speed) and the landing gear is not extended. The 84% - 86% N_1 is conservative compared to § 23.729(f)(1), which requires a warning when the throttle is in the idle position without the gear extended. Section 23.729(f)(1) allows the warning to be muted; however, the red warning light(s) is not extinguished in the Beech warning system.

The landing gear warning system is conservative compared to the requirements of § 23.729(f)(1). However, it has two undesirable results: (1) nuisance landing gear warnings occur during descent and traffic pattern maneuvers prior to final approach for landing, and (2) bright red warning light(s), which are not extinguished, annoy during night operations.

Beech has requested an equivalent of safety finding to the requirements of § 23.729(f)(1). The finding would allow a "q" switch in the landing gear warning system to prevent a warning if the airspeed of the airplane is approximately 144 knots or higher.

The "q" switch setting (144 kts) is approximately 25 knots above the highest normal landing approach speed (118 KIAS) and below the minimum recommended "holding" and VFR pattern speed of 160 KIAS. The "q" switch will greatly reduce the nuisance warnings, but it will allow a warning above normal landing approach speed, approximately 20 kts, in sufficient time to extend the gear.

The "q" switch will not have any effect upon the warning system, which was previously approved for substantiating compliance with § 23.729(f)(2).

The following table summarizes the aural warning logic for any flight condition where the landing gear is not fully extended and locked:

	Above 144 Knots	Below 144 knots		
	Regardless of Power Lever	Both Power Levers Above 84% N ₁	Either or Both Power Levers Below 84% N ₁	One Engine Inop*
Wing Flaps Retracted or in Approach Position	No Aural Warning	No Aural Warning	Aural Warning Can be Silenced**	Aural Warning Can be Silenced**
Wing Flaps Extended Beyond the Approach Position	Aural Warning Cannot be Silenced	Aural Warning Cannot be Silenced	Aural Warning Cannot be Silenced	Aural Warning Cannot be Silenced

* One-engine-inoperative assumes that the inoperative engine is feathered, and that the power lever on the inoperative engine is at the idle position. This is the normal configuration for an enroute or approach flight phase where one engine has failed.

** Warning lights cannot be cancelled.

Applicable Regulations:

The applicable Federal Aviation Regulations (FAR) paragraph (as amended by Amendment 23-26) states:

"23.729(f) Landing gear warning. For landplanes, the following aural or equally effective landing gear warning devices must be provided:

(1) A device that functions continuously when one or more throttles are closed beyond the power settings normally used for landing approach if the landing gear is not fully extended and locked. A throttle stop may not be used in place of an aural device. If there is a manual shutoff for the warning device prescribed in this paragraph, the warning system must be designed so that when the warning has been suspended after one or more throttles are closed, subsequent retardation of any throttle to, or beyond, the position for normal approach will activate the warning device.

The following table summarizes the proposed landing gear warning logic for any flight condition where the landing gear is not fully extended and locked.

	Above 144 Knots	Below 144 Knots		
	Regardless of Power Lever Position	Both Power Levers Above 84% N ₁	Either or Both Power Levers Below 84% N ₁	One Eng Inop*
Wing Flaps Retracted or in Approach Position	No Aural Warning	No Aural Warning	Aural Warning Can Be Silenced**	Aural Warning Can Be Silenced**
Wing Flaps extended Beyond the Approach Position	Aural Warning Cannot be Silenced	Aural Warning Cannot be Silenced	Aural Warning Cannot Be Silenced	Aural Warning Cannot Be Silenced

* One-engine-inoperative assumes that the inoperative engine is feathered, and that the power lever on the inoperative engine is at the idle position. This is the normal configuration for an enroute or approach flight phase where one engine has failed.

** Warning lights cannot be cancelled.

EXTENT OF NON-COMPLIANCE WITH THE REQUIREMENTS:

The intent of FAR 23.729(f)(1) is to prevent landings with the landing gear retracted by requiring continuous warning to the pilot during normal landing operations if the landing gear is not fully extended and locked. The regulation requires a device which functions continuously when one or more throttles are closed. The regulation does not permit automatic silencing into the logic, therefore, the inclusion of a "q" switch into the logic does not comply literally with the regulation.

