

**E**  
SEE MANUFACTURING NOTES ON PAGE 2

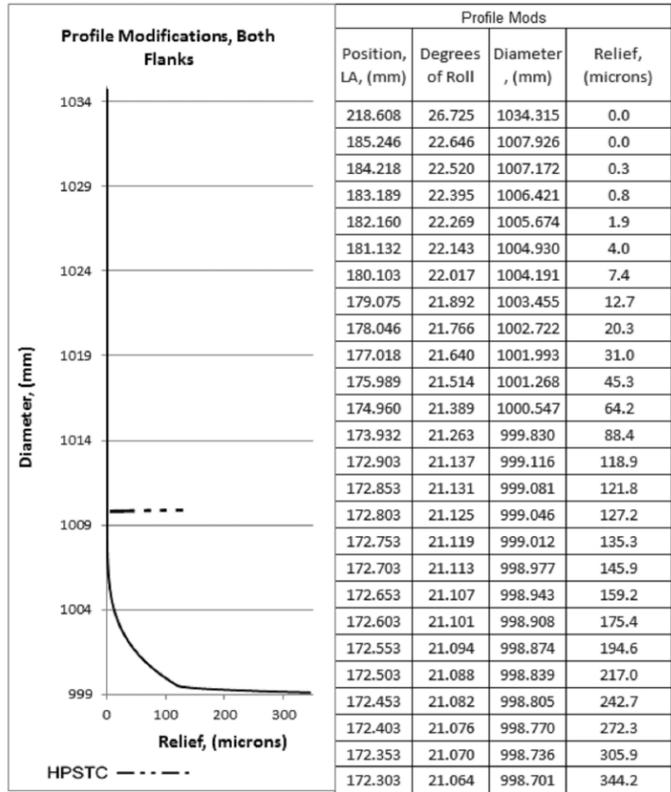
REV	CHANGED FROM	BY	DATE	APRD
C	REVIEWED & UPDATED PER 1509-ENC-004 IF REQUIRED	CPS	1/18/13	
D	CHANGE TAPPED HOLES TO THRU BOLT HOLES FOR TENSIONER	CPS	2/15/13	
E	CHANGES PER CUSTOMER REVIEW & RELEASE FOR PRODUCTION	CPS	4/8/13	
F	RE-DIMENSION, REPAIR DANGLING DIMENSIONS AND NOTES	JMG	10/17/13	
G	CHANGES REQUESTED PER MANUFACTURER DRW REVIEW	CPG	11/27/13	
H	NOTE 1 MATERIAL TYPO, ALT MATERIAL, AND HEAT TREAT CLARIFICATIONS	CPG	3/24/14	
I	CLARIFIED NOTE 1 FOR AGMA MATERIAL REQUIREMENT	CH	2/4/13	
J	CLARIFIED MPI REQUIREMENT	CH	4/4/13	

REPORT ERRORS & CHANGES  
REMOVE ALL BURRS AND SHARP EDGES  
DIMENSIONS ARE IN MILLIMETERS.  
UNSPECIFIED TOLERANCES:  
DECIMALS: FINISH: ANGLES:  
X. ±1.0 3.2  $\mu\text{m Ra}$   $\leq \pm 0.5^\circ$   
.X ±0.5  
.XX ±0.25  
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OTHER DRAWINGS OR MACHINERY  
DRAWN JFC DATE: 8/13/12  
CHECKED NJB THIRD ANGLE PRJ

MADE FROM: 1509-GS-012-C  
**National Renewable Energy Laboratory**  
TITLE: RING GEAR  
SIZE **B** DWG. NO. 254491 REV **J**  
SCALE: 1:10 WEIGHT: 509.10 kgs SHEET 1 OF 2

**ANNULUS**

Internal Involute Helical Gear Data	
Number of Teeth	99
Normal Module (mm)	10.0000
Normal Pressure Angle	20.0000
Whole Depth Constant (REF)	2.350
Oper Pitch Diameter (mm)	1016.4000
Gen Pitch Diameter (mm)	998.5305
Base Diameter (mm)	937.3633
Major Diameter (REF) (mm)	998.700
Form Diameter with Planet (mm)	1034.320
Root Diameter (REF) (mm)	1046.260
Min Tool Tip Radius (mm)	3.000
Addendum Modification X2	-0.9654
Hand of Helix	Left
Gen Helix Angle	7.4947
Lead (mm)	23844.7435
Number of teeth in Mate	39
Center Distance (mm)	308.000
Normal Cir BL w/ Planet (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)	8.284 / 8.185
Size Between 18 Balls (max/min) (mm)	991.363 / 991.1130

