

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
KANSAS CITY, MISSOURI 64106

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In the matter of the petition of *
*
BEECH AIRCRAFT CORPORATION *
*
for an exemption from § 23.207(c) *
of the Federal Aviation Regulations *

Regulatory Docket No. 072CE

GRANT OF EXEMPTION

By letter dated June 14, 1989, Mr. W.H. Schultz, Division Manager Technical Service and FAA Liaison, Beech Aircraft Corporation, P.O. Box 85, Wichita, Kansas 67201-0085 petitioned for an exemption from § 23.207(c) of the Federal Aviation Regulations (FAR) to permit type certification of the Beech Model 2000 airplane with a stall warning beginning at airspeeds greater than 10 knots or 15 percent above the stalling speed.

Section of the FAR affected:

Section 23.207(c) requires that the stall warning must begin at a speed exceeding the stalling speed by a margin of not less than 5 knots, but not more than the greater of 10 knots or 15 percent of the stalling speed, and must continue until the stall occurs.

The Petitioner's supportive information is as follows:

At the beginning of the Model 2000 program, FAA Order 8110.7, "FAA Flight Test Guide for Small Airplanes", paragraph 40a(4), interpreted § 23.207(c) as follows:

"The stall warning margin between 5 and the greater of 10 knots or 15% of the stall speed is applicable when the speed is reduced at a rate of 1 knot per second with the power off. Stall warning margin in other configurations may not be less than 5 knots above the stall or above a speed at which warning would become objectionable in the normal operating range."

On April 3, 1986, the FAA, Wichita Aircraft Certification Office, sent Beech Aircraft a letter superseding paragraph 40a(4) of FAA Order 8110.7. The superseding text reads:

"The stall warning margin between 5 and the greater of 10 knots or 15% of the stalling speed is applicable when the speed is reduced at the rate of 1 knot per second. Stall warning margin at greater deceleration rates should not be less than 5 knots above the stall or above a speed at which warning would become objectionable in the normal operating range."

This new paragraph was later incorporated, unchanged, into Advisory Circular 23-8. It is this AC that currently comprises the guidelines and methods for complying with § 23.207(c). Therefore, it is these guidelines that are being used in the Model 2000 certification program.

Beech states that the Model 2000 utilizes a very sophisticated stall warning system which uses the inputs of elevator position, angle of attack, "G" switch, flap position and aircraft power setting to meet the requirements of § 23.207(c). A canard configuration, such as the Model 2000, requires a design which prevents the main wing from stalling. As a result, this aircraft does not stall in an aerodynamic sense, but reaches a minimum speed in which the pitch control has reached the aft stop without the attendant uncontrolled nose-down pitching motion and loss of altitude associated with the classic "aerodynamic stall". Although the Model 2000 has equipment with the latest stall warning technology installed, it is very difficult to bring stall warning margins within the limits of literal compliance with § 23.207(c). Production repeatability of the stall warning system designed to comply with the AC 23-8 interpretation, if possible, would be very costly without any associated increase in safety.

Beech believes that it is evident that the current literal interpretation of § 23.207(c) did not envision an aircraft of the configuration of the Model 2000. They also believe that aircraft with large power-to-weight ratios were not envisioned. The Model 2000's large power-to-weight ratio results in a large cockpit deck angle before a stall warning occurs when meeting the stall margins of § 23.207(c) in a "power-on" condition. The airplane characteristic of the stall being elevator limited, with elevator on the aft stop and power on, results in a climb rate of over 3,000 ft./min with a large deck angle. Beech does not believe operations should be conducted at the large cockpit deck angles exhibited by the Model 2000. They believe the stall warning margins, originally set forth in § 3.120 of the Civil Air Regulations, envisioned low performance small airplanes with low power-to-weight ratios. If a stall warning were allowed to occur at a speed greater than 10 knots, or 15% above the elevator limit defined stall, the pilot would be discouraged from operating the airplane with such large deck angles.

To the best of Beech's knowledge, no one, other than Beech, has been able to comply with the literal interpretation of § 23.207(c). However, there are many aircraft that have been certificated to § 23.207(c) as interpreted by the original FAA Order 8110.7 without any historical evidence of a compromise to safety. Beech believes that the increased cost of meeting the exact wording of § 23.207(c) does not increase safety and is not in the public interest.

Beech proposes, in the public interest and to provide a level of safety equal to that provided by the rule, that the requested exemption to § 23.207(c) include the following requirements:

1. The stall warning must begin at a speed exceeding the stalling speed by five (5) knots. For stalls where the pitch control reaches the stop without uncontrollable downward pitching motion (i.e., minimum steady speed), a lesser margin is acceptable if the stall warning has enough clarity, duration, distinctiveness or similar properties.
2. The stall warning margin must not be above a speed at which warning would become objectionable in the normal operating range (i.e., adequate maneuvering capability exists prior to stall warning to conduct normal maneuvers).

The above requirements are similar to those in Advisory Circular 25-7 in logic and utilize wording from the original FAA Order 8110.7 which has been satisfactorily applied to most in-service type certificated aircraft. These requirements would maintain the level of safety originally envisioned by § 23.207(c) without an increase in cost to the public.

