design number. The designation system describes (in part) the use and type of the blade. As an example, on a blade designated as a C6353A-18B, the numbers and letters indicate the following:

1—42. The first letter, in this case "C", indicates that a molded rubber fairing has been added over the blade shank. Various styles of fairings are indicated by changes in this letter designation.

1—43. The first number group, in this case 6353, specifies the basic blade design.

1—44. The letter "A" which follows the basic blade design number group shows that the blade is a blade assembly; an assembly, which may vary slightly among the different size blades, usually includes the blade proper, the thrust bearing beveled washer, flat washer, and retainer assembly, the chafing ring, the balancing plug assembly, the bushing, the bushing screws, and the bushing drive pins.

Figure 1—12. Blade Cut-Off Diagram

Figure 1—13. Blade With and Without Fairing

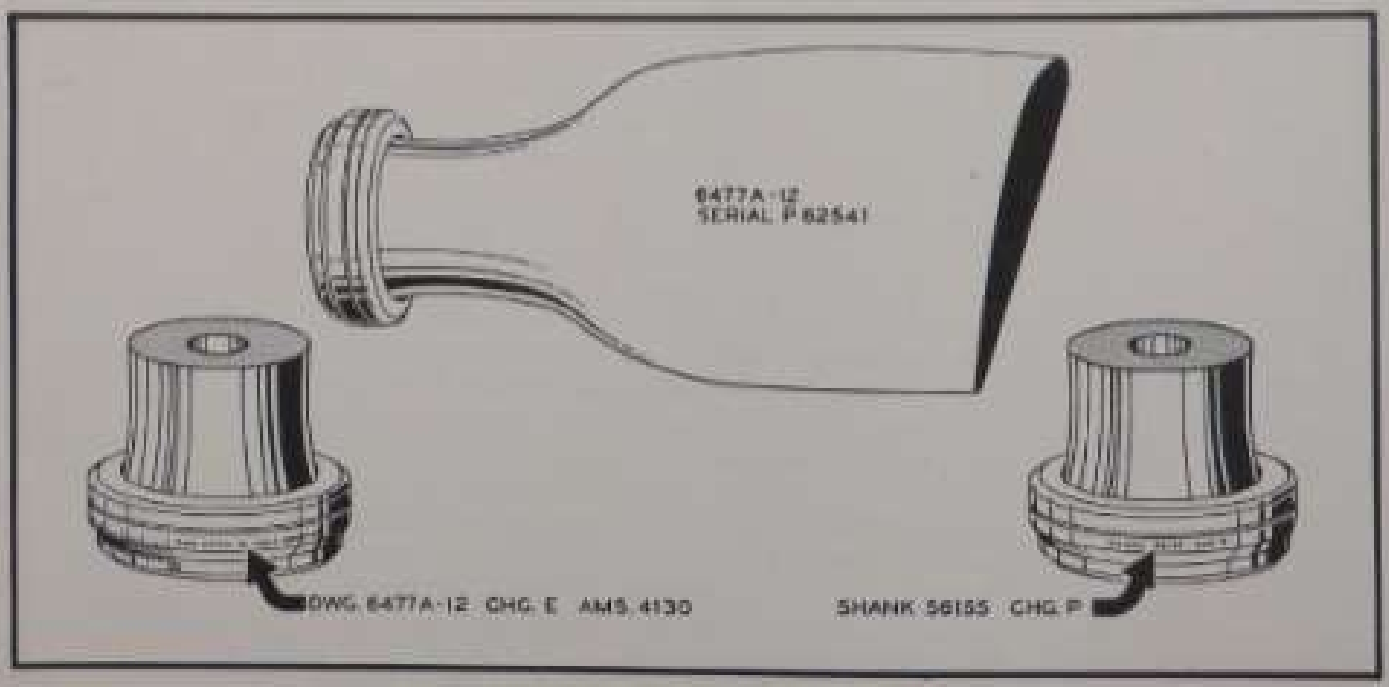
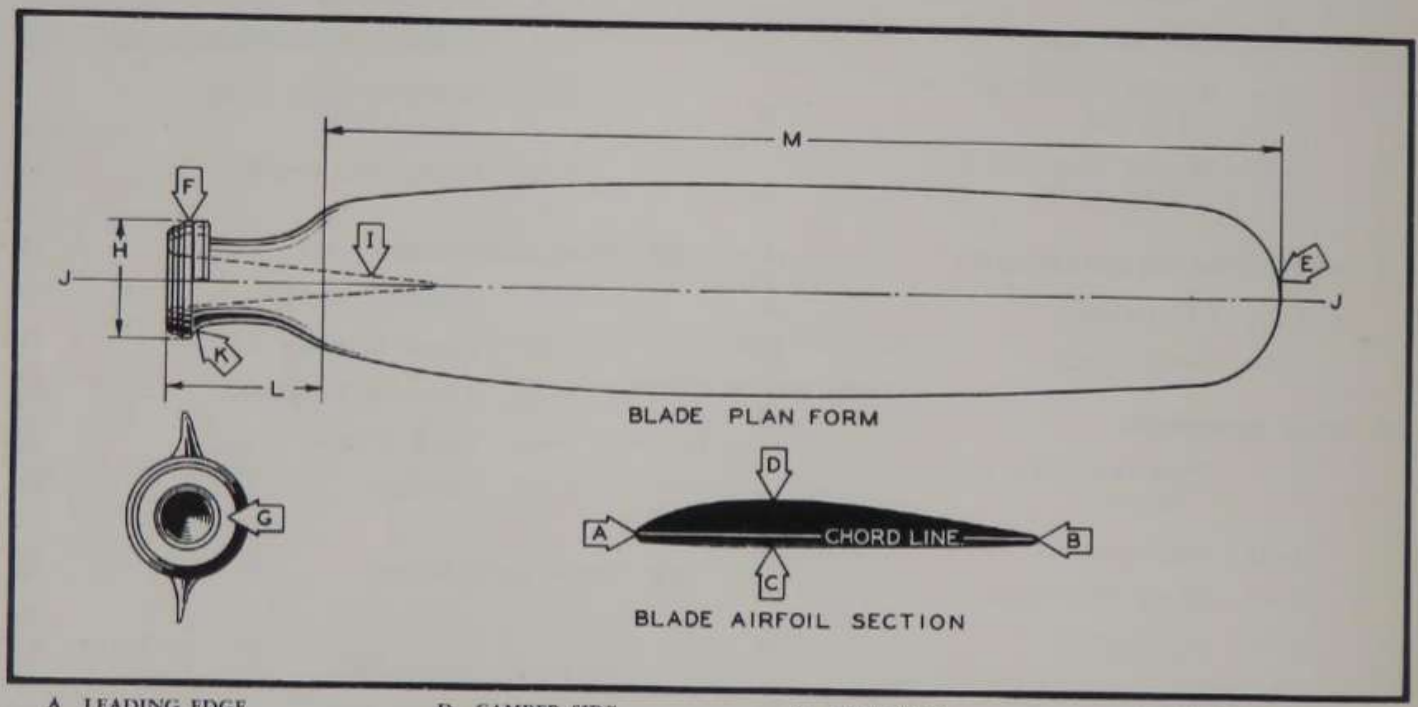


