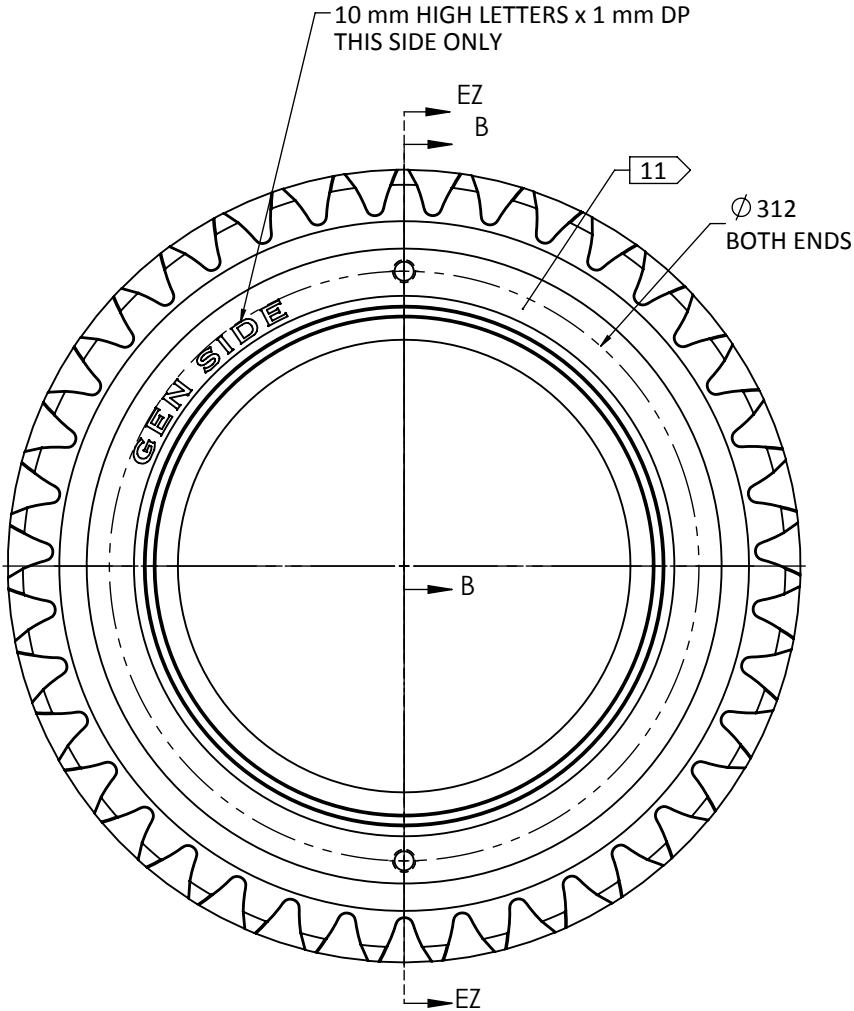
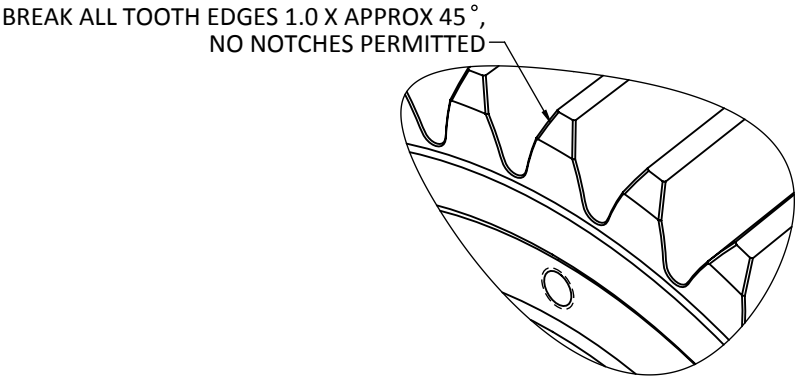
