CANCELLED 5/94

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.
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NEW YORK 17, N.Y.

AERONAUTICAL RECOMMENDED PRACTICE

ARP 265A

AIRFOIL SHAPES — DIMENSIONING OF TURBINE ENGINE

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1. PURPOSE

THIS AERONAUTICAL RECOMMENDED PRACTICE PROVIDES A STANDARD METHOD FOR LOCATING AND DIMENSIONING THE AIRFOIL PORTIONS OF PARTS SUCH AS BLADES, AND VANES.

2. GENERAL

THIS METHOD WILL APPLY TO BLADES, OR VANES WITH OR WITHOUT A BASE. THE FORMS OF ATTACHMENT ARE VARIED; THEREFORE, THE BLADE BASES SHOWN IN THE FOLLOWING FIGURES ARE FOR ILLUSTRATION ONLY. ALL DIMENSIONS AND NOTES SHOWN PERTAINING TO THE COMMON FUNCTIONAL POINT, LINE OR PLANE ARE CONSIDERED TO BE APPLIED TO A DATUM, ON OR OFF THE PART, IRRESPECTIVE OF THE FORM OF ATTACHMENT.

2.1 THE AIRFOIL SHAPE OF SUCH PARTS SHALL BE DEFINED BY MEANS OF SECTIONS CHOSEN ENTIRELY (EXCEPT REFERENCE SECTIONS) FROM WITHIN THE AIRFOIL PORTION.

2.2 THE "TYPICAL AIRFOIL SECTION" SHALL BE DEFINED BY A SERIES OF NUMBERED STATIONS ESTABLISHED BY RECTANGULAR COORDINATES. THE STATIONS SHALL BE NUMBERED CONSECUTIVELY IN A CLOCKWISE DIRECTION FROM THE LEADING EDGE. THESE NUMBERS MAY BE SHOWN ON THE TYPICAL AIRFOIL SECTION FOR CONVENIENCE. THE SPECIFIC TERMINOLOGY SHOWN SHALL BE FOLLOWED, WHERE APPLICABLE, TO ASSURE DRAWING CONSISTENCY. NEGATIVE LINEAR OR ANGULAR DIMENSIONS ARE NOT RECOMMENDED. WHEN ADDITIONAL SECTIONS NOT WHOLLY WITHIN THE AIRFOIL PORTION ARE DEEMED NECESSARY, THEY MAY BE DEFINED AND SHALL BE MARKED REFERENCE.

2.3 IT IS RECOMMENDED THAT MANUFACTURERS BE SUPPLIED WITH METAL, GLASS, OR EQUIVALENT LAYOUT MASTERS, OR WITH AIRFOIL DATA IN COORDINATE FORM OR BOTH. IF BOTH ARE SUPPLIED, ONE SHOULD BE INDICATED AS TAKING PRECEDENCE.

3. TERMINOLOGY

BASE — A PORTION OF THE PART WHICH IS USED FOR ATTACHMENT. (FORMERLY, FOOTING, ROOT, FIR TREE, DOVETAIL, TANG).

ANGLE DATUM PLANE — A DATUM PLANE TO BE USED FOR CONTROLLING THE ANGULAR RELATION OF THE VARIOUS AIRFOIL SECTIONS.

BASE CENTER PLANE — A PLANE PASSING THRU THE CENTER OF THE BASE WHICH MAY, OR MAY NOT, COINCIDE WITH THE ANGLE DATUM PLANE.

STACKING POINT — THE POINT FOR EACH AIRFOIL SECTION ABOUT WHICH THE SECTION IS TWISTED. THIS POINT MAY COINCIDE WITH THE C.G.

STACKING AXIS — A STRAIGHT LINE PASSING THRU THE BASIC STACKING POINT OF EACH SECTION. (FORMERLY, AXIS OF TWIST).

TWIST ANGLE — THE ANGLE BETWEEN THE SECTION DATUM LINE AND THE ANGLE DATUM PLANE (OR BASE CENTER PLANE WHERE THESE PLANES COINCIDE).

SECTION DATUM LINE — A LINE IN THE PLANE OF THE SECTION TO WHICH THE COORDINATE SYSTEM IS APPLIED. (THIS DATUM LINE IS GENERALLY PARALLEL TO THE CHORD LINE OF THE SECTION).

