

MIL-S-6073

29 March 1950

LOCATION: 24GC

PRODUCT : 13-14900

AIRCRAFT SPRUCE & PLYWOOD

MILITARY SPECIFICATION

SPRUCE; AIRCRAFT

This specification was approved by the Departments of the Army, the Navy, and the Air Force for use of procurement services of the respective Departments, and supersedes the following specification:

AN-S-6b
6 November 1945

This specification consists of this cover sheet and Specification AN-S-6b, dated 6 November 1945, modified as follows:

Paragraph G-3: Delete "Specification AN-S-6b"
and substitute "Specification MIL-S-6073."

Copies of this specification may be obtained from the Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio; or the Commanding Officer, U. S. Naval Air Station, Johnsville, Pennsylvania.

When a request for this specification is received by a supplying activity it will be necessary to attach this cover sheet to the pertinent specification before issue.

Custodian:
Air Force

Other interest:
Navy-BuAer

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.-

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.
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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 Rubra)
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.

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, dots, 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.-

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.

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

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:
 SPRUCE; AIRCRAFT
 Specification AN-S-6b
 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	1-1/32	1-5/32
1-1/2	1-9/32	1-13/32
1-3/4	1-7/16	
2	1-5/8	1-26/32
2-1/4		2-1/8
2-1/2	2-1/8	2-3/8
3	2-5/8	2-6/8
3-1/2	3-1/8	
4	3-5/8	3-6/8

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 unreliable 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.

F. METHODS OF SAMPLING, INSPECTION, AND TESTS.

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

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

F-1b. Previous Approval.- 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. Examination of Product.- All finished aircraft plywood in any lot or shipment shall be examined to determine conformance with the requirements for workmanship, construction, thickness, straightness of grain, defects, joints, size, and finish.

F-2a. Examination of Veneer.- In determining the allowable defects in veneer, a 12-inch square placed parallel with the grain shall be used.

F-3. Sampling.

F-3a. Sampling for Mandrel Bending Tests on Veneers.- Each sheet of veneer shall be inspected visually. The number of sheets of veneer to be taken for mandrel bending tests shall be left to the discretion of the Inspector except that not less than one sheet from each flitch or 5 sheets from each crate or stack of veneers shall be selected. Bending specimens shall be cut from the entire width of each sheet of veneer from within 24 inches of each end, and at intervals not to exceed 6 feet along the length of the sheet in such a way that the specimens shall include representative proportions of any areas in which slope of grain steeper than 1 in 10 is suspected. At the discretion of the Inspector all specimens may be tested but not less than 1 in 5 specimens shall be tested.

F-3b. Sampling for Specific Gravity Tests.- Samples shall be selected at the discretion of the Inspector except that each flitch, crate, stack or bolt from which veneer is cut shall be represented by not less than 20 determinations from not less than 4 sheets. The specimens for specific gravity determination shall be uniformly distributed over each selected sheet of veneer.

F-3c. Sampling for Shear Tests on Glue Joints.- The number of samples to be taken for test shall be left to the discretion of the Inspector, except that in any case not less than one sample from each of two separate panels shall be selected at random from each 200 panels of each lot, and each working shift for each press shall be represented by not less than one sample.

F-3d. Lot.- A lot shall consist of 500 or less panels of the same material, size, thickness, and number of plies, furnished under the same contract or order.

F-4. Moisture Content.- The moisture content of specimens shall be determined in accordance with AN Aeronautical Specification AN-W-3.

F-5. Test Methods.-

F-5a. Mandrel Bending Test - The size of the specimen for mandrel bending tests shall be one inch wide across the grain of the veneer and between nine and eleven inches in length. The ratio of the radius of the mandrel to the thickness of the veneer shall be as specified in Table IV. The specimens shall be cut with the minimum slope of grain from the edges and shall be oven dry at the time of the test. Upon test, the tight side of the veneer shall be outward and the open side against the mandrel. The specimens shall be bent at the specified radius to a parallel-sided "U" shape without support on the tension side. Breakage shall consist of fractures extending 1/8 inch or more across the

width of the specimen. Tears along the fiber direction that begin at the edge and extend into the specimen along grain sloping from the edge shall not be considered breakage. Whether a specimen breaks shall be determined before removal from the mandrel. Breakage of more than 20 percent of all the specimens tested shall be considered cause for rejection of the flitch, crate, or stack.