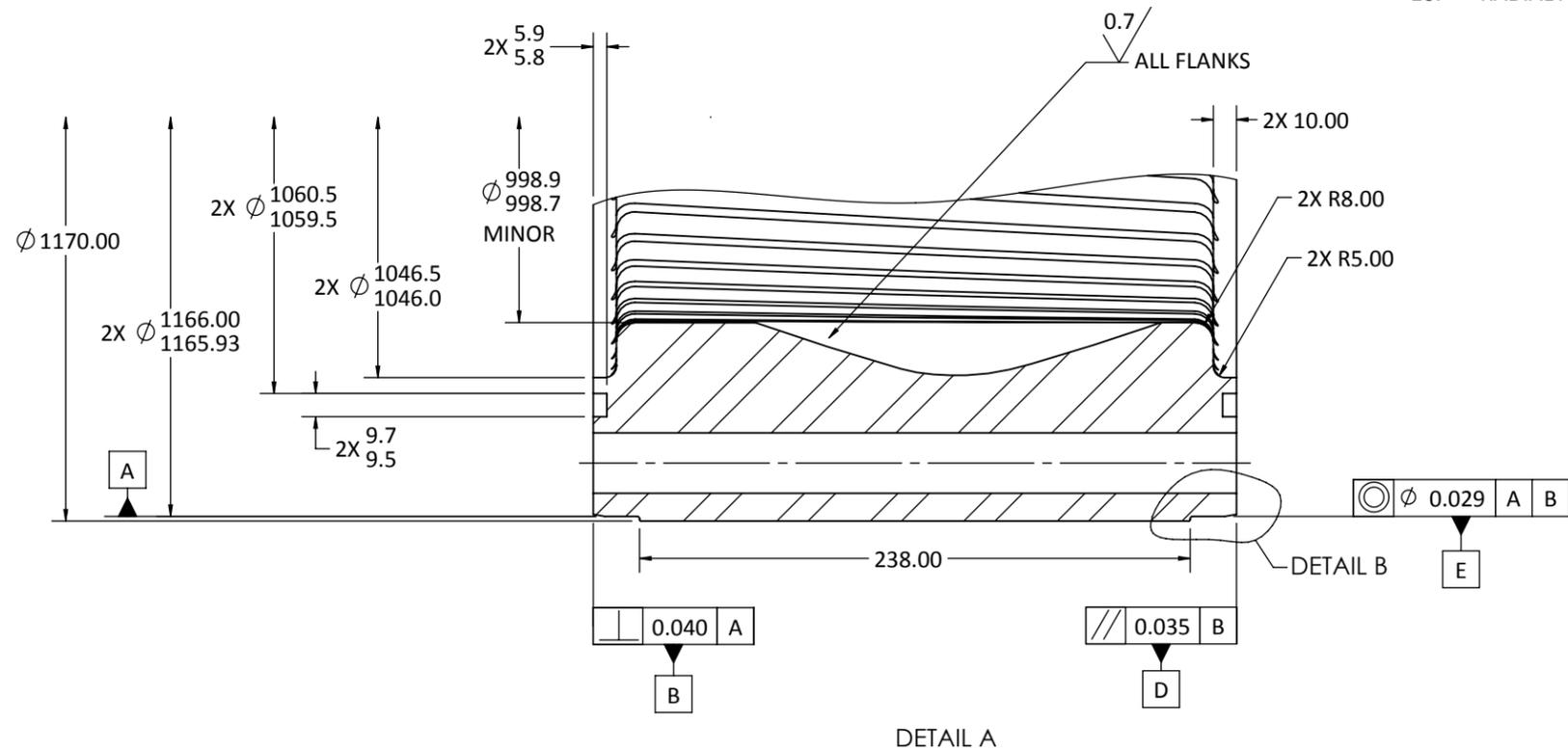


NOTES:



