

**NASA LANGLEY RESEARCH CENTER
FABRICATION OF GRMS TRANSMISSIONS GEARS
STATEMENT OF WORK
10/14/14**

Introduction

The General Rotor Model System (GRMS) Transmission is a highly specialized transmission for helicopter wind tunnel testing at NASA Langley Research Center. Two electric 75 HP motors operate at 8000 RPM to power the output shaft through a 5.47:1 or 6.90:1 gear ratio. The original design was completed by Sikorsky Aircraft in 1974. The scope of this task is to fabricate new gear sets from the original drawings. The contractor will be not be provided gear summary files or a master gears from the Government.

Fabrication

The contractor shall fabricate the parts listed in Table 1. Items 1 and 2 are required and shall be quoted as a set. The item lead time shall be included in the quote. Items 3-7 are optional items. If the quote includes the optional items, the cost and lead time shall be itemized by item number. The associated drawings are included in the Appendix of this document.

Table 1: Part Fabrication Summary

Item #	Description	P/N	Qty
1	Input pinion Shaft	1096290-52	4
2	Driven Bevel Gear	1096290-53	4
3	Intermediate Shaft	1096290-11	2
4	Intermediate Shaft	1096290-12	2
5	Driven Spur Gear	1096290-13	1
6	Driven Spur Gear	1096290-14	1
7	Output Shaft	1096290-15	1

The contractor is responsible for developing the summary file or master gear from the drawings provided. The contractor is responsible for meeting all standards and tolerances provided on the drawings. The contractor may not use the drawings for any other use other than the intent of this project.

Certifications Required

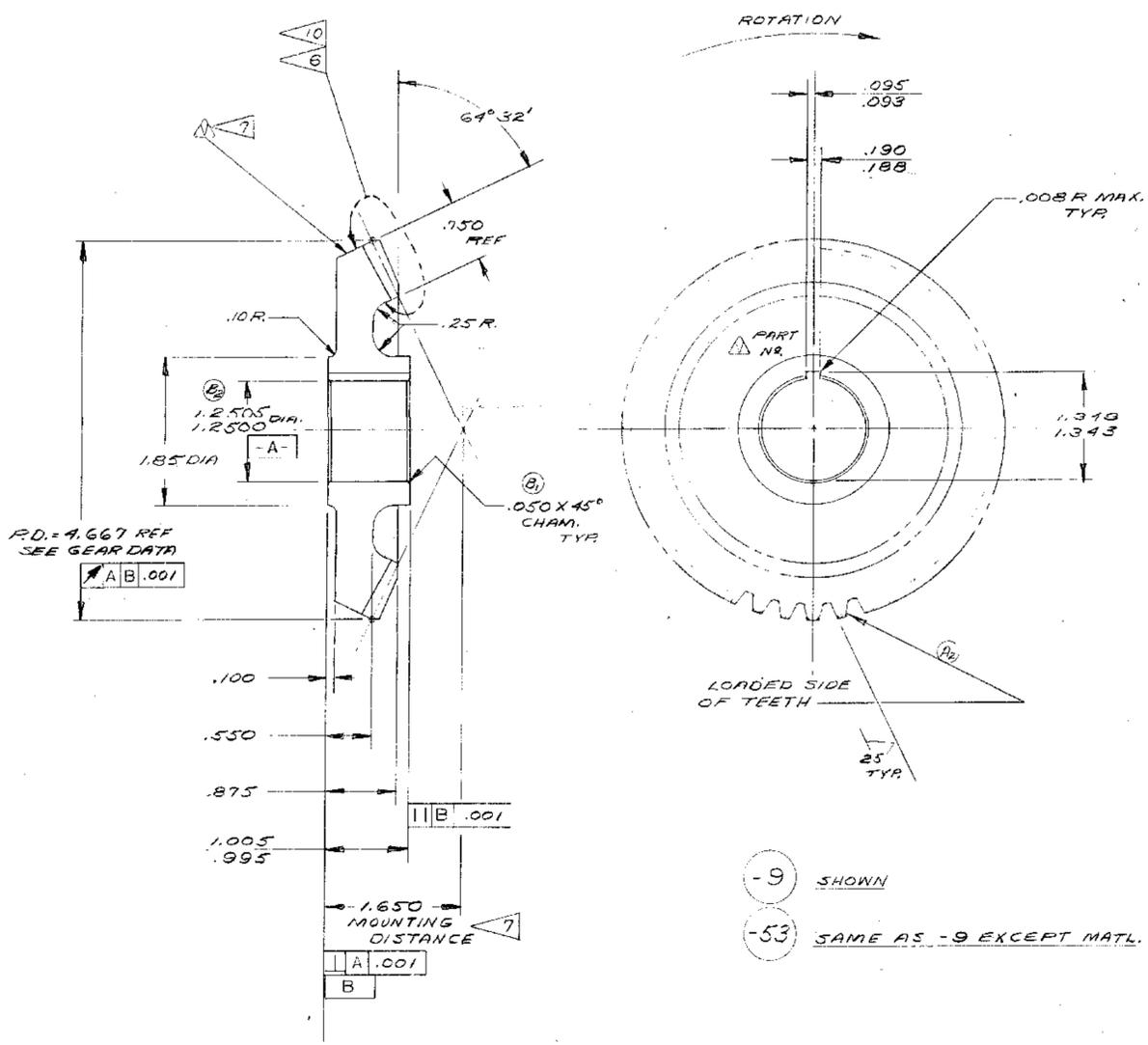
At a minimum the contractor must be certified to ISO 9001:2008 and AS9100-C for the scope of manufacturing precision gears and gear boxes for the aerospace industry.