TABLE IV
 Ratio of Radius.(R) of mandrel to Thickness (T) of veneer
 of different species for use in mandrel bending tests.

		Groups of Species		
Thickness of veneer		Basswood	Magnolia	Douglas-fir
		Soft Maple	American Elm	Noble fir
		Yellowpoplar	Sweetgum	Western hemlock
		Water tupelo	Birch, Alaska	Spruce, white, red
		Sycamore	and paper	and sitka
		Mahogany	Pecan	Port Orford white
		Khaya	Black Walnut	cedar
			Sugar maple	Pine, ponderosa
			Yellow birch	Pine, sugar
			Beech	
Inch	Ratio: = R/T			
0.011 and 0.020	46	34	47	
0.030	46	34	57	
0.034 to 0.047 incl.	50	40	57	
0.060 to 0.095 incl.	55	50	67	

F-5b. Determination of Specific Gravity.- Specific gravity shall be determined by means of a Jolly balance spring on a specimen the surface area of which is 50 or 100 square centimeters. The thickness shall be measured to the nearest 0.001 inch. The specimens shall be oven dry at the time of the test.

F-5c. Shear Tests on Glue Joints.- Shear tests shall be conducted on specimens of the form shown in Figure 1. Five to 15 specimens from each sample shall be tested for each condition specified under section E. The ends of the specimen shall be gripped in jaws of the type shown in Figure 2, and the load applied at a rate of 600 to 1,000 pounds per minute. Plywood consisting of more than 3 plies shall be stripped of all except any three selected plies, and then prepared as shown in Figure 1. In plywood of 7 plies, and over, tests shall be made on both the center three plies and either or both of the outer three plies. In plywood with face plies thicker than .047 inch, the shear area shall be one square inch, as shown in Figure 1, specimen A. Specimens of plywood with face plies .047 inch or less in thickness shall be of the form shown in Figure 1, specimen B in which the shear area shall be reduced without changing the width of the specimen, to 1/2 square inch. Test machine loads obtained from specimens of 1/2 square inch shear area shall be multiplied by 2 to convert to pounds per square inch then reduced by 10 percent before comparing with the requirements set forth in Table IV.

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F-5c(1). Shear Tests in Dry Condition.- Five to 15 specimens from each sample shall be tested to failure by the method described herein. The specimens at the time of test shall have a moisture content of between 8 and 12 percent inclusive.

F-5c(2). Shear Tests After Immersion in Boiling Water.- Five to 15 specimens from each sample shall be completely submerged for 3 hours in boiling water. They shall then be removed from the boiling water, placed in cold water, until at approximately room temperature and, while still water soaked, tested to failure by the method described herein.

F-6. Rejection and Retest.- Failure of any panel of plywood to conform to the requirements of this specification shall be cause for rejection. If shear test averages fail to meet either the dry or wet shear test requirement, the lot represented shall be rejected or at the option of the manufacturer and with the consent of the Inspector, each panel of the lot may be individually tested and rejected or accepted. Plywood which has been rejected may be reworked or replaced to correct the defects and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and the action taken to correct the defects found in the original shall be furnished the Inspector. Plywood rejected after retest shall not be resubmitted without the specific approval of the Procuring Agency.

G. PACKAGING, PACKING, AND MARKING FOR SHIPMENT.

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

G-2. Exterior Packing.- Unless otherwise specified plywood shall be packed for domestic shipment. Each shipping container insofar as possible shall contain the identical number of articles, shall be of a uniform size and shall be designed to inclose the contents in a snug, tight fitting manner. The faces of the outermost panels or veneers in the shipping container shall be protected with thick veneer, rejected plywood, or other suitable material providing complete surface coverage.