Figure 1—14. Typical Butt and Shank Markings



A LEADING EDGE
B TRAILING EDGE
C FACE SIDE
D CAMBER SIDE
E TIP
F BUTT
G BUTT FACE
H BUTT OD
I TAPER BORE
J CENTER LINE
K FILLET
L SHANK PORTION
M AIRFOIL PORTION

Figure 1–1. Blade Nomenclature Diagram

SECTION I
INTRODUCTION

1–1. GENERAL.

1–2. This manual is issued as the basic technical Handbook on the repair of Hamilton Standard Hydromatic and Counterweight type aluminum alloy propeller blades. It contains, wherever practical, step-by-step procedures for blade repair according to approved factory methods. The manual is divided into 10 sections, each pertaining to a particular phase of blade repair. With the information and illustrations herein, it should not ordinarily be necessary to refer to blueprints of the subject parts for dimensions and specifications. Although the text and illustrations discuss and show the standard heavy duty repair equipment, in an emergency at bases where such equipment is not obtainable, improvised tools can, in some cases, be used to good advantage.

1–3. It should be noted that damaged blades are repaired in sets and must be kept together as a set after repair. Where blades are repaired in quantity, it is recommended that blades of the same design be grouped in sets according to the similarity of damage. Blades selected for a given propeller assembly (or set) should be identified as mating blades and kept together throughout the entire repair procedure, following the straightening operation.

1–4. There are two kinds of aluminum alloy blades: standard and hard alloy. The standard alloy blades were formerly designated as HSP-5; these are now identified as AMS-4130. The composition of AMS-4130 is the same as HSP-5, and an individual blade may have both designations. The hard alloy blades are identified as HSP-26.

