

MIL-S-6073

AN-S-6b

6 November 1945

Superseding

AN-S-6a

22 September 1942

**ARMY-NAVY AERONAUTICAL SPECIFICATION
SPRUCE; AIRCRAFT**

This specification was approved on the above date by joint action of the War and Navy Departments for use in the procurement of aeronautical supplies and shall become effective immediately upon issue.

A. APPLICABLE SPECIFICATIONS.

A-1. The following specifications of the issue in effect on date of invitation for bids shall form a part of this specification:

A-1a. AN Aeronautical Specifications.--

A-1a. AN Aeronautical Specifications.--

AN-W-2	Wood; Method for Kiln Drying.
AN-W-3	Wood; Determination of Moisture Content of.
AN-W-4	Wood; Determination of Specific Gravity of.

A-1b. ANC Bulletin.--

ANC-19 Wood Aircraft Inspection and Fabrication.

B. GRADE AND CONDITION.

B-1. This specification provides for one grade of Aircraft Spruce.

B-2. Unless otherwise specified, unsurfaced material shall be supplied under this specification. However, the limitations herein given, apply to surfaced material and in the inspection of rough or unsurfaced material the effect of surfacing on the depth and surface measurement of defects and blemishes shall be taken into consideration.

C. MATERIAL AND WORKMANSHIP.

C-1. Material.--

C-1a. The following species of spruce are acceptable:

Sitka Spruce	(Picea Sitchensis)
Red Spruce	(Picea Rubens or Picea Maria)
White Spruce	(Picea Canadensis or Picea Glauca)

C-2. Workmanship.-- All details of workmanship shall be in accordance with high grade manufacturing practice for aircraft spruce.

D. GENERAL REQUIREMENTS.

D-1. See Section E.

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E. DETAIL REQUIREMENTS.

E-1. Moisture Content.- Unless otherwise specified spruce shall be furnished seasoned to a moisture content of not less than eight or more than 12 percent in individual pieces. Kiln drying, if done, shall be in accordance with AN-W-2. If air dried, the material shall meet the acceptance requirements of Specification AN W 2 as to moisture content, moisture content distribution and freedom from drying defects, such as warp, surface checks, end checks, honey comb and case hardening.

E-2. Specific Gravity and Weight per Cubic Foot.- The specific gravity shall be not less than 0.36 based on weight and volume when oven dry, or weights per cubic foot (including the moisture) of seasoned material shall be not less than:

23.4 pounds per cubic foot at 8 percent moisture content.
23.6 pounds per cubic foot at 10 percent moisture content.
23.8 pounds per cubic foot at 12 percent moisture content.
24.0 pounds per cubic foot at 14 percent moisture content.
24.2 pounds per cubic foot at 16 percent moisture content.

Acceptance or rejection may be based on weights per cubic foot, except that in case of question, or at the discretion of the Inspector, acceptance or rejection shall be based on specific gravity.

E-3. Grain.-

E-3a. Slope of Grain.- In pieces comprising at least 70 percent of the footage in any lot or shipment the slope of grain shall be not steeper than one in 15 on one face combined with straight grain on the adjacent face or equivalent combinations. (See notes). In the remaining pieces the slope of grain shall be not steeper than one in 12 on one face combined with straight grain on the adjacent face or equivalent combinations. This refers to the general slope of grain. Burly or curly grain or other local deviations or dips of grain are permitted provided they do not extend over more than 1/4 of the width of either wide face at not more than one point in each four feet of the length of the piece. Deviations of grain due to knots of permissible size included in the piece may be disregarded.

E-3b. Flat or Edge-Grained Material.- All material shall be edge-grained insofar as possible, but flat grain will be accepted up to 33-1/3 percent of the board foot contents of a shipment when necessary to utilize all the material in the log or cant that is of a quality suitable for aircraft construction.

E-4. Rings Per Inch.- There shall be no fewer than six annual rings in any one inch measured in the radial direction on either end section.

E-5. Defects.-

E-5a. Pitch or Bark Pockets.-

E-5a(1). On flat-grained faces pockets shall not exceed 1/8 inch in depth, the product of the width and length of any pocket shall not exceed two square inches, and the sum of such products in any square foot of surface shall not exceed four square inches.

E-5a(2). On edge-grained faces pockets shall not be less than 12 inches apart longitudinally when in the same or adjacent growth layers, the product of the width and length of a pocket shall not exceed 1/4 square inch, and the sum of such products in any square foot of surface shall not exceed one square inch. The longitudinal resinous or block streaks commonly associated with pitch or bark pockets are not cause for rejection unless there is definite evidence of shake or other ring separation.

E-5b. Pitch Streaks.- Shall not exceed 1/2 inch in width and in no case shall the aggregate width of such streaks exceed ten percent of the width of the face on which they appear.