Comments on published petition summary:

A summary of this petition was published in the FEDERAL REGISTER for public comment on July 31, 1989 (54 FR 31608). The comment period closed August 21, 1989. No comments were received.

The Federal Aviation Administration's (FAA) analysis is as follows:

To obtain the exemption, the Petitioner must show, as required by § 11.25(b)(5), that: (1) granting the request is in the public interest, and (2) the exemption would not adversely affect safety, or that a level of safety will be provided which is equal to that provided by the rule from which the exemption is sought.

The FAA has carefully reviewed the information contained in the Petitioner's request for exemption.

The Petitioner is correct concerning a policy change from FAA Order 8110.7 to Advisory Circular 23-8A on acceptable methods of compliance

with the stall warning margin requirement. The policy in FAA Order 8110.7 effectively provided relief from a regulation and since policy cannot relieve a regulation, a change to the policy was in order. The policy change was transmitted to the Petitioner by a Wichita Aircraft Certification Office letter of April 3, 1986.

Beech cited the complexity and sophistication of the existing stall warning system and expressed concern that additional complexity necessary to comply with the AC 23-8 interpretation could result in production repeatability that would be difficult to attain. The FAA agrees that any difficulties in production repeatability would be magnified during in-service maintenance actions and could result in a degraded level of safety and increased expense to the operating public.

The FAA is aware of the problems being encountered during type certification programs in showing compliance with § 23.207(c) when airplanes with high power-to-weight ratios are being evaluated. This issue was discussed during the Part 23 Airworthiness Review Conference which was held in St. Louis, Missouri, during the week of October 22-26, 1984. It was concluded at that time that § 23.207(c) needs to be revised and the FAA is considering several proposals addressing this issue. The specific upper limits for stall warning margins in the current rule were established in lieu of opening up the upper limit to subjective determinations without specific criteria on which to base those determinations.

Beech cited large cockpit deck angles that can occur before stall warning with the large thrust-to-weight ratios of current airplane designs as a safety consideration in stall warning. The FAA is concerned about these large cockpit deck angles and the characteristics of the affected airplanes in recovering from stalls that occur with such large deck angles. The FAA agrees that evaluations should not be conducted at such large deck angles and that the stall warning margin requirements were not intended for operations involving such large deck angles.

Beech stated that they believed that, other than Beech, no one had been able to comply with the literal interpretation of § 23.207(c). The Piper Model 42-1000, has shown compliance with the revised FAA Order 8110.7 guidance and the Piper Model 42-1000 is a high power-to-weight ratio airplane. However, the FAA agrees that the service history of airplanes certificated using the original FAA Order 8110.7 wording has been satisfactory.

Although not addressed specifically by Beech in their supportive information, some applicants have contended that stall warning should not be required when the airplane pitch control reaches the full-up stop and the airplane has not exhibited the classic pitch-down motion of aerodynamic wing stall but, instead, enters a minimum airspeed condition

referred to as V_{MIN} . Some applicants have contended that this condition is not intended by the applicable requirements to be a stall and; thus, a stall warning is not required. The FAA has reviewed the definition of a stall in § 23.201 and continues to consider this so-called V_{MIN} condition as a stall condition for the purposes of the regulatory requirements and stall warning requirements continue to be applicable. Section 23.207 does not exempt any condition defined by § 23.201 as a stall from the applicable requirements for stall warning. However, the FAA agrees that the degree of hazard is far less in such a stall (V_{MIN}) versus a stall where the wing exhibits aerodynamic stall.

The FAA has evaluated each of the specific conditions proposed by the Petitioner with respect to assuring the intended level of safety equivalent to the requirement from which the exemption is sought. Section 23.207(c) includes speed margins such that any other margin does not provide an equivalent level of safety. However, these specific speed margins were selected to achieve the intended level of safety for the airplane envisioned when the rule and its amendments were promulgated. The FAA has concluded that, when compliance is shown with specific conditions set forth as limitations herein, the level of safety intended by § 23.207(c) will be achieved.

In consideration of the foregoing, I find that a grant of exemption is in the public interest and will not adversely affect safety. Therefore, pursuant to the authority contained in Sections 313(a) and 601(c) of the Federal Aviation Act of 1958, as amended, delegated to me by the Administrator (14 CFR 11.53), Beech Aircraft Corporation is granted an exemption from § 23.207(c) of the Federal Aviation Regulations to the extent necessary to allow type certification of the Beech Model 2000 airplane without an exact showing of compliance with the requirements of § 23.207(c). For the Model 2000, this exemption is subject to the following conditions and limitations:

1. The stall warning must begin at a speed exceeding the stalling speed by five (5) knots. For stalls where the pitch control reaches the stop without uncontrollable downward pitching motion (i.e. minimum steady speed), a lesser margin is acceptable if the stall warning has enough clarity, duration, distinctiveness or similar properties.
2. The stall warning margin must not be above a speed at which warning would become objectionable in the normal operating range (i.e., adequate maneuvering capability exists prior to stall warning to conduct normal maneuvers).

Issued in Kansas City, Missouri on September 8, 1989.


Barry D. Clements, Manager
Small Airplane Directorate
Aircraft Certification Service