Aerospace Industries Association

NATIONAL AEROSPACE STANDARD

FED. SUP CLASS

(REAFFIRMED OCTOBER 9, 1991)

SPECIFICATION - AIRCRAFT SKIS

This specification defines the minimum requirements for aircraft skis suitable for use on civil aircraft.

1. APPLICABLE SPECIFICATIONS

1.1 The applicable sections of the latest issue and amendment of ANC-5 Strength of Metal Aircraft Elements and ANC-18 Design of Wood Aircraft Structures - are made a part of this specification as hereinafter noted.

2. TYPES

2.1 This specification provides design criteria for skis for use on civil aircraft.

3. MATERIAL AND WORKMANSHIP

All materials used in the ski assembly shall be of a quality which experience or tests have demonstrated to be suitable and dependable for use in aircraft skis and shall conform to specifications which will insure their having the strength and other properties assumed in the design. All workmanship shall be consistent with high-grade aircraft ski manufacturing practice.

3.1 Fabrication Methods: The methods of fabrication employed in the construction of the ski assembly shall be such as to produce consistently sound structures. When a fabrication process requires close control to attain this objective, the process shall be performed in a manner for which suitability and dependability have been established on the basis of experience or tests.

3.2 Standard Fastenings: All bolts, pins, screws, and rivets used in the ski assembly shall be of a type the suitability and dependability of which have been demonstrated by experience or tests. The use of a suitable and dependable locking device or method is required for all such bolts, pins, screws. Self-locking nuts shall not be used on bolts subject to rotation.

3.3 Castings: All castings shall be of high quality, clean, sound, and free from blow holes, porosity, or surface defects.

3.4 Protection: All members of the ski assembly shall be suitably protected against deterioration or loss of strength in service due to weathering, corrosion, abrasion, or other causes.

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3.5 Inspection Provisions: Adequate means shall be provided to permit the close examination of such parts of the ski assembly as require periodic inspection, adjustments for proper alignment and functioning, and lubrication of moving parts.

3.6 Identification: Each aircraft ski shall be suitably placarded with the following information:

Manufacturer's Name
Ski Model
Maximum Limit Load in Pounds
Serial No. and Date of Manufacture
NAS Spec. No.
"For Installation Geometry, see
Ski Installation Drawing No. ___"

These markings shall be displayed in a conspicuous place on the ski and shall be of such character that they will not be obliterated or effaced as a result of service usage.

4. DETAIL REQUIREMENTS

4.1 Design

4.1.1 If safety cables are used, separate means of attaching the cables shall be provided at the forward and aft ends of the ski. In designs on which a tension cord is used, the cord shall be attached to a point on the ski different from that to which the safety cable is attached.

4.2 Strength

4.2.1 Material Strength Properties: The strength properties of the materials used shall be based on a sufficient number of tests of material to establish design values on a statistical basis. The values contained in ANC-5 and ANC-18 shall be used unless shown to be inapplicable in a particular case. The design values shall be so chosen that the probability of any ski assembly being understrength because of material variations is extremely remote. When consideration of the design for fatigue conditions may be important, the ski assembly shall be designed, insofar as practicable, to avoid points of stress concentration.

4.2.2 The strength of the ski, including the pedestal, shall be substantiated by a stress analysis or by static tests to ultimate load.

4.2.2.1 Structural or stress analysis may be used for substantiation only when the structure conforms with types for which experience has shown such methods to be reliable.

4.2.3 Loads: Strength requirements are specified in terms of limit and ultimate loads. Limit loads are the maximum loads anticipated in service. Ultimate loads are equal to the limit loads multiplied by the factor of safety and in certain cases by an additional special factor as noted below. Unless otherwise noted, loads specified are limit loads.

4.2.4 Factor of Safety: The factor of safety shall be 1.5.

4.2.4.1 Special Factors: When there may be uncertainty concerning the actual strength of particular parts of the ski assembly or when the strength is likely to deteriorate in service prior to normal replacement, additional factors of safety shall be provided to insure that the strength and reliability of such parts are not less than the rest of the ski assembly. The following special factors shall be considered for both stress analysis and static tests. When several factors are involved, only the largest factor need be used. (See following note)

Note: Special Factor Examples: The ultimate load for a casting equals the limit load times 1.5 times the appropriate casting factor specified in 4.2.4.1(a), (1) or (2).

The ultimate load for a casting when considering casting, bearing and/or fitting factors equals the limit load times 1.5 times the largest special factor involved. This special factor will be 2.0 if section 4.2.4.1(a)(1) is pertinent or 1.25 if section 4.2.4.1(a)(2) is pertinent, unless the bearing factor is larger. Since the fitting factor of 1.15 is less than either of the above two casting factors, it ceases to be critical and may be ignored.

(a) Casting Factors

(1) If visual inspection only is to be employed, the special factor shall be 2.0.