E-5c. Compression Wood or "Hard Grain".- Compression wood in streaks wider than 1/2 inch shall not be permitted. In no case shall the aggregate width of such streaks exceed ten percent of the width of the face on which they appear.

E-5d. Wane.- Wane is not permitted.

E-5e. Knots.- Knots on the wide surfaces of flat-grained pieces shall not exceed 1/2 inch in diameter and the sum of the diameters in any square foot of surface shall not exceed one inch; knots on the narrow surfaces which do not appear on the wide surfaces may be disregarded. Knots (usually spike knots) on the wide surfaces of edge grain pieces shall not exceed 1/4 inch in diameter; knots on the narrow surfaces or edge grained pieces shall not be permitted except where they appear on a wide surface in permissible size.

E-5f. Brashness.- The material shall not be brash. Not less than four specimens from each board selected for examination by the Inspector, shall be tested in accordance with section F. The average test value shall be not less than 75 inch-pounds, the range in individual test values shall not exceed 1 to 2-1/2, and no single test value shall be less than 60 inch-pounds. Any piece failing to meet these requirements, as determined by tests on representative specimens, shall be considered brash.

E-5g. Black Streak.- Black streaks, except for maggot chambers, are admissible. Maggot chambers shall be limited to the same extent as pitch or bark pockets. The length of a maggot chamber should be considered only as that of the definitely wider or thicker portion of the black streak as seen on an edge grained surface. Deviations of grain associated with maggot chambers shall be limited in the same manner as other deviations of grain.

E-5h. Miscellaneous.- Bright sapwood and indented rings ("bear scratches" or "snail grain") are not defects. All stock shall be free from compression failures, shake, rot, dote, or decay and from excessive crook and warp.

E-6. Texture.- This specification includes no requirements for texture. Material conforming to the requirements of this specification for brashness, rings per inch, specific gravity, slope of grain, defects, and blemishes is considered of satisfactory texture.

E-7. Dimensions.-

E-7a. Government Procurement.- Dimensions of material procured by the Government shall be in accordance with the following limits:

Thickness shall be as ordered. Lengths and widths may be random or standard up to a width of 12 inches and a length of 32 feet with a minimum width of two inches, minimum length of three feet, and minimum surface measure of one square foot. Length segregations shall be in the six groups below from which the orders for material shall be made.

3 up to 5 feet
5 up to 8 feet
8 up to 12 feet
12 up to 17 feet
17 up to 23 feet
23 up to 32 feet, inclusive

E-7b. Non-Government Procurement.- Dimensions shall be as specified by the purchaser.

E-7c. Basis of Measurement.-

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E-7c(1). Thickness.- Material one inch and thicker shall be measured and tallied as of surface measure multiplied by specified thickness in inches and fractions of an inch. Thickness under one inch shall be measured and tallied as of surface measure.

E-7c(2). Length.- In scaling lengths, fractions of 1/2 foot or less will be counted back to the next lower figure and larger fractions up to the next higher figure, but a piece will not be considered as belonging to a length group unless its length is at least as great as the minimum of that group.

F. METHODS OF SAMPLING, INSPECTION, AND TESTS.

F-1. General.- When inspection is conducted at the contractor's plant, all tests specified herein shall be accomplished by the contractor under the supervision of the Government Inspector.

F-1a. Contractors not having laboratory facilities satisfactory to the Inspector shall engage the services of a commercial testing laboratory acceptable to the Inspector.

F-1b. Acceptance or approval of material during course of manufacture shall in no case be construed as a guaranty of the acceptance of the finished product.

F-2. Test Reports.- The contractor shall furnish test reports, in duplicate, showing quantitative results for all tests required by this specification, and signed by the Director of the laboratory or his authorized assistant in which the tests were conducted. When inspection is conducted at the contractor's plant, these reports shall be furnished to the Inspector.

F-3. Examination of Product.-

F-3a. Each piece shall be carefully examined to determine conformance with this specification, with respect to material and workmanship, grain, rings per inch, defects, and dimensions.

F-4. Sampling.-

F-4a. Not less than one piece out of every 20 pieces in a lot or shipment shall be selected at random and examined for specific gravity and moisture content in accordance with the methods specified herein. If the samples chosen meet the requirements of this specification relative to specific gravity and moisture content in addition to the other requirements, the material represented by the samples shall be considered to meet these requirements. If the samples chosen fail to meet the specification requirements, each piece of the lot or shipment shall be examined for specific gravity and moisture content, as well as the other requirements, and pieces shall be individually accepted or rejected on the basis of these tests.

F-4b. Tests for brashness shall be made, by the method specified herein, on specimens taken from not less than one piece out of every twenty pieces selected at random from pieces having acceptable specific gravity and moisture content. At least four test specimens, selected at random from various parts of the piece shall be taken from each piece to be tested for brashness. If the samples chosen fail to meet the brashness requirement, each piece of the lot or shipment shall be examined for brashness, and pieces shall be individually accepted or rejected on the basis of this test.

