

MIL-P-5444
14 December 1949

MILITARY SPECIFICATION

PROPELLER BLADES; GENERAL SPECIFICATION
FOR DETACHABLE
(LAMINATED VENEER UNCOMPRESSED)

This specification was approved on the above date by joint action of the Air Force and Navy Departments for use in the procurement of aeronautical supplies, and supersedes the following specification:

AN-P-82
22 March 1946

This specification consists of this cover sheet and Specification AN-P-82, dated 22 March 1946, with amendment -1, dated 8 October 1948, modified as follows:

Paragraph G-3a: Delete "Specification AN-P-82" and substitute Specification MIL-P-5444."

Copies of this specification 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 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

MIL-P-5444

AN-P-82
AMENDMENT-I

8 October 1948

AIR FORCE-NAVY SPECIFICATION
PROPELLER BLADES; GENERAL SPECIFICATION FOR DETACHABLE
(LAMINATED VENEER, UNCOMPRESSED)

This amendment, approved on the above date by joint action of the Air Force and Navy Departments, forms a part of and should be attached to AN Aeronautical Specification AN-P-82, dated 22 March 1946. It shall become effective immediately upon issue.

Paragraph A-1d: Add new paragraph as follows

"A-1d. Joint Army-Navy Specifications.-

JAN-A-397

Adhesives, Thermosetting - Resin, Room Temperature and Intermediate Temperature Setting, Waterproof (Phenolic, Resorcinol and Melamine Base) (for Wood)."

Paragraph D-2b: The formula shall be amended to read as follows:

$$\text{Unit Stress} = \frac{CF}{A_s} + \frac{MC}{I_s}$$

CF = Centrifugal force for take-off or high speed RPM.

A_s = Total cross sectional area of steel based on root diameter of the lag screws.

M = Net bending moment (bending moment due to air load minus centrifugal restoring moment).

C = Distance from centerline of shank to center of outer row of screws.

I_s = Moment of inertia of steel screws.

$$I_s = \frac{a n_1 r_1^2}{2} + \frac{a n_2 r_2^2}{2}$$

a = Cross sectional area of screw based on root diameter.

n₁ = Number of screws in outer row.

n₂ = Number of screws in inner row.

r₁ = Distance from shank centerline to center of outer row of screws.

r₂ = Distance from shank centerline to center of inner row of screws."

Paragraph H-1a(2): Amended to read as follows:

"H-1a(2). U. S. Air Force Specification No. 14139, Glue; High-Temperature-Setting Resin (Phenol, Melamine, and Resorcinol Base), and Specification JAN-A-397 Adhesives; Thermosetting-Resin, Room-Temperature and Intermediate-Temperature Setting, Waterproof (Phenolic, Resorcinol, and Melamine Base) (for Wood)."

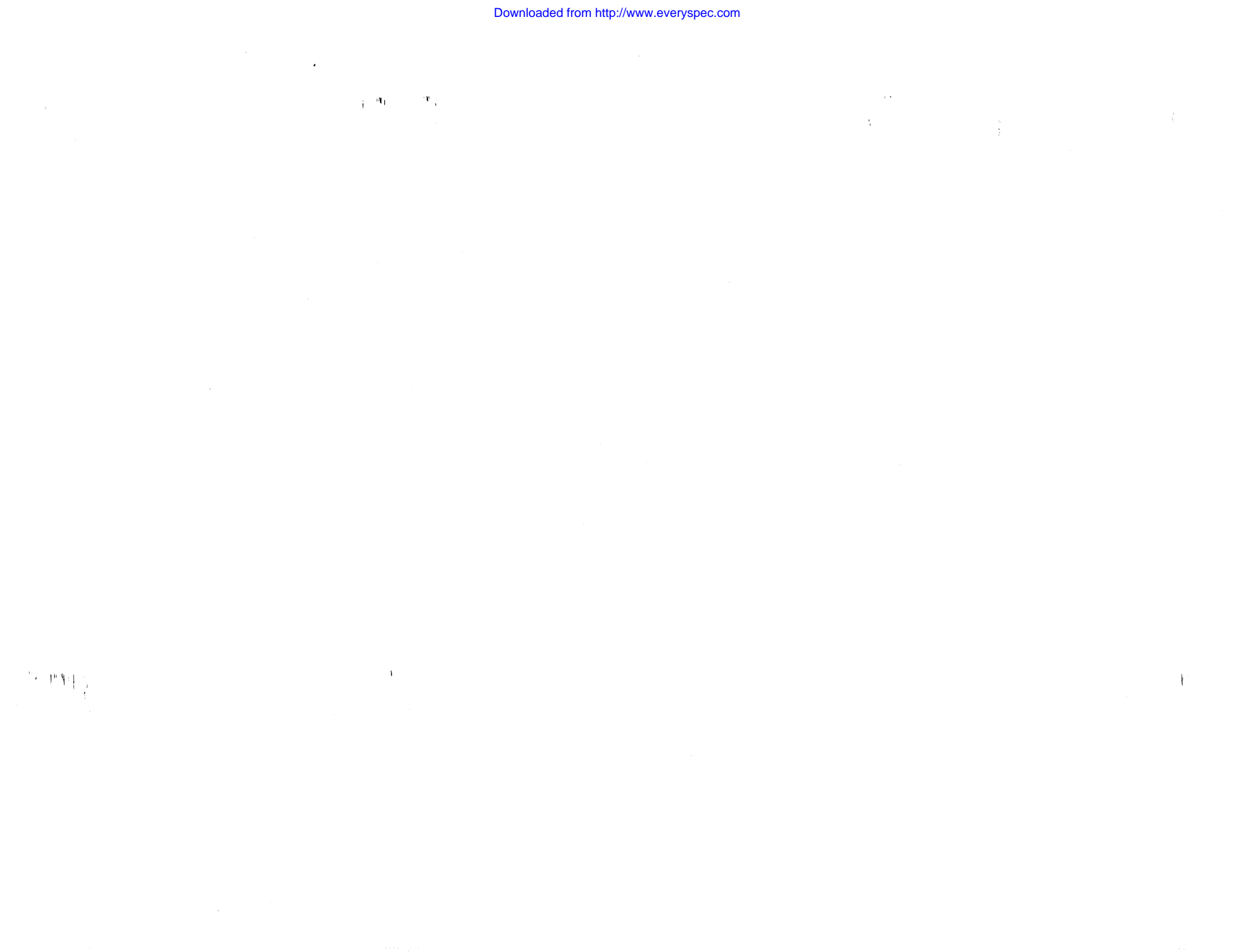
AN-P-82 -2
Amendment -1
(October 1948)

Paragraph I-5a: Amended to read as follows:

"I-5a. Sources.- Copies of Air Force-Navy Aeronautical Specifications, Drawings and Joint Army-Navy Specifications required for Government procurement, and ANA Bulletins and the Index of ANA 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. ANA Specifications and 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 ANA 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.

Paragraph I-5b: Amended to read as follows:

"I-5b. Federal Specifications.- Copies of Federal Specifications and the Federal Specifications Index may be obtained upon application, accompanied by money order, coupon, or cash, to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. The price of Federal Specifications may be obtained from the Federal Specifications Index or the Superintendent of Documents.



