

APPENDIX 3.

SAMPLES OF DRAWING OFFICE
DATA SHEETS USED BY A TYPICAL
JAPANESE AIRCRAFT FACTORY.

INTRODUCTION.

A number of Japanese design data sheets have been translated by the Language School, Directorate of Intelligence, R.A.A.F., and the writer gratefully acknowledges this assistance. An examination of these data sheets shows that they follow American standard practice very closely, and hence it has not been considered necessary to reproduce them in this report, with the exception of one series of data sheets dealing with forging design.

These data sheets were issued after a conference between Japanese Army Officials, representatives of the forging industry and aircraft designers. They cover the subject in considerable detail, and it is the opinion of the writer that similar standards could with advantage be adopted by the Allies.

TRANSLATION OF JAPANESE DATA SHEETS ON FORGING

DESIGN.

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TRANSLATION.FORGING PROCEDURE.GENERAL.

The object of this procedure is to ensure good design, and to improve the quality of mass produced light alloy drop forgings for army aircraft. All personnel must be conversant with these standards and draw up specifications in accordance with them.

Where it is impossible to conform to these standards, designer and forger are to co-operate with a view to producing the best possible product.

DRAWING PROCEDURE.1. LINING.

If possible only one drawing is to be made of the part and the following lining used where necessary.

- (a) Rough forging outline -- Full Line (heavy)
Portions left 'as forged' to be shaded or coloured.
- (b) Rough cut outline -- Broken Line.
- (c) Finished forging outline -- Full line (light)
Note - Only to be used for clarification.
- (d) Aircraft section system to be followed.

2. DIMENSIONS.

- (a) Rough forging outlines -- numerals alone, e.g., 95
- (b) Rough cut outlines ----- numerals in
rectangle, e.g., 95
- (c) Finished forging outlines - numerals in
brackets, e.g., (95)

3. FLASH LINES.

Flash lines to be shown thus =====

The following are to be marked on the drawing where necessary.

- 4. Angle of draw on die.
- 5. Tolerances.
- 6. Position for taking test pieces, or for hardness test and direction of strike.
- 7. Datum lines to be shown thus -----

8. TITLE BLOCK.

This must conform to the standard aircraft drawing system and at least the data below must be entered.

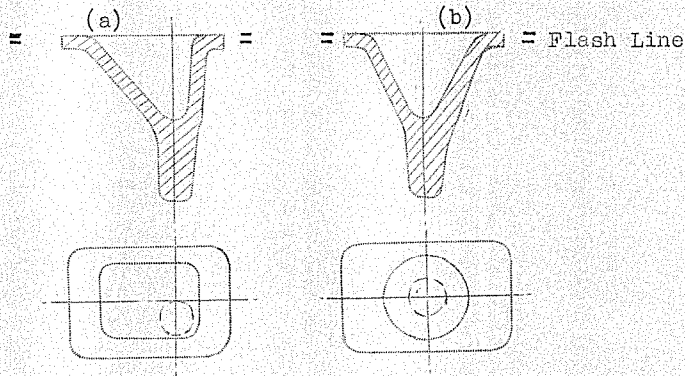
- (a) Equipment required (Code name can be used).
- (b) Part Name.
- (c) Quantity.
- (d) Scale.
- (e) Drawing Number

- (f) Section number.
- (g) Material.
- (h) Condition on delivery (heat treatment, surface finish, extent of working, etc.).

ESSENTIAL POINTS IN DESIGN OF FORGINGS.

1. In designing parts symmetrical shapes should be aimed at, in order to simplify manufacture of striker and die. (See Figure 1).

FIGURE 1.



(a) Unsuitable.

A strong shearing force acts on the upper mould in the direction of the arrow, a special guide bar is needed and the cost of the die is high.

(b) Suitable.

As it is a symmetrical cone there is no possibility of any large shearing force and the die can be made easily with a lathe.

2. Acute angles, sudden changes in section, large differences in section thickness and parts with large surface area, etc., are to be avoided as far as possible.

3. Angle of Draw.

For the angle of draw and the angle of slope of base of striker, Figure 2 and Table I will be followed as standard practice.

FIGURE 2.

