S A E

AERONAUTICAL INFORMATION

REPORT

NO. 18

PROPELLER SHAFT ENDS - DUAL ROTATION

(ENGINE SUPPLIED BEARING)

DECEMBER 1, 1947

PREPARED BY

Committee E-21, Aircraft Engine Components & Accessories - Steering Committee
Committee P-6, Propeller Standards

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.
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INTRODUCTION

This report was prepared by SAE Committees E-21 and P-6 in accordance with the decisions and recommendations of the Aeronautics Committee at their meeting on January 8, 1947.

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PROPELLER SHAFT ENDS - DUAL ROTATION

(ENGINE SUPPLIED BEARING)

1. PURPOSE:

1.1. It is the purpose of this report to record the results of an investigation of a dual rotation propeller shaft standard for an engine supplied bearing and the reason for deciding that such a bearing is impracticable.

1.2. For reference purposes the appended data and figures record the dimensions of the space considered available and the tentative requirements which were proposed for an engine supplied bearing at the time of origin May 25, 1945.

2. BACKGROUND:

2.1. In the dual rotation engine-propeller arrangement it is not practicable to support both shafts on bearings incorporated within the engine, because of the extreme length of the outboard shaft. Therefore, it is necessary that a bearing be incorporated near the outboard end of the inboard shaft to provide the support needed to prevent contact between the shafts under some operating loads.

2.2. A satisfactory propeller supplied bearing has been developed and Aeronautical Standard AS91 covering dual rotation shafts for this type of bearing has been published by the SAE and adopted by aircraft engine manufacturers. Supplementing AS91, Aeronautical Recommended Practice ARP375 has been proposed covering all involute splines and larger shaft sizes.

3. CONCLUSION:

3.1. An engine supplied bearing seemed to offer some advantages in space and weight-saving but design studies showed the problem of supplying and sealing lubricant to such a bearing was so difficult that the engine supplied bearing was abandoned as impracticable.

SHAFT SEAL SPECIFICATION
LEAKAGE IN EITHER DIRECTION PAST SEAL BETWEEN SHAFTS TO BE A MAX OF .02 OUNCE PER HOUR WITH SHAFTS STATIONARY AND A MAX OF ONE OUNCE PER HOUR WITH SHAFTS RUNNING, THE LEAKAGE FROM THE PROPELLER INTO THE ENGINE TO BE MEASURED WITH 12 INCH HEAD OF SAE NO.10 OIL AT OPERATING CONDITIONS OF SHAFTS

LEAKAGE PAST SEAL BETWEEN INBOARD SHAFT AND NOSE TO BE ZERO FROM ENGINE INTO PROPELLER WITH SHAFTS STATIONARY AND A MAX OF ONE OUNCE PER HOUR IN EITHER DIRECTION WITH SHAFTS RUNNING AND WITH A MIST OF SAE NO.10 OIL PRESENT ON PROPELLER SIDE OF SEAL

TAPER NOTE:
SURFACE AT DIAS **G** AND **H** NOT TO TAPER MORE THAN .0005 PER INCH OF LENGTH

ENGINE MANUFACTURER TO PLUG SHAFT TO PREVENT LEAKAGE IN EITHER DIRECTION UNDER 12 INCH HEAD OF SAE NO. 10 OIL. FRONT SURFACES OF PLUG TO BE WITHIN THIS 1.000 LENGTH

CONCENTRICITY NOTES:
WITH EITHER SHAFT MOUNTED ON DIA **G** AND REAR BEARING SURFACE, DIA **H**, OTHER BEARING SURFACES, AND DIA **A** ON STRAIGHT SPLINES SHALL BE CONCENTRIC WITHIN .001 FIR. THD T-PITCH DIA **S** SHALL BE CONCENTRIC WITHIN .005 FIR AND DIA **Z** ON INVOLUTE SPLINES SHALL BE CONCENTRIC WITHIN .002 FULL INDICATOR READING

AXES OF SHAFTS AS DETERMINED BY DIAMETERS **G** AND **H** SHALL BE PARALLEL WITHIN .001 PER INCH OF LENGTH

DIA **H** ON INBOARD SHAFT AND DIA **HH** SHALL BE CONCENTRIC WITHIN .007 FIR

ENGINE MFR TO PROVIDE OIL SEAL BETWEEN SHAFTS, AND BETWEEN INBOARD SHAFT AND ENGINE NOSE

THIS SPACE RESERVED FOR ENGINE MFR SUPPLIED BEARING, SEAL, ETC. BEARING TO BE LUBRICATED BY ENGINE MFR

SURFACE MUST BE SQUARE WITH DIA **H** OF OUTBOARD SHAFT WITHIN .005 FIR AND FREE FROM HOLES OR SLOTS. SHOULDER NEED NOT BE INTEGRAL WITH SHAFT