MIL-P-5444
AN-P-82
 22 March 1946

**ARMY-NAVY AERONAUTICAL SPECIFICATION
 PROPELLER BLADES; GENERAL SPECIFICATION FOR DETACHABLE
 (LAMINATED VENEER, UNCOMPRESSED)**

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 not later than 22 September 1946. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE SPECIFICATIONS.

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

A-1a. AN Aeronautical Specifications.-

| | |
|-------------|--|
| AN-C-121 | Cloth; Mercerized Cotton, Airplane. |
| AN-E-7 | Enamel; Camouflage, Quick Drying. |
| AN-TT-D-554 | Dope; Cellulose Nitrate Pigmented. |
| AN-P-23 | Propellers; Installation Model Specification (Instructions for Preparation). |
| AN-P-24 | Propellers; Type Test of. |
| AN-P-30 | Packaging and Packing; Aircraft Propellers (For Domestic and Overseas Shipment). |
| AN-S-9 | Steel; Molybdenum (4037) Bar and Rod. |
| AN-V-27 | Varnish; Wood Propeller. |
| AN-QQ-S-690 | Steel; Nickel-Chromium (3140) Bar and Rod. |
| AN-QQ-S-756 | Steel; Chrome-Nickel, Molybdenum (X4340) Bar and Rod. |
| AN-QQ-S-757 | Steel; Corrosion and Heat-Resisting (18 Cr-8 Ni) Plate, Sheet, and Strip. |
| AN-QQ-S-772 | Steel; Corrosion-Resisting (18 Cr-8 Ni) Plate, Sheet, and Strip. |

A-1b. Federal Specification.-

| | |
|----------|---|
| QQ-N-281 | Nickel-Copper Alloy; Forgings, Plates, Rods, Shapes, Sheets, Strips and Wire. |
|----------|---|

A-1c. Army-Navy Commerce Bulletin.-

| | |
|--------|---|
| ANC-19 | Wood Aircraft Inspection and Fabrication. |
|--------|---|

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

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(March, 1946)

B. TYPE.

B-1. This specification covers one type of adjustable wood propeller blades.

C. MATERIAL AND WORKMANSHIP.

C-1. Material.- Materials used in the manufacture of aircraft propeller blades shall be high quality, suitable for the purpose, and shall conform to applicable Government specifications. Material conforming to contractor's specifications for blades and for ferrules may be used provided the specifications are acceptable to the Government and contain provisions for adequate tests. The use of contractor's specifications will not constitute waiver of Government inspection.

C-2. Workmanship and Finish.- The workmanship and finish on all propeller blades shall be in accordance with high grade propeller practice and to the satisfaction of the Procuring Agency. The blades shall be finished smooth, free from defects, finish runs, scratches, excess glue, excess finish, excess solder, overlap ridges, and tool marks.

D. GENERAL REQUIREMENTS.

D-1. Model Specification.- Where the blades are furnished as part of an assembly, a propeller model specification shall be furnished by the contractor for approval and release in accordance with Specification AN-P-23.

D-2. Design.- Unless otherwise specified, when the blades are designed by the contractor, the contractor shall submit three complete sets of blue prints of drawings, made in accordance with Army practices and standards, to the Procuring Agency for approval. One of these sets will be returned to the contractor, and the contractor notified of the approval or disapproval.

D-2a. Data and Drawings.- Blades shall be made strictly according to drawings which have been accepted by the Procuring Agency. Drawings shall not be scaled. In cases of discrepancies, the contractor shall communicate with the Procuring Agency or its duly authorized representative.

D-2a(1). In addition to the dimensions and tolerances normally included on drawings, the contractor's drawings or specifications shall carry the following information when applicable: (When the following information is specified in the specification, the drawing shall reference the applicable specification). Omission of any of this data from contractor's drawings or specifications, shall be explained to the satisfaction of the Procuring Agency unless self-evident.

Material:

Kind of wood used
Weight of blade
(at _____% moisture content)
Protective treatment
Part number, serial number and marking locations
Gage fits.

D-2b. Blade Retention.- The blade retention shall be the Army Air Forces multiple screw retention method or one approved by the Procuring Agency. When the former is used a suitable analysis shall be made and furnished the above agency, showing the distribution of the centrifugal force and bending moments, due to normal operating conditions, among the retaining screws. The screws shall be assumed to carry the bending moments due to the torque force, thrust and centrifugal force. The net unit tensile stress in the retaining screws shall not exceed 40,000 pounds per square inch under normal operating conditions. This unit stress shall be determined from the formula for combined loads, as follows:

AN-P-82 -3
(March, 1946)

$$\text{Unit Stress} = \frac{CF}{A_s} + \frac{MC}{I_s}$$

CF = centrifugal force for normal operating conditions
 A_s = total area of steel based on root diameter of threads
 M = Net bending moment
 C = distance from center of shank to center of outer row of screws
 I_s = Moment of inertia of steel

$$I_s = \frac{a n_1 r_1^2}{2} + \frac{a n_2 r_2^2}{2}$$

a = area of screw based on root diameter
 n_1 = moment of screws in outer row
 n_2 = moment of screws in inner row
 r_1 = radius of outer row of screws
 r_2 = radius of inner row of screws.

D-3. Type Test.- The acceptance of any blade as a service model shall be predicated on the satisfactory completion of a type test in accordance with Specification AN-P-24 or portions thereof, as specified by the Procuring Agency.

D-4. Dimensions and Tolerances.- The blades shall conform to the dimensions shown on drawing within the tolerances specified in Table I, unless otherwise specified by the Procuring Agency.

D-4a. Blades of the same design shall be identical within the limits specified herein.

D-5. Veneer.- Veneer shall be rotary cut from logs of hard maple of minimum specific gravity 0.60 or sweet or yellow birch of minimum specific gravity 0.58. Mill run sound veneer shall be graded to eliminate shakes, decay (rot, dote, etc.), open knots and pronounced discoloration. Veneer containing closed knots of one-half inch diameter or more shall also be eliminated. Only tight cut veneer shall be used in which there shall be no apparent difference in resistance to bending between pith and bark sides of the sheet and upon bending, no knife checks shall appear on the pith side. Rough and loose cut veneers shall be considered defective for propellers.

D-6. Moisture Content.- The moisture content of the veneer shall not exceed five percent at the time of gluing.

D-7. Laying up Veneer.- The plys of veneer shall be laid so that the grain makes an angle of 15 degrees with the axis of the blade and an angle of 30 degrees between the grain of adjacent plys.

D-8. Twisted Blocks.- The plys of veneer shall preferably be laid up on a form or die such that it will be pressed into a form incorporating the twist or pitch desired in the outer 2/3 of the finished blade with the veneers substantially parallel to the chord line of the blade sections. This twist shall be washed out on the inboard heavy sections of the blade.

D-9. Edge Gluing.- Sheets of veneer may be edge glued to form plys of the necessary width. This gluing shall be accomplished in a machine especially designed for the purpose with a thermosetting resin glue and in a manner acceptable to the Procuring Agency. Edge joints shall run substantially parallel to the grain of the veneer.