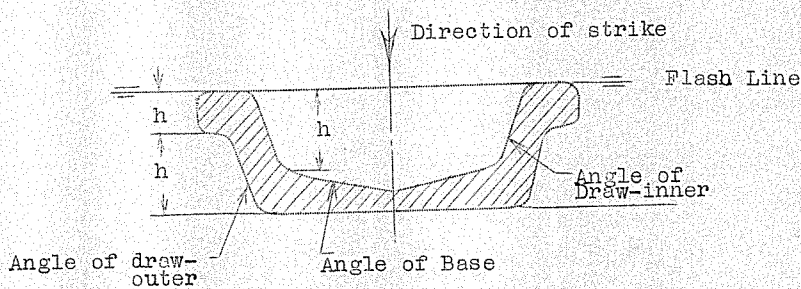


TABLE 1.

	<u>Angle of draw of outer surface.</u>	<u>Angle of draw of Inner Sur- face.</u>	<u>Angle of Base</u>
Up to 2.36"	3°	6°	3°
More than 2.36"	6°	10°	

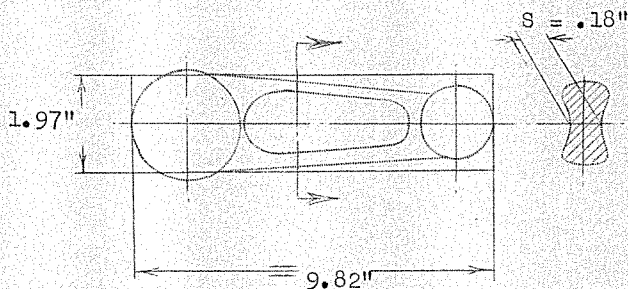
4. Section Thickness.

For the Section thickness in direction of striking, Figure 3 and Table 2, will be followed as standard practice. The thickness in direction of striking is to be made as great as possible.

TABLE 2.

Surface Area Struck (sq. ins)	Less than 3.88	3.88 to 7.76	7.76 to 11.6	11.6 to 15.5	15.5 to 23.2	23.2 to 38.8	38.8 to 77.5	77.5 to 132	132 to 186	186 to 310
Min. Thickness S (ins.)	.10	.12	.14	.16	.18	.20	.24	.28	.32	.40

FIGURE 3.



For thickness of side walls perpendicular to direction of striking Figure 4, Table 3, will be followed as standard practice.

FIGURE 4.

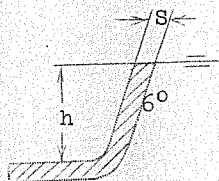


TABLE 3.

h (ins.)	Less than .39	.39 to .55	.55 to .79	.79 to .98	.98 to 1.26	1.26 to 1.77	1.77 to 2.36
Minimum S (ins.)	.12	.14	.16	.18	.20	.24	.28

5. Rib Design.

In designing ribs Figure 5 and Table 4 will be followed as standard practice; thin and high shapes must be avoided as far as possible. With reference to the taper of rib section the inner angle of draw in relevant paragraph is applicable.

FIGURE 5.

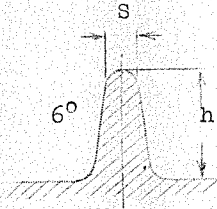
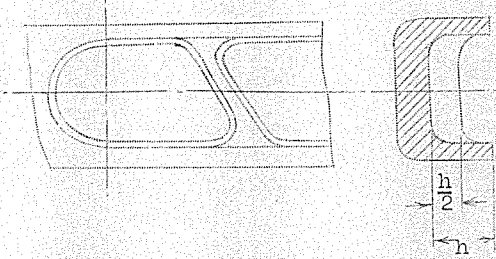


TABLE 4.

h (ins.)	.12	.12 to .20	.20 to .32	.32 to .47	.47 to .79	.79 to .98	.98 to 1.18	1.18 to 1.58
Minimum S (ins.)	.10	.12	.14	.16	.18	.20	.24	.32
h (ins.)	1.58 to 1.97							
Minimum S (ins.)	.40							

When a centre rib is necessary for strength as in Figure 6, it is satisfactory to use a height of less than half that of the surrounding flange.

FIGURE 6.