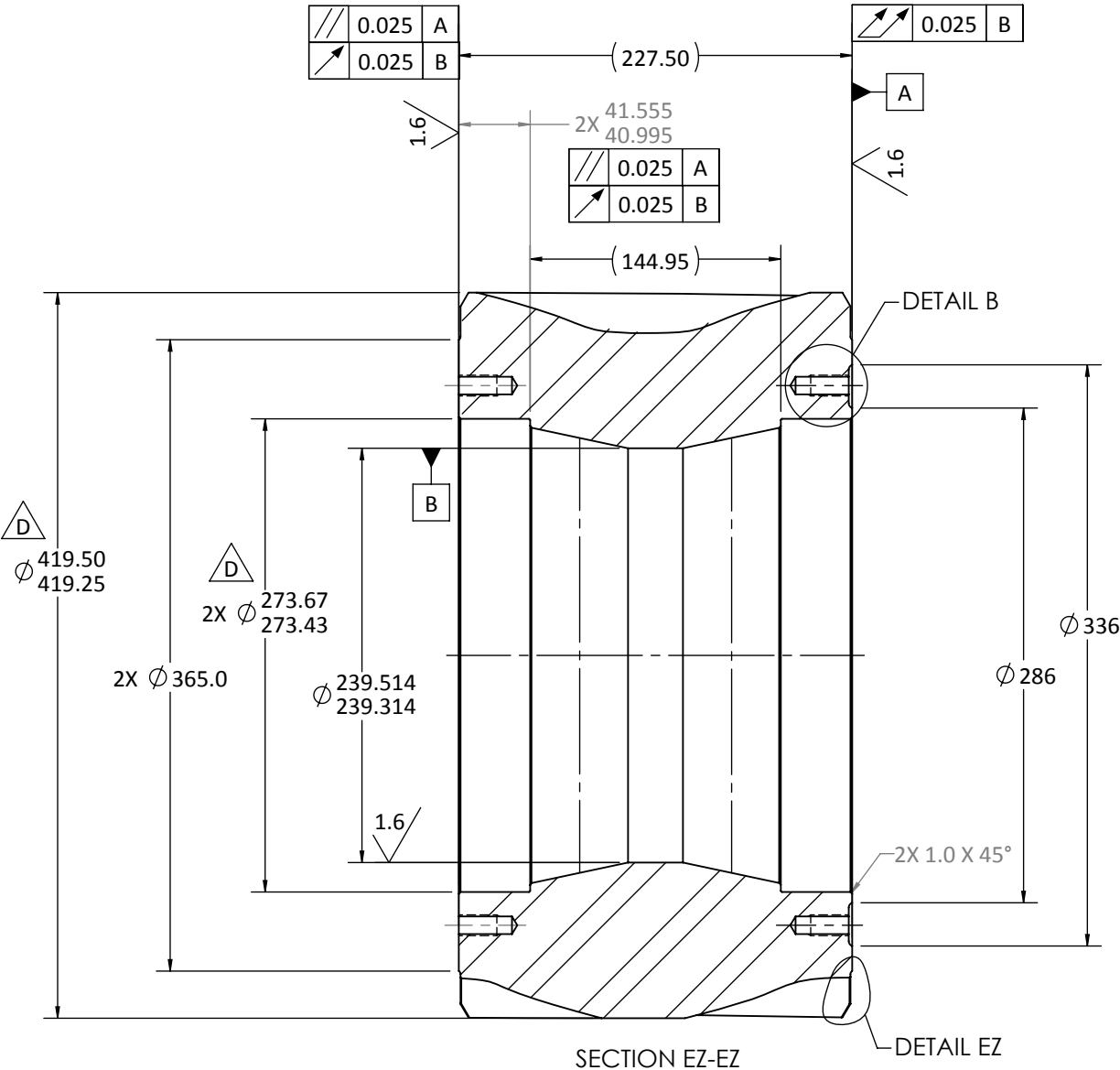