D-10. Veneer Thickness.- Veneer of 1/16 to 1/32-inch nominal thickness may be used. Veneer of only one thickness, plus or minus .003 inch, may be used in the same blade.

D-11. Preparation of Plys for Gluing.- The sheets of veneer shall be visually examined for freedom from dirt, dust, grease or any foreign substances or materials that would interfere with the adhesion of the glue. The proper percentage of moisture content for the method of gluing employed shall be held within two percent for the block and sufficient check shall be made on the moisture content of the plys to insure uniformity.

AN-P-82 -4
(March, 1946)TABLE I
BLADE DIMENSIONAL TOLERANCES
(in the white)

| | | |
|---|---|---------------------------|
| Blade Length | : | Plus or Minus $1/16$ |
| Edge Alignment | : | Plus or Minus $1/16$ |
| Face Alignment (from shank to 24 inch station) | : | Plus or Minus $3/32$ |
| Face Alignment (30 inch station to tip) | : | Plus or Minus $1/32$ |
| Width of Blade (from shank to 24 inch station) | : | Plus or Minus $3/32$ |
| Width of Blade (30 inch station to tip) | : | Plus or Minus $1/16$ |
| Thickness of Blade (from shank to 24 inch station) | : | Plus $1/8$ Minus $1/16$ |
| Thickness of Blade (30 inch station to tip) | : | Plus $3/64$ |
| Template Fit (from shank to 24 inch station) | : | $3/32$ |
| Template Fit (30 inch station to tip) | : | Plus $1/32$ |
| Blade Angle (from shank to and including 18 inch station) | : | Plus or Minus 1.0 Degrees |
| Blade Angle (24 inch and 30 inch stations) | : | Plus or Minus 0.5 Degrees |
| Blade Angle (36 inch station to tip) | : | Plus 0.4 Degrees |
| | : | |

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(March, 1946)

D-12. Glue.- The glue used in the manufacture of propeller blades shall be as specified in section H. One type of glue only shall be used throughout the manufacturer of blades or blade blocks. Glue shall be prepared in accordance with the manufacturer's instructions. Prior approval shall be obtained from the Procuring Agency for each type of glue used.

D-13. Metal.- The metal used in making ferrules shall conform to Specification AN-QQ-S-756, heat treated to 125,000 to 135,000 pounds per square inch. The steel used in manufacturing screws for attaching the ferrules to the blades shall conform to Specification AN-QQ-S-690 or Specification AN-S-9, heat treated to 140,000 to 150,000 pounds per square inch. Both shall be adequately protected against corrosion by a method satisfactory to the Procuring Agency.

D-14. Blade Ends.- Blade end ferrules shall conform to dimensions shown in Figure 1 or other ferrules acceptable to the Procuring Agency.

D-15. Gluing Blocks.- The blade manufacturer shall so control the temperature of the gluing room and/or heat applied to the block for setting the glue, the amount of glue spread, the time that elapses between spreading the glue and application of pressure and the amount and distribution of pressure so that glue points of maximum strength will be obtained. Manufacturers gluing technique shall be in accordance with the recommendations of Bulletin ANC-19 and shall receive prior approval of the Procuring Agency.

D-15a. Application of Glue.- Glue shall be applied in accordance with the manufacturer's instructions. If the moisture content of the veneer is above three percent at the time of gluing, the pressure may not be removed until the blocks have been cooled to room temperature. Minimum gluing pressures shall be 100 pounds per square inch for fluid pressure or 200 pounds per square inch for pressure applied mechanically through rigid plates, molds or cauls. The gluing shall be done in a room which shall be enclosed, light, clean, and free from dust. Particular care should be taken to spread the glue evenly and in correct amounts. It is recommended that gluing of the entire block be accomplished in one operation. However, if more than one operation is required the gluing technique and methods shall be identical in all operations.

D-16. Installation of Ferrules.- The ferrules shall be installed before the blocks are shaped or rough carved. The blade shank shall be turned down to a press fit with a minimum of plus .003 of an inch, and a maximum of plus .005 of an inch, over the actual inside diameter of the ferrule. The shank shall then be immersed in varnish Specification AN-V-27, for not less than one minute. After the excess varnish has been drained or wiped off, the ferrule is pressed on immediately.

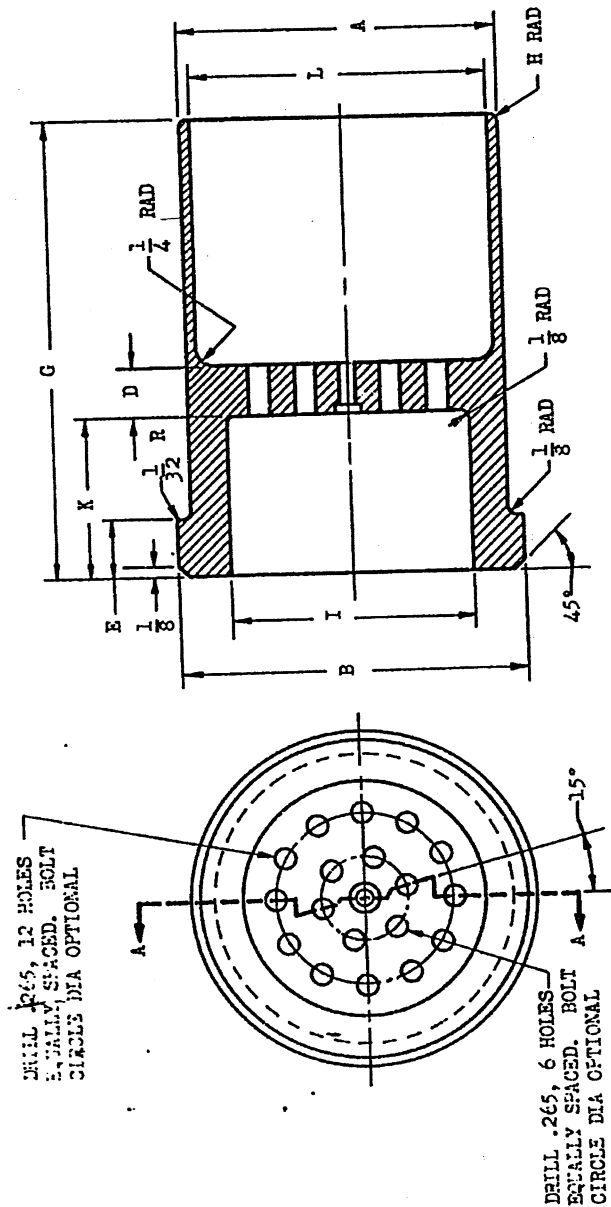
D-16a. The lead holes for the lag screws shall be bored the root diameter of the screws. They shall be concentric with the holes in the web of the ferrule within .005 full indicator reading and parallel to the centerline of the shanks within 1/2 degree. A bushing shall be used in the hole in the ferrule web to accurately center the drill and act as a guide. Holes shall be drilled to a depth equivalent to 1-1/2 times the root radius of the screw greater than that of the wood penetrated by the screw. The bottom of the hole shall be rounded as shown in Figure 2. Air shall be used for cooling the drill during drilling. The use of liquids shall not be permitted for this purpose. Drilling speeds shall be used that will not in any way injure the wood fibers adjacent to the holes.

