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AEROSPACE STANDARD

AS 483

SKID CONTROL EQUIPMENT

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Revised

1. PURPOSE:

To specify minimum requirements for aircraft skid control equipment for civil aircraft applications.

2. SCOPE:

This specification covers minimum requirements for skid control equipment for use on all types and models of civil aircraft. It shall be the responsibility of the applicant (See Paragraph 5.1) to determine the compatibility of these requirements with the applicable aircraft and to specify requirements in excess of these minimums as necessary.

3. GENERAL REQUIREMENTS:

3.1 Materials and Workmanship:

3.1.1 Materials: Materials shall be of high quality and suitable for the purpose intended. The use of dissimilar metals in contact shall be avoided where practicable. Where complete compliance proves impractical, electrolytic action shall be minimized by plating or some other suitable method.

3.1.2 Workmanship: Workmanship and finish shall be in accordance with high grade aircraft accessory manufacturing practice.

3.2 Identification: All major components of the skid control system shall be plainly marked as follows:

(a) SAE AS
(b) Name of unit
(c) Unit assembly number
(d) Serial number and date of manufacture
(e) Manufacturer's name

3.3 Design and Construction: Design and construction shall conform to the requirements specified herein.

3.3.1 Electrical Operation: Electrically operated components of the skid control system shall operate satisfactorily on a voltage of from 20 to 29 volts DC or 98 to 124 volts and 380 to 420 cycles per second AC. The maximum allowable power to be specified by the applicant.

3.3.2 Hydraulic Operation: Hydraulically operated components of the skid control system shall be designed and manufactured to be compatible with the type of fluid specified by the applicant. They shall be assembled in an area which is free of dust, metal particles, and other foreign material. The ports shall be suitably capped to prevent entrance of foreign material. These components shall have a finish which will not be adversely affected by the fluid with which they will be used.

3.3.3 Sealing: All components of the skid control system shall be sealed against dust, dirt, moisture, and water, insofar as is practical. Where applicable, suitable precautions shall be taken against collection of moisture due to condensation.

3.3.4 Temperatures:

3.3.4.1 Non-Operating Temperatures: The skid control components shall be designed and constructed to withstand temperatures of from -54°C to 71°C (-65°F to 160°F).

3.3.4.2 Operating Temperatures: The skid control components shall be designed and constructed for operation at the following temperatures:

(a) Controlled Temperature Zone: The temperature extremes which may be experienced during normal operation.

(b) Non-Controlled Temperature Zones: -54°C to 71°C (-65°F to 160°F).

3.3.5 Strength: Structural strength of all skid control equipment shall be such that, when installed, designed operation is not impaired and no part of the device or its mountings shall give evidence of failure under the maximum imposed mechanical operating loads, wrench torque loads required for making connections, thermal effects, or aircraft operation. Skid control equipment mounted on the unsprung portion of the landing gear, such as the wheel driven unit, shall be designed to withstand shocks and vibrations encountered due to wheel and brake vibration, rebound shock, etc., without damage or malfunction. These factors shall be specified by the applicant.

3.3.6 Lubrication: No lubrication or other servicing shall be required throughout the life of the wheel driven unit as defined by the Life Cycle Test.

3.4 Performance: The skid control system covered by this specification shall provide a means of detecting an incipient skid condition of the aircraft tires and thereupon function to control the brakes in time to prevent tire damage or loss of aircraft control. The skid control system shall be capable of functioning from maximum rolling speed to the lowest speed compatible to ground handling of the aircraft, with limitations defined by the applicant.

4. QUALIFICATION TESTS:

4.1 Test Samples: A test sample shall consist of all the components of the skid control system required for the control of one wheel. In the case of electrically operated equipment, where a common control box is used for the control of more than one wheel, the entire control box shall be submitted for testing, but only one wheel control circuit need be tested.

4.2 Tests: The equipment shall function properly when or after being subjected to the following tests.

4.2.1 Environmental Tests:

4.2.1.1 High Temperature: The equipment shall be placed within the chamber and the internal temperature of the chamber raised to 71°C (160°F) (*) with an internal relative humidity of not more than 5 percent. The items of equipment shall be maintained at 71°C (160°F) (*) for a period of 50 hours. The temperature shall then be adjusted in accordance with Paragraph 3.3.4 until the temperature has stabilized. Then the equipment shall be operated through not less than 2 1/2 percent of the total number of cycles as determined in Paragraph 4.2.2.

(*) Note: Those units which may be exposed to a higher ambient temperature shall be tested at the higher temperature as specified by the applicant.

Those units which may be exposed to brake heat shall be tested at a higher temperature, but the time may be reduced as specified by the applicant.