PROPELLER PARTS WILL CLEAR A MAX RADIUS OF **CH**

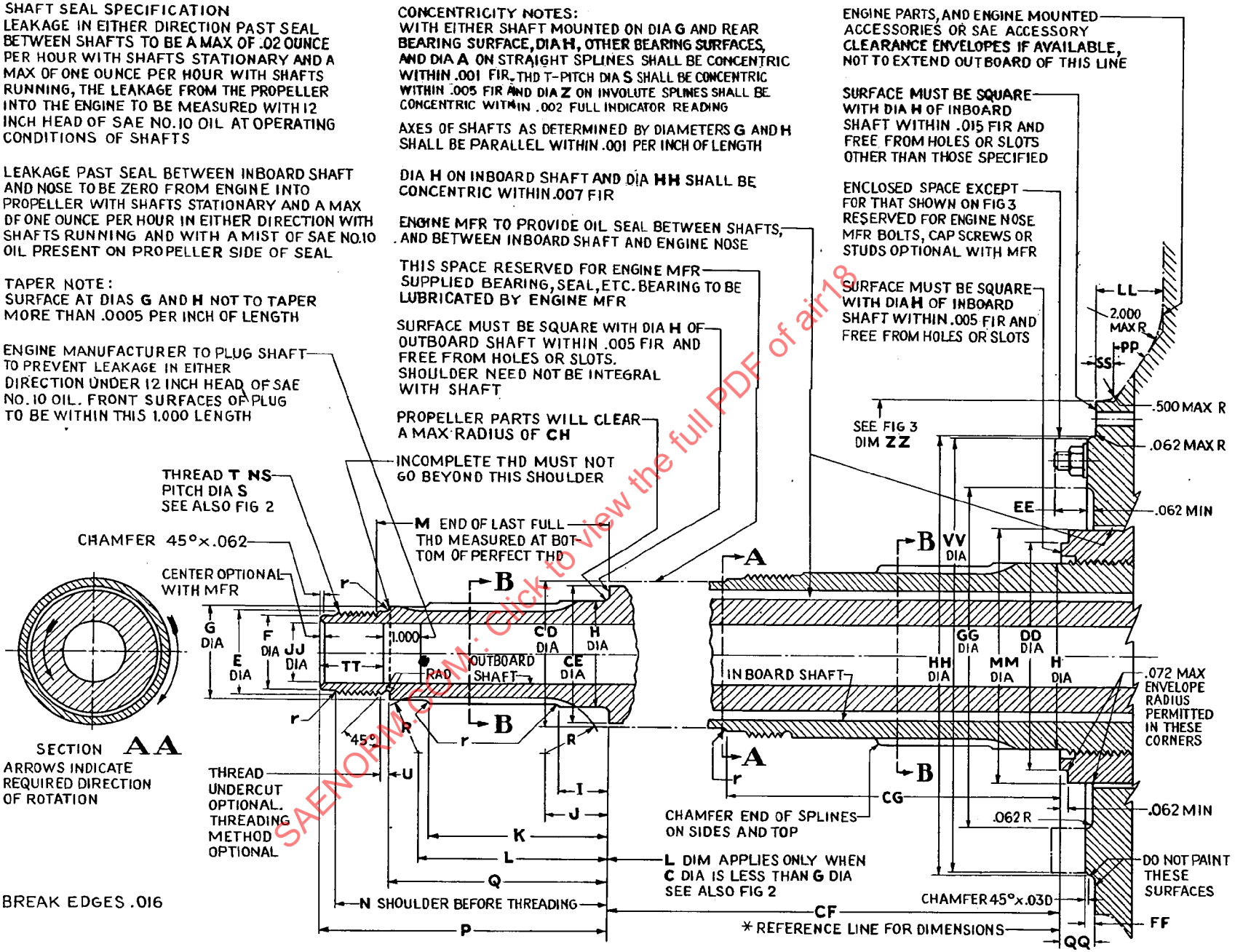
INCOMPLETE THD MUST NOT GO BEYOND THIS SHOULDER

ENGINE PARTS, AND ENGINE MOUNTED ACCESSORIES OR SAE ACCESSORY CLEARANCE ENVELOPES IF AVAILABLE, NOT TO EXTEND OUTBOARD OF THIS LINE

SURFACE MUST BE SQUARE WITH DIA **H** OF INBOARD SHAFT WITHIN .015 FIR AND FREE FROM HOLES OR SLOTS OTHER THAN THOSE SPECIFIED