D-16b. After holes are drilled, blow out chips and dust and apply a coat of varnish Specification AN-V-27, to the inside of the holes. Excess varnish must be removed from the holes and screws driven immediately. The screws may be dipped in varnish, and the excess shaken off, for a lubricant.

D-16c. The screws shall be driven by a means which will insure a 1/8 inch pitch tapped hole and will not strip the metal or wood threads. Each 1/4- inch diameter lag screw shall be brought to a final torque of 160 plus or minus five inch-pound torque. The torque shall be determined with a suitable torque wrench.

c i t c

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(March, 1946)



| BLADE | A | DIA | B | DIA | D | E | G | H | I | K | L |
|-------|-------|-------|-----|------|--------|-------|-------|---------|-----------|-------|-----------|
| END | + | .000 | + | .000 | D | +.005 | | ±.010 | DIA ±.003 | ±.010 | DIA ±.002 |
| NO. | - | .003 | - | .003 | | -.000 | | | | | |
| 0 | 2.953 | 3.746 | 5/8 | 500 | 4-5/32 | 1/32 | 2.700 | 1-1/32 | 2.812 | | |
| 1 | 3.875 | 4.245 | 5/8 | 500 | 4-5/16 | 3/64 | 3.085 | 1-23/32 | 3.700 | | |
| 1-1/2 | 4.187 | 4.620 | 3/4 | .875 | 6-3/8 | 1/8 | 3.312 | 2-1/8 | 3.938 | | |
| 2 | 4.500 | 4.995 | 3/4 | .875 | 6-3/4 | 1/8 | 3.500 | 2-3/8 | 4.250 | | |

MATERIAL: STEEL, SPEC AN-QQ-S-690, AN-QQ-S-756, OR EQUIVALENT.
DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED, TOLERANCES: FRACTIONS $\pm 1/64$, ANGLES $\pm 1/2^\circ$

FIGURE 1. Propeller Blade Ferrule

AN-P-82 -7
(March, 1946)

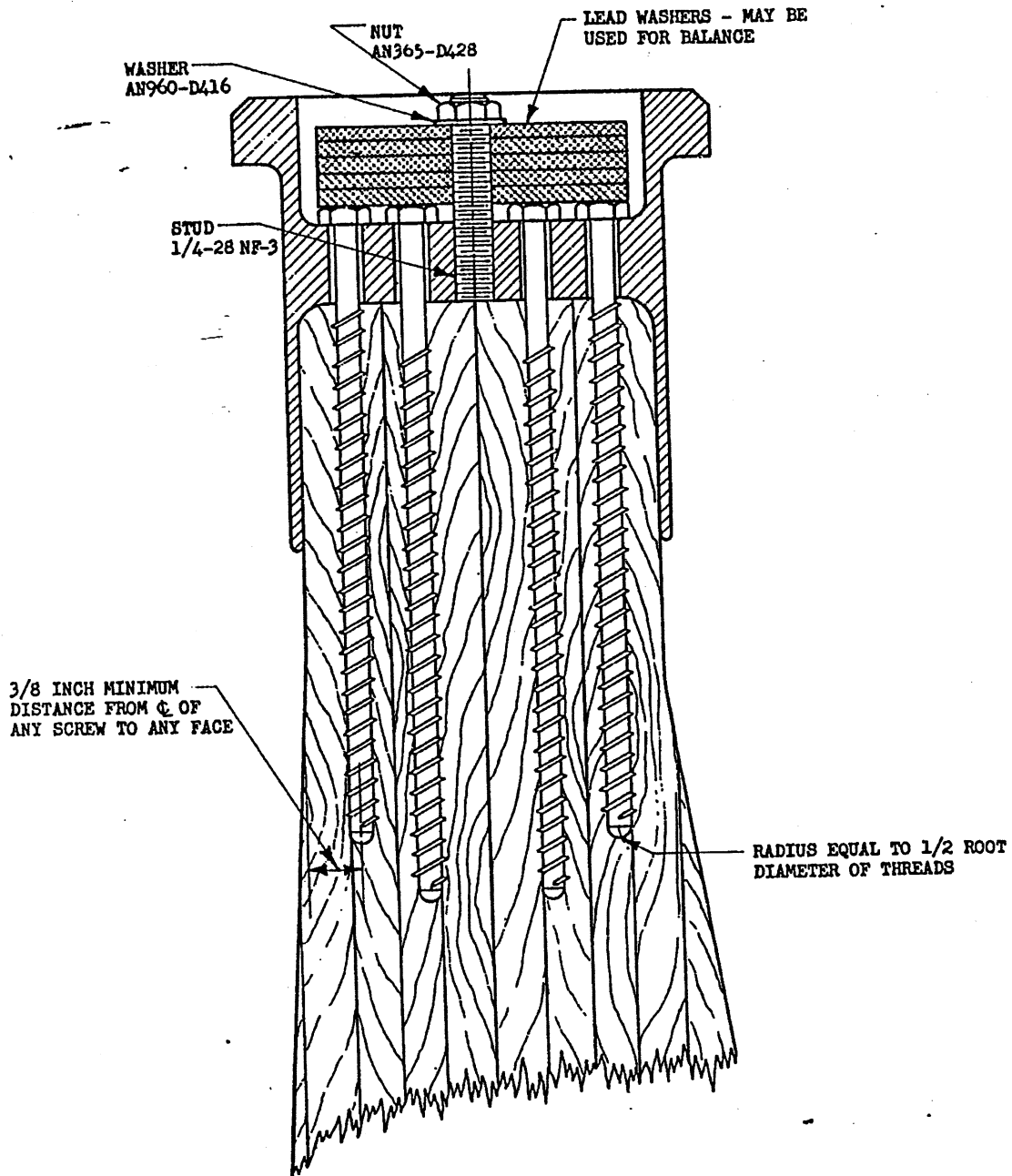


FIGURE 2. Balancing Blade

AN-P-82 -8
(March, 1946)

D-17. Rough Shaping and Conditioning of Blocks.- The blocks shall be roughed out (not closer than 1/16-inch to the finished dimensions). They shall then be placed in a closed conditioning room wherein the relative humidity shall be controlled to maintain an equilibrium moisture content compatible with that of the veneer at the time of gluing. They shall be conditioned therein for not less than seven days at 21 degrees Centigrade (70 degrees Fahrenheit) or not less than two days at 49 degrees Centigrade (120 degrees Fahrenheit). The temperature and humidity shall be recorded periodically in various parts of the room, and, if the conditions vary, the air shall be circulated by means of fans properly located.

D-17a. Final Shaping.- The blocks shall be carved, worked to final size, shaped, and smoothly sandpapered. The change in pitch angle from station to station shall be smooth and true throughout the length of the blade. Irregularities in contour will not be allowed.

D-18. Stations.- The stations used in carving and checking the cross sections are located by planes perpendicular to the center line of the propeller and tangent to arcs whose radii are shown on the drawings. Stations shall be designated according to their radial distances in inches from the center of the hub as indicated on the blade drawing. The first shall be located 12 inches from the center of the hub (an 8-inch or 10-inch station may be added for fairing control) the remaining stations thereafter located in successive increments of 6 inches. A cross-section profile for an intermediate station will be established at the tip portion of the blade and shall be located one-half the total distance between the standard station and the extreme tip when in excess of the 6-inch increment spacing.