NOTES:

1. PROVIDE INSPECTION REPORTS OR PROOF ACCORDING TO THE PROVISIONS EN 10204-3.1
 2. MATERIAL: STEEL GRADE E3311 PER TIMKEN SPECIFICATION. VENDOR APPROVAL FROM TIMKEN REQUIRED, CLEANNESS MAXIMUM LIMITS TO BE

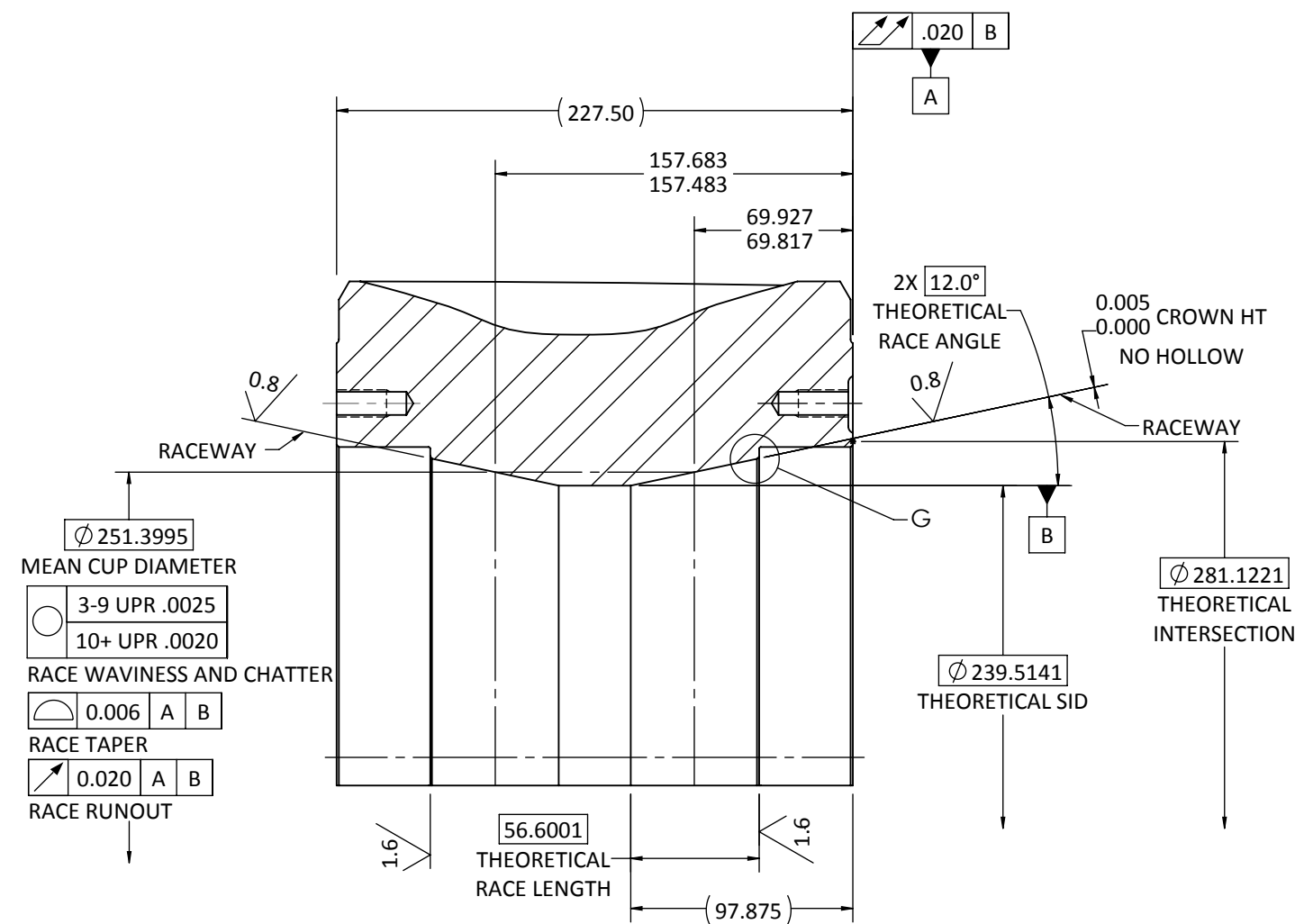
TYPE	A	B	C	D
THIN	2.5	1.5	0	1.0
HEAVY	1.5	0.5	0	0.5
 3. ULTRASONIC TESTING OF FORGINGS MUST FOLLOW THE PROVISIONS OF EN 10228-3 LEVEL 3 (AGMA A-388- TO AN EQUIVALENT3 mm FLAT BOTTOMED HOLE IS AN ACCEPTABLE ALTERNATIVE.)
 4. CASE HARDENED TO AN EFFECTIVE CASE DEPTH OF 1.9-2.9mm (MEASURED TO 52HRC) AFTER FINISH MACHINING AND TEMPER AT 170 °C min. SURFACE HARDNESS 58/63 HRC AND CORE HARDNESS 28/40 HRC. REMAINDER OPTIONAL OTHER THAN THREADS WHICH MUSH REMAIN SOFT. PROCESS TO AGMA 2001 D-04 GRADE 2
