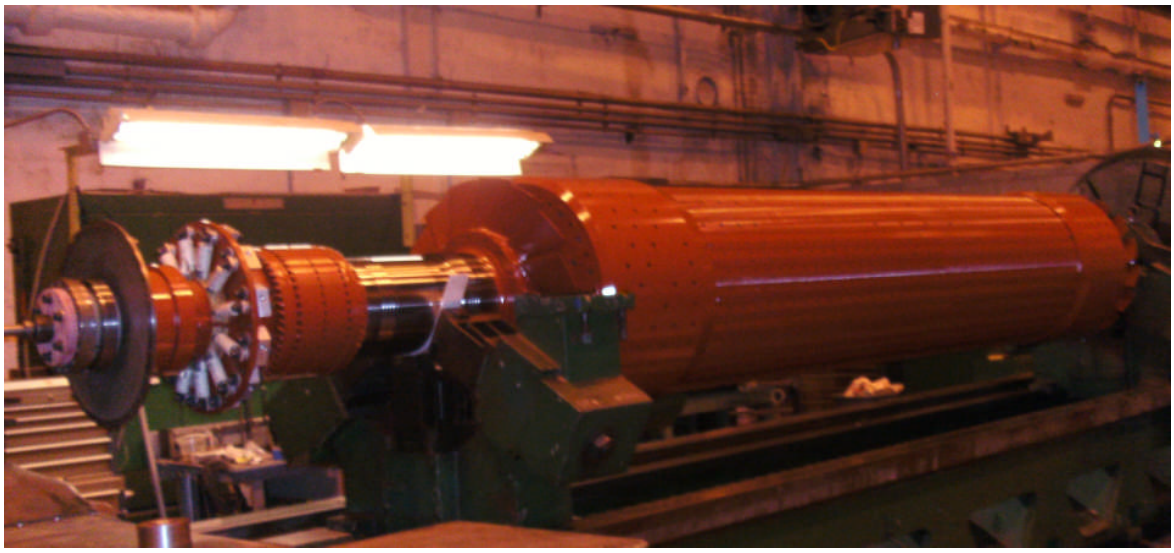
OKLAHOMA GAS & ELECTRIC

MUSTANG/TINKER STATION

5A GENERATOR ROTOR REWIND

FALL 2011 OUTAGE

Document No. 11G799



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and
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Generator & Motor Services, LLC

March 2012

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BGMS GENERATOR ROTOR REWIND REPORT
for
OKLAHOMA GAS & ELECTRIC
Mustang/Tinker Unit 5A Generator

I. INTRODUCTION

On October 13, 2011, a 47-MW Twin-Pac Electric Machine generator rotor from the OG&E Mustang Tinker Station 5A generator arrived at Brush Generator & Motor Service (BGMS) for a complete rewind and an overhaul of its shrunk-on brushless exciter. Work was carried out under OG&E Purchase Order 4500573019.

In addition to the rotor, the bearings, seals and exciter stator were crated and shipped to BGMS. Upon receipt, work proceeded in accordance with GMS Quality Plan using specifications and procedures defined by the project Traveler (Route Card).

Close coordination was maintained with Oklahoma Gas & Electric throughout the project. As contracted, the field rewind, inspection, repair, reassembly, high-speed balancing and final electrical tests were successfully completed and the rotor was shipped back to the Mustang Tinker Station in Oklahoma on Feb. 18, 2012.

II. INCOMING INSPECTION FINDINGS AND RECOMMENDATIONS

While it was being unloaded at the BGMS facility, an appreciable amount of water poured out of the rotor indicating high likelihood of water damage to the insulation. In this condition, and in light of the plans for a rewind, rotor incoming electrical measurements were restricted. However, Megger testing indicated a ground wall short in the rotor.

After disconnecting the exciter armature from the rotor, standard incoming exciter electrical tests were completed and results are given below. All testing and inspections were performed in accordance with formal GMS Rotor Receiving Incoming Inspection and Test Procedures.