D-19. Template Fit.- The blades shall be inspected for template fit as specified in section F.

D-20. Interchangeability.- Blades manufactured to the same design shall be interchangeable in all respects including balance.

D-21. Balancing.- All blades shall be balanced against a master balance which has been checked and approved by the Procuring Agency. They shall balance horizontally and vertically at any two blade angles 90 degrees apart.

D-21a. Propeller blades shall be tested for balance after shaping and after each successive process which might affect their balance.

D-21b. Final Balance.- Horizontal balance shall be attained to within the sensitivity of the balancing equipment which shall be 0.04 pound-inch maximum. Vertical balance shall be obtained within 0.2 pound-inch.

D-21c. The boring of holes and insertion of lead in wood blades to obtain balance will not be permitted. The addition of solder to the tips likewise will not be permitted.

D-21d. Balance may be obtained by carving from the maximum to minimum allowable tolerances and the addition of lead washers to the web of the ferrule as shown in Figure 2. Additional coats of finish may be applied to correct small discrepancies in balance. Other methods of correcting unbalance must be approved by the Procuring Agency.

D-22. Cross Mark.- A cross mark consisting of fine straight lines, approximately 3/8-inch in length, shall be etched on the tipping of the flat surface of each blade and located approximately 1-inch from the tip. One line shall be a projection of the blade center line, perpendicular to the face of the blade at this station, while the other shall be a transverse line forming the cross and located at the nearest inch station to the tip. The designation of the station shall be marked near the cross by etching in accordance with Figure 3. A tolerance of plus or minus 0.010 inch shall be permitted on the marks.

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(March, 1946)

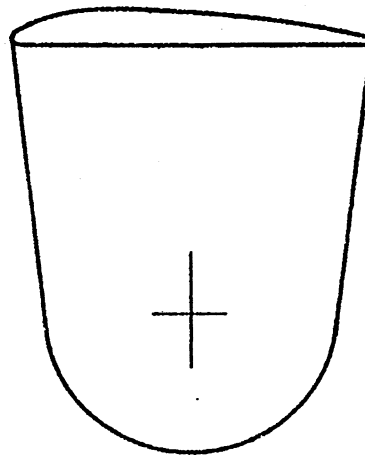


Figure 9. Cross Mark

AN-P-82 -10
(March, 1946)

D-23. Serial Number.- Unless otherwise specified by the Procuring Agency, serial numbers shall be assigned by the manufacturers.

D-24. Identifying Model Designation.- The manufacturer's model designation and design number, whether part number or drawing number, shall be the same.

D-25. Identification Marking.- Each blade shall have the following information etched on the ferrule in a location to be readable after assembly, if possible, and in such a manner as not to affect the balance or strength of the blade:

Blade Model Designation
Ferrule Model Designation
Inspector's Stamp
Serial Number.

D-25a. In addition to the above marking, the blade model and blade assembly number shall be placed on the camber face parallel to the longitudinal axis of the blade approximately 15 inches from the center line of the hub after the first coat and before the last four coats of finish have been applied, either by means of decalcomania, rubber stamp or other suitable manner. The manufacturer's trademark may be applied on the same side of the blade and in a like manner, if desired. Steel stamps or other means of marking which will crush or cut the fibers of the wood shall not be used.

D-26. Sheathing and Tipping of Blades.- Blades shall be sheathed with mercerized cotton fabric, Specification AN-C-121, unless otherwise specified on the drawing. The tips of all individual blades 40 inches or over shall be sheathed for an inboard distance of not less than 15 inches, measured from the tip, and all individual blades under 40 inches shall be sheathed for not less than 12 inches.

D-26a. Application of Fabric.- The fabric shall be cemented to the wood, before any finish is applied, with a suitable adhesive which has been given prior approval by the Procuring Agency.

D-26a(1). Apply fabric to the propeller as follows: After the application of an even coat of adhesive on the camber face, the fabric is laid on starting at the leading edge and trimming the cloth to exactly follow its contour. It is then smoothed down, working from the leading edge and pressing out the glue towards the trailing edge. As soon as the back is covered the blade is turned over. The pitch face is then covered in a similar manner, smoothing the cloth and working the glue from the trailing edge to the leading edge. The excess cloth is trimmed off on the leading edge to follow the contour of the blade. No overlap is necessary where a metal cap is to be applied. The tip shall be allowed to dry under shop conditions for at least 24 hours before further working. The fabric shall be laid free of wrinkles and air pockets and shall adhere tightly throughout. No laps or seams shall appear on the exposed surfaces after the application of metal tipping.

D-26a(2). Prior to further finishing operations, the fabric sheathing shall be given one brush or spray coat of pigmented nitrate dope conforming to Specification AN-TT-D-554. Further finishing shall be in accordance with the requirements as described herein under Finish.

D-26b. Tipping Blades with Metal.- Blades shall be tipped with stainless steel or nickel-copper alloy 0.019 inch plus or minus 0.002 inch thick, conforming to Specification QQ-N-281, Specification AN-QQ-S-757 or AN-QQ-S-772 respectively. The leading edge strip shall be serrated, scalloped, or plain type acceptable to the Procuring Agency. The metal shall be so cut as to be easily formed to the contour of the leading edge of the blade, and burrs shall be removed from all metal edges before application to the blade. The edges of the metal shall be filed to a knife edge at the tip section where overlapping occurs to prevent a ridge being formed by the overlap. The method of applying tipping is illustrated in Figure 4. Any other method of applying the metal tipping to the blade shall be subject to approval by the Procuring Agency.