4.2.1.1.1 Wheel Driven Unit: The wheel driven unit shall be accelerated from zero rpm to the rpm to be obtained on the wheel driven unit at an aircraft speed of 0.5V (See Paragraph 4.2.2) and then decelerated to zero rpm. Acceleration and deceleration shall be equivalent to at least 400 radians per second^2 of the wheel or higher as specified by the applicant. The wheel driven unit shall also be cycled to the conditions of Paragraph 4.2.2.1.1 for 100 cycles to demonstrate structural integrity at the elevated temperature.

4.2.1.1.2 All Other Components: See Paragraph 4.2.2 (**) Note.

The temperature shall then be reduced to prevailing room conditions and a visual examination conducted.

4.2.1.2 Low Temperature: The items of equipment shall be placed within the test chamber and the chamber cooled to and maintained at a temperature of -54°C (-65°F) until stabilization is reached. The temperature shall then be adjusted in accordance with Paragraph 3.3.4 until the temperature has stabilized and then the equipment shall be operated through not less than 2 1/2 percent of the total number of cycles as determined in Paragraph 4.2.2.

4.2.1.2.1 Wheel Driven Unit: The acceleration, deceleration, and velocities shall be the same as for the High Temperature Test.

4.2.1.2.2 All Other Components: See Paragraph 4.2.2 (**) Note.

4.2.1.3 Vibration: This test shall follow the Life Cycle Tests.

4.2.1.3.1 System Components: The test specimen shall be mounted on the apparatus dynamically similar to the most severe condition likely to be encountered in service. The test specimen shall be functioning during a maximum of 50 percent of the entire test period and shall be in its normal inoperative condition throughout the remainder of the test period. At the end of the test period, the test specimen shall be inspected thoroughly for damage or defects resulting from the Vibration Tests. The amplitude or acceleration for the frequency cycling test shall be within ±10 percent of the specified values. Vibration tests shall be conducted under both resonant and cycling conditions according to the Vibration Test Schedule (Table 1).

Table 1

Vibration Test Schedule
(Times shown refer to one axis of vibration)

Type	Vibration at Room Temp	Vibration at Each of the Temp Extremes as Determined in Paragraph 3.3.4
Resonance	60 minutes	15 minutes
Cycling	60 minutes	15 minutes

4.2.1.3.1.1 Resonance: Resonant frequencies of the test specimen shall be determined by varying the frequency of applied vibration slowly through the specified range of frequencies at vibratory accelerations not exceeding those shown in Figure 1.* Individual resonant frequency surveys shall be conducted with vibration applied along each of any set of three mutually perpendicular axes of the test specimen.

The test specimen shall be vibrated at the indicated resonant conditions for the periods shown in the Vibration Test Schedule and with the applied double amplitude or vibratory acceleration specified in Figure 2.* These periods of vibration shall be accomplished with vibration applied along each of three mutually perpendicular axes of vibration. When more than one resonant frequency is encountered with vibration applied along any one axis, the test period may be accomplished at the most severe resonance or the period may be divided among the resonant frequencies, whichever is considered most likely to produce failure. When resonant frequencies are not apparent within the specified frequency range, the specimen shall be vibrated for periods twice as long as those shown for resonance in the Vibration Test Schedule at a frequency of 55 cps and an applied double amplitude of 0.060 inch.

(*) Note: An investigation shall be made to determine the magnitude of the amplitudes, frequencies, and accelerations to which these units will be subjected. In cases where these values are higher than those given above, the higher value shall be used.

4.2.1.3.1.2 Cycling: The vibration test shall be conducted with the frequency cycling between 10 and 500 cps in 15-minute cycles at an applied double amplitude of 0.035 inch or an applied acceleration of 10 g, whichever is the limiting value. Vibration shall be applied along each of three mutually perpendicular axes according to the Vibration Test Schedule (Table 1).

4.2.1.4 Humidity: All units except those hermetically sealed shall be subjected to the following tests (After the Vibration Test).

The equipment shall be placed in a test chamber and set up to simulate installed conditions. The temperatures in the chamber shall be raised from a temperature of between 20° and 38°C (68° to 100.4°F) to 71°C (160°F) during a 2-hour period. The temperature of 71°C (160°F) and a relative humidity of 95 percent shall be maintained during the next 6-hour period. During the following 16-hour period, the temperature in the chamber shall drop at a uniform rate to 20° to 38°C (68° to 100.4°F), which constitutes one cycle.

