Federal Aviation Agency

ADVISORY CIRCULAR CHANGE

AC NO:	25.253-1 CH 1
	AIRCRAFT
EFFECTIVE:	1/10/66

SUBJECT: CH 1 TO CIRCULAR AC 25.253-1, SUBJ: HIGH SPEED CHARACTERISTICS

1. PURPOSE. This circular transmits a revised page.

2. CHANGE. This change corrects a typographical error in paragraph 3.g.(5). The reference to FAR 121.1505(b)(1) should be FAR 25.1505(b)(1).

PAGE CONTROL CHART

Remove Page	Dated	Insert Page	Dated
3 & 4	11/24/65	3	1/10/66
		4	11/24/65

for George S. Moore
Director
Flight Standards Service

Federal Aviation Agency

ADVISORY CIRCULAR

AC NO: 25.253-1
AIRCRAFT
EFFECTIVE: 11/24/65

SUBJECT: HIGH-SPEED CHARACTERISTICS

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1. PURPOSE. This circular sets forth an acceptable means by which compliance may be shown with FAR 25.253 during certification flight tests. Due consideration will be given to any other means of determining compliance the applicant elects to present.

2. REGULATIONS AFFECTED. These acceptable means of compliance refer to certain provisions of the recodified Federal Aviation Regulations (FARs), Part 25, effective February 1, 1965. They may also be used in showing compliance with the corresponding provisions of the former Civil Air Regulations (CARs) in the case of aircraft to which those regulations are applicable. For convenience, the CAR reference is shown in parentheses, following the FAR reference.

   FAR 25.175 Stability During Cruising (4b.155)
   FAR 25.251 Vibration and Buffeting (4b.190)
   FAR 25.253 High Speed Characteristics (4b.191)
   FAR 25.335(b) Design Dive Speed V_D (4b.210(b)(5))
   FAR 25.1303(a)(11) and (b) Flight and Navigational Instruments (4b.603(k))
   FAR 25.1505 Maximum Operating Limit Speed V_{MO}/M_{MO} (4b.711)

3. DISCUSSION.

   a. The maximum flight demonstrated speed, V_{DF}/M_{DF}, is used when establishing V_{MO}/M_{MO} and the associated speed margins under the provisions of FAR 25.1505. Both V_{MO} and M_{MO} are then evaluated during flight tests for showing compliance with FAR 25.253.

   b. The upset criteria of FAR 25.1505 is predicated on an upset in pitch while the operational upsets expected to occur in service envisaged under FAR 25.253 cover pitch, roll, yaw and combined upsets.

c. In general, the same maneuvers should be accomplished in both the "q" (dynamic pressure) and "M" (Mach) critical ranges. All maneuvers in either range should be accomplished at thrust and trim points appropriate for the specific range. It must be realized that some maneuvers in the "M" range may be more critical for some aircraft due to drag rise characteristics.

d. The airplane's handling characteristics in the high speed range should be investigated in terms of anticipated action on the part of the flight crew during normal and emergency conditions. Consideration should be given to their duties which not only involve piloting the airplane, but also the operational and navigational duties having to do with traffic control and computation of records pertaining to the progress of the flight.

e. The following factors are involved in the flight test investigation of high-speed characteristics:

(1) Effectiveness of longitudinal control at V_{MO}/M_{MO} and up to V_{DF}/M_{DF}.

(2) Effect of any reasonably probable mistrim on upset and recovery.

(3) Dynamic and static stability.

(4) The speed increase that results from likely passenger movement when trimmed at any cruise speed to V_{MO}/M_{MO}.

(5) Trim changes resulting from compressibility effects.

(6) Characteristics exhibited during recovery from inadvertent speed increase.

(7) Upsets due to vertical and horizontal gusts (turbulence).

(8) Speed increases due to horizontal gusts and temperature inversions.

(9) Effective and unmistakable aural speed warning at V_{MO} plus 6 knots, or M_{MO} plus 0.01M.

(10) Speed control during application of devices.

(11) Characteristics and controllability during and after failure or malfunction of any stability augmentation system.

f. Operational experience has revealed that the most important and effective deterrent to inadvertent overspeeding is an aural warning device, which is distinctively different from aural warnings used for other purposes. Aerodynamic buffeting is influenced by, and is similar to, the effects of turbulence at high speed and is normally not considered to be suitable as an overspeed warning.

g. The factors outlined in FAR 25.1505(b)(2) have been considered in establishing minimum speed margins during past type certification programs for the "M" and "q" ranges as follows:

(1) Increment allowance for horizontal gusts (0.02M).

(2) Increment allowance for penetration of jet stream or cold front (0.015M).

(3) Increment allowance for production differences of airspeed systems (0.005M), unless larger differences are found to exist.

(4) Increment allowance for instrument tolerances of overspeed warning errors (0.01M), unless larger tolerances or errors are found to exist.