Selection Criteria

The Government will consider item technical merit, lead times, historical performance and cost in the selection of a contractor for this task.

DESIGN SUPV.	DESIGN CHKR.	RECORD CHKR.	MATERIAL	FINISH	STRUCT. ANAL.	STRUCT. SUPV.	MASS PROP.	SYS. ENGR.	TASK MGR.	CLASS	CMO	RELEASE GROUP	GOVT.	CONTRACT MOD. NO.
REV. SYM.	RELEASE AUTHORITY	FD ZONE	FIND NO.	DESCRIPTION OF CHANGE										
A1	ENGR. CHG	1-A		SHT 13 & 14 ADDED										
A2	ENGR. CHG	4-B		LOADED SIDE OF TOOTH CHG.										
B1	"	5-B		INCREASE CHAM FROM .030 TO .050										
B2	"	6-B		CHG DIA FROM 1.251/1.249										

SPIRAL BEVEL GEAR DATA	
NO. OF TEETH	42
PRESSURE ANGLE	20° 0'
SPIRAL ANGLE (MEAN)	35°
FACE WIDTH	.750
DIAMETRAL PITCH	9.000
PITCH DIAMETER	4.667
CONE DISTANCE (OUTER) 2.584; (MEAN) 2.209	
CIRCULAR PITCH	.349
WORKING DEPTH	.189
WHOLE DEPTH	.210
CLEARANCE	.021
ADDENDUM	.061
DEDENDUM	.149
PITCH ANGLE	64° 32'
ADDENDUM ANGLE	1° 49'
DEDENDUM ANGLE	3° 18'
FACE ANGLE OF BLANK	66° 21'
ROOT ANGLE	6° 14'
OUTSIDE DIAMETER	4.719
PITCH CONE APEX TO CROWN	1.056
MATING PART	20 TOOTH GEAR (RS-315-3)
DIRECTION OF ROTATION	CCW (VIEWED FROM SHAFT END)
CIRCULAR TOOTH THICKNESS	.106 (MEAN)
BACKLASH ROTATIONAL	— WITH MATE
BACKLASH NORMAL	.003/005 WITH MATE
EXACT AMOUNT TO BE ETCHED ON GEAR	1
DRIVING MEMBER	RS-315-3 OR -52
DRIVEN MEMBER	RS-315-9 OR -53
HAND OF SPIRAL	R.H. (VIEWED FROM CONE CENTER END)
SUMMARY NUMBER	173.399 (GLEASON)