The cycle shall be repeated a sufficient number of times to extend the total time of the test to 240 hours (10 cycles). At the conclusion of the 240-hour period, the equipment shall be operated and a visual examination made. Distilled or demineralized water having a pH value of between 6.5 and 7.5 at 25°C (77°F) shall be used to obtain the desired humidity.

4.2.1.5 Fungus Resistance: (After Humidity Test): All electrical components of the skid control system which are not hermetically sealed shall be subjected to the following test.

4.2.1.5.1 Procedure: Four groups of fungi are listed below and one species of fungus from each group shall be used. In preparing the spore suspension, distilled water, having a pH value between 3.8 and 7.2 at a temperature between 22°C and 32°C (72°F and 89°F), shall be utilized. Approximately 10 ml of the solution shall then be introduced directly into a tube culture of the fungus and the spores brought into suspension by vigorous shaking or by gentle rubbing of the spore layer with an inoculating loop without disturbing the agar surface. This process shall be repeated for each species of fungus. The separate spore suspensions from the four types of fungi shall be mixed together to provide a composite suspension. Actively growing cultures between 7 to 21 days old after initial inoculation shall be used for the preparation of the spore suspension. After preparation, the spore suspension will not be kept for more than a 24-hour period at temperatures from 2°C to 7°C (35°F to 45°F). The equipment, including applicable external connections, shall be placed in a chamber, maintaining an internal temperature of 30° ±2°C (86 ± 3.6°F) and a relative humidity of 95 ± 5 percent, and sprayed with the suspension of mixed spores. The test period shall be 28 days. At the end of the test, the units shall be examined and operated.

4.2.1.5.1.1 Organism:

Group I	Chaetomium globosum	6205
	Myrothetium verrucaria	9095
Group II	Memenoniella echinata	9597
	Aspergillus niger	6275
Group III	Aspergillus flavus	10836
	Aspergillus terreus	10690
Group IV	Penicillium citrinum	9849
	Penicillium ochrochloron	9112

4.2.1.5.1.2 Stock Culture Designation and Source: When ordering cultures, request the cultures by name and serial number. The serial numbers of the cultures remain the same regardless of source.

4.2.1.6 Sand and Dust: All components which will not be installed in sheltered compartments shall be subjected to the following test (After Fungus Test).

The equipment shall be placed within the test chamber and the sand and dust density raised and maintained at 0.1 to 0.5 grams per cubic foot within the test space. The relative humidity shall not exceed 30 percent at any time during the test.

Sand and dust used in the test shall be of angular structure and shall have characteristics as follows:

(a) 100 percent of the sand and dust shall pass through a 100-mesh screen, U S Standard Sieve Series.

(b) 98 ± 2 percent of the sand and dust shall pass through a 140-mesh screen, U S Standard Sieve Series.

(c) 90 ± 2 percent of the sand and dust shall pass through a 200-mesh screen, U S Standard Sieve Series.

(d) 75 ± 2 percent of the sand and dust shall pass through a 325-mesh screen, U S Standard Sieve Series.

(e) Chemical analysis of the dust shall be as follows:

Substance	Percent by Weight
SiO_2	97 to 99
Fe_2O_3	0 to 2
Al_2O_3	0 to 1
TiO_2	0 to 2
MgO	0 to 1
Ign Losses	0 to 2

The internal temperature of the test chamber shall be maintained at 25°C (77°F) for a period of 6 hours with sand and dust velocity through the test chamber between 100 and 300 feet per minute. After 6 hours at these conditions, the temperature shall be raised to and maintained at 71°C (160°F). These conditions shall be maintained for 6 hours. At the end of this test period, the equipment shall be removed and allowed to cool to room temperature and shall be operated and examined.

4.2.1.6.1 Wheel Driven Unit: This test shall be performed with the unit rotating at a speed equivalent to that for a wheel speed of 400 rpm. The unit shall be functionally checked after completion of the test.

4.2.1.6.2 Other Applicable Units: Other applicable units shall be subjected to not less than 15 percent of the total number of cycles as determined in Paragraph 4.2.2.

4.2.1.7 Salt Spray: The skid control units shall be subjected to the Salt Spray Test in accordance with Federal Test Method Standard No. 151, Method No. 811, July 17, 1956.

4.2.1.8 Explosion Proof: All units of the skid control system with electrical make and break contacts so located in the aircraft as to require explosion proofing shall be subjected to the following test.

4.2.1.8.1 Preparation: The equipment to be tested shall be installed in the test chamber in such a manner that normal electrical operation is possible and mechanical controls may be operated through the pressure seals from the exterior of the chamber. All external covers of the test item shall be removed or opened to insure adequate circulation of the explosive mixture. Large equipment may be tested one or more units at a time by extending electrical connections through the cable port to the balance of the equipment located externally.