(5) Increment allowance ΔM due to speed overshoot from M_{MO} established by upset during flight tests in accordance with FAR 25.253 should be added to the values for production and instrument tolerances, and the minimum acceptable combined value should not be less than .05M between M_{MO} and M_D/M_{DF}. The value of M_{MO} should then be not greater than the lowest value obtained from each of the following equations and from FAR 25.1505(b)(1): *

$$M_{MO} \leq M_D/M_{DF} - \Delta M - .005M - .01M$$

or

$$M_{MO} \leq M_D/M_{DF} - .05M$$

(6) At altitudes where V_{MO} is limiting, the allowances of item (1) and (2) are applicable when the Mach number increment is converted to the units used in the presentation of V_{MO}.

(7) At altitudes where V_{MO} is limited, the increment allowance for production differences of airspeed systems and instrument tolerances of overspeed warning errors are 3 and 6 knots respectively, unless larger tolerances or errors are found to exist.

(8) Increment allowance ΔV due to speed overshoot from V_{MO} established by upset during flight tests in accordance with FAR 25.253 should be added to the values for production and instrument tolerances, and the speed margin in the "q" range should be as follows, unless a lower value of V_{MO} results from FAR 25.1505(b)(1):

$$V_{MO} \leq V_D/V_{DF} - \Delta V - 3 \text{ knots} - 6 \text{ knots}$$

4. ACCEPTABLE MEANS OF COMPLIANCE. Using the speeds V_{MO}/M_{MO} - V_{DF}/M_{DF} determined in accordance with FAR 25.1505 and 25.251 respectively and the associated speed margins, the airplane should be shown to comply with the high-speed characteristics of FAR 25.253. Unless otherwise stated, the airplane characteristics should be investigated at any likely speed up to and including V_{MO}/M_{MO}, and the recovery procedures used should be those selected by the applicant, except that the normal acceleration during recovery should be 1.5g (total).

a. Center of Gravity Shift. The aircraft should be upset by the center of gravity shift corresponding to the forward movement of representative number of passengers depending upon the aircraft interior configuration. The aircraft should be permitted to accelerate until three seconds after the overspeed warning occurs.

b. Inadvertent Control Movement. Simulate an evasive control application when trimmed at V_{MO}/M_{MO}, by applying sufficient forward force to the elevator control to produce 0.5g (total) for a period of five seconds, after which recovery should be affected at not more than 1.5g (total).

c. Gust Upset

(1) With the airplane trimmed at any likely cruise speed up to V_{MO}/M_{MO} in wings level flight, perform a lateral upset to the same angle as that of the autopilot approval, or to a maximum bank angle appropriate to the aircraft, whichever is critical. The maximum bank angle appropriate for the aircraft should not be less than 45° and need not be greater than 60°, and should depend upon airplane stability and inertia characteristics. The lower and upper limits should be used for airplanes with low and high maneuverability respectively. Following this, the controls should be abandoned for a minimum of ten seconds or three seconds after overspeed warning occurs, whichever occurs first.

(2) Perform a longitudinal upset from normal cruise by displacing the attitude of the airplane 6-12 degrees nose-down from the trimmed attitude. The value of displacement should be appropriate to the airplane type, and should depend upon airplane stability and inertia characteristics. The lower and upper limits should be used for airplanes with low and high maneuverability respectively. The airplane should be permitted to accelerate until three seconds after the overspeed warning occurs.

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(3) Perform a 2-axis upset, consisting of a longitudinal upset combined with a lateral upset. Perform a longitudinal upset by displacing the attitude of the airplane 6-12 degrees nose-down from the trimmed attitude, and simultaneously perform lateral upset by rolling the airplane 15-25 degrees wing down. The values of displacement should be appropriate to the airplane type and should depend upon airplane stability and inertia characteristics. The lower and upper limits should be used for airplanes with low and high maneuverability respectively. The established attitude should be maintained until the overspeed warning occurs. The airplane should be permitted to accelerate until three seconds after the overspeed warning occurs.

d. Leveling Off From Climb. Perform transition from climb to level flight without reducing power below the maximum value permitted for climb until the overspeed warning has occurred. Recovery should be accomplished by applying not more than 1.5g (total).

e. Descent From Mach to Airspeed Limit Altitude. A descent should be initiated at M_{MO} and performed at the airspeed schedule defined by M_{MO}, until the overspeed warning occurs. The airplane should be permitted to descend into the airspeed limit altitude where recovery should be accomplished after overspeed warning occurs by applying not more than 1.5g (total). The maneuver should be completed without exceeding V_D/V_{DF} whichever is the lesser.

George S. Moore
Director
Flight Standards Service

Superseded by -1A

Federal Aviation Agency

ADVISORY CIRCULAR

AC NO: 25.253-1 INCLUDES CHG 1
AIRCRAFT
EFFECTIVE: 11/24/65

SUBJECT: HIGH-SPEED CHARACTERISTICS

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c. In general, the same maneuvers should be accomplished in both the "q" (dynamic pressure) and "M" (Mach) critical ranges. All maneuvers in either range should be accomplished at thrust and trim points appropriate for the specific range. It must be realized that some maneuvers in the "M" range may be more critical for some aircraft due to drag rise characteristics.

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