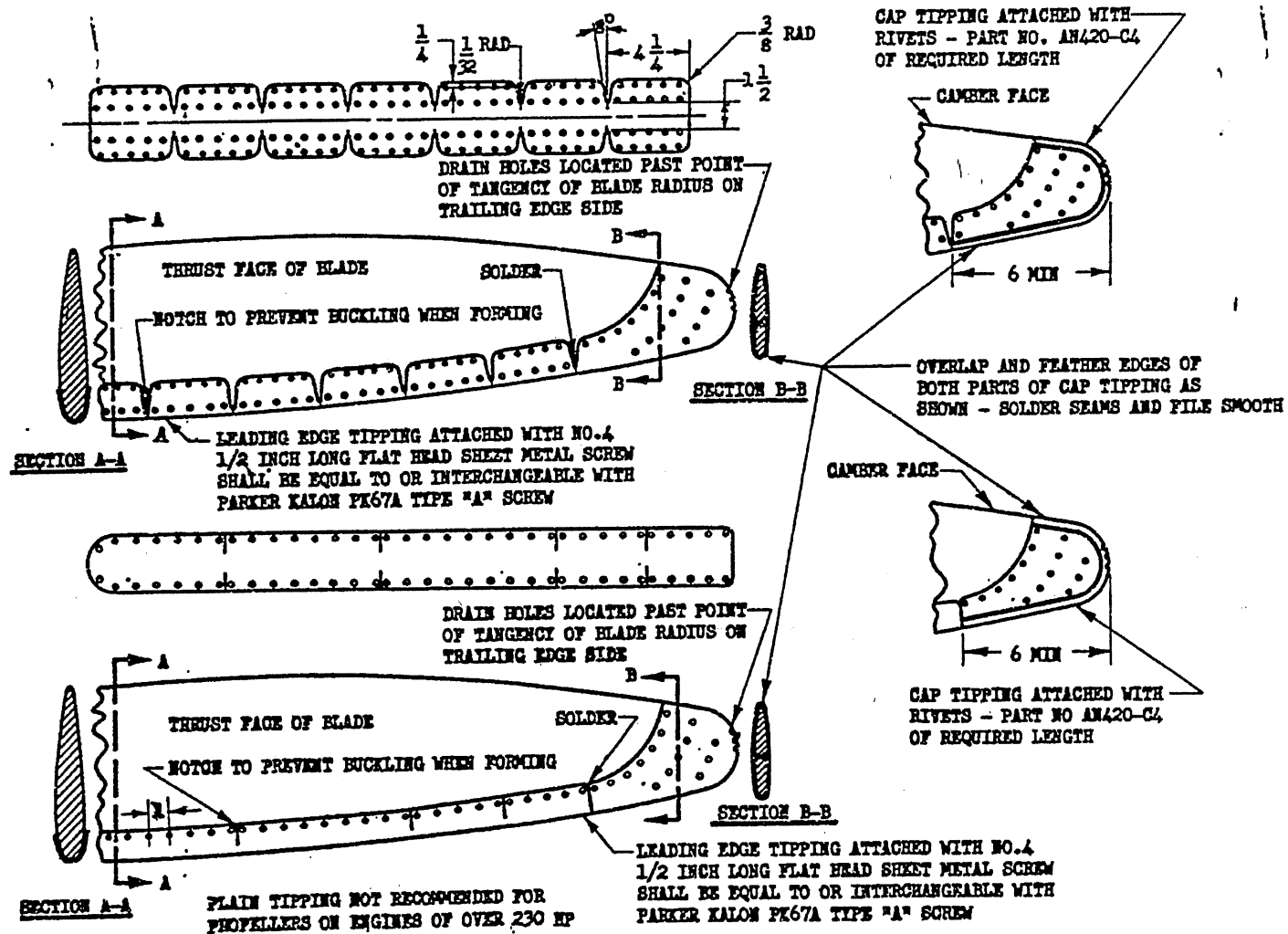


Figure 4. Tipping Blades with Metal

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(March, 1946)

D-26c. Application of Metal Tip.- The metal tip shall be applied over the third coat of finish. The small piece of metal shall be applied to the camber face of the tip first. The ends of the large piece shall then be so lapped over the small piece as to effect a continuous piece of metal along the leading edge. The metal shall be secured by No. 4 brass or plated steel, flat head, sheet metal pointed screws, 1/2-inch long except in the thin section near the tip where 1/8-inch diameter copper rivets shall be used. A lead hole shall be bored in the wood of the blade for the screws and countersunk for the screw heads. The countersunk holes shall be coated with a protective finish. The metal shall not be countersunk to take the screw heads, but shall be dimpled into the countersunk holes in the wood by a method that avoids splitting or compressing the wood.

D-26d. Rivet Holes.- The holes for the rivets shall be drilled through the metal and wood with the metal tip in place. Countersinking of the metal tipping will not be permitted; the metal shall be removed, the holes in the wood countersunk, and a protective coating applied as in the case of the screws. The metal shall then be replaced and carefully dimpled into the countersunk holes before heading as illustrated in Figure 5. Rivet holes shall be drilled to the exact size of the rivet so that the rivets may be pressed in by hand. Rivets shall not be driven in. When completed, the metal tip shall fit snugly against the wood. Buckling or lifting of the metal shall be cause for rejection. Solder shall be filled in over the heads of these rivets and screws and filed down to the smooth surface of the metal tip. Care shall be exercised in soldering screws and rivets to avoid undue heating or charring of the wood.

D-27. Finish.- Unless otherwise specified by the Procuring Agency, all wood propeller blades shall be finished in the following manner:

D-27a. Dipping.- Three dip coats of varnish conforming to Specification AN-V-27 shall be applied. The varnish shall be reduced to not less than 18 percent non-volatile for dipping. The first dip coat shall be applied by complete immersion until rapid bubbling, indicating displacement of air, has ceased. Succeeding coats shall be applied by immersion for not less than ten seconds.

D-27a(1). Drainage.- Following the application of each coat, the blade shall be held in a horizontal position to permit drainage toward the trailing edge. The accumulated material shall be wiped off with rags wet with suitable solvent to prevent the formation of fatty edges. If the ferrule was immersed, all the varnish must be wiped off of it after each immersion.

D-27b. After each coat of varnish has dried, the surface shall be sanded lightly to remove nibs or other irregularities.

D-27c. After the third coat of varnish has dried and has been sanded, the metal tipping shall be applied.

D-27d. Two additional coats of varnish, prepared as described herein under Dipping, shall be applied by spraying or brushing.

D-27e. If camouflage finish is specified, one coat of infrared reflecting camouflage enamel shall be applied by spraying in addition to the previous finish.

D-27f. After the last coat of finish has been applied, coat the tip of each blade for an inboard distance of 4 inches with enamel, Specification AN-E-7, Color No. 614 Orange-Yellow.

E. DETAIL REQUIREMENTS.

E-1. The requirements of drawings and detail specifications specified or approved by the Procuring Agency are applicable as detail requirements of this specification.