6. IMPRESSIONS.

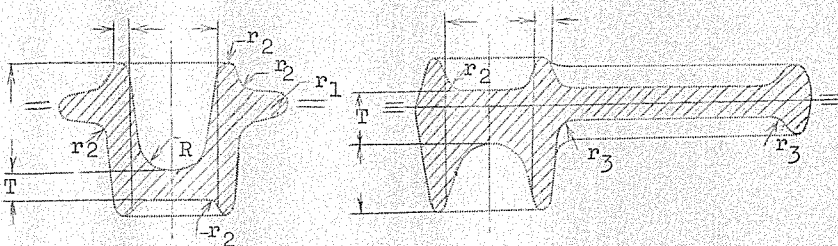
When there is an impression on one side only, Figure 7 shall be taken as the standard.

FIGURE 7.

D .63" Hole not Struck	D = .63"-.95" R = $\frac{D}{2}$ H = $\frac{D}{2}$	D = .95"-1.77" R = $\frac{d}{2}$ H = D	D 1.77" H = D

When there are impressions on both sides Figure 8 is to be followed as the standard.

FIGURE 8.



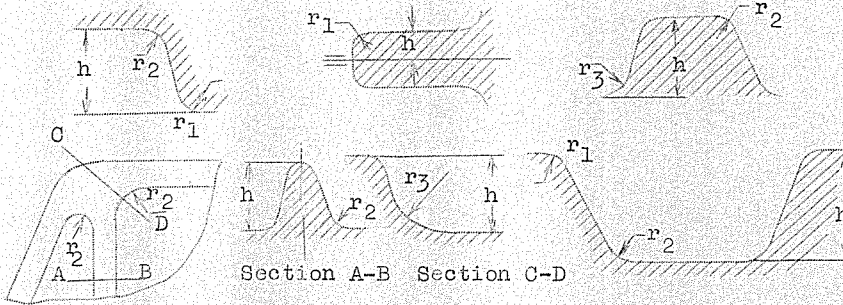
NOTE.

- (i) The web must be at least three times the regulation thickness for forged parts.
- (ii) Impressions which are squeezed out by the bottom die must not be so deep as to pass beyond the Flash Line.

7. RADII.

For radii on forgings, take Figure 9 and Table 5 as the standard. Always use the largest radius possible.

FIGURE 9.



T A B L E 5.

h (ins.)	Under .16	.16 to .39	.39 to .98	.98 to 1.58	1.58 to 2.36	2.36 to 3.94	More than 3.94
Minimum r_1 (ins.)	.06	.08	.12	.16	.24	.39	.63
Minimum r_2 (ins.)	.10	.16	.24	.39	.63	.79	.98
Minimum r_3 (ins.)	.24	.39	.63	.98	1.26	1.58	1.97

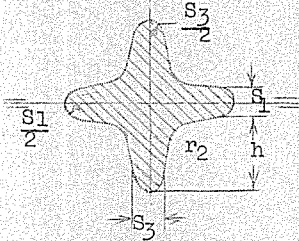
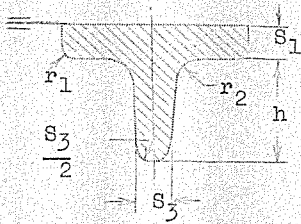
8. SECTION SHAPES.

(a) "T" Section

Figure 10.

(b) "X" Section

Figure 11.

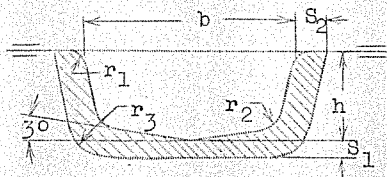


NOTE.

- (i) There are no restrictions as to the height of the rib.
 - (ii) For r_1 and r_2 see paragraph on radii.
 - (iii) For S_1 see paragraph on thickness of forgings.
 - (iv) Surfaces parallel to the Flash Line may be assumed to have no slope.
 - (v) For S_3 see paragraph on rib design.
- (c) "U" Section.

When the Flash Line is on the brim take Figure 12 and Table 6 as standards. (For Table 6 see Appendix).

FIGURE 12.

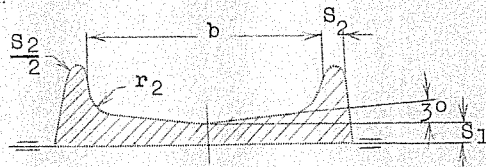


NOTE.

- (i) For S_1 see paragraph on the thickness of forgings.
- (ii) r_3 is approximately $r_2 + S_1$
- (iii) For S_2 see paragraph on side wall thickness.

When the Flash Line is on the base take Figure 13 and Table 7 as the standard. (For Table 7 see Appendix).