ENCLOSED SPACE EXCEPT FOR THAT SHOWN ON FIG 3 RESERVED FOR ENGINE NOSE MFR BOLTS, CAP SCREWS OR STUDS OPTIONAL WITH MFR

SURFACE MUST BE SQUARE WITH DIA **H** OF INBOARD SHAFT WITHIN .005 FIR AND FREE FROM HOLES OR SLOTS



* DIMENSIONS, DIMENSION LETTERS AND NOTES ARE FOR BOTH SHAFTS AS APPLICABLE

FIG. 1

UNLESS OTHERWISE SPECIFIED	
ALLOWABLE TOLERANCE ON :-	
FINISHED DIMS IS	±.010
ANGULAR DIMS IS	± 2°

LET	TOLERANCE OUT-BOARD SHAFT	TOLERANCE IN-BOARD SHAFT	40 — 60 STRAIGHT SPLINES	40 — 60 INVOLUTE SPLINES	50 — 70 STRAIGHT SPLINES	50 — 70 INVOLUTE SPLINES	60 — 80 INVOLUTE SPLINES	60 — 80 INVOLUTE SPLINES	60L — 80 INVOLUTE SPLINES	60L — 80 INVOLUTE SPLINES
A	+.000	-.002	3.117	—	3.804	—	—	—	—	—
	+.000	-.005	—	4.680	—	5.539	4.680	6.411	4.680	6.411
B	MAX		2.875	4.436	3.554	5.294	4.436	6.151	4.436	6.151
C	MIN		2.783	—	3.462	—	—	—	—	—
	+.010	-.020	—	4.321	—	5.179	4.321	6.036	4.321	6.036
D	±.0008		.3040	—	.3750	—	—	—	—	—
	+.0000	-.0030	—	.2233	—	.2233	.2233	.2233	.2233	.2233
E	+.000	-.004	2.807	4.245	3.432	5.120	4.245	5.995	4.245	5.995
F	+.000	-.005	2.688	4.062	3.312	4.938	4.062	5.812	4.062	5.812
G	+.000	-.002	2.812	4.296	3.500	5.156	4.296	6.011	4.296	6.011
H	+.000	-.002	3.125	4.687	3.812	5.562	4.687	6.426	4.687	6.426
I	±.025		2.062	1.812	5.000	1.812	3.312	3.250	3.312	3.250
J	±.040		2.562	2.312	5.500	2.312	3.812	3.750	3.812	3.750
K	±.020		5.875	5.375	8.812	5.375	7.359	7.400	7.359	7.400
L	±.030	—	6.000	—	8.938	—	—	—	—	—
M	+.010	-*	7.100	8.360	10.037	8.360	8.870	10.360	8.870	10.360
N	+.010	-.030	8.266	9.735	11.203	9.735	10.245	11.610	10.245	11.610
P	±.020	—	8.938	—	11.875	—	10.750	—	10.750	—
Q	±.020		7.000	8.250	9.938	8.250	8.750	10.250	8.750	10.250
R	MAX		1.530	2.030	1.530	2.030	2.030	2.030	2.030	2.030
	MIN		1.125	1.125	1.125	1.125	1.125	1.125	1.125	1.125
r	+.030	-.000	.062	.062	.062	.062	.062	.062	.062	.062
S	+.0000	-.0030	2.7560	—	3.3810	—	—	—	—	—
	+.0000	-.0050	—	4.1668	—	5.0418	4.1668	5.9168	4.1668	5.9168
T	—		2.8125-12	4.250 - 8	3.4375-12	5.125 - 8	4.250 - 8	6.000 - 8	4.250 - 8	6.000 - 8
U	±.030		.170	.250	.170	.250	.250	.250	.250	.250
V	APPROXIMATE		—	.068	—	.068	.068	.068	.068	.068
X	—		16	32	16	38	32	44	32	44
Y	—		—	7/16	—	7/16	7/16	7/16	7/16	7/16
Z	THEO		—	4.5714	—	5.4286	4.5714	6.2857	4.5714	6.2857
CD	MAX		4.032		4.908		5.782		5.782	
CE	MIN	—	3.972	—	4.843	—	5.718	—	5.718	—
CF	±.040		13.062		13.062		17.500		22.500	
CG	—	±.030	—	10.312	—	10.312	—	12.188	—	12.188
CH	MAX	—	.062	—	.188	—	.188	—	.188	—
DD			5.812		6.688		7.562		7.562	
EE	MAX		.750		.750		.750		.750	
FF			.312		.312		.312		.312	
GG	MIN		7.750		8.750		9.625		9.625	
HH	±.001		10.123		11.123		12.625		12.625	
JJ	+.005	-.000	2.188	—	2.812	—	3.562	—	3.562	—
LL	MIN **		2.062		2.062		2.062		2.062	
MM	MAX		6.188		7.062		7.938		7.938	
PP	MIN **		35°		35°		35°		35°	
QQ	±.025		.938		.938		.938		.938	
SS	MIN		.500		.500		.500		.500	
TT	±.030	—	3.000	—	3.000	—	3.000	—	3.000	—
VV	MAX		10.102		11.072		12.574		12.574	