- NOTES:**
- 90° ALL OVER EXCEPT AS NOTED. SS8100 SHALL APPLY FOR HOLES UNLESS OTHERWISE INDICATED. AREAS OF TRANSITION SHALL CONFORM TO THAT SPECIFIED FOR THE ROUGHEST ADJACENT FINISHED AREA UNLESS OTHERWISE INDICATED.
 - BREAK ALL SHARP EDGES .005-.015 INCH RADIUS UNLESS OTHERWISE SPECIFIED.
 - UNLESS OTHERWISE SPECIFIED, ALL DIAMETERS ON A COMMON ϕ ARE TO BE CONCENTRIC WITHIN .010 DIA.
 - MATL: NITRALLOY 135 MODIFIED, MIL-S-6709 COND. C OR E.
 - BEFORE FINISH MACHINING, HEAT TREAT TO 150,000 PSI. MIN. T.S. ROCKWELL C 34-38 PER MIL-H-6875. AUSTENITIZE: 1700-1750°F ONE HOUR. QUENCH: OIL. TEMPER: 1100-1300°F ONE HOUR.
 - AFTER FINISH MACHINING NITRATE AREA INDICATED BY FLOE PROCESS TO PRODUCE ON THE COMPLETED PART AN .008 IN. MIN. DEPTH OF CASE HARDNESS OF ROCKWELL 15N90 MIN. OR EQUIV. APPLICABLE TO PART-9 ONLY.
 - EXACT MOUNTING DISTANCE TO BE ETCHED ON GEAR.
 - FINISH GRINDING TO BE IN ACCORDANCE WITH SS8705.
 - ALL BEVEL GEAR CUTTING & GRINDING SUMMARIES BECOME PROPERTY OF S.A. AND ONE REPRODUCIBLE COPY MUST BE DELIVERED WITH COMPLETED GEAR.
 - CARBURIZE AREAS INDICATED PER SS8015 TO PRODUCE .015-.030 DEPTH OF CASE IN THE FINISHED PART. BEFORE FINISH MACHINING HEAT TREAT TO ROCKWELL C58-64 OR EQUIVALENT CASE HARDNESS WITH ROCKWELL C 30-45 CORE HARDNESS PER SS8015. PART -53 ONLY.

CONTRACT NO.		NATIONAL AERONAUTICS & SPACE ADMINISTRATION LANGLEY RESEARCH CENTER HAMPTON, VIRGINIA 23865-5225	
APPROVALS	DATE	TITLE	
		GENERAL ROTOR MODEL SYSTEM	
DRAWN		SIZE	FSCM NO.
CHECKED		DWG NO.	REV.
ISSUED	8-1-36	LD 1096290	B
		SCALE	SHEET 3 OF 14

DASH NO.	NOMENCLATURE	SPECIFICATION	MATERIAL OR NOTE	REQ'D	UNIT WT	ZONE
-53	BEVEL GEAR	AMS-6260	9310	2		
-9	BEVEL GEAR		4 5 6	2		

APPLICATION OF PROTECTIVE FINISHES	
TYPE	DASH NO.'S APPLICABLE
FN #1	-9 F-53
FN #2	
FN #3	
FN #4	

SPEC.	TREATMENT	FN#1	FN#2	FN#3	FN#4
MIL A-8625	ANODIZE (TYPE 1)				
TT-P-1757	PRIMER				
SS8486	CHEM SURFACE TREAT				
QQ-P-416	CADMIUM PLATE (CL 2 TYPE II)				
SS8830	INSULATE DISSIMILAR METALS ON ASSY/INSTR				
	TOUCH UP ON ASSY/INSTR				
MIL-C-13924	BLACK OXIDE (DULUTE OR EQUIV.)				

DASH NO.	ROUGH PART	FIN PART	ROUGH PART	FIN PART	ROUGH PART	FIN PART
-9 F-53						

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SYMBOLS & ABBREVIATIONS

SS — SIKORSKY STANDARD
 SER — SIKORSKY ENGRG REPORT
 SE — SIKORSKY ENGRG SPEC
 EO — ENGINEERING ORDER
 RTE — REQUEST TO ENGR

▶ VENDOR ITEM—SEE SOURCE CONTROL OR SPECIFICATION CONTROL DRAWING

▲ PART MARKING
 ▲ SEE PARTS CHART
 ▲ SEE NOTE NO.