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(2) The special factor may be reduced to 1.25 for ultimate loads and 1.15 for limit loads if at least three sample castings are tested to show compliance with these factors, and if all sample and production castings are determined to be acceptable upon completion of a visual and radiographical inspection.

(b) Bearing Factors

The factor of safety in bearing at bolted or pinned joints shall be in accordance with those bearing factors specified in ANC-5.

(c) Fitting Factor

Fittings are defined as parts such as end terminals used to join one structural member to another. A multiplying factor of safety of at least 1.15 shall be used in the analysis of all fittings the strength of which is not proved by limit and ultimate load tests in which the actual stress conditions are simulated in the fitting and the surrounding structure. This factor shall be applied to all portions of the fitting, the means of attachment, and bearing on the members joined. The fitting factor need not be applied if a type of joint design based on comprehensive test data is used.

4.2.5 Strength and Deformation: The ski assembly shall be capable of supporting limit loads without suffering detrimental permanent deformations. At all loads up to the limit loads, the deformation shall be such as not to interfere with safe operation of the aircraft on which the ski is to be used. The ski assembly shall be capable of supporting ultimate loads without failure for at least three seconds, unless proof or strength is demonstrated by dynamic tests simulating actual conditions of load application.

5. RATING QUALIFICATIONS

5.1 Ratings: The ski manufacturer shall select the maximum limit load for which the ski assembly will be rated.

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(a) Each design of ski assembly shall be substantiated as described herein to establish the following selected rating:

L = Maximum Limit Load in Pounds

Note: In order for the ski to be eligible for installation on any given model aircraft, the maximum limit load (L) shall be at least equal to S x n where "S" is the maximum static load and n is the limit landing load factor previously determined from static drop tests of the airplane by the aircraft manufacturer. In lieu of a value of n determined from such drop tests, a value of n determined from the following formula may be used:

$n = 2.80 + \frac{9000}{W + 4000}$ where W is the weight of the aircraft.

5.2 Loading Requirements: The ratings for ski assemblies shall be substantiated for the following conditions:

(a) Distributed Up Load

(b) Concentrated Up Load

(c) Distributed Side Load

(d) Concentrated Side Load

5.3 Test Requirements and Methods: The ski assembly shall be investigated for limit and ultimate loads as set forth below.

The pedestal type ski, including the pedestal, shall be designed to withstand the loads when supported at the pedestal bearing sleeve.

In the case of the clamp-on ski:

(a) The ski assembly shall be supported at those places on the cradle which will transmit the test loads as they would be imposed during ground operation.

(b) If a wheel and tire combination is used as a means of support, simulating an actual installation of the ski assembly, steps shall be taken to prevent the tire from being pushed off the wheel (e.g., water under pressure within the tire) during the application of the loads for the conditions specified in sections 5.2(c) and (d).

(c) The condition specified in section 5.2(b) need not be considered when, upon installation, the tire rests on the ski runner and the

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test load would be transmitted directly from the ski to the tire.

5.3.1 Distributed Limit Up Load: An upward load equal to the rated load (L) shall be distributed uniformly along the ski bottom and symmetrically with respect to the pedestal bearing sleeve in the fore-and-aft direction. That portion of the front of the ski which is at a greater distance from the bearing sleeve than the aft end need not carry any of the load.

5.3.2 Concentrated Limit Up Load: A concentrated up load equal to the load specified in 5.3.1 shall be applied to the ski bottom directly under the pedestal bearing sleeve.

5.3.3 Distributed Limit Side Load: A sideward load equal to 35% of the load specified in 5.3.1 shall be distributed uniformly along the outside edge of the ski bottom and symmetrically with respect to the pedestal bearing sleeve in the fore-and-aft direction. That portion of the front of the ski which is at a greater distance from the bearing sleeve than the aft end need not carry any of the load.

Note: Reduction for Pedestal Height: When the height of the aircraft axle from the ground with the ski installed is greater than the moment arm R given by the formula

$$R = 9 + \frac{S}{1000}, \text{ when } S \leq 6000, \text{ or}$$

$$R = 12 + \frac{S}{2000}, \text{ when } S > 6000$$

where S is defined in 5.1, the side load may be reduced to the value which is obtained by multiplying the side load specified in 5.3.3 by a factor equal to the ratio of the moment arm to the height of the axle from the ground.

5.3.4 Concentrated Limit Side Load: A horizontal load equal to .134L shall be applied to the edge of the ski bottom at a distance forward of the axle equal to three times the height of the skiplane axle from the ground, except that, if this pedestal height is less than the moment arm given by the formula in 5.3.3. then the distance shall be three times the moment arm given by the above formula.

5.4 Cut-Away Skis: In the case of a ski where the center section of the aft end of the runner is cut away, the applicable load for that section of the ski shall be divided between the two parts of the runner in proportion to the relative widths of these parts.