 5. MICROSTRUCTURE: CARBIDE NETWORKS ARE NOT PERMITTED. RETAINED AUSTENITE TO BE 25% MAXIMUM. INTER-GRANULAR OXIDATION AND CARBIDE PRECIPITATION TO BE PER ISO 6336-5. MEASURED AT TOOTH TIPS, VERIFIED USING METALLOGRAPHIC EXAMINATION OF TEST BARS (ALT: AGMA 2001-D04)
 6. THERE IS TO BE NO PARTIAL DE-CARBURISATION OF THE TOOTH FLANKS AFTER GRINDING; THE SURFACE CARBON CONTENT MUST BE 0.65% TO 1%; CASE STRUCTURE SHOULD BE FINE ACICULAR MARTENSITE. ACICULAR FERRITE AND BAINITE. NO BLOCKY FERRITE. AS ASSESSED ON REPRESENTATIVE TEST BAR
 7. THE TOOTH ROOT FILLET- THERE SHALL BE NO STEP AFTER PROFILE GRINDING
 8. MAGNETIC PARTICAL TESTING OR DYE PENETRANT TEST GROUND SURFACES TO ISO 6336-5. NO CRACKS ALLOWED
 9. INSPECTION OF FINISHED GEAR SURFACES FOR TEMPER BURN TO AGMA 2007 GRADE FB1 USING ETCH TECHNIQUES OR BARKHAUSEN NOISE
 10. NON SPECIFIED FILLETS R3. CHAMFERS 1X45 °
- IDENTIFY WITH PART NUMBER, SUPPLIER CODE NUMBER, MANUFACTURERS LOT NUMBER AND REV LEVEL