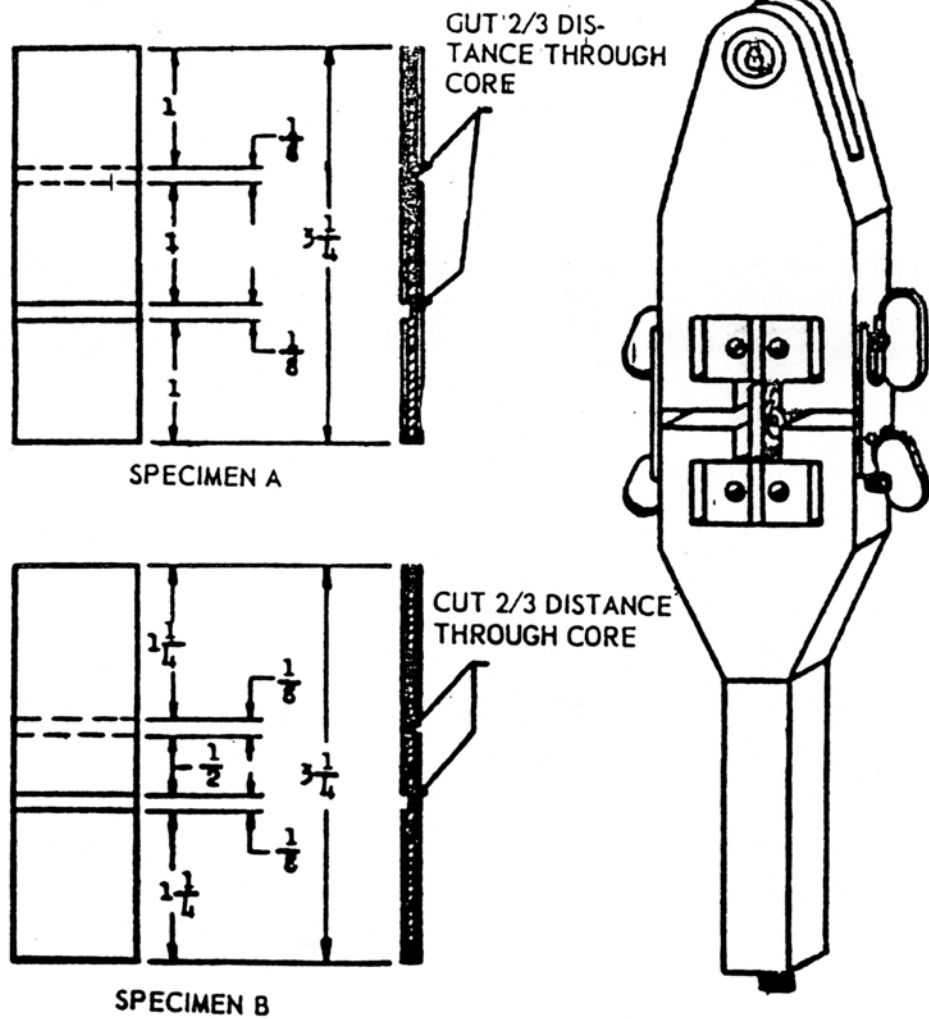
G-2a. Domestic Shipment.- Shipping containers shall be so constructed as to insure acceptance of plywood or veneers, by common or other carrier, for safe transportation, at the lowest rate, to the point of delivery. The plywood or veneer shall be packed in containers which will protect all edges from injury during shipment.

G-2b. Export Shipment.- Unless otherwise specified, for export shipment, plywood or veneers shall be packed in crates in accordance with Specification JAN-P-132.

G-3. Marking.-

G-3a. Exterior Shipping Container.- Each shipping container shall be marked as follows and as specified in section H.

PLYWOOD AND VENEER; AIRCRAFT FLAT PANEL
Specification AN-P-69a
Species of faces
Species of inner plies
Number of plies
Size and Thickness of Panels
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,
Stock No. _____ (AAF or Navy as applicable)



DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED, TOLERANCE $\pm 1/64$.

Figure 1. Plywood Glue Shear-Test Specimens

Figure 2. Testing Grips

E. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS.

H-1. The following departmental specifications of the issue in effect on date of invitation for bids shall form a part of this specification, applicable to purchases by the agency indicated.

H-1a. Army.- U. S. Army Specification 94-40645 Marking; Shipment (Domestic and Export). Copies of this specification may be obtained upon application to any of the Army Air Forces activities listed in section I.

H-1b. Navy.- Navy Shipment Marking Handbook.- Copies of this handbook may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington 25, D. C.

I. NOTES.

I-1. Use.- Plywood covered by this specification is intended for use in the fabrication of structural or highly stressed parts of aircraft such as wing and fuselage coverings, wing rib webs, etc.

I-2. Procurement of Aircraft plywood will be expedited and simplified, with less waste of materials and labor on the part of the manufacturer, if the grade, type and construction details, provided for in this specification are followed. Ordering of plywood of large sizes that is to be later cut to smaller sizes, diagonal grained plywood, veneers of unusual thickness, and more restrictive provisions than herein specified, limit the amount of suitable material available and increase the time required for manufacturer. Such special requirements should be avoided as much as possible by procuring agencies.