INBOARD AXIAL DIMENSIONS ARE FROM THRUST NUT
M DIM MAX LIMIT GIVES MIN FULL THREAD
* MINUS VALUE DEPENDS ON METHOD OF THREADING AND THD RUNOUT RELATION TO SHOULDER **Q**
TO OBTAIN DIM FOR FULL NUMBER OF PITCHES, WHEN DESIRED, DEDUCT BASIC **M** FROM BASIC **N**
M DIM DOES NOT APPLY WHEN UNDERCUT IS USED
LL TO BE 4.000 AND **PP TO BE 45° WHEN PRACTICABLE

TABLE FOR FIG 1 AND 2

(PART I)

UNLESS OTHERWISE SPECIFIED	
ALLOWABLE TOLERANCE ON FINISHED DIMS IS	±.010
ANGULAR DIMS IS	±2°

LET	TOLERANCE		41 — 60		51 — 70		70 — 90		—
	OUT-BOARD SHAFT	IN-BOARD SHAFT	INVOLUTE SPLINES	INVOLUTE SPLINES	INVOLUTE SPLINES	INVOLUTE SPLINES	INVOLUTE SPLINES	INVOLUTE SPLINES	
A			—	—	—	—	—	—	
	+.000	-.005	3.083	4.680	3.750	5.539	5.539	7.554	
B	MAX		2.917	4.436	3.583	5.294	5.294	7.294	
C	+.000	-.020	2.850	—	3.517	—	—	—	
	+.010	-.020	—	4.321	—	5.179	5.179	7.179	
D	—		—	—	—	—	—	—	
	+.0000	-.0030	.1299	.2233	.1299	.2233	.2233	.2233	
E	+.000	-.004	2.807	4.245	3.432	5.120	5.120	7.120	
F	+.000	-.005	2.688	4.062	3.312	4.938	4.938	6.938	
G	+.000	-.002	2.812	4.296	3.500	5.156	5.156	7.156	
H	+.000	-.002	3.125	4.687	3.812	5.562	5.562	7.570	
I	±.025		2.062	1.812	5.000	1.812	3.312	3.312	
J	±.040		2.562	2.312	5.500	2.312	3.812	3.812	
K	±.020		5.875	5.375	8.812	5.375	8.188	8.000	
L	±.030	—	—	—	8.938	—	—	—	
M	+.010	-*	7.100	8.360	10.037	8.360	10.360	11.610	
N	+.010	-.030	8.266	9.735	11.203	9.735	11.735	13.110	
P	±.020	—	8.938	—	11.875	—	12.375	—	
Q	±.020		7.000	8.250	9.938	8.250	10.250	11.500	
R	MAX		1.530	2.030	1.530	2.030	2.030	2.030	
	MIN		1.125	1.125	1.125	1.125	1.125	1.125	
r	+.030	-.000	.062	.062	.062	.062	.062	.062	
S	+.0000	-.0030	2.7560	—	3.3810	—	—	—	
	+.0000	-.0050	—	4.1668	—	5.0418	5.0418	7.0418	
T	—		2.8125-12	4.250-8	3.4375-12	5.125-8	5.125-8	7.125-8	
U	±.030		.170	.250	.170	.250	.250	.250	
V	APPROXIMATE		.035	.068	.035	.068	.068	.068	
X	—		36	32	44	38	38	52	
Y	—		12/24	7/16	12/24	7/16	7/16	7/16	
Z	THEO		3.0000	4.5714	3.6667	5.4286	5.4286	7.4286	
CD	MAX		4.032		4.908		6.908		
CE	MIN	—	3.972	—	4.843	—	6.593	—	
CF	±.040		13.062		13.062		25.000		
CG	—	±.030	—	10.312	—	10.312	—	13.750	
CH	MAX	—	.062	—	.188	—	.219	—	
DD			5.812		6.688		8.750		
EE	MAX		.750		.750		1.000		
FF			.312		.312		.312		
GG	MIN		7.750		8.750		11.375		
HH	±.001		10.123		11.123		14.373		
JJ	+.005 -.000	—	2.188	—	2.812	—	4.375	—	
LL	MIN		2.062 **		2.062 **		4.0000		
MM	MAX		6.188		7.062		9.125		
PP	MIN		35° **		35° **		45°		
QQ	±.025		.938		.938		.938		
SS	MIN		.500		.500		.500		
TT	±.030	—	3.000	—	3.000	—	3.000	—	
VV	MAX		10.102		11.072		14.250		

INBOARD AXIAL DIMENSIONS ARE FROM THRUST NUT
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TABLE FOR FIG 1 AND 2

(PART II)

UNLESS OTHERWISE SPECIFIED
ALLOWABLE TOLERANCE ON
FINISHED DIMS IS ± .010
ANGULAR DIMS IS ± 2°