◆ NOT TO BE USED FOR PRODUCTION AIRCRAFT OR SPARES

TOLERANCES:

ANGULAR ± 0° 30'
 LINEAR (EXCEPT HOLES) .XX ± .03, .XXX ± .010
 HOLES PER SS5100

TORQUE ALL BOLTS AND NUTS PER SS9300

PART MARKING PER SS8798
 DRAWING INTERPRETATION PER MIL-STD-100
 DIMENSIONS IN INCHES
 ADVANCE PROCUREMENT E.I.

DRAWN BY [Signature]
DESIGNER [Signature]
DESIGN SUPV [Signature]
RECORD CHKR [Signature]
STRUCT. ANAL [Signature]
STRUCT. SUPV [Signature]

ORIGINAL PREPARED UNDER CONTRACT NUMBER NAS1-12674

RELEASE AUTHORITY

TASK MANAGER [Signature]
RELEASE GROUP [Signature]
GOVERNMENT

Sikorsky Aircraft
 STRATFORD, CONNECTICUT 06602

DRAWING TITLE
 NASA/LANGLEY HEL. MOD. SYS. TRANS-DRIVEN BEVEL GEAR DETAILS.

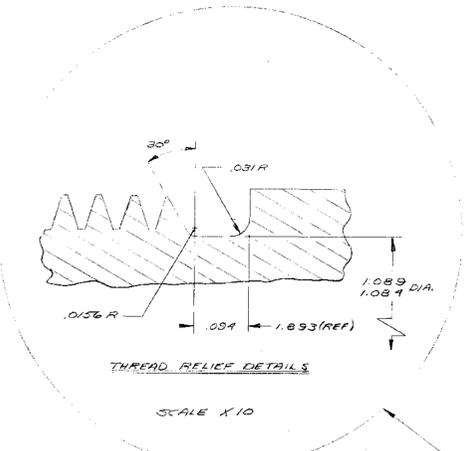
SIZE D
CODE IDENT. NUMBER 78286
DRAWING NUMBER L 1096290 SHT 3
REV B

SCALE FULL

SHEET 3 OF 14

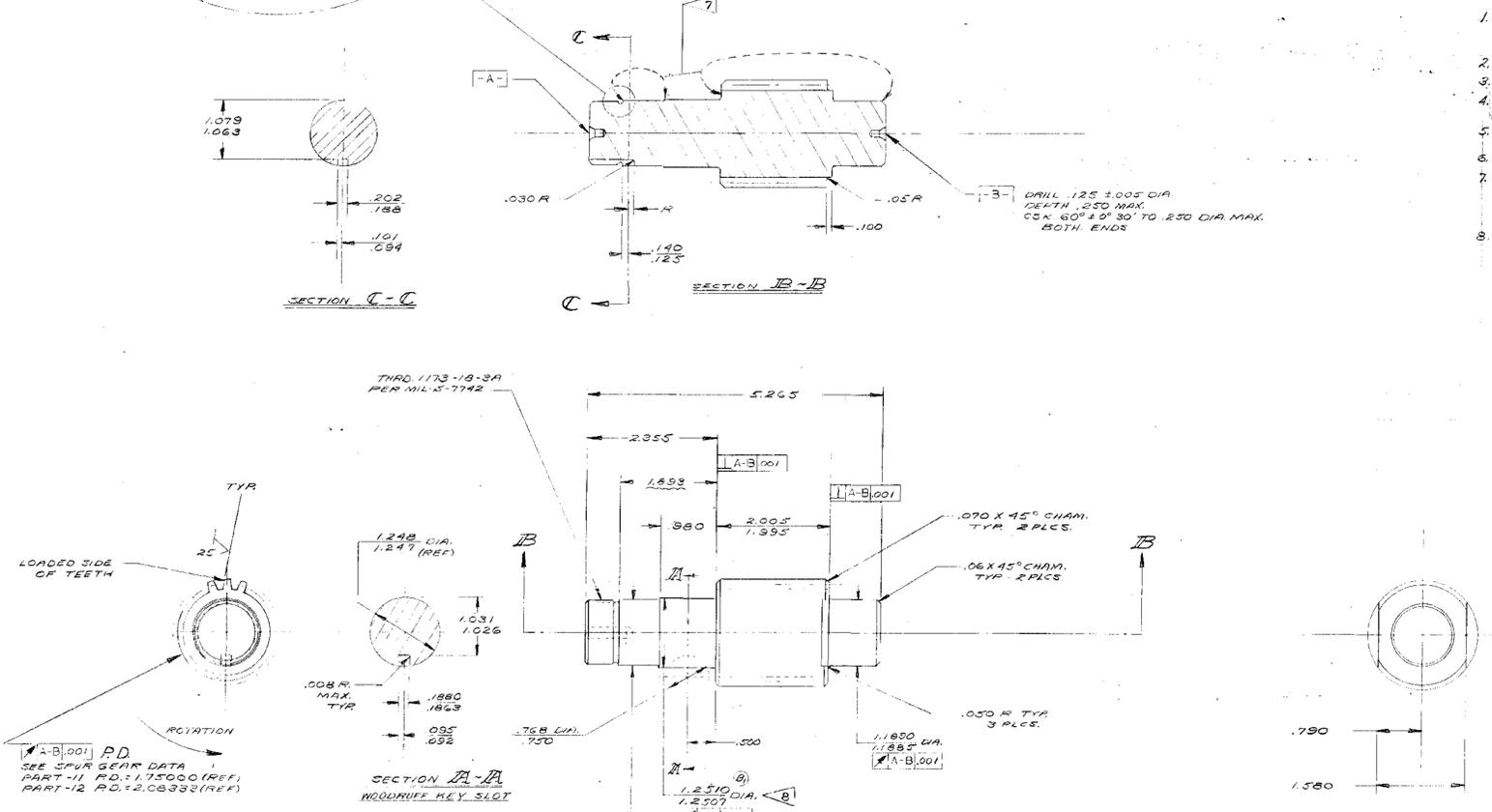
QBU

REV. SYM.	RELEASE AUTHORITY	FD ZONE	FIND NO.	DESCRIPTION OF CHANGE
A	ENGR CHG	1-A		SHT 13 & 14 ADDED
B	"	5-C		DIA CHG FROM .249/1.218



SPUR GEAR DATA PART-11	
NO. OF TEETH	21
DIAMETRAL PITCH	12.0000
PRESSURE ANGLE	20.0°
PITCH DIAMETER	1.75000