DISPLACEMENT — VARIATION OF AIRFOIL SECTIONS FROM BASIC LOCATIONS. (INCLUDES BOW, LEAN, TILT AND CENTRALITY).

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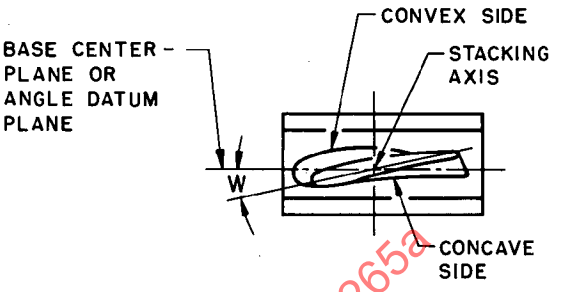
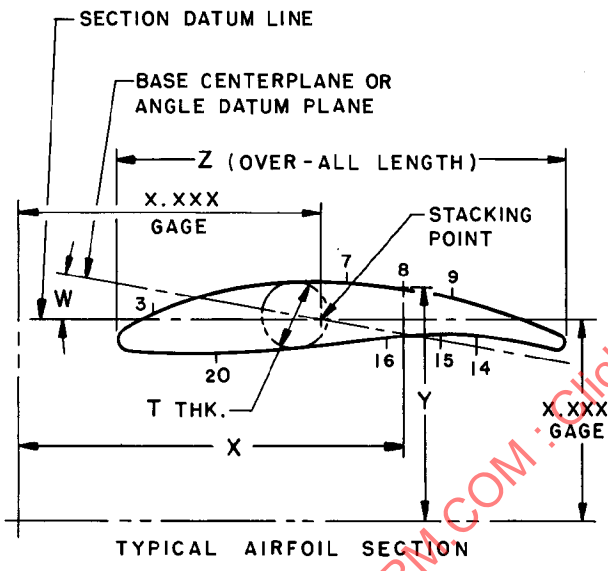
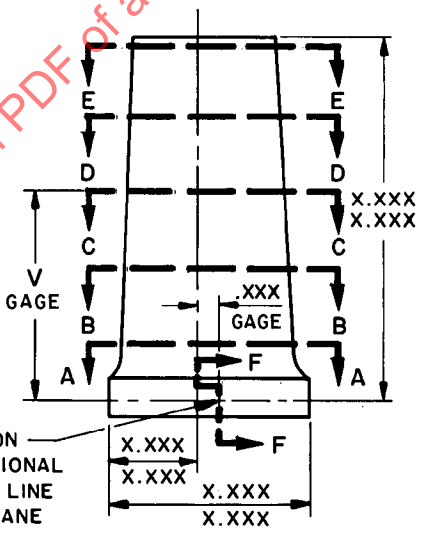
4. TYPICAL DRAWING. RECOMMENDED DRAWING AND DIMENSIONING PRACTICES FOR THE AIRFOIL PORTION OF A BLADE ARE SHOWN IN FIGURE 1.

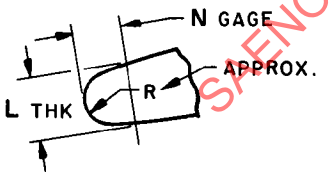
AIRFOIL DATA					
SECTION	A – A	B – B	C – C	D – D	E – E
Z	.XXX–.XXX				
W ±	X° X'				
V	.XXX				
U	.XXX–.XXX				
T	.XXX–.XXX				
S	.XXX				
L	.XXX–.XXX				
N	.XXX				