REV	CHANGED FROM	BY	DATE	APRD
B	UPDATED CHARTS ON P3, CHANGED FACE AND EVALUATION LENGTHS	JFC	10/26/12	
C	CHANGES AS PER ROMAX MARK-UP	JFC	11/1/12	
D	CHANGES PER NJB MARKUP	CPS	2/14/13	
E	RELEASE FOR PRODUCTION	CPS	4/19/13	
F	TYPE D THIN VALUE 1.0 WAS 0.5 (ROMAX DOC 1509-ECN-015 REFERS)	NJB	09/11/13	
G	ROTOR SIDE HANDLING THREADS (ROMAX DOC 1509-ECN-016 REFERS)	CPG	11/18/13	
H	MICROGEOMETRY DIAGRAM (ROMAX DOC 1509-ECN-025 REFERS)	CPG	7/8/14	

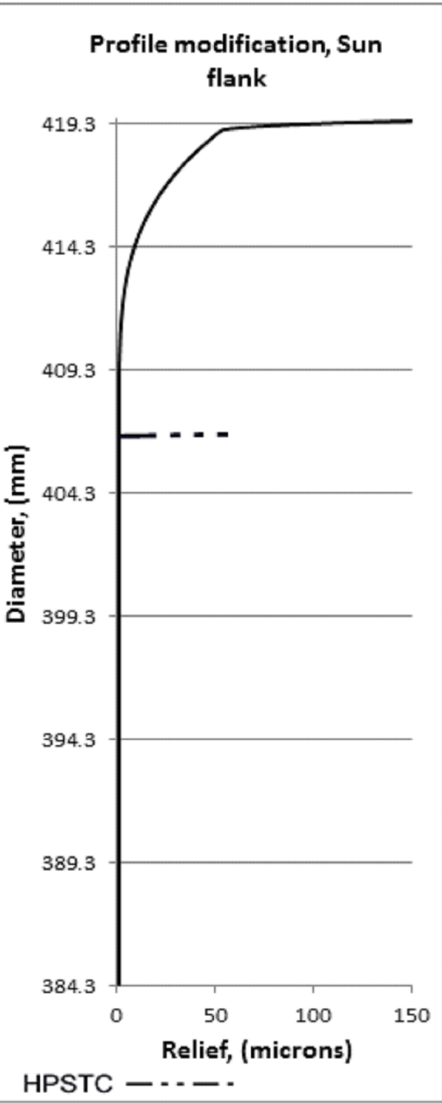
REPORT ERRORS & CHANGES REMOVE ALL BURRS AND SHARP EDGES DIMENSIONS ARE IN MILLIMETERS. UNSPECIFIED TOLERANCES: DECIMALS: FINISH: ANGLES:		
X. ±1.0 .X ±0.5 .XX ±0.25	3.2 / √ μm Ra	≤ ± 0.5°
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DRAWN	JFC	DATE: 8/27/12
CHECKED	NJB	THIRD ANGLE PRJ

MADE FROM 1509-GS-015-B		
National Renewable Energy Laboratory		
TITLE: PLANET GEAR		
SIZE B	DWG. NO. 254504	REV H
SCALE: 1:4	WEIGHT: 126.52 kgs	SHEET 1 OF 3

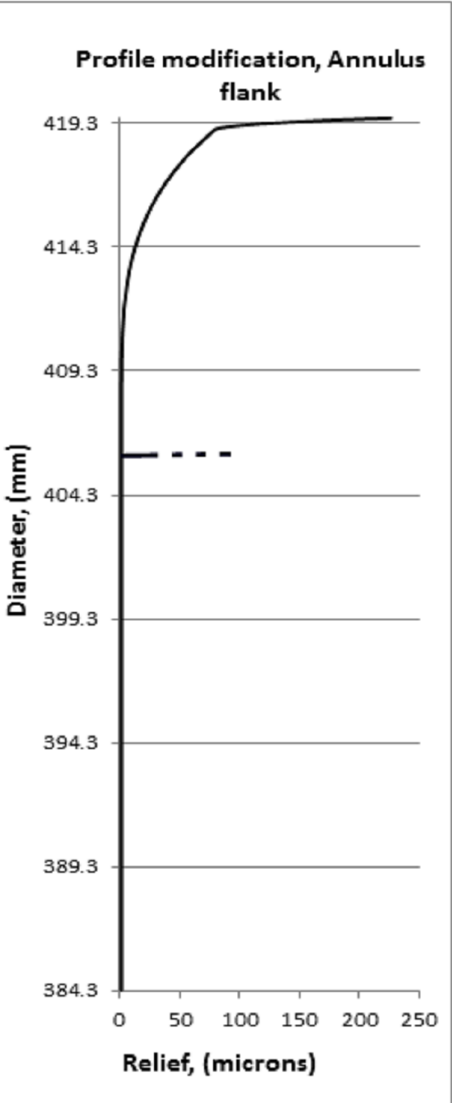


REPORT ERRORS & CHANGES REMOVE ALL BURRS AND SHARP EDGES DIMENSIONS ARE IN MILLIMETERS. UNSPECIFIED TOLERANCES: DECIMALS: FINISH: ANGLES:			<h1>National Renewable Energy Laboratory</h1>			
X: ±1.0 3.2 $\sqrt{\mu\text{m Ra}}$ $\angle \pm 0.5^\circ$.X ±0.5 .XX ±0.25						TITLE: <h2>PLANET GEAR</h2>
COPYRIGHT © NOT TO BE REPRODUCED OR USED TO MAKE OTHER DRAWINGS OR MACHINERY			SIZE B	DWG. NO. <h1>254504</h1>		REV <h1>H</h1>
DRAWN	JFC	DATE: 8/27/12				
CHECKED	NJB	THIRD ANGLE PRJ 	SCALE: 1:3	WEIGHT: 126.52 kgs		SHEET 2 OF 3