F-5. Test Methods.-

F-5a. Moisture Content.- Shall be determined in accordance with Specification AN-W-3.

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F-5b. Specific Gravity.- Shall be determined in accordance with Specification AN-M-4.

F-5c. Brashness.- (1)

F-5c(1). The work absorbed by each specimen (i.e., toughness) shall be measured on a pendulum-type impact or toughness machine similar to that described in Forest Products Laboratory mimeograph 1308.

F-5c(2). The specimens shall be $5/8$ by $5/8$ inches in cross section, shall be 10 inches long, and shall have a moisture content of between eight and 12 percent. They shall be tested on an 8-inch span, with the impact load applied at the center of the length of a tangential surface.

F-5c(3). If the material is of such size that a $5/8$ by $5/8$ inch specimen cannot be cut from it, the width of the specimen (the dimension perpendicular to the direction of the impact load) may be decreased by not to exceed $1/8$ inch. The dimension of the specimen in the direction of the impact load (the depth) shall not be decreased. When a width (dimension perpendicular to direction of impact load) of less than $5/8$ inch is used, the required value of toughness may be determined by the following equation:

$$75 \text{ (or 60) inch-pounds } \times \frac{\text{actual width in inches}}{5/8 \text{ inch}}$$

G. PACKAGING, PACKING, AND MARKING FOR SHIPMENT.

G-1. General.- The packaging, packing, and marking requirements specified herein apply only to direct purchases by or direct shipments to the Government.

G-2. Packing.- Rail shipments shall be made in closed cars. Dry timbers either four or six inches in width, and surfaced on two sides to not less than $1-1/2$ inches in thickness, shall be placed crosswise on the floor of the car not more than four feet apart to protect the lower layer of the lumber.

G-2a. In the shipment of lumber having a moisture content in excess of 19 percent, every precaution shall be taken by the shipper to protect the lumber from stain, decay, warping and checking, including the dipping of the lumber prior to shipment in a fungicide solution containing (1) not less than 1.24 percent (by weight) of sodium pentachlorophenate, or (2) not less than 1.24 percent (by weight) of sodium tetrachlorophenate, or (3) not less than 1.75 percent (by weight) of a mixture of sodium pentachlorophenate and commercial borax in which the ratio (by weight) of sodium pentachlorophenate to borax is not less than 2:3, or (4) not less than 2.10 percent of a mixture of sodium pentachlorophenate and commercial borax in which the ratio (by weight) of sodium pentachlorophenate to borax is not less than 1:5, or (5) not less than 1.42 percent (by weight) of a mixture of sodium pentachlorophenate, ethyl mercuric phosphate, and commercial borax in which the ratio (by weight) of the sodium pentachlorophenate, ethyl mercuric phosphate and borax shall be 32:1:160, or (6) not less than 0.0224 percent (by weight) of ethyl mercuric phosphate. Lumber of a 19-percent or less moisture content may be bulk piled. Lumber of a moisture content of from 20 percent to 30 percent will be separated by stacking sticks every fourth layer. The stacking sticks shall be evenly planed to $3/4$ inch thickness and shall not be less than $1-1/2$ inches and not more than $2-1/2$ inches in width. Sticks shall be centered over supporting timbers on the car floor and shall be in good alignment vertically throughout each pile. Lumber of a moisture content of more than 30 percent shall be separated by stacking sticks every two layers, and shall be evenly piled in the car to prevent warping.

Note: (1) Material inspected for brashness by the "pick test" or by any other test not recognized by this specification is subject to reinspection by the purchaser at any time by the brashness test method specified herein and is subject to rejection if deficient in toughness as required herein.

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G-2b. Either seasoned or unseasoned material shall be protected against drip of condensation from the car ceiling if shipment is made under such conditions that condensation is probable. Nails shall not be driven into any of the material comprising the shipment. The ends of each piece shall be coated with a preparation to retard checking while in transit or in storage. This preparation shall be equal to or better than that described in Technical Note 186 issued by Forest Products Laboratory, U.S. Forest Service, Madison, Wisconsin.

G-3. Marking.— The following information shall appear on each shipment:
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Quantity contained as defined in contract or order
Name of contractor (and name of manufacturer if not the same)
Government order number (or contract number if order number is not assigned)

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS.

H-1. There are no requirements applicable to the individual Departments.

I. NOTES.

I-1. Use.— This material is for use in the fabrication of highly stressed aircraft parts and should not be used for other purposes except to utilize waste incurred in the production of such parts.