BASE CIRCLE DIAMETER	1.64446
OUTSIDE DIAMETER	1.9700-1.9650
ROOT DIAMETER	1.600-1.5910
CHORDAL TOOTH THICKNESS	1.489-1.469
CHORDAL ADDENDUM	1.132-1.106
DIMENSION OVER DIA PINS	1.9794-1.9836
MAX INVOLUTE PROFILE ERROR AT T.I.F.	0.002-0.0003 AT TIP 0/-0.0004
MAX. ACCUMULATED SPACING ERROR BETWEEN ANY TWO TEETH	0.008
MAX. TOOTH TO TOOTH SPACING ERROR	0.0004
MAX. LEAD ERROR (PER INCH OF FACE)	0.0003
MAX. T.I.F. DIA	1.660
MATING PART NUMBER	RS-315-13 (65 TOOTH)
BACKLASH WITH MATE	0.07-0.03
FILLET RADIUS	0.040-0.030

SPUR GEAR DATA PART-12	
NO. OF TEETH	23
DIAMETRAL PITCH	12.0000
PRESSURE ANGLE	20.0°
PITCH DIAMETER	2.08333
BASE CIRCLE DIAMETER	1.95769
OUTSIDE DIAMETER	2.3033-2.2983
ROOT DIAMETER	1.9343-1.9243
CHORDAL TOOTH THICKNESS	1.489-1.469
CHORDAL ADDENDUM	1.127-1.101
DIMENSION OVER DIA PINS	2.3633-2.3196
MAX INVOLUTE PROFILE ERROR AT T.I.F.	0.002-0.0003 AT TIP 0/-0.0004
MAX. ACCUMULATED SPACING ERROR BETWEEN ANY TWO TEETH	0.008
MAX. TOOTH TO TOOTH SPACING ERROR	0.0004
MAX. LEAD ERROR (PER INCH OF FACE)	0.0003
MAX. T.I.F. DIA	1.989
MATING PART NUMBER	RS-315-14 (65 TOOTH)
BACKLASH WITH MATE	0.07-0.03
FILLET RADIUS	0.040-0.030