BASIC AIRFOIL SECTION DATA								
STATION	X	Y	X	Y	X	Y	X	Y
1	.XXX	.XXX						
2								

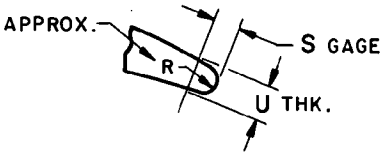








ENLARGED VIEW OF LEADING EDGE



ENLARGED VIEW OF TRAILING EDGE

GENERAL DRAWING NOTES

1. BLEND SMOOTHLY BETWEEN STATIONS & SECTIONS.
2. CONTOUR OF CONCAVE & CONVEX SIDES OF AIRFOIL SECTIONS MAY VARY WITHIN A .XXX BAND, PARALLEL TO BASIC.
3. THE STACKING AXIS IS A STRAIGHT LINE DEFINING THE BASIC LOCATION OF THE AIRFOIL SECTION STACKING POINTS.
4. AIRFOIL SECTION STACKING POINTS MAY BE DISPLACED A MAXIMUM OF .XXX FROM STACKING AXIS.
5. THE ANGULAR RELATION OF THE STACKING AXIS MAY VARY .XXX PER INCH OF LENGTH IN ANY DIRECTION IN RELATION TO A PLANE CONTAINING THE COMMON FUNCTIONAL POINT, LINE OR PLANE OF THE PART.
6. T THICKNESS, MEASURED AT POINT OF GREATEST THICKNESS.
7. THICKNESSES L & U, MEASURED PERPENDICULAR TO MEAN CAMBER LINE.

Where it is desired to combine the tolerances expressed in notes 4 & 5 (for composite inspection), these notes may be replaced by the following note:– AIRFOIL SECTION MAY BE DISPLACED A MAXIMUM OF .XXX FROM BASIC LOCATIONS.

FIGURE 1

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5. SIX-POINT SYSTEM FOR POSITIONING AIRFOILS. THE PURPOSE OF THIS SYSTEM IS TO ESTABLISH A METHOD OF POSITIONING AIRFOILS WITH THE PRIMARY OBJECTIVE OF ASSURING CONSISTENCY IN POSITIONING.

5.1 THIS SYSTEM USES SIX (6) POINTS ON THE SURFACES OF THE PART, ESTABLISHING DATUM PLANES FOR RELATING AIRFOIL SECTIONS TO EACH OTHER AND/OR TO THE BASE OR ANY OTHER FUNCTIONAL POINT, LINE OR PLANE. THESE POINTS MUST BE CHOSEN IN A MANNER BEST SUITED TO SATISFY DESIGN AND PERFORMANCE REQUIREMENTS. POINTS P1 THROUGH P6 DETERMINE PHYSICAL LOCATION AND EVALUATION AREAS AND SHALL NOT BE ALTERED BY ANY MACHINING OPERATION AFTER PART HAS BEEN INITIALLY QUALIFIED.

5.2 FIGURE 2 SHOWS AN EXAMPLE WHERE THREE POINTS HAVE BEEN CHOSEN ON THE CONVEX SIDE AND TWO ON THE LEADING EDGE OF THE AIRFOIL. THE SIXTH POINT HAS BEEN CHOSEN ON THE TOP OF THE BASE.