The equipment shall be operated to determine that it is functioning properly and to observe the location of any sparking or high temperature components which may constitute potential explosion hazards.

Mechanical loads on drive assemblies and servomechanical and electrical loads on switches and relays may be simulated when necessary if proper precaution is given to duplicating the normal load in respect to torque, voltage, current, inductive reactance, etc. In all instances, it shall be considered preferable to operate the equipment as it normally functions in the system during service use.

4.2.1.8.2 Test Procedure: The test chamber shall be sealed and the ambient temperature within shall be raised to +71 + 3°C (+160 ± 5°F). The temperature of the test item and the chamber walls shall be permitted to rise to within 11°C (20°F) of that of the chamber ambient air, prior to introduction of the explosive mixture.

The internal test chamber pressure shall be reduced sufficiently to simulate an altitude approximately 10,000 feet above the desired test altitude. The weight of fuel necessary to produce an air-vapor ratio of 13 to 1 at the desired test altitude shall be determined from consideration of chamber volume fuel temperature and specific gravity, chamber air and wall temperature, test altitude, etc. A time of 3 ± 1 minutes shall be allowed for introduction and vaporization of the fuel. Air shall be admitted into the chamber until a simulated altitude of 5,000 feet above the test altitude is attained. At this time, the potential explosiveness of the resulting air-vapor mixture shall be verified by a suitable sampling method.

Operation of the test item shall at this time be commenced, all making and breaking electrical contacts being actuated. If high temperature components are present, a warm-up time of 15 minutes shall be permitted. If no explosion results, air shall be admitted into the chamber so as to steadily reduce the altitude down past the desired test altitude to an elevation 5,000 feet below that altitude or as close thereto as permitted by local ground level altitude. The operation of the test item shall be continuous throughout this period of altitude reduction and all making and breaking electrical contacts shall be operated as frequently as possible.

The above-described test shall be accomplished at simulated test altitudes of local ground level to 5,000 feet, 10,000, 20,000, 30,000, 40,000, and 50,000 feet, unless an explosion is caused by the test item during a test, in which case the item shall be considered to have failed to pass the test and no further trials need be attempted.

4.2.1.9 Water, Ice, and Slush: If it is determined that any unit with exposed rotating or reciprocating parts will be subjected to water, ice, or slush during operation, suitable tests shall be performed to assure proper functioning under such adverse conditions.

4.2.2 Life Cycle Tests: The skid control units selected for the Environmental Tests shall be used for these tests and shall be cycled for an additional number of cycles (**) without failure or adjustment to give a total equivalent to the maximum number of cycles per landing experienced during testing of the system on the aircraft (***) multiplied by the maximum anticipated landings in the life of the gear. If the maximum number of anticipated landings cannot be determined, use 8,000. The number of cycles required under this and all subordinate paragraphs for components to be subjected to service temperatures in excess of 71°C (160°F) may be reduced to reflect the adverse effects of the higher temperature cycles which have previously been run. The cycles shall be performed at normal room temperature. For calculating cycling conditions, the following factors shall be used:

r = rolling radius of the tire used on aircraft on which the equipment is to be installed. The radius shall be that at rated static tire load and deflection. This "r" shall be used in calculating tire and wheel rpm.

V = the V_2 speed of the aircraft, on which the equipment is to be installed with maximum gross takeoff weight at 8,000 feet altitude, as determined by the aircraft manufacturer.

(**) Note: Cycling shall consist of the action required to effect a reduction and reapplication of brake pressure sufficient to control skids in both incipient and locked wheel conditions. Where the system differentiates between the control for incipient skid and locked wheel condition, the number of cycles for incipient skid condition shall be 75 percent of the total and the remainder shall be for the locked wheel condition, unless determined otherwise by prototype testing. The incipient skid control cycle shall be that action required to reduce the maximum brake pressure to 50 percent. The locked wheel control cycle shall be that action required to completely release the brake torque.

(***) Note: In cases where the vibration conditions exceed those indicated on Figure 1, the number of cycles required shall be changed in a rational manner.

4.2.2.1 Wheel Driven Unit:

4.2.2.1.1 Maximum Velocity Test: Ten percent of the total number of cycles, as determined in Paragraph 4.2.2, shall be made in the following manner. The wheel driven unit shall be accelerated from zero rpm to the rpm to be obtained on the wheel driven unit at a speed of V (See Paragraph 4.2.2) and then decelerated to zero rpm. Acceleration and deceleration shall be equivalent to at least 3,000 radians per second^2 of the wheel.