External Involute Helical Gear Data	
Number of Teeth	39
Normal Module (mm)	10.0000
Normal Pressure Angle	20.0000
Whole depth Constant (REF)	2.350
Oper pitch diameter with Sun (mm)	400.4000
Oper pitch diameter with Anulus (mm)	400.4000
Gen Pitch diameter (mm)	393.3605
Base diameter (mm)	369.2643
Major Diameter (REF) (mm)	419.5000
Form Diameter with Sun (tight mesh) (mm)	384.360
Form Diameter with Anulus (mm)	384.301
Root Diameter (REF) (mm)	374.416
Min Tool Tip Radius (mm)	4.199
Addendum Modification X1	0.3900
Hand of Helix	Left
Gen Helix Angle	7.4947
Lead (mm)	9393.3838
Number of teeth in Mate	21 / 99
Center Distance (mm)	308.0000
Normal cir BL w/ Sun (max/min) (mm)	0.329 / 0.21
Norm cir backlash w/ Anulus (max/min) (mm)	0.5 / 0.361
Quality per AGMA 2015-1	A 5
Quality Datum Surface	A-B
Trans Cir TT on Gen Dia, (max/min) (mm)	18.82 / 18.781
Size over 16.8 balls (max/min) (mm)	422.527 / 422.439
Span over 5 teeth (max/min) (mm)	141.217 / 141.181

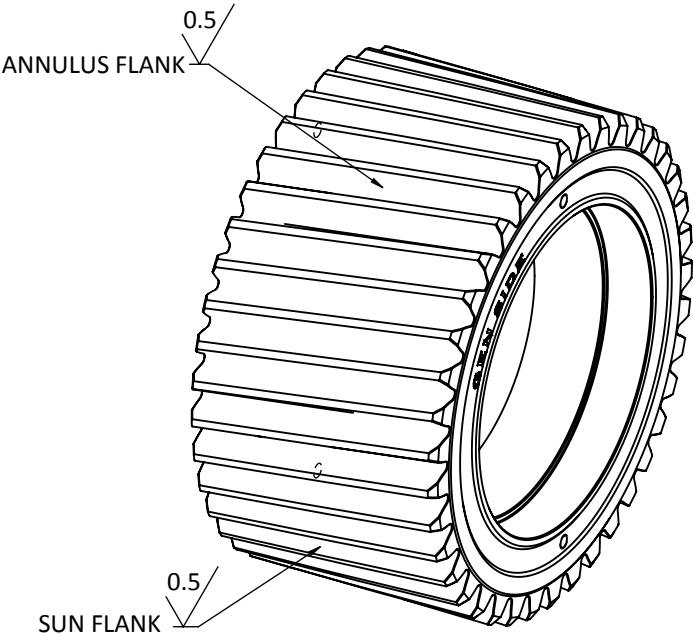
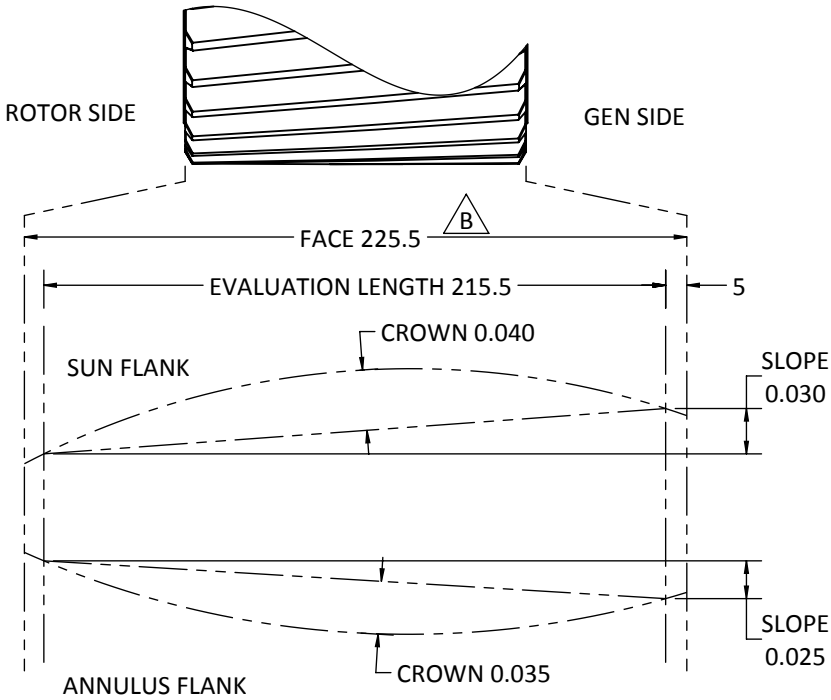