CAUTION

A new surface treatment consisting of cold rolling of the blade fillet and shank area, and shot-blasting of a portion of the airfoil section has been developed. Blades having this surface treatment are identified by design numbers beginning with 6801A and all blades having a numerically higher design number will also be surface treated. These blades cannot be repaired according to the regular procedures described in this book. See paragraph 5–87 for the repair procedures which may be used.

1–5. DEFINITION OF BLADE TERMS.
(See figure 1–1.)

1–6. Reference to various propeller blade terms is made throughout the text of this manual. The following paragraphs will serve to define these terms.

1–7. LEADING EDGE. The edge of the rotating blade which first meets the relative wind.

1–8. TRAILING EDGE. The edge opposite to the leading edge.

1–9. FACE SIDE. The side of the blade opposite the direction of flight. The face is less curved than the camber side and, on some blades, it is flat over the airfoil portion.

1–10. CAMBER SIDE. The side of the blade in the direction of flight. The camber is more curved than the face side.

1–11. TIP. The portion of the blade outermost from the axis of propeller rotation.

1–12. BLADE BUTT. The portion of the blade which fits inside the propeller hub.

1–13. BUTT FACE. The flat portion on the end of the blade butt.

1–14. BUTT OD. The outer diameter of the blade butt. The blade drawing number, serial number, etc. are stamped on the butt OD.

1–15. TAPER BORE. The conical shaped hole machined in the inside of the blade shank. The taper bore extends from the butt face to a point beyond the 12-inch station.

1–16. CENTER LINE. The theoretical extension of the taper bore axis. It is about this axis that the blade changes pitch.

1–17. FILLET. The radius which is machined on the blade butt and blended into the shank.

1–18. SHANK PORTION. That portion of the blade from the butt face to the first blade station. This is generally the 12-inch station.

1–19. AIRFOIL PORTION. That portion of the blade from the first blade station to the tip.

1–20. STATIONS. Locations perpendicular to the blade center line at which dimensions are checked. They are usually spaced at six-inch intervals.

1–21. FACE ALIGNMENT. The dimension from the center line of the blade to the outermost point on its face side measured perpendicular to the chord of the blade cross section at the various stations.

1–22. EDGE ALIGNMENT. The dimension from the center line of the blade to the outermost point on its leading edge measured chordwise of the blade cross section at the various stations.

1–23. DRIVE PIN ANGLE. The blade bushing, accurately located in the blade by means of the blade bushing drive pins, joins the blade to the pitch changing mechanism in the propeller. In order that the pitch setting requirements of the propeller be obtained, the chord of the cross section at the blade reference station must form a specified angle in respect to the plane through the center line of the drive pin holes in the blade butt. This specified angle is commonly called "drive pin angle."

1–24. BLADE ANGLE. The variation of the angles formed by the chord of the cross sections at the various blade stations is called blade pitch or twist. To measure blade pitch, the blade is positioned in a fixture in such a way that the chord of the cross section at the reference station forms a specified angle with the surface of a checking table, and then the angles of the chord at the cross sections of the remaining blade stations are measured against specified angles also with respect to the surface of the checking table. These specified angles are commonly called "blade angle." It should be noted that, in order to insure that the twist at the blade reference station is correct, specified "drive pin angle" should be first obtained before "blade angle" is measured.

1–25. THICKNESS. The maximum dimension of the blade cross section measured perpendicular to the chord at the respective blade stations.

1–26. WIDTH. The maximum dimension of the blade cross section measured chordwise at the respective blade stations.

1–27. BENDING. By *bending* is meant that pressure is exerted on the face or camber side of the blade, thereby changing the face alignment values.

1–28. TWISTING. By *twisting* is meant that the blade is installed in a fixture that holds the blade stationary at one point and twists the blade at another point, thereby changing the angular values of the blade.

1–29. BOOSTING. By *boosting* is meant that the blade is held rigidly in a fixture at the shank portion and force is exerted on either the leading or trailing edge of the blade, thereby changing the edge alignment values.

1–30. DESCRIPTION.

1–31. BLADE. As previously stated, the blades are made from aluminum alloy forgings, heat-treated for high strength. The butt end has a flange (or shoulder) that is perpendicular to the shank center line. A radius called the blade fillet is incorporated on the outboard face of the butt to form the bearing seat and take the operating loads. To accommodate the blade bushing, the inboard face of the butt is flat and a portion of the shank section of the blade is hollow. This hollow portion also serves to lighten the blade. Before the butt end of the blade is upset in the forging operation, two hardened steel washers are installed on the shank. These washers transmit the operating loads from the blade fillet to the barrel.

