

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 *
*
THE KING'S ENGINEERING FELLOWSHIP *
* Regulatory Docket No. 105CE
*
for an exemption from § 23.207(c) *
* of the Federal Aviation Regulations *

GRANT OF EXEMPTION

By letter dated January 31, 1992, The King's Engineering Fellowship (TKEF), Municipal Airport, Orange City, Iowa 51041, petitioned for an exemption from compliance with § 23.207(c) of the Federal Aviation Regulations (FAR), as amended through Amendment 23-36, to permit the type certification of the Model 44 airplane with a stall warning beginning at airspeeds greater than 10 knots or 15 percent above the stalling speed when power is on.

Section of the FAR affected:

Section 23.207(c) requires 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:

The King's Engineering Fellowship (TKEF) contends that, in the past, Order 8110.7, FAA Flight Test Guide for Small Airplanes, applied to specified stall warning margin only when the airspeed is reduced at a rate of 1 knot per second with the power off. It also required that the stall warning not occur above a speed at which the warning would become objectionable in normal operation. The petitioner believes this is still the most logical interpretation of the rule, that it enhances rather than diminishes safety, and is in the public's best interest.

TKEF goes on to state that recent FAA guidelines for interpreting § 23.207(c) do not allow the power-on stall warning to precede the stall by more than 10 knots or 15 percent above the stalling speed. The petitioner believes this interpretation substantially diminishes safety in high-power stalls, and is not in the public's best interest.

Furthermore, the stall warning system senses and indicates when the main portion of the wing reaches a certain angle of attack. It is set to warn when the desired angle of attack margin, before the stalling angle of attack, is reached. Applying power over the inboard portions of the wings pumps sufficient airflow over those areas to reduce the wings' overall angle of attack. This lowers the forward airspeed at which the warning angle of attack is reached, and lowers the onset of stall warning. However, high applications of power also enable the wing to sustain flight to substantially lower forward airspeeds before the stalling angle of attack is finally reached. In this high-power condition, the stall speed can be worked down more than 10 knots below the onset of the stall warning with unusually high deck angles. This is not a normal operating condition. It is a dangerous situation because the airspeed can be well below the power-off stall speed, setting up the airplane for a sudden severe stall and loss of control if power is lost.

TKEF contends that, in the case of the Model 44 airplane, the power-on stall occurs as much as 10 knots below the power-off stall speed and as much as 18 knots below V_{MC} . It is in the interest of the public to permit the power-on stall warning to exceed 10 knots. In this condition, more stall warning margin is highly desirable from a safety standpoint.

Additionally, current stall warning systems sense angle of attack, as noted above. A system that could meet the 10 knot range requirement with both power off and power on would require a sophisticated and possibly unreliable method of varying the angle of attack at which the warning is given, with warning angle margins being reduced as power and potential for loss of control increase. Such a system is not available but would be close to danger if it were.

The TKEF proposes that the Model 44 be certificated with a stall warning that occurs at a speed exceeding the stall 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 in the wings-level, power-off condition at the most forward center of gravity (c.g.) at the maximum gross weight, at all flap positions.

The petitioner also proposes to conduct tests to ensure that there are no stall warnings occurring that would be objectionable in normal operation, including the following:

1. With power on, the stall warning must not activate at speeds higher than with power off.
2. The stall warning must not activate during normal takeoff climb at $1.1 V_{MC}$.
3. The stall warning must not activate during normal and single-engine landing approaches at 1.2 times the power-off stall speed before commencing the flare to land.
4. The stall warning must not activate during a balked-landing climb at the best rate-of-climb speed in that configuration.

Comments on published petition summary:

A summary of this petition for exemption was in the FEDERAL REGISTER on April 21, 1992 (57 FR 14616) and no comments were received in response to the summary.

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.

TKEF cited that a stall warning system that would be necessary for compliance with the applicable requirements would tend to be complex and possibly unreliable. The FAA agrees with the need for reliable stall warning systems. The FAA doesn't agree that a complex system is, of necessity, unreliable. The FAA considers the basic issue is to achieve the intended level of safety. TKEF implies the sophisticated system would need stringent preflight procedures and that small airplane pilots do not consistently perform vigorous preflights. The FAA agrees that many pilots' preflight inspections are "less than vigorous". As a result, the FAA typically does not allow credit in system reliability for small airplane preflight checks.

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.

TKEF 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.

TKEF also cited as a safety concern that these multiengine airplanes with high thrust-to-weight ratios, when complying with the applicable stall warning margin requirements, may not have a stall warning in the power-on condition until the airspeed has reduced to a speed well below single-engine failure minimum control speed V_{MC} . The FAA agrees that the power-on stall warning should occur prior to the airplane entering a speed range where engine failure would probably be catastrophic, due to loss of control of the airplane. However, such a warning system would need to be activated at some margin relative to V_{MC} . Due to variations in V_{MC} with weight and C.G location, the FAA does not consider requiring the stall warning to occur at or above V_{MC} to be workable. If a warning keyed to V_{MC} becomes necessary, such a warning requirement appears to be an issue independent of the stall warning envisioned in applicable requirements.

The FAA has evaluated each of the specific conditions proposed by the petitioner with respect to ensuring a 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), TKEF is granted an exemption from § 23.207(c) of the FAR to the extent necessary to allow type certification of the Model 44 airplane without an exact showing of compliance with the requirements of § 23.207(c). For the Model 44, this exemption is subject to the following conditions and limitations:

1. The stall warning must activate at a speed 5 to 10 knots or 15 percent of stalling speed, whichever is greater, above the wings-level, power-off stalling obtained at forward center of gravity (c.g.) and maximum takeoff and landing weights.

2. The wings-level stall warning must be examined at forward c.g. regardless of weight, forward c.g. at maximum takeoff weight, and aft c.g. at maximum takeoff weight to ensure that the stall warning will not activate at a speed greater than the maximum speed specified in item 1 above. This evaluation must be performed with power-on and power-off at all approved flap settings.

3. Evaluations must be conducted at each takeoff, landing and configuration for which approval is requested to ensure that no stall warnings occur, except as set forth in the following specific conditions. The following specific conditions must be evaluated:

a. Two-engine takeoff (all approved takeoff flap settings) at scheduled takeoff speed minus 5 knots but not less than V_{MC} . The climb must be at the minimum scheduled speed to 50 feet above the takeoff surface. The stall warning must not sound during the rotation phase except for a short (approximately 1 second) duration prior to achieving liftoff from the takeoff surface.

b. Two-engine approach and landing, in accordance with Airplane Flight Manual (AFM) schedule minus 5 knots, per § 23.153. There must be no stall warning before commencing the flare to land.

c. One-engine-inoperative approach and landing at the AFM schedule speed minus 5 knots. There must be no stall warning before commencing the flare to land.

d. Two-engine approach and balked landing climb in accordance with AFM schedule. There must be no stall warning.

4. In all configurations, except those resulting in V_{MIN} (pitch control against upper stop without wing aerodynamic stall), the stall warning must sound 5 knots or more prior to the actual stall. When the airplane configuration is such that the pitch control reaches the full-up stop without the airplane exhibiting a pitch-down motion, the stall warning must sound before the pitch control reaches the stop. This evaluation must

be performed with the wings level and with 30-degrees banked turns to both the right and left.

5. All stalls, in demonstrating compliance with above requirements, must be approached at an entry rate of 1 knot per second.

Issued in Kansas City, Missouri on June 4, 1992



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