FIGURE 13.



NOTE.

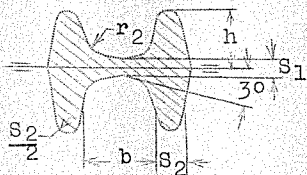
- (i) For S_1 see paragraph on thickness of forgings.
 - (ii) The angles of draw on the outer and inner surface of flanges must be identical in order to facilitate manufacture of the die.
- (d) "H" SECTION.

Standardise "H" Sections on Figure 14 and Table 7. (See Appendix).

FIGURE 14.

NOTE.

- (i) For S_1 see paragraph on thickness of forgings.
- (ii) The angles of draw on the outer and inner surface of flanges must be identical in order to facilitate manufacture of the die.



9. MACHINING ALLOWANCES.

The machining allowance on each surface varies with the shape and dimensions of the forging but except for singularly complicated cases the allowances per Figure 15 and Table 8 are generally applicable.

T A B L E 8.

Maximum length of surface to be worked (ins.)	Less than 1.97	1.97 to 4.92	4.92 to 9.84	9.84 to 19.7	More than 19.7
Standard machining allowance of each surface (ins)	.06	.08	.10	.12	.16

FIGURE 15.

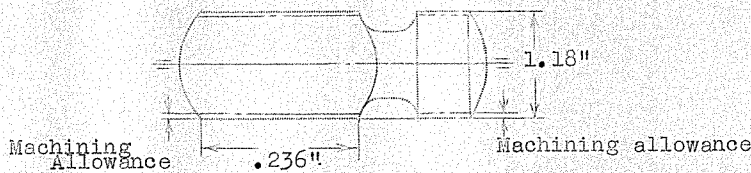
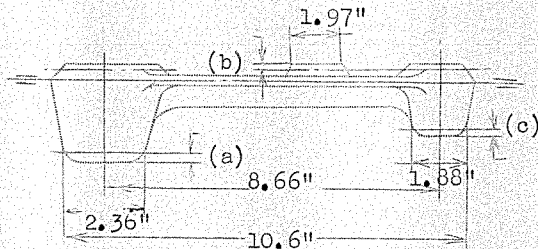


FIGURE 16.



Example.

As length is 10.6 ins. bending tolerance is .04 ins. and must be added to tolerances at each surface.

- (i) Machining allowance at 'a' = machining allowance for surface of length 2.36 ins. + bending tolerance
 $= .08 + .04$
 $= .12''$
- (ii) Machining allowance at 'b' = machining allowance for surface of length 1.97 ins. + bending tolerance
 $= .06 + .04 = .10''$
- (iii) Machining allowance at 'c' = machining allowance for surface of length 1.58 ins. + bending tolerance
 $= .06 + .04 = .10''$

10. FORGING TOLERANCES.

(a) THICKNESS - 'as forged' finish

For tolerance on thickness in direction of forging, follow Table 9. (See Appendix).

These tolerances are to be applied on the basis of surface area struck. If maximum length perpendicular to the direction of forging or maximum thickness in direction of forging is exceeded tolerances must be adopted which correspond with the length or the thickness, and will not depend on surface area struck.

(b) THICKNESS - machined finish

For parts which have a machining allowance the allowance may be used as a tolerance.

(c) LENGTH, WIDTH - 'as forged' finish.

For tolerances perpendicular to direction of forging, follow Table 10.

T A B L E 10.

Standard Measurement (ins.)	Less than 1.97	1.97 to 3.15	3.15 to 4.72	4.72 to 7.9	7.9 to 15.8	15.8 to 31.5	31.5 to 63
Tolerances (ins.)	±.020	±.024	±.032	±.039	±.059	±.079	±.118

(d) MISALIGNMENT.

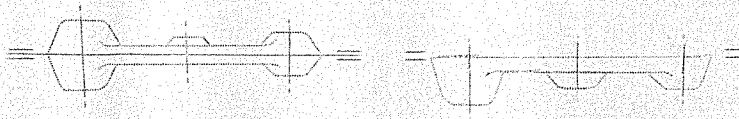
Misalignment tolerances for parts with an 'as forged' finish are shown in Table II. For the full tolerance perpendicular to the direction of forging, add the width tolerance to the misalignment tolerance.

T A B L E 11.