1–32. THRUST BEARING ASSEMBLY. The thrust bearing assembly consists of a beveled washer, a flat washer, and the retainer assembly. The beveled washer, which is nearer the blade butt, has a radius matching the blade fillet either directly or through a chafing ring, whereas the outer washer is flat on both sides. The retainer assembly, consisting of the retainer and the rollers, is installed between the two washers to provide the bearing between the blade and the barrel, and to transmit the operating loads.

1–33. CHAFING RING. A phenolic, detachable type chafing ring is used on newer blades, except the B shank Counterweight type, to fit between the beveled washer and the blade fillet. The chafing ring may have either a straight-sided or interlocking type joint. The straight-sided type chafing rings for D, E, and F shank blades are 56371-B, 56370-B, and 56360 respectively. The interlocking cotton phenolic type chafing rings are 56371-C, 56370-C, and 56369-A for D, E, and F shank blades respectively. The interlocking laminated glass cloth phenolic type rings are 56371-D, 56370-D, and 56360-B for D, E, and F shank blades respectively. Older Hydromatic type blades used a sleeve type ring which was molded directly to the blade and could not be removed unless it was destroyed.

1–34. BUSHING AND ASSOCIATED PARTS. Blade bushings, made of aluminum bronze alloy, provide the bearing between the steel spider arms and the aluminum blades. At blade assembly, the bushings are shrunk into the tapered blade bore and located by two drive pins and two screws. This applies to all types except the B shank Counterweight in which the bushing is located by two blade keys and two screws. On Hydromatic type blades, the bushing may have either spring pack slots or serrations for the blade gear segment, and the Counterweight type bushing has a series of half-circle notches for attaching the bracket on all sizes except the B shank which uses two keys. The ID of the bushing incorporates the two bearing surfaces which match those on the

1—45. The dash number following the basic blade design number indicates the number of inches the propeller diameter is reduced from that provided by the basic blade design. In this case the basic blade design, if used, would be identified as C6353A-0; however, the "-18" in the first example shows that the propeller diameter has been reduced 18 inches which would mean each blade has been cut down nine inches as outlined in figure 1—12. If the letter "B" is incorporated in the cut-off identification number, it indicates that a bushing with oversize bearing diameters is used in the blade.

1—46. SHANK. The shank is identified by a five-digit design number stamped on the blade butt OD. The engineering change letter is stamped immediately after the shank drawing number. This number, with its change letter, should be referred to when checking shank dimensions during rework and inspection. Blade shanks are also identified (but not marked) by a size letter, either B, D, F, or J, approximately equivalent to SAE blade shank sizes 1, 1½, 2, and 3, respectively.

1—47. BLADE VARIATION SUMMARY.

1—48. GENERAL. Listed in the blade variation summary (Table I) are the changes in design and characteristics which distinguish one blade from another. Wherever possible, each design is compared with another to point out the similarity.

1—49. EXPLANATION OF CLASSIFICATIONS. The first column in table I, lists the blades according to their design number. In the second column is a listing of the shank size of the blades. In the third column is listed the shank assembly drawing number which governs the shank dimensions and assembly of the blade. The fourth column lists the alloy designation number of the blades. HSP-26 designates the hard alloy blades, whereas AMS-4130 (HSP-5) designates the standard alloy blades. The basic diameter of the blade is given in the fifth column. The blade radius is the dimension from the basic reference line on the blade blueprint to the tip of the blade, and should not be confused with actual blade length which is always less than the radius. The blade radius for a "-0" blade is, of course, one half the basic diameter. The sixth column indicates whether the blade incorporates the old style integrally molded chafing ring, the detachable type, or none at all. The page number containing the dimensional form governing the blade airfoil section is given in the seventh column. The page number containing the dimensions for face template manufacture is given in the eighth column. Under remarks, any similarity of one blade design to another is discussed.