Profile Mods			
Position, LA, (mm)	Degrees of Roll	Diameter , (mm)	Relief, (microns)
53.331	16.550	384.360	0.0
87.779	27.240	408.873	0.0
88.904	27.589	409.844	0.2
90.029	27.938	410.825	0.6
91.154	28.287	411.816	1.6
92.279	28.636	412.817	3.2
93.404	28.985	413.828	6.0
94.529	29.335	414.848	10.2
95.654	29.684	415.878	16.4
96.779	30.033	416.918	25.0
97.904	30.382	417.968	36.6
99.029	30.731	419.026	51.9
99.071	30.744	419.066	53.4
99.112	30.757	419.105	56.6
99.154	30.770	419.145	61.7
99.196	30.783	419.184	68.5
99.237	30.796	419.224	77.1
99.279	30.809	419.263	87.6
99.321	30.822	419.302	100.1
99.362	30.835	419.342	114.5
99.404	30.847	419.381	131.1
99.446	30.860	419.421	149.9
99.487	30.873	419.460	171.1
99.529	30.886	419.500	194.8



Profile Mods			
Position, LA, (mm)	Degrees of Roll	Diameter , (mm)	Relief, (microns)
53.331	16.550	384.360	0.0
86.654	26.891	407.912	0.0
87.779	27.240	408.873	0.1
88.904	27.589	409.844	0.3
90.029	27.938	410.825	1.0
91.154	28.287	411.816	2.3
92.279	28.636	412.817	4.9
93.404	28.985	413.828	9.0
94.529	29.335	414.848	15.4
95.654	29.684	415.878	24.6
96.779	30.033	416.918	37.5
97.904	30.382	417.968	54.9
99.029	30.731	419.026	77.8
99.071	30.744	419.066	79.6
99.112	30.757	419.105	83.2
99.154	30.770	419.145	88.6
99.196	30.783	419.184	95.7
99.237	30.796	419.224	104.7
99.279	30.809	419.263	115.5
99.321	30.822	419.302	128.4
99.362	30.835	419.342	143.2
99.404	30.847	419.381	160.2
99.446	30.860	419.421	179.4
99.487	30.873	419.460	201.0
99.529	30.886	419.500	225.2

B



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X. ±1.0 .X ±0.5 .XX ±0.25	3.2 / $\sqrt{\mu\text{m Ra}}$	≤ ± 0.5°
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DRAWN	JFC	DATE: 8/27/12
CHECKED	NJB	THIRD ANGLE PRJ

National Renewable Energy Laboratory		
TITLE: PLANET GEAR		
SIZE B	DWG. NO. 254504	REV H
SCALE: 1:5	WEIGHT: 126.52 kgs	SHEET 3 OF 3