- MATERIAL QUALITY: MATERIAL - STEEL GRADE 34CrNiMo6 OR EQ. MAT. 4340H RING FORGING, NORMALIZED AND TEMPERED OR ANNEALED TO 231BHN MAX. HARDNESS. MATERIAL SHALL CONFORM TO EN-10083-3 AND ISO 6336-5 GRADE MQ, OR AGMA 2001-D04-GRADE 2 WITH MATERIAL CLEANLINESS CERTIFIED TO ASTM E45 METHOD 'A' TO MEET
 

A		B		C		D	
Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy
3	3	2.5	1.5	2.5	1.5	2	1.5
- HEAT TREAT: QUENCH AND TEMPER, AFTER ROUGH MACHINING TO 35-38 Rc. RECORD TEMPERING TEMPERATURE.
- CRACK TESTING: MAGNETIC PARTICLE TEST GROUND SURFACES TO ISO 6336-5 GRADE MQ (ALT: INSPECT TEETH AREAS TO ASTM E1444, MAX ONE INDICATION OF MAX SIZE 3mm PER 25mm OF FACE WIDTH AND MAX OF FIVE INDICATIONS IN ONE TOOTH FLANK. NO INDICATIONS ALLOWED BELOW 1/2 OF WORKING DEPTH OF TOOTH. REMOVAL OF DEFECTS WHICH EXCEED THE STATED LIMITS IS ACCEPTABLE, PROVIDED THE INTEGRITY OF THE GEAR IS NOT COMPROMISED). NO CRACKS ALLOWED.
- ULTRASONIC TESTING: TESTING OF FORGINGS MUST FOLLOW THE PROVISIONS OF EN-10228-3 LEVEL 3 (AGMA A-388- TO AN EQUIVALENT 3mm FLAT BOTTOMED HOLE IS AN ACCEPTABLE ALTERNATIVE)
- MATERIAL REPORTING: PROVIDE INSPECTION REPORTS OR PROOF ACCORDING TO THE PROVISIONS EN-10204-3.1 IDENTIFY WITH PART NUMBER, SUPPLIER CODE, MANUFACTURER'S LOT NUMBER, AND REV. LEVEL.
- NITRIDE TEETH IN ENVELOPE SHOWN, USE GAS OR PLASMA METHOD. 0.55/0.70mm DEPTH MEASURED TO 400HV / 40.8HRC OR +50HV (IF CORE HARDNESS > 380HV AT MID-TOOTH ROOT DIAMETER). MAXIMUM TEMPERATURES 565°C AND AT LEAST 28°C BELOW TEMPERING TEMPERATURE FROM NOTE 2. WHITE LAYER 0.020mm WITH NO CRACKS OR POROSITY. OTHER AREAS TO BE MASKED FROM NITRIDING (ALL THREADED HOLES MUST BE PLUGGED BEFORE NITRIDE TO PREVENT HARDENING OF THE THREADS). CHOSEN PROCESS, APPLICATION & INSPECTION TO BE FULLY RECORDED & TRACEABLE.
- TOOTH ROOT PROFILE: THERE SHALL BE NO STEP AFTER PROFILE GRINDING
- FINISH GEAR INSPECTION: INSPECTION OF FINISHED GEAR SURFACES FOR TEMPER BURN TO ISO 14104-GRADE FB1 USING ETCH TECHNIQUES OR BARKHAUSEN NOISE
- MACHINE ALL OVER, INCLUDING GEAR PROFILE, TO 3.2 μm Ra UNLESS OTHERWISE STATED.
- RADIAL ALIGNMENT OF TEETH TO OTHER FEATURES NOT REQUIRED



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DECIMALS: FINISH: ANGLES:

X.  $\pm 1.0$  3.2  $\sqrt{\mu m Ra}$   $\leq \pm 0.5^\circ$

.X  $\pm 0.5$

.XX  $\pm 0.25$

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DRAWN JFC DATE: 8/13/12

CHECKED NJB THIRD ANGLE PRJ

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SIZE: **B** DWG. NO. 254491 REV J

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