COMPENSATORY FACTORS

The addition of a "q" switch to the Model 1900D landing gear warning system will enhance the function of the system by reducing nuisance warnings during flight operations not intended to have gear warning notifications. This will not only reduce pilot work load, but enhance the effect of the system by providing warnings more closely associated with the landing phase of flight. By completely inhibiting the gear warning system above 144 KIAS with the flaps in the UP or APPROACH position, the red gear handle warning lights are less likely to illuminate at night providing a better cockpit environment.

FINDING:

FAR 23.729(f)(1), when literally interpreted, is not complied with, but is compensated for by the above factors that provide an equivalent level of safety.

STAFF STUDY

SUBJECT: Equivalent Level of Safety Proposal for the Installation of a Landing Gear Warning "q" Switch on the Beech Model 1900D.

The current landing gear warning system for the Beech Model 1900D Airliner consists of the following components:

1. An aural warning horn.
2. Dual red warning lights in the landing gear control handle.
3. Power lever switches set at 84% - 86% N_1 .
4. A flap position switch.

The Model 1900D has three flap positions; UP, APPROACH, and DOWN. A normal landing is conducted with the flaps DOWN. Landings conducted with the flaps set at APPROACH or UP are considered abnormal.

To comply with 23.729(f)(1) the gear warning horn and warning lights activate anytime one or both power levers are retarded below approximately 84% - 86% N_1 (gas generator speed) and the gear are not down. If the flaps are set at the UP or the APPROACH position, the warning horn may be cancelled using a push-to-cancel button on the instrument panel. If the flaps are beyond the APPROACH position, the warning horn cannot be cancelled in accordance with the requirements of 23.729(f)(2). The warning lights in the landing gear control handle can never be cancelled at any flap position. The power lever position switches are set at a significantly higher power than the idle position required by 23.729(f)(1) in order to give the pilot some degree of protection from landing with the gear up when the flaps are set at the UP or APPROACH position.

As a result of providing this extra measure of safety, two undesirable characteristics were created. First, nuisance activations of the gear warning system occur during descent and traffic pattern maneuvers prior to the final approach segment. Although the warning horn can be cancelled, the warning lights can not, producing the second undesirable characteristic: bright red lights that are annoying during night operations.

To alleviate these undesirable characteristics Beech proposes to add a "q" switch which will inhibit the landing gear warning system when the airspeed is approximately 144 knots or higher and the flaps are in the UP or APPROACH position, i.e., the configuration regulated by 23.729(f)(1). The "q" switch will not alter the gear warning system when the flaps are beyond the APPROACH position, i.e., the configuration regulated by 23.729(f)(2). The "q" switch setting of approximately 144 knots was selected to be at least 20 knots above the highest normal landing approach speed (118 KIAS) and sufficiently below the minimum recommended "holding" and VFR pattern speed of 160 KIAS. The 20 knot margin ensures a sufficient duration of gear warning during a deceleration to an attempted landing with the gear up and the flaps in the UP or APPROACH position.

Applicant Position:

Beech has submitted a Staff Study in support of their request for an Equivalent Level of Safety to the requirements of § 23.729(f)(1) in accordance with § 21.21. The Staff Study is attached.

FAA Position:

The intent of § 23.729(f)(1) is to ensure the presence of a warning if the landing gear is not fully extended and locked whenever the throttles have been retarded to a position where normal landings are possible. The addition of a "q" switch that automatically disables the warning at airspeeds above those where landing is reasonably possible is acceptable. The "q" switch will also greatly reduce the number of nuisance warnings and comply with the intent of § 23.729(f)(1).

Recommendation:

We concur that the addition of a "q" switch is acceptable and will not decrease the safety of the warning system previously approved; therefore, it is considered as providing an equivalent level of safety to the requirements of § 23.729(f)(1).

Concurred by:

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For Everett Pittman, Manager Date
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John Colomy 12/2/93
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