TABLE I

BLADES FOR COUNTERWEIGHT TYPE PROPELLERS

BLADE DESIGN NUMBER	SHANK SIZE	SHANK ASSEMBLY DRAWING NUMBER	ALLOY DESIGNATION	BASIC DIAMETER	CHAFING RING	TEMPLATE REPAIR LIMIT FORM (Page No.)	TEMPLATE MANUFACTURING FORM (Page No.)	REMARKS
6091A	E	96152	AMS-4150	10'6"	**Detachable	98-99	181	
6095A	D	*96151	AMS-4150	9'6"	None	100-102	181	
6101A	D	96151	AMS-4150	10'0"	**Detachable	103-107	183	
6105A	E	96152	AMS-4150	11'6"	**Detachable	108-111	185	
6109A	E	96152	AMS-4150	11'0"	**Detachable	93-97	181	
6107A	D	*96151	AMS-4150	9'0"	None	112-114	183	
6100A	B	*96150	AMS-4150	9'0"	None	114-115	185	
6111A	E	96152	AMS-4150	11'6"	**Detachable	116-118	185	
6127A	D	96151	AMS-4150	10'9"	**Detachable	119-121	185	
6135A	B	96150	AMS-4150	9'0"	None	122-124	187	
6137A	E	96152	AMS-4150	10'6"	**Detachable	125-128	187	
6107A	D	96151	AMS-4150	9'6"	**Detachable	144-147	191	
6227A	E	96152	HSP-26	10'6"	**Detachable	125-128	187	6137A with HSP-26 alloy.
6237A	D	96151	HSP-26	9'6"	**Detachable	144-147	191	6107A with HSP-26 alloy.
6241A	B	96150	HSP-26	9'0"	None	153-154	191	
6249A	E	96152	HSP-26	11'0"	**Detachable	93-97	181	6109A with HSP-26 alloy.

BLADES FOR HYDROMATIC TYPE PROPELLERS

BLADE DESIGN NUMBER	SHANK SIZE	SHANK ASSEMBLY DRAWING NUMBER	ALLOY DESIGNATION	BASIC DIAMETER	CHAFING RING	TEMPLATE REPAIR LIMIT FORM (Page No.)	TEMPLATE MANUFACTURING FORM (Page No.)	REMARKS
6139A	E	*96155	AMS-4150	11'0"	Molded	116-118	185	6130A with molded chafing ring.
6133A	E	*58155	AMS-4150	11'0"	Molded	93-97	181	6131A with molded chafing ring.
6139A	E	*58155	AMS-4150	10'0"	Molded	140-143	189	6139A with molded chafing ring.
6181A	D	*96154	AMS-4150	9'6"	Molded	144-147	191	6181A with molded chafing ring.
6183A	D	*58154	AMS-4150	10'0"	Molded	103-107	183	6183A with molded chafing ring.
6191A	E	*96155	HSP-26	11'0"	Molded	148-150	191	6191A with molded chafing ring.
6129A	E	*96155	HSP-26	11'0"	Molded	93-97	181	6129A with molded chafing ring.
6241A	E	*96155	HSP-26	10'0"	Molded	129-131	187	6441A with molded chafing ring.
6237A	D	*96154	HSP-26	9'6"	Molded	155-160	193	6237A with molded chafing ring.
6261A	E	*58155	AMS-4150	11'6"	Molded	164	195	6161A with molded chafing ring.
6277A	E	*96155	AMS-4150	11'0"	Molded	162-163	193	6177A with molded chafing ring.
6139A	E	96155	AMS-4150	11'6"	Detachable	116-118	185	6130A with detachable chafing ring.
6440A	E	96155	AMS-4150	11'6"	Detachable	116-118	185	Left-hand version of 6139A.
6333A	E	98155	AMS-4150	11'0"	Detachable	93-97	181	6131A with detachable chafing ring.
6334A	E	98155	AMS-4150	11'0"	Detachable	93-97	181	Left-hand version of 6331A.
6339A	E	96155	AMS-4150	10'0"	Detachable	140-143	189	6139A with detachable chafing ring.
6360A	E	96155	AMS-4150	10'0"	Detachable	140-143	189	Left-hand version of 6339A.
6379A	E	96155	AMS-4150	10'6"	Detachable	125-128	187	
6380A	E	96155	AMS-4150	10'6"	Detachable	125-128	187	Left-hand version of 6379A.
6381A	D	96154	AMS-4150	9'6"	Detachable	144-147	191	6181A with detachable chafing ring.
6383A	D	96154	AMS-4150	10'0"	Detachable	103-107	183	6183A with detachable chafing ring.
6385A	D	96154	AMS-4150	10'9"	Detachable	119-121	185	

BLADES FOR HYDROMATIC TYPE PROPELLERS (CONT'D)