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 - BREAK ALL SHARP EDGES .005-.015 INCH RADIUS UNLESS OTHERWISE SPECIFIED.
 - UNLESS OTHERWISE SPECIFIED, ALL DIAMETERS ON A COMMON ϕ ARE TO BE CONCENTRIC WITHIN .010 DIA.
 - GEARS TO BE MANUFACTURED IN ACCORDANCE WITH S 5-50654 CLASS 5.
 - FINISH GRINDING TO BE IN ACCORDANCE WITH S18705.
 - CARBURIZE AREAS INDICATED PER SS8315 TO PRODUCE .010-.025 DEPTH OF CASE IN THE FINISHED PART. BEFORE FINISH MACHINING HEAT TREAT TO ROCKWELL C58-64 OR EQUIVALENT CASE HARDNESS WITH ROCKWELL C 30-45 CORE HARDNESS PER SS8015.
 - GRIND NOMINAL 1.2510 DIA. FOR LIGHT INTERFERENCE FIT (.0002/.0005) ON -.53 DAVEN BEVEL GEAR. MARK MATING PARTS ACCORDINGLY.

CONTRACT NO.	NATIONAL AERONAUTICS & SPACE ADMINISTRATION LANGLEY RESEARCH CENTER HAMPTON, VIRGINIA 23065-5225		
APPROVALS	DATE	TITLE	GENERAL MOTOR MODEL SYSTEM
DRAWN			
CHECKED			
ISSUED	D. Rain	8-9-96	SIZE E FSCM NO. DWG NO. LX 1096190 REV B
			SCALE SHEET 47 OF 114

DASH NO.	NOMENCLATURE	SPECIFICATION	MATERIAL OR NOTE	REQ. NO.	UNIT WT.	ZONE
-12	INTERMEDIATE SHAFT	AMS 6260	9310			
-11	INTERMEDIATE SHAFT	AMS 6260	9310			

DESIGNED BY	7. LAWTON	DATE	10/27/94
DESIGNER	A. WALKER	DATE	10/27/94
DESIGN CHK.	J. K. GRIFFIN	DATE	11/17/94
RECORD CHK.	J. K. GRIFFIN	DATE	11/17/94
STRUCT. ANAL.	J. K. GRIFFIN	DATE	11/17/94
STRUCT. SUPV.	J. K. GRIFFIN	DATE	11/17/94
MATERIAL	J. K. GRIFFIN	DATE	11/17/94
FINISH	J. K. GRIFFIN	DATE	11/17/94
MASS PROP.	J. K. GRIFFIN	DATE	11/17/94
SYS. ENGR.	J. K. GRIFFIN	DATE	11/17/94

FIN. NO.	TREATMENT	FINISH NUMBER
1	ANODIZE (TYPE II)	1
2	PRIMER	2
3	CHEM SURFACE TREATMENT	3
4	CADMIUM PLATE (6.2 TYPE II)	4
5	INSULATE DISSEMBLY METALS ON ASSY/INSTL TOUCH UP ON ASSY/INSTL	5

SPEC	TREATMENT	FINISH NUMBER
MIL-A-8625	ANODIZE (TYPE II)	1
TT-1153	PRIMER	2
SS8486	CHEM SURFACE TREATMENT	3
QQ-P-416	CADMIUM PLATE (6.2 TYPE II)	4
SS8630	INSULATE DISSEMBLY METALS ON ASSY/INSTL TOUCH UP ON ASSY/INSTL	5

SYMBOLS & ABBREVIATIONS	UNLESS OTHERWISE SPECIFIED
SS - SIKORSKY STANDARD OR SPEC.	TOLERANCES:
SEK - SIKORSKY ENGR. REPORT	ANGULAR ± 0°30'
SES - SIKORSKY ENGR. SPEC.	LINEAR (EXCEPT HOLES)
EO - ENGINEERING ORDER	XX ± .03, XXX ± .010
RTS - REQUEST TO ENGR.	HOLES PER SS5100
△ PART MARKING	TORQUE ALL BOLTS AND NUTS PER SS9300
◊ SEE NOTE NO.	PART MARKING PER SS9796
○ TORQUE	DRAWING INTERPRETATION PER MIL-STD-100
	DIMENSIONS IN INCHES
	ADVANCE PROCUREMENT E.I.

8-1125-11