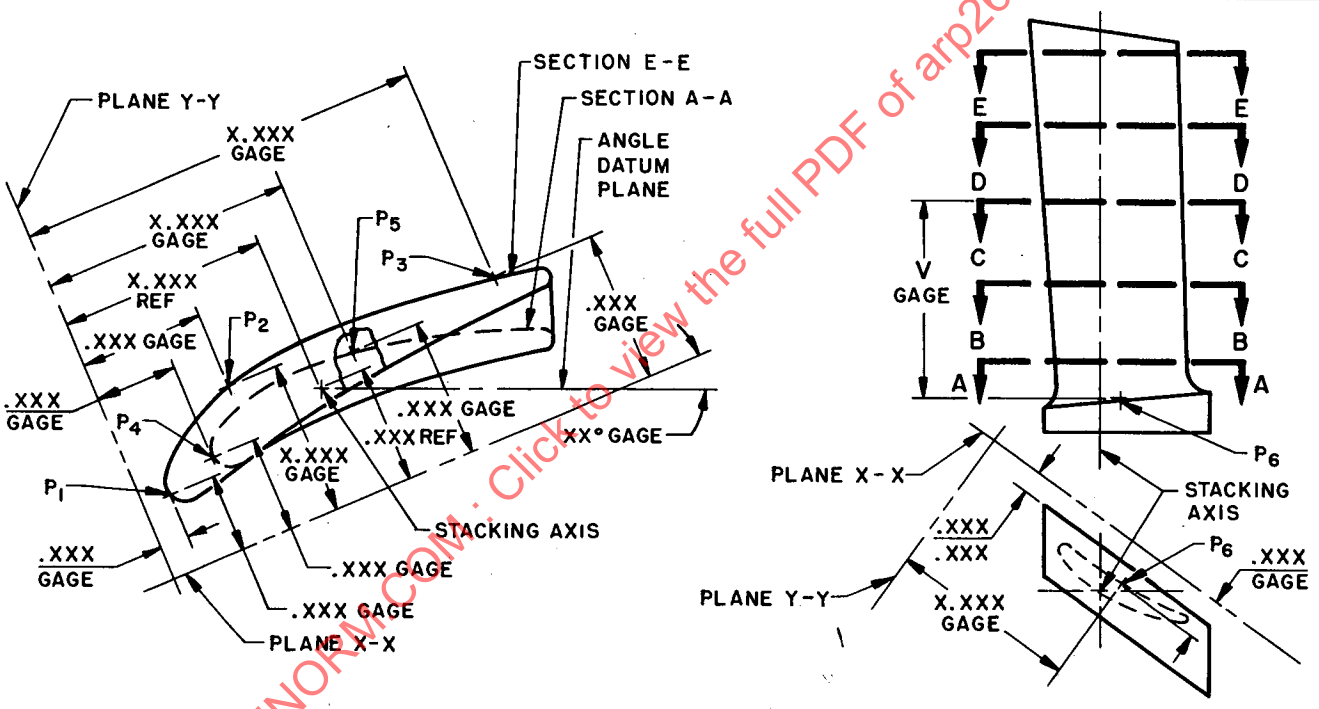

FIGURE 2

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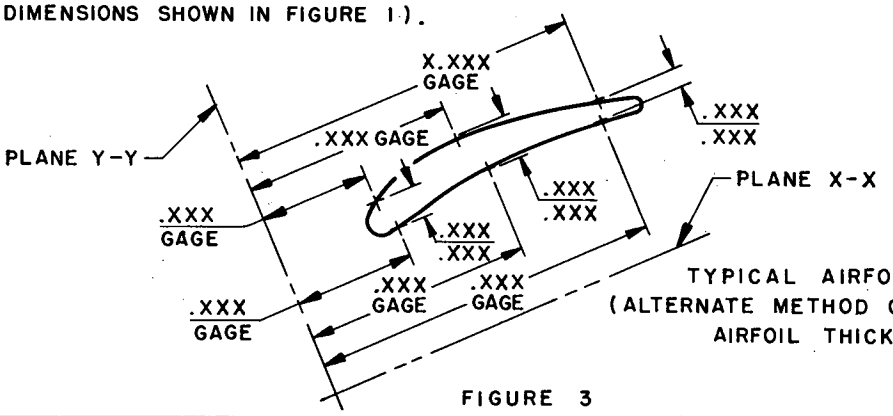
6. ALTERNATIVE METHOD FOR THICKNESS DIMENSIONS. FIGURE 3 SHOWS AN ALTERNATIVE METHOD FOR DIMENSIONING AIRFOIL THICKNESS (INSTEAD OF THE "L", "T", AND "U" DIMENSIONS SHOWN IN FIGURE 1).



TYPICAL AIRFOIL SECTION (ALTERNATE METHOD OF DIMENSIONING AIRFOIL THICKNESS)