I-3. Multiple Sizes.- Multiple sizes may be furnished under this specification. The number of multiples in size to be furnished shall be acceptable to the purchaser and a sufficient excess of material to allow for cutting the panel to the required size or sizes shall be provided by the plywood manufacturer.

I-4. Superseding Data.- Specification AN-P-69a supersedes all previous issues of AN-P-69 which superseded the current issue of AN Aeronautical Specification AN-NW-P-511 for Army and Navy aeronautical use.

I-5. Design Data.- For design data see the latest issue of the ANC Bulletin 18, Design of Wood Aircraft Structures.

I-6. Specific Gravity of Veneer.- A method for determination of specific gravity of veneer using a Jolly balance spring is described in Report No. 1397 which is available for free distribution by the Forest Products Laboratory, Madison 5, Wisconsin.

I-7. Ordering Data.- Requisitions, contracts and orders should state the number of piece, length and width in inches, direction of grain, thickness of the plywood, number of plies, the species of wood which shall be used for faces and inner plies, and whether Export Shipment packing is desired (see section G). Size specified should be finished sizes and should conform to commercial sizes, where practicable.

I-8. Compression Wood.- Pronounced compression wood ordinarily has wide annual rings, less than six per inch, and summerwood that lacks definite contrast in appearance with adjacent springwood. Summerwood of mild compression wood usually occupies less than one-third of the width of the annual rings, and is contrasting and well defined from adjacent springwood.

I-9. Slope of Grain.- Slope of grain from the edge of the sheet may be readily determined in rotary cut veneer by tearing the sheet and measuring the slope of the tear.

I-10. Publication.- When requesting publications, refer to both title and number.

I-10a. Sources.- Copies of Army-Navy aeronautical specifications, INC publications, and Joint Army-Navy specifications 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.

NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

TABLE I
 Species of Wood

Group I (High-Density)		Group II (Medium Density)		Group III (Low Density)	
Species	Minimum Specific Gravity(1)	Species	Minimum Specific Gravity(1)	Species	Minimum Specific Gravity(1)
American Beech	0.60	Birch (Alaska and Paper)	0.53	Basswood	0.36
Birch (Sweet and Yellow)	0.58	Khaya (African Mahogany)	0.42	Yellowpoplar	0.38
Maple (Hard)	0.60	Magnolia, Southern	0.48	Port Orford White Cedar	0.40
Pecan	0.62	Mahogany (Tropical American)	0.46	Spruce (Red, White and Sitka (Quarter- sliced)	0.36
		Maple, Soft	0.46	Ponderosa Pine (Quarter-sliced)	0.38
		Sweetgum	0.48	Sugar Pine	0.34
		Water Tupelo	0.47	Noble Fir (Quar- ter-sliced)	0.36
		Black Walnut	0.52	Western Hemlock (Quarter-sliced)	0.40
		Douglas Fir (Class N) (Quarter-sliced)	0.45	Redwood (Quarter- sliced)	0.38
		American Elm (Quarter-sliced)	0.50	Douglas Fir (Class L) Quar- ter-sliced)	0.38
		Sycamore	0.49		

NOTE: (1) Based on weight and volume when oven-dry.

D. GENERAL REQUIREMENTS.

D-1. See section E.

E. DETAIL REQUIREMENTS.

E-1. Veneer.-

E-1a. The veneer may be rotary cut, sliced, or sawed except as otherwise specified in Table I.

E-1b. The thickness of veneer shall be within the tolerances shown in Table III. These thicknesses and tolerances apply when the veneer has a moisture content of 8 to 12 percent, inclusive.

E-1c. The specific gravity shall not be less than the minimum specified in Table I.

E-2 Workmanship.- The veneer shall comply with the best aircraft standards for flatness, smoothness, uniformity of thickness, and tightness of cut. Upon bending, the veneer shall show no appreciable difference between the "closed" and "open" side. Evidence of "open" cutting shall be cause of rejection.