After completion of incoming inspection, a Findings and Recommendations Report (GMS Document No. GR1533S) was issued to OG&E on October 29, 2011. Inspection results and BGMS recommendations are summarized as follows:

A. Exciter Visual Inspection and *Recommendations*

- General condition of the exciter appeared to be acceptable for reconditioning. See Appendix A, Figure 1
- During disassembly of the diode wheel, the insulating bushing around the bolt for the #6 fuse was found to be missing. The insulation had been replaced by wrapping the bolt in electrical tape. See Appendix A, Figure 2. *BGMS recommended replacing all insulating components.*
- Many of the insulating components for the diode wheel hardware were found to be poor condition. See Appendix A, Figure 3. *BGMS recommended replacing all insulating components.*
- All twelve diodes were found to be in poor condition. The ends of the flexible connectors were most likely trimmed, twisted to reduce overall length and then tied with wire (see Appendix A, Figures 4 and 5). The diodes should appear as shown in Figure 6. *BGMS recommended replacing all twelve (12) diodes with new properly manufactured diodes.*
- Insulation on the exciter stator connection wires was found to be brittle and damaged in several areas, see Appendix A, Figure 7. *BGMS recommended removing existing insulation from all connections and replacing with new insulation.*
- The ground detector was found to be disconnected from the diode wheel terminal. Wires exiting the ground detector had been cut off. See Appendix A, Figure 8. *BGMS recommended replacing the ground detector.*
- Minor damage was found on the outboard exciter armature band, see Appendix A, Figure 9. In addition, some cracking was found in the paint on the bottom of the armature coil series connections. *BGMS recommended light sanding of the exposed band surface and applying a coat of epoxy resin to the banding and to areas of the armature coils.*
- Two heaters were found to be missing from the exciter stator. *BGMS recommended replacing the heaters.*

B. Rotor Visual Findings and *Recommendations*

- The rotor bearings were found to be wiped as shown in Appendix A, Figure 10. *BGMS recommended Babbitt replacement on both bearings.*
- Upon removal, the rotor end winding blocking was found in poor condition. See Appendix A, Figure 11. *BGMS recommended replacing all rotor blocking.*
- Multiple J-lead wedges were found to be in poor condition. See Appendix A, Figure 12. *BGMS recommended replacing all J-lead wedges.*
- The retaining ring keys were highly deformed and sheared in multiple areas upon removal. *BGMS recommended replacing both retaining ring keys.*

- Cracks were found in multiple copper turns during inspection conducted while coils were being removed from the rotor. See Appendix A, Figure 13. A more complete assessment was made after the bonded insulation material has been removed from the coils. *BGMS recommended grinding minor cracks and filling with brazing material and in more severe cases, replacement of whole sections of material was found to be required.*
- The rotor end wedges had significant loss of material, most likely due to electrical arcing. Three rotor end wedges were damaged during retaining ring removal and required replacement. See Appendix A, Figure 14. *BGMS recommended sending the end wedge material out for analysis and replacing the three wedges damaged during ring removal. Subsequent NDE test results led to an expansion of this recommendation to include replacing all rotor slot wedges (see below).*
- Aluminum deposits were found on the fit-surface of the retaining ring as shown in Appendix A, Figure 15. It is believed to have been a material transfer from the end wedges due to arcing. The presence of this aluminum prevented visual inspection as well as NDE of the fit area in those regions. *BGMS recommended performing machining of the raised aluminum material to evaluate pitting beneath the transferred material.*

C Rotor Electrical Tests and Measurements

As indicated above, rotor incoming electrical measurements were restricted to ground wall insulation resistance measurements. Results shown in Appendix B-1 indicated a circuit-to-ground short. In light of this data and the plan to rewind the rotor, no additional incoming electrical tests were attempted, with the exception of D.C. winding resistance, which is also shown in Appendix B-1.

Prior to disassembly, the rotor was mounted in a lathe for dimensional measurements. Rotor diameter measurements are contained in Appendix B-2 and Total Indicated Run-Out (TIR) data are given in Appendix B-3. These results do not indicate mechanical concerns.