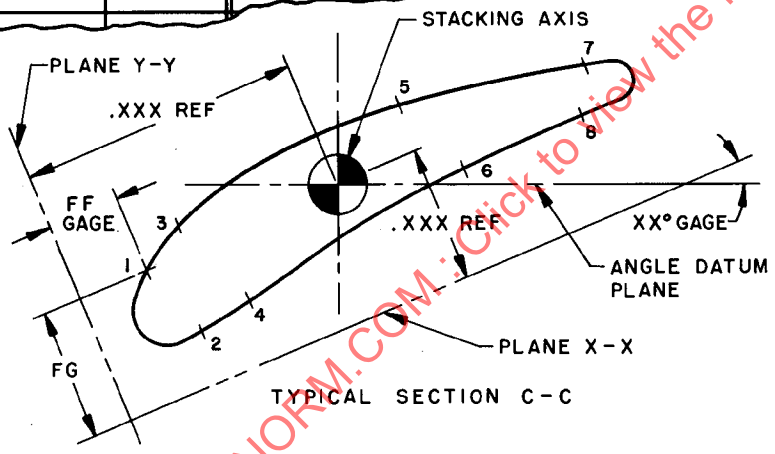
FIGURE 3

7. COMPOSITE TOLERANCE DIMENSIONING. TO AID HIGH VOLUME INSPECTION TECHNIQUES, A COMPOSITE TOLERANCE SYSTEM OF DIMENSIONING MAY BE EMPLOYED. THE COMPOSITE TOLERANCE SYSTEM SHALL BE CONSIDERED SUPPLEMENTARY TO THE CONVENTIONAL METHODS OF DIMENSIONING.

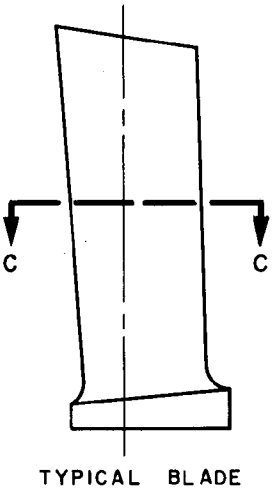
7.1 GENERAL REQUIREMENTS. IN USING THIS SYSTEM, STATIONS ARE CHOSEN ON EACH AIRFOIL SECTION. THE NUMBER OF STATIONS SHOULD BE DETERMINED BY CHORDAL LENGTH AND CAMBER, BUT A MINIMUM OF SIX STATIONS PER SECTION IS RECOMMENDED. ALL STATIONS IN THIS SYSTEM SHALL BE ESTABLISHED RELATIVE TO THREE PLANES PERPENDICULAR TO EACH OTHER. THESE PLANES MAY BE THOSE ESTABLISHED BY THE SIX-POINT POSITIONING SYSTEM OR THEY MAY BE PLANES ORIENTED TO OTHER DATUM FEATURES DESCRIBED IN PARAGRAPH 2. TO MAINTAIN UNIFORMITY, STATIONS SHALL BE CHOSEN FROM THE LEADING EDGE TO THE TRAILING EDGE, ODD NUMBERED STATIONS BEING ON THE CONVEX SIDE AND EVEN NUMBERED STATIONS ON THE CONCAVE SIDE. SEE FIGURE 4.

AIRFOIL INSPECTION DATA

SECTION	A-A		C-C		E-E	
STATION	FF	FG	FF	FG	FF	FG
1	.XXX	.XXX-.XXX				
2						



TYPICAL SECTION C-C



TYPICAL BLADE

FIGURE 4

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7.1.1 COMPOSITE TOLERANCES WHICH INCLUDE CONTOUR (AND LINEAR AND ANGULAR VARIATIONS WHEN GIVEN) MAY BE ASSIGNED TO EACH OF THE STATIONS CHOSEN. WHEN DESIGN REQUIREMENTS DEMAND DIRECT CONTROL OF AIRFOIL THICKNESS AT ONE OR MORE POSITIONS, SUCH THICKNESS SHALL BE INSPECTED INDEPENDENTLY.

7.1.2 OVER-ALL LENGTH AND SQUARENESS, OR CENTRALITY OF SECTION, SHALL BE INSPECTED INDEPENDENTLY OF THE COMPOSITE TOLERANCES.

7.1.3 THE MAGNITUDE OF THE COMPOSITE TOLERANCES SHALL BE DETERMINED BY A STATISTICAL MEANS WHICH ENSURES THE ADHERENCE TO DESIGN INTENT.

7.1.4 A PRIME REQUISITE OF COMPOSITE TOLERANCE APPLICATION IS THAT ALL CHOSEN INSPECTION STATIONS BE INSPECTED SIMULTANEOUSLY. THIS IS MANDATORY IF OFFENDING FACTORS ARE TO BE RECOGNIZED AND SEGREGATED ON DISCREPANT PARTS.