TABLE II
Permissible Panel Construction

No of Plies	Plywood Thickness and Tolerances in Inches	Thickness of Plies in Inches (8-12 Percent Moisture Content)								
		Group I or II			All Group I or All Group II			All Group III		
		Faces with Group III Inner Plies								
		F&B	XB	C	F&B	XB	C	F&B	XB	C
3	.035±.004	--		--	.011	(1)	.011	--		--
3	.070±.007	.020		.030	.020		.030	.020		.034
3	.100±.008	.030		.040	.030		.040	.030		.047
3	.125±.010	.034		.060	.034		.060	.034		.068
3	.155±.011	.040		.080	.040		.080	.040		.080
3	.185±.012	.047		.095	.047		.095	.047		.095
5	.160±.012	.030	.034	.030	.030	.034	.030	.030	.034	.030
5	.190±.015	.034	.047	.034	.034	.047	.030	.034	.047	.034
5	.225±.015	.040	.060	.030	.040	.060	.030	.040	.060	.034
5	.250±.015	.047	.060	.047	.047	.060	.040	.047	.060	.047
5	.315±.015	.060	.080	.047	.060	.080	.040	.060	.080	.047
5	.375±.018	.060	.095	.080	.060	.095	.080	.060	.095	.080
7	.410±.020				All Plies				.060	
7	.460±.022				All Plies				.068	
7	.540±.023				All Plies				.080	
9	.590±.025				All Plies				.068(2)	
9	.695±.028				All Plies				.080(2)	
11	.850±.035				All Plies				.080(2)	
11	1.010±.035				All Plies				.095(2)	

NOTES: (1) All plies of 0.035-inch plywood must be of Group I species.
(2) Faces, backs, and outer cross-bands of plywood having nine or more plies must be of the same species.

CODE: F&B = Face and Back

XB = Cross Bands

C = Core

E-3. Defects.-

E-3a. Veneer containing the following defects is not acceptable:

Brash Wood

Pronounced Compression Wood (Present in coniferous species only)

Shakes

Compression Failure

Patching in any Form

Rot or any other form of decay (mineral streaks, stains, and colorations shall not be considered as defects unless associated with decay).

TABLE III
Veneer Thickness and Tolerances
(8 to 12 Percent Moisture Content)

Veneer Thickness	Tolerance
Inch	Inch
.011	±.001
.020	±.002
.030	±.002
.034	±.003
.040	±.003
.047	±.003
.060	±.003
.068	±.004
.080	±.004
.095	±.004

E-3b. The face ply shall be free of open defects to provide a smooth finish surface. The inner plies and back may have the same permissible defects as the face, and in addition, open defects as hereinafter specified. Permissible defects may appear singly (one type only) or as a combination of more than one type. When more than one type of defect is present, their total limitation, computed according to the equivalent defects given below, shall not exceed the limit specified for any one type. When defects other than those specified, or concentration of defects, are encountered, they are permitted provided their damaging effect is not more serious than those herein specified.

E-3c. Equivalent Defects - The following shall be regarded with respect to their effect as the equivalent of one 3/8-inch sound knot:

- One 3/8" knot hole
- One 3/4" sound tight burl
- One insect hole 2 inches in length that cuts across the grain 3/8"
- One pitch pocket, with the product of length and width equal to 1/4 square inch
- One bark pocket, with the product of length and width equal to 1/4 square inch
- One split 8 inches in length and 1/32 inch in width.

E-3c(1). Face Plies.-

E-3c(1)a. Sound Tight Knots.- No single knot shall exceed 3/8 inch in average diameter. The total number of sound tight knots shall be not more than six in any 12-inch square, and the sum of the diameters in any 12-inch square shall not exceed three-fourth of an inch.

E-3c(1)b. Sound Tight Burls.- No single burl shall exceed 3/4 inch in average diameter. The total number of sound tight burls shall be not more than six in any 12-inch square, and the sum of the diameters in any 12-inch square shall not exceed 1-1/2 inches.

E-3c(1)c. Mild Compression Wood.- Streaks of mild forms of compression wood (present in coniferous species only) shall not aggregate more than 10 percent of the width of the panel and shall in no case be wider than 1/2 inch.

E-3c(2). Inner Plies and Back.- The following defects, in addition to those permitted in the face, are acceptable in the inner plies and back.

E-3c(2)a. Knot Holes.- No single knot hole shall exceed $3/8$ inch in average diameter. The total number of knot holes shall be not more than six in any 12-inch square and the sum of the diameters in any 12-inch square shall not exceed $3/4$ inch.

E-3c(2)b. Insect Holes.- No single hole shall exceed 2 inches in length along the grain, $1/8$ -inch diameter, nor cut across the grain more than $3/8$ inch. The total number of insect holes shall be not more than six in any 12-inch square and the sum of the lengths across the grain shall not exceed $3/4$ inch.