After completion of rotor measurements, all shrunk-on parts were match-marked. Following this, coupling and blowers were removed from the shaft to allow removal of the diode wheel and exciter.

After removal of the D-lead (bore copper) insulating tube and insulating divider, high potential tests were conducted to verify that these component were-qualified for use. All insulating components passed the tested and were deemed suitable for operation.

D Exciter Electrical Component Tests

Prior to or during disassembly, the following incoming electrical tests were conducted on the exciter with the results in the presented in Appendix B.

- Exciter Insulation Resistances – See Appendix B-4.
- Exciter Winding Resistances – See Appendix B-4.
- Stator Resistance – See Appendix B-5.
- Field Coil Pole Drop Test – See Appendix B-5.
- Diode Wheel Fuse Resistances – See Appendix B-6.
- Diode Hi-Pot Leakage Tests – See Appendix B-7.
- Forward and Reverse Diode Resistances – See Appendix B-8.

No electrical anomalies were detected.

III. NON-DESTRUCTIVE TESTS CONDUCTED AFTER DISASSEMBLY

After inspection and testing described above, the rotor retaining rings were removed and the coils were secured with banding. The wedges were marked and removed for inspection. The main leads, blocking, coils and insulation were then carefully removed. Test results, inspection observations and *recommendations* recorded during these disassembly steps are discussed below.

A. NDE TESTING

After thoroughly cleaning of all rotor components that are prone to develop increased hardness or cracking, Non-Destructive Examination (NDE) tests and inspections were performed. The following NDE test reports and photographs are compiled in Appendix C.

- J-Lead Wedges Liquid Penetrant Inspection – See Appendix C-1 and C-2.
- Body Wedges Liquid Penetrant Inspection – See Appendix C-3 and C-4.
- Shafts, Journals & Coupling Magnetic Particle Inspection – See Appendix C-5.
- Rotor Body Magnetic Particle Inspection – See Appendix C-6 through C-8.
- Retaining Ring Magnetic Particle Inspection – See Appendix C-9 through C-11.
- Retaining Ring Hardness Tests – See Appendix C-12 through C-14.
- Blower Fans Magnetic Particle Inspection – See Appendix C-15.
- J-Lead Ultrasonic Inspection – See Appendix C-16.

B. NDE FINDINGS AND RECOMMENDATIONS

The following Findings and Recommendations were issued, based upon results of NDE tests described in the previous section. *Recommendations are shown in italics*.

- Three rotor body teeth in the ring fit area were damaged during removal of the turbine end retaining ring. Local dye penetrant testing of those teeth uncovered indications at the root of the outboard teeth. See Appendix A, Figures 16 and 17. *BGMS recommended machining out the indications and performing a verification dye penetrant test.*
- Magnetic particle testing of the EE retaining ring uncovered four indications on the radius transition located at the nose of the ring. These test results were verified in a subsequent dye penetrant test. See Appendix A, Figures 18 and 19. Hardness readings taken around the cooling holes of the retaining ring were found to be above the 38 HRC specification limit. Results of hardness measurements taken in control areas removed from the cooling holes were satisfactory. *In light of linear indications found in a highly stressed area of the EE ring and out-of-specification hardness measurements found on both rings and considering the age of the rings as well as the amount of cyclic operation seen by this rotor, BGMS recommended replacing both retaining rings.*
- Magnetic particle testing of the rotor body showed 34 indications in the tooth top region. See Appendix A, Figures 20 and 21. *In light of the tooth-top indications and the need to replace retaining rings, BGMS recommended that a "Long Ring Modification" be performed. In this modification, the shrink-fit geometry is changed in a fashion that eliminates conditions that produce tooth-top cracking. After machining the tooth-tops for the Long Ring Modification, all machined areas would be de-burred and magnetic particle examination repeated.*
- A sample of 15 rotor slot wedges was dye penetrant tested. Indications were found on the wedge lands. The majority of the wedges had signs of pitting from either arcing or fretting on the wedge lands. *BGMS recommended replacing all wedges.*

Essentially all of the GMS recommendations were subsequently approved by OG&E Engineering.