BLADE DESIGN NUMBER	SHANK SIZE	SHANK ASSEMBLY DRAWING NUMBER	ALLOY DESIGNATION	BASIC DIAMETER	CHAFING RING	TEMPLATE REPAIR LIMIT FORM (Page No.)	TEMPLATE MANUFACTURING FORM (Page No.)	REMARKS
6395A	E	50155	HSP-26	132"	Detachable	148-150	195	6385A with detachable chafing ring.
6420A	E	50155	HSP-26	130"	Detachable	93-97	181	6351A with HSP-26 alloy.
6441A	E	50155	HSP-26	130"	Detachable	129-131	187	6341A with detachable chafing ring.
6446A	E	50155	HSP-26	130"	Detachable	129-131	187	Left-hand version of 6443A.
6447A	E	50155	HSP-26	108"	Detachable	125-128	187	6379A with HSP-26 alloy.
6497A	D	50154	HSP-26	130"	Detachable	155-160	193	6237A with detachable chafing ring.
6499A	D	50154	HSP-26	115"	Detachable	151-152	191	6311A with HSP-26 alloy.
6601A	E	50155	AMS-4130	132"	Detachable	164	195	Remanufactured from used 6351A.
6477A	E	50155	AMS-4130	119"	Detachable	162-173	193	6277A with detachable chafing ring.
6487A	D	50004	HSP-26	130"	Detachable	155-160	193	6457A except serrated bushing.
6491A	E	50155	HSP-26	95.0"	Detachable	171-174	197	6317A with HSP-26 alloy.
6493A	D	50154	HSP-26	130"	Detachable	161	195	
6495A	D	*50154	HSP-26	130"	Molded	161	195	6495A with molded chafing ring.
6497A	F	50156	HSP-26	170"	Detachable	132-139	189	6321A with HSP-26 alloy.
6501A	E	50155	HSP-26	130"	Detachable	165-167	195	6367A with HSP-26 alloy.
6503A	E	50155	AMS-4130	132"	Detachable	148-150	191	6393A with AMS-4130 alloy.
6507A	D	50004	HSP-26	115"	Detachable	151-152	191	6459A except serrated bushing.
6507A	E	50155	AMS-4130	130"	Detachable	165-167	195	6503A with AMS-4130 alloy.
6511A	D	50154	AMS-4130	115"	Detachable	151-152	191	6459A with AMS-4130 alloy.
6517A	E	50155	AMS-4130	95.0"	Detachable	171-174	197	6401A with AMS-4130 alloy.
6525A	E	50155	AMS-4130	130"	Detachable	168-170	197	6369A with AMS-4130 alloy.
6526A	E	50155	AMS-4130	130"	Detachable	168-170	197	Left-hand version of 6501A.
6527A	E	50156	AMS-4130	170"	Detachable	132-139	189	6407A with AMS-4130 alloy.
6535A	D	50004	AMS-4130	130"	Detachable	155-160	193	6487A with AMS-4130 alloy.
6535A	E	50155	AMS-4130	130"	Detachable	129-131	187	6443A with AMS-4130 alloy.
6539A	D	50004	AMS-4130	115"	Detachable	151-152	191	6511A except serrated bushing.
6541A	D	50004	AMS-4130	9'6"	Detachable	144-147	191	6581A except serrated bushing.
6555A	D	50004	AMS-4130	10'0"	Detachable	101-107	185	6585A except serrated bushing.
6555A	D	50004	AMS-4130	10'9"	Detachable	119-121	189	6589A except serrated bushing.
6558A	D	50004	HSP-26	130"	Detachable	161	193	6489A except serrated bushing.
6561A	E	62004	AMS-4130	130"	Detachable	165	195	6587A with torsional vibration absorber.
6565A	D	50154	AMS-4130	130"	Detachable	155-160	193	6417A with AMS-4130 alloy.
6567A	D	50004	AMS-4130	115"	Detachable	176-177	199	
6569A	E	50155	HSP-26	130"	Detachable	168-170	197	6519A with HSP-26 alloy.
6587A	E	50155	AMS-4130	130"	Detachable	174	199	
6963A	E	66215	AMS-4130	130"	Detachable	90	181	6535A with torsional vibration absorber.
6971A	D	68475	HSP-26	130"	Detachable	178	201	Uses torsional vibration absorber.
6979A	E	66215	AMS-4130	130"	Detachable	164	195	6461A with torsional vibration absorber.

*For dimensional reference only; see Table VII. Blades were not manufactured to these shank drawing numbers.

**See Table XVII.