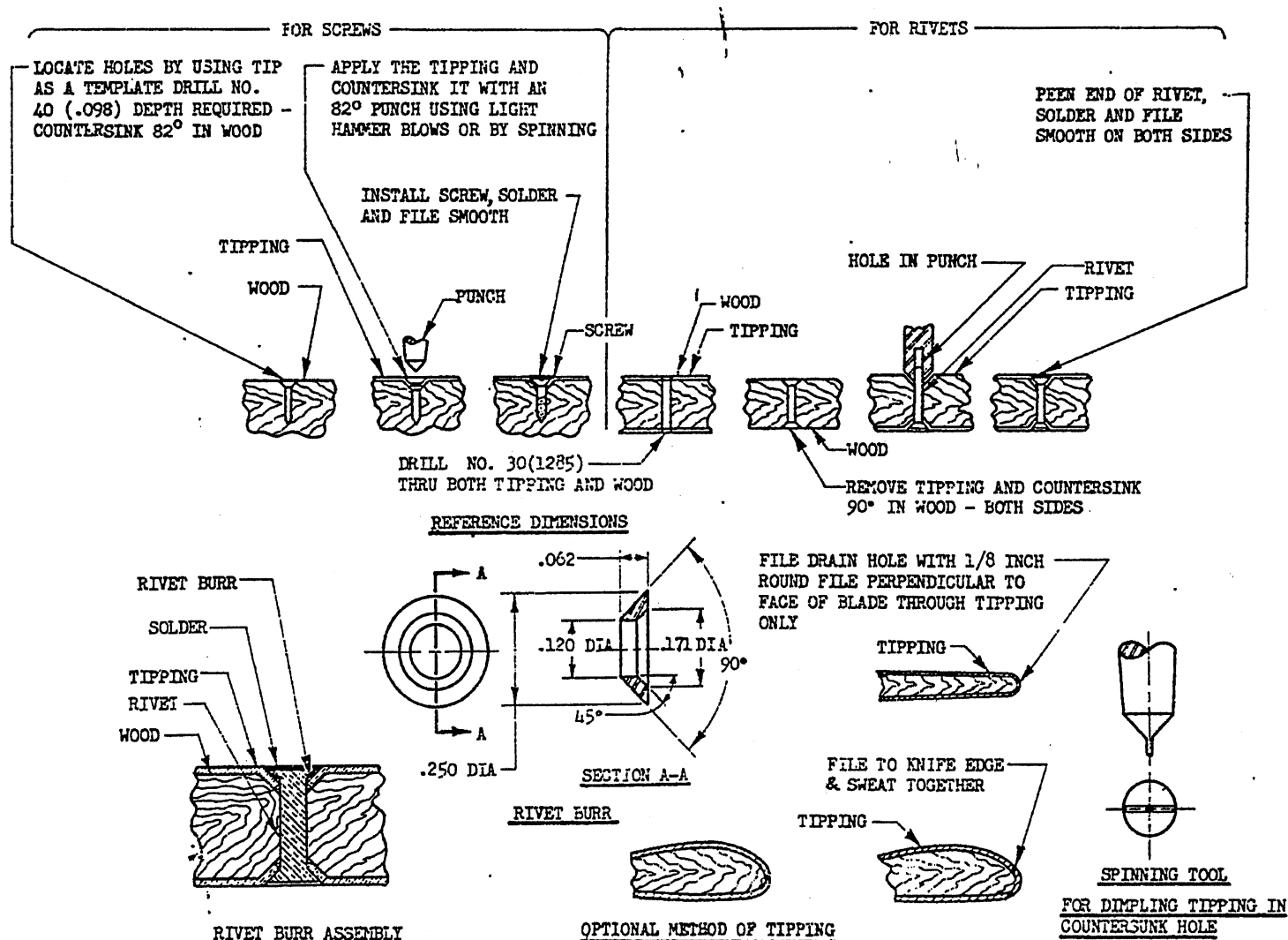


Figure 5 Rivet Holes

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F. METHOD OF INSPECTION AND TEST.

F-1. General.- When inspection is conducted at the contractor's plant tests shall be conducted by the contractor, under the supervision of the authorized 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.- Previous acceptance or approval of material and/or the release of any design by the Procuring Agency, shall in no case be construed as a guarantee of the acceptance of the finished product.

F-1c. All equipment used for the final inspection for acceptance of propellers shall be acceptable to the Government. This equipment shall be subject to checking by the inspector at any time and shall be checked as frequently as deemed advisable to assure consistency of required accuracy.

F-1d. The materials and processes used in the fabrication of the blades shall be subject to inspection in accordance with the Wood Aircraft Inspection and Fabrication Bulletin ANC-19. In case of any discrepancy between the manual and the specifications, the requirements of the specification shall govern.

F-2. Reports of Tests.- The contractor shall furnish test reports, in duplicate, showing quantitative results for all tests and analyses required by this specification and signed by the Director, or his authorized assistant, of the laboratory 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. Inspection of Glue Joints:

F-3a. Each propeller block shall be made up sufficiently oversize in length so that a standard shear block, as shown in Figure 7 may be made of sufficient glue joints to give a representative picture of their quality.

F-3b. On not less than ten percent of the blades, strength of glue joints shall be determined and the records thereof kept for a period not less than one year. At the discretion of the inspector, tests of joint strength may be required on more than ten percent of the blades. Joints between plys of veneer shall develop not less than 1700 pounds per square inch for maple or 1500 pounds per square inch for birch. Selection of joints for testing shall be at the discretion of the Inspector.

F-3c. In addition to the block shear tests, cycle glue tests shall be performed on a minimum of two specimens from the same blade blocks. These specimens shall consist of a cross section of the blade blocks, 1/2-inch in thickness. The cycle test shall consist of immersion for 24 hours in water at room temperature followed by drying for 24 hours at room temperatures. The cycle shall be repeated a second time on the same specimen. Visible delamination of any glue joint during any part of the cycle test shall be cause for rejection of the blade.

F-4. Template Fit:

F-4a. Steel templates constructed as shown in Figure 6 and within plus or minus 0.005 inch of drawing dimensions shall be used to determine the template fit and for final inspection for acceptance.

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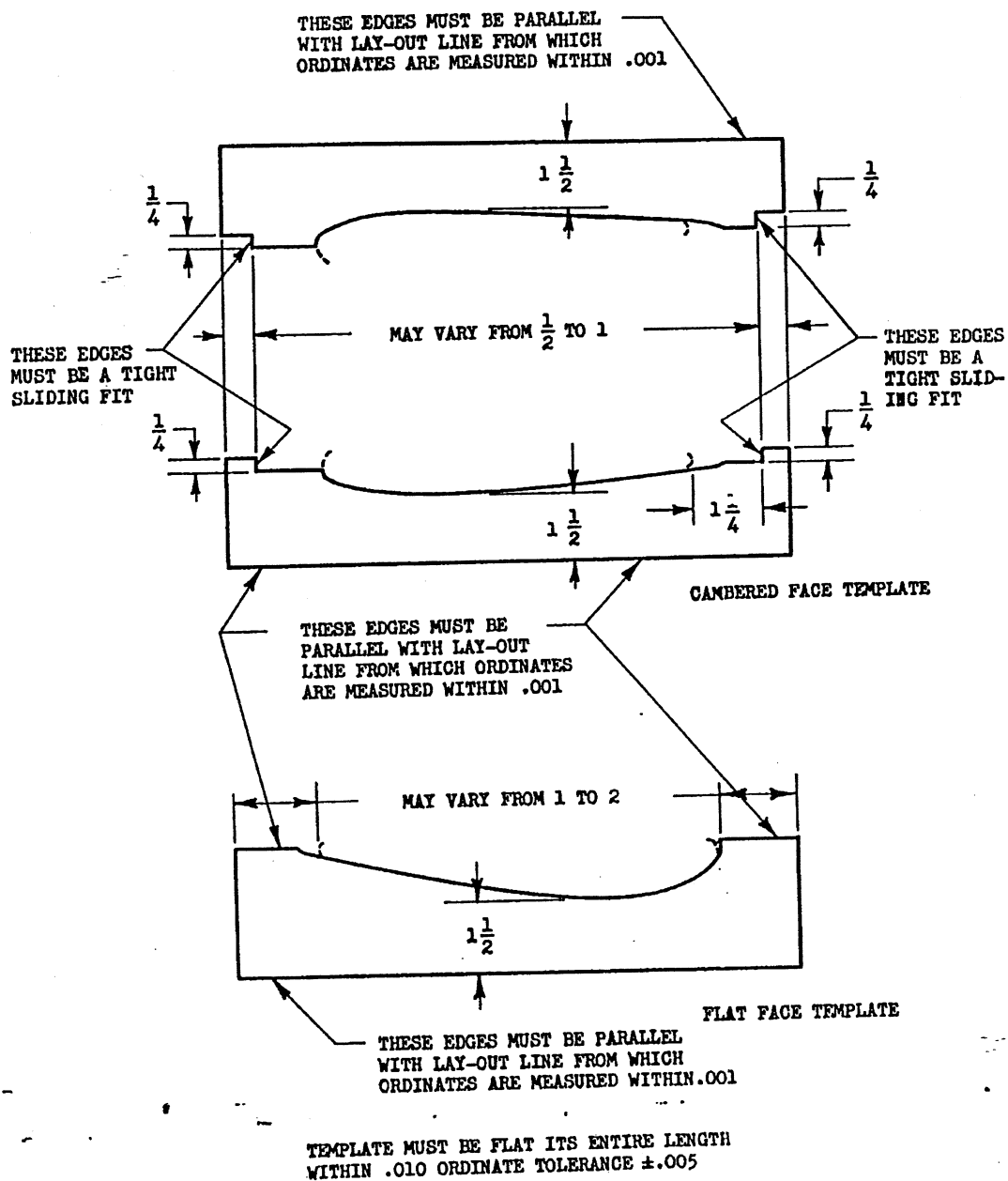