E-3c(2)c. Pitch Pockets and Bark Pockets.- The product of the length and width of any pitch or bark pocket shall be not more than one-fourth square inch. The total number of pitch or bark pockets shall be not more than one-fourth square inch. The total number of pitch or bark pockets in any 12-inch square shall be not more than six, and the sum of the products shall not exceed one-half square inch. Pockets shall be not closer than 24 inches on the same or adjacent grain lines.

E-3c(2)d. Splits.- Splits shall be no more than $1/32$ inch in width and shall not occur more frequently than twice in any 12 inches measured perpendicular to the grain of the ply in question. The length of a split in any ply shall not exceed ten percent of the distance between the edges of a panel, as measured along a line parallel to the grain of that ply and passing through the split.

E-4. Straightness of Grain.- On at least 90 percent of the area of each sheet of veneer, the slope of grain from the edge of the sheet shall be not steeper than 1 in 10, nor shall the slope of the grain from the plane of the sheet be steeper than 1 in 10, or the veneer shall withstand mandrel bending tests, described in section F, at ratios of radius of curvature to thickness as specified in Table IV with breakage of not more than 20 percent of the specimens.

E-5. Thickness.- The thickness of individual plies, the number of plies, and the thickness of the plywood shall be as stated in Tables II and III, unless otherwise specified by the Procuring Agency. All veneer of any one layer shall be of the same thickness.

E-6. Construction.- All plies except the core or center ply shall occur in pairs, be of the same species, thickness and direction of grain, but on opposite sides of the core, to give symmetrical construction. Except as otherwise specified, in Table II, footnote (b), all inner plies should preferably be of one species. In all panels of 9 plies or more the two outside plies on each side shall be of the same species and of the thickness specified in Table II. The grain of all plies shall be at right angles to the grain of adjacent plies and to the edges of the plywood, unless otherwise specified by the Procuring Agency.

E-7. Thickness Tolerances.-

E-7a. Veneer.- The allowable thickness tolerances for veneer are given in Table III. The thickness of any sheet shall be considered as the average of ten or more measurements taken at random at the discretion of the Inspector.

E-7b. Plywood.- The allowable thickness tolerances for plywood are given in Table II. The thickness of any sheet shall be considered as the average of ten or more measurements taken at random at the discretion of the Inspector.

E-8. Gluing.- The gluing shall be done in suitable hot-plate presses and the manufacturing details shall be controlled so as to produce joints of uniformly high quality throughout the plywood.

E-9. Joints.-

E-9a. Edge Joints.- Plywood shall have all plies either of one-piece veneer, or of two or more pieces, properly glued on the edges (joints running parallel with the grain of the pieces). The edges of the pieces of veneer shall be jointed straight and square and shall be glued with a water-resistant glue. No metal staples or tape shall be used on interior plies. In plies other than the face, open joints will be permitted provided that in any one joint the opening does not exceed $1/32$ -inch in width or in length, 10 percent of the distance between the edge of the panel as measured along a line parallel to the grain of the ply and passing through the opening.

AN-P-69a

7 February 1946

Superseding

AN-P-69

14 March 1945

ARMY-NAVY AERONAUTICAL SPECIFICATION
PLYWOOD AND VENEER; AIRCRAFT FLAT PANEL

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 publications of the issue in effect on date of invitation for bids shall form a part of this specification:

A-1a. AN Aeronautical Specification.-

AN-W-3 Wood; Determination of Moisture Content of.

A-1b. ANC Publication.-

ANC Bulletin 19 Wood Aircraft Inspection and Fabrication.

A-1c. Joint Army-Navy Specification.-

JAN-P-132 Crates, Unsheathed, Wood; Nailed

A-2. Special requirements of the individual Departments of the Government are noted under section H.

B. GRADE AND TYPE.

B-1. Plywood shall be furnished in one grade only in the species and of the panel construction as selected from Tables I, II and III.

C. MATERIAL AND WORKMANSHIP.

C-1. Species of Wood.- The species of wood given by Table I and as specified in the purchase order shall be used in aircraft flat panel plywood construction.

C-2. Glues.- The glues used in the manufacture of the plywood shall be of the hot-press, thermo-setting, synthetic-resin type.