Standard Measurement (ins.)	Less than 1.97	1.97 to 4.72	4.72 to 11.8	11.8 to 15.8	15.8 to 23.6
Permissible Misalignment (ins.)	.012	.020	.032	.039	.059

Misalignment occurs through errors in the meeting of the dies and is difficult to avoid. In design, therefore, it is preferable to use one die only, where possible.

Example.



Misalignment occurs.

Misalignment does not occur.

(c) BENDING.

Tolerances on straightness and flatness are to be in accordance with Table 12 -

T A B L E 12.

Measurements perpendicular to direction of forging (ins.)	Less than 1.97	1.97 to 4.72	4.72 to 9.8	9.8 to 15.8	15.8 to 23.6	23.6 to 6.39	39 to 59
Permissible tolerances (ins.)	.012	.016	.024	.039	.059	.079	.118

Variations from this procedure are to be limited to a minimum.

According to standards for design of light alloy drop forgings as laid down at the industrial conference on army aircraft, and the conference of light alloy drop-forging departments.

A P P E N D I X.

Table 6

Table 7

Table 9

T A B L E 6.

D. (ins.)		Less Than .63	.63 to .79	.79 to .98	.98 to 1.26	1.26 to 1.58	1.58 to 1.97	1.97 to 2.36	2.36 to 3.15	3.15 to 3.94	3.94 to 4.92
h (ins.)		r ₂ Minimum Measurements (ins.)									
Minimum r ₁ (ins.)											
Less than .39	.06	.10	.16	.16	.16	.16	.24	.24	.40	.40	.40
.39 to .47	.06		.16	.16	.16	.24	.24	.24	.40	.40	.40
.47 to .63	.10			.16	.16	.24	.24	.24	.40	.40	.40
.63 to .79	.10				.24	.24	.40	.40	.40	.40	.63
.79 to .98	.10					.24	.40	.40	.40	.40	.63
.98 to 1.26	.16						.40	.40	.40	.63	.63
1.26 to 1.58	.16							.40	.40	.63	.63
1.58 to 1.77	.24								.63	.63	.79

T A B L E 7.

b (ins.)	Less than .63		.63 to .79		.79 to .98		.98 to 1.26		1.26 to 1.58		1.58 to 1.97		1.97 to 2.48		2.48 to 3.15		3.15 to 3.94		3.94 to 4.92				
	r2	S2	r2	S2	r2	S2	r2	S2	r2	S2	r2	S2	r2	S2	r2	S2	r2	S2	r2	S2			
h (ins.)	Minimum Measurements. (ins.)																						
Less than .24	.16	.10	.16	.10	.24	.10	.24	.10	.24	.10	.24	.12	.40	.12	.40	.16	.63	.16	.63	.16	.63	.20	
	.16	.12	.16	.12	.24	.12	.24	.12	.24	.12	.24	.16	.40	.16	.40	.16	.63	.16	.63	.16	.63	.20	
			.16	.12	.24	.12	.24	.12	.24	.12	.24	.16	.40	.16	.40	.16	.63	.16	.63	.16	.63	.20	
					.24	.16	.24	.16	.24	.16	.24	.40	.16	.40	.16	.40	.16	.63	.16	.63	.16	.63	.20
										.40	.16	.40	.16	.40	.16	.40	.16	.63	.16	.63	.16	.63	.20
												.40	.20	.40	.20	.63	.20	.63	.20	.63	.20	.24	
													.63	.20	.63	.20	.63	.20	.63	.24	.63	.24	.24
															.79	.24	.79	.24	.79	.24	.79	.32	
																					.98	.32	

T A B L E 9.

Surface Area Struck sq. ins.	Less than .98	.98 to 1.97	1.97 to 2.96	2.96 to 3.94	3.9 to 5.9	5.9 to 9.8	9.8 to 19.7	19.7 to 33	33 to 47	47 to 79
Maximum thickness in direction of forging (ins.)	1.18	1.58	1.97	2.36	2.75	3.15	3.54	3.94	4.33	4.72
Maximum length perpendicular to direction of forging (ins.)	3.9	5.9	7.9	9.8	11.8	13.8	15.8	17.7	19.7	23.6
Tolerances (ins.)	+ .020 - 0	+ .024 - 0	+ .028 - 0	+ .032 - 0	+ .035 - 0	+ .039 - 0	+ .047 - 0	+ .059 - 0	+ .079 - 0	+ .098 - 0