IV. REPAIRS AND REPLACEMENT COMPONENT TESTS

Based on GMS recommendations, the following repairs were implemented before reassembly of the exciter and rotor:

- The bearings were sent to a subcontractor for refurbishment including replacement of all Babbitt material. Refurbished bearing inspection results are presented in Appendix B-9 (Drive End) and B-10 (Exciter End).

- All J-lead wedges were remanufactured. The new J-Lead wedges were liquid penetrant test with satisfactory results as shown in Appendix C-17.
- New ASTM A288-91 magnetic retaining ring forges were procured and the rings were final machined for the "Long Ring Modification." Appendix D contains certifications for the two rings. Magnetic Particle inspection results for the finish-machined rings are presented in Appendix C-18.
- New retaining ring keys were manufactured.
- All body slot wedges were remanufactured. The new wedges were liquid penetrant test with satisfactory results as shown in Appendix C-19.
- All cracks found in copper coils were repaired.
- Aluminum deposits found on rotor forging retaining ring fit areas were removed.
- The "Long Ring Modification" machining was completed on the rotor body.
- After machining, NDE tests were repeated to ensure that all indications found on tooth tops had been removed.
- All diode wheel insulating components were replaced.
- Twelve new diodes were procured for installation into the diode wheel. Electrical test data from the replacement components was satisfactory as show in Appendix B-11 and B-12.
- New end blocking kits were procured for both ends of the rotor.
- All stator connection wires and associated insulation were replaced.
- All outboard armature banding surfaces were repaired and painted.
- All coil surfaces were hand-cleaned, glass blasted, deburred and straightened. The cleaned coils were placed on storage racks in preparation for rewind.
- New class "F" Nomex slot insulation and Nomex / epoxy glass turn insulation materials were procured.
- New retaining ring insulation liners were procured.

V. ROTOR RE-ASSEMBLY AND TESTING

The rotor rewind was completed in accordance with GMS procedures. Figures 22 and 23 in Appendix A show various stages in the winding process. Hi-Pot and pole balance tests were conducted to verify insulation quality throughout the winding process.

The remainder of the assembly sequence was completed as follows:

- After rewind, the coils were pressed and baked to ensure proper stacking.
- Rotor wedges were installed.

- New end blocking kits were fitted and installed on both the turbine and exciter ends of the rotor.
- End plates were shrunk-fit into the retaining rings and new liners were installed.
- The retaining ring, blower and coupling were installed on the rotor turbine end.
- The exciter and diode wheel were cleaned, painted, reassembled and shrunk onto the rotor shaft.
- The couplings and a set of temporary slip rings required for the balance test were installed on the shaft.
- Electrical components were installed on the diode wheel. See Figures 24 and 25 in Appendix A.
- The diode wheel was cleaned, painted and shrunk onto the shaft.

The rotor was then set up in the lathe for cleanup of journals and seal areas as shown in Appendix A, Figure 26. Final dimensional inspection and electrical test data verified that the rotor was ready for high-speed balance. Dimensional data is included in the High Speed Balance Report (see Appendix E); electrical data is presented in Appendix B-13 and B-14.

VI. HIGH SPEED BALANCE AND TESTING

The rotor was shipped by truck to ReGENco in Milwaukee, Wisconsin, where it arrived and was installed in the spin pit on February 16, 2012. Balance Testing at 3600 rpm and Over-Speed Testing to 3960 rpm and were successfully completed on February 17, 2012. Running tests conducted during spin pit operation included impedance, flux probe waveform data and insulation resistance. These test results are shown in the ReGENco Balance Report, included as Appendix E to this report. The flux probe and running impedance results showed no shorted turns and rotor balance was successfully achieved through criticals and at speed.

Also shown in the Balance Report are final balance weight locations.

Following Balance Test, the temporary slip rings were removed and the bore plug was installed. After this, the Unit 5A rotor was wrapped in a sealed bag and purged with