C-3. Workmanship.- All details of workmanship shall be in accordance with high-grade aircraft plywood manufacturing practice and recommendations of the manual on "Wood Aircraft Inspection and Fabrication"

Ø Paragraph G-3a. Exterior Shipping Container: Amended by deletion of "AAF" in parentheses after "Stock No." and substitution of "USAF."

Ø Paragraph H-1a. Army: Amended to read as follows:

"H-1a. Air Force.- U. S. Army Specification No. 94-10645, Marking; Exterior, Domestic and Export Shipment by Contractors. Copies of U. S. Army Specifications may be obtained upon application to the U. S. Air Force activity listed in section 6."

Ø Paragraph I-4. Superseding Data: Amended by changing "Army" in the third line to "Air Force."

Ø Paragraph I-10a. Sources: Amended to read as follows:

"I-10a. Sources.- Copies of this publication and copies of applicable publications thereto required for Government procurement, and the Index of Military Aeronautical (AN or MIL) Standards may be obtained upon application to the Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio; or to the Commanding Officer, U. S. Naval Air Development Station, Johnsville, Pennsylvania. Military Specifications (aeronautical AN or MIL), ANA Bulletins, and ANA Drawings are available for purchase from the above agencies, acting as agents for the Superintendent of Documents. The price may be obtained from the Index of Military Aeronautical (AN or MIL) standards or upon application to either of the above agencies, and payment shall be made by check or money order, payable to the Superintendent of Documents or the Treasurer of the United States.

Ø Indicates changes incorporated in this amendment over previous amendment.

AN-P-69a
AMENDMENT-2

25 July 1949
Superseding
Amendment -1
17 February 1947

AIR FORCE-NAVY AERONAUTICAL SPECIFICATION
PLYWOOD AND VENEER; AIRCRAFT FLAT PANEL

This amendment, approved on the above date by joint action of the Air Force and Navy Departments, forms a part of and shall be attached to AN Aeronautical Specification AN-P-69a, dated 7 February 1946.

¶ Paragraph A-1a. Amended by the addition of the following:

"AN-A-45 Adhesive; High-Temperature-Setting Resin
(Phenol, Melamine and Resorcinol Base)
AN-W-4 Wood; Determination of Specific Gravity of"

¶ Paragraph A-1b. Amended by the addition of the following:

"AWC Bulletin 18 Design of Wood Aircraft Structures"

¶ Paragraph C-2. Glues: Amended to read as follows:

"C-2. Adhesives.- The adhesives used in the manufacture of the plywood shall be of the hot-press thermosetting, phenol-, melamine-, or resorcinol-type conforming to Specification AN-A-45."

¶ Paragraph E-1c. Amended to read as follows:

"E-1c. Specific Gravity.- Specific gravity shall be determined as described in section F. The average specific gravity of all samples from any one crate, stack, flitch, or bolt shall not be less than the minimum specified in table I, and the average specific gravity of any one sheet of veneer shall not be less than the minimum specified in table I."

Paragraph E-13. Shear Test Values of Wood Failure: Amended to read as follows:

"E-13. Shear Test Values of Wood Failure.- Specimens shall be subjected to shear tests as described in section F. The test specimens shall not show delamination or separation at the bond lines before testing or during the boiling period. When the test specimens have an average shear strength of less than 250 psi, they shall show not less than 30 percent minimum and 60 percent average wood failure. When the test specimens have an average shear strength ranging from 250 to 400 psi, they shall show not less than 15 percent minimum and 30 percent average wood failure. When the test specimens have an average strength greater than 400 psi, no wood failure shall be required."

29 March 1950

MILITARY SPECIFICATION

PLYWOOD AND VENEER;
AIRCRAFT FLAT PANEL

This specification was approved by the Departments of the Army, the Navy, and the Air Force for use of procurement services of the respective Departments, and supersedes the following specification:

AN-P-69a
7 February 1946

This specification consists of this cover sheet and Specification AN-P-69a, dated February 1946, with Amendment -2, dated 25 July 1949, modified as follows:

Paragraph G-3a: Delete "Specification AN-P-69a" and substitute "Specification MIL-P-6070."

Copies of this specification may be obtained from the Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio; or the Commanding Officer, U. S. Naval Air Station, Johnsville, Pennsylvania.

When a request for this specification is received by a supplying activity it will be necessary to attach this cover sheet to the pertinent specification before issue.

Custodian:
Air Force

Other interest:
Navy - BuAer