Figure 6. Blade Templates

CVI 2

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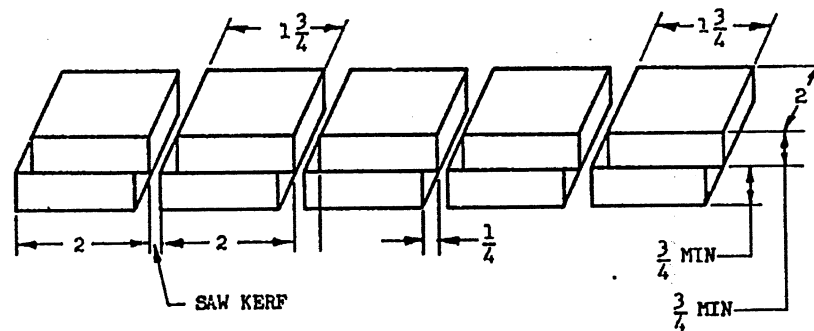


FIGURE 7. Shear Test Specimen

CVI 1/2

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F-4b. The template shall be applied in such a manner that the plane of the template will coincide with the plane of the cross section, as indicated on the drawing. The parting edges of the two halves of the templates shall be kept parallel, the opening or gap being the same at the leading and trailing edges of the section, and the orientation of the template shall be maintained within the angle tolerances of the corresponding station while the gaps between the parting surface of the template and the profile irregularities between template and the surface of the blade section are checked with a narrow feeler gage or other equipment acceptable to the Procuring Agency. The distance between the template halves (gap) shall come within the allowable template fit tolerance at the respective station. All checking with templates shall be accomplished with the blade in the "white". When the use of a straight edge is acceptable for this purpose, it is considered as half a template. The manufacturer may substitute variations in the above procedure for template design and checking provided the variations are acceptable to the Procuring Agency.

F-5. Examination of Product.- Each blade shall be examined for conformance to the requirements of this specification with respect to Workmanship, Defects and Finish.

F-6. Testing.- Testing of materials shall be in accordance with this and referenced specifications or other methods acceptable to the Procuring Agency.

F-6a. All blades or test specimens destroyed in conducting tests required by this or detailed specifications, or to determine conformance with this specification, shall be in addition to the quantity specified in the contract or order and shall be furnished without additional charge to the Procuring Agency.

F-6b. Balancing shall be in accordance with the requirements as specified herein.

F-6b(1). The blades shall be inspected for balance by the use of stands, bushings, mandrels, hubs or holding fixtures, master counterweights or balancing moment, and other necessary equipment which will be acceptable in every detail to a duly authorized Government representative. The conditions and adjustments of the balancing equipment shall be checked for accuracy and correctness at frequent intervals, and the contractor shall immediately correct any error discovered or replace defective equipment.

F-7. Rejection and Retest.- Blades failing to meet the requirements of this specification shall be rejected. Failure of any sample to conform to any one of the requirements of this specification shall be cause for rejection of the lot represented. Rejected articles shall not be resubmitted for approval without full particulars concerning previous rejection and measures taken to overcome the defects being given to the Procuring Agency.

F-8. Acceptance Stamp.- After final acceptance of the product the inspector shall stamp the official stamp of acceptance upon the outboard edge of the steel ferrule. This shall be visible on assembly of the blade into the hub.

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. All propeller blades shall be prepared for shipment in accordance with Specification AN-P-30.

G-3. Marking.-

G-3a. Interior Containers.- The boxes shall be marked to give the following information:

CMV

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Blades; Detachable Propeller (Laminated Veneer, Uncompressed)
General Specification For.

Specification AN-P-82

Design No. _____

Serial No. _____

Government Order No. _____ (or contract number if order number is not assigned)

Name of Contractor (and name of blade manufacturer, if not the same).

G-3b. Exterior Shipping Containers.- Each exterior shipping container shall be marked as specified herein for "Interior Containers" and as specified in section H.

H. 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.-

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

H-1a(2). Army Air Forces Specification No. 14139, Glue; High-Temperature-Setting Resin (Phenol, Melamine, and Resorcinol Base), and Specification No. 14124 Glue; Low-Temperature-Setting Resin (Phenol, Melamine, and Resorcinol Base).

H-1b. Navy.-

H-1b(1). 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.

H-1b(2). Navy Specification No. G-33 (Type I and Type II Glue) Glue; Phenol Aldehyde Resin.

I. NOTES.

I-1. Use.- The wood blades covered by this specification are intended for use on aircraft or for testing aircraft engines.

I-2. Superseding Data.- This specification supersedes Army Air Forces Specification No. 29540 for aeromutical use.

I-3. The contractor will find it to his advantage, when the balancing stage of manufacture is reached, to exercise great care in maintaining a high degree of accuracy throughout the entire blade. It is essential that the allowable tolerances on blade dimensions be utilized solely for balance purposes. For reasons which will be made apparent by subsequent requirements of this specification, the contractor will find it to his advantage to adhere to accurate craftsmanship in machining the shank and ferrule so as to assure concentricity of any cylindrical form to a high degree of perfection.

I-4. Definitions.-

I-4a. Face Alignment.- Face alignment is defined as the distance from the center line of the blade to its thrust or working face as measured perpendicular to the chords of the cross sections of the blade at the various stations.

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I-4b. Edge Alignment.- Edge alignment is defined as the distance parallel to the respective chords of the sections from the center line of the blade to the leading edge of the cross-sections as designated on the drawing. Optional use of the projected edge alignment is permitted when specified on the drawing.

I-5. Publications.- When requesting publications, refer to both title and number.

I-5a. Sources.- Copies of Army-Navy Aeronautical Specifications, Drawings, and Bulletins may be obtained upon application to the Commanding General, Army Air Forces, Air Materiel 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, Pennsylvania.

I-5b. Copies of Federal Specifications may be obtained upon application, accompanied by money order or coupon, or cash, to the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

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.