I-1a. The spruce covered by this specification is intended for fabrication of aircraft structural parts which are highly stressed in bending in compression parallel to the grain, or in tension parallel to the grain, such as spars, spar-cap strips or flanges, cap strips and web members of ribs, skin-stiffeners and longerons which will at the time of fabrication be subject to further selective inspection in accordance with Bulletin ANC-19 or as specified by the Procuring Agency.

I-2. Ordering Data.— Requisitions, contract, and orders for the Government should state the thickness, width and length group.

I-3. Superseding Data.— This specification supersedes Specification AN-S-6a, which superseded Specification AN-S-6, for Army and Navy aeronautical use.

I-4. Thickness of Lumber.— The usual practice in the production of aircraft lumber is to cut to such thicknesses that any found unsuitable for aircraft use can be marketed in the usual channels. American Lumber Standards ("Lumber" Simplified Practice Recommendation R16-39) requires that rough lumber of softwood species, in the condition of seasoning as sold and shipped, be of such thicknesses as to permit surfacing two sides in accordance with the following:

Thickness of lumber measured and described as --	Actual thickness S2S	
	Yard and Industrial	Shop and Factory
	In.	In.
1. In. or 4/4	25/32	25/32 and 26/32
1-1/4 5/4	1-1/32	1-5/32
1-1/2 6/4	1-9/32	1-13/32
1-3/4 7/4	1-7/16	—
2 8/4	1-5/8	1-26/32
2-1/4 9/4	—	2-1/8
2-1/2 10/4	2-1/8	2-3/8
3 12/4	2-5/8	2-6/8
3-1/2 14/4	3-1/8	—
4 16/4	3-5/8	3-6/8

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It is also required that the description of thickness of dressed stock less than 1 inch thick, board measure, S1S or S2S be its actual thickness in the condition of seasoning as sold and shipped and that the thicknesses of rough lumber are in excess of those in finished lumber of the corresponding thickness by the amount necessary to permit of surfacing either one side or both sides.

I-5. Texture.- The "pick test" (lifting of splinters by a chisel, knife, or other pointed instrument) is unsuitable as a criterion of "texture" or "fiber quality", and is to be used in connection with this specification only as an aid to determining conformity to the requirements for slope of grain and not as a test for "texture".

I-6. Specific Gravity.- In spruce that otherwise complies with this specification the percentage that is below the required specific gravity limit is ordinarily quite small. Consequently, it will usually be more economical and expedient to defer the making of determinations of specific gravity or weight per cubic foot until the stock has been seasoned. It must be assured, however, that not to exceed 10 percent of the material in any order supplied in the green condition is below the specified limit. In either green or seasoned material, pieces that are below the required specific gravity limit can often be detected by an unusually small proportion of summerwood as observed on the ends or on edge-grained faces. Unacceptable pieces of seasoned material may also be recognized by their unusually light weight.

I-7. Equivalent Slope of Grain.- Direction of grain is shown on edge-grained faces by the summerwood bands and on flat grained faces by resin ducts or checks, by the direction in which a free flowing ink or dye spreads, or by the course taken by a narrow strip lifted by a knife point or torn out. When one of these faces is straight grained the true slope of grain is shown on the other face. When there is a slope on both edge-grained and flat-grained faces the true or combined slope is greater than the slope on either face.

I-7a. Combinations equivalent to one in 12 on the flat grained face and straight grain on the edge grain face (or vice versa) are:

1 in 13 and 1 in 31
1 in 14 and 1 in 23
1 in 15 and 1 in 20
1 in 16 and 1 in 18
1 in 17 and 1 in 17

I-7b. Combinations equivalent to one in 15 on the flat grained face and straight grain on the edge grain face (or vice versa) are:

1 in 16 and 1 in 43
1 in 17 and 1 in 32
1 in 18 and 1 in 27
1 in 19 and 1 in 24
1 in 20 and 1 in 23
1 in 21 and 1 in 21

I-8. Definitions.-

I-8a. Pitch Pocket.- A pitch pocket is a well-defined opening between rings of annual growth, usually containing, or which has contained, more or less pitch either solid or liquid. Bark also may be present in the pocket.

I-8b. Bark Pocket.- A bark pocket is a patch of bark partially or wholly enclosed in the wood.

I-8c. Shake.- A shake is a longitudinal crack in wood extending, in general, between two annual rings.

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I 8d. Edge-Grain.- A piece will be considered edge grained if on 2/3 or more of the width of both wide faces the annual growth layers make an angle of 45 degrees or more with the face.

I-9. Publications.- When requesting publications, refer to both title and number.

I-9a. Sources.- Copies of Army-Navy Aeronautical specifications and AEC publications may be obtained upon application to the Commanding General, Air Technical Service Command, Wright Field, Dayton, Ohio; or to the Bureau of Aeronautics, Navy Department, Washington 25, D.C. Naval activities should make application to the Commanding Officer, Naval Aircraft Modification Unit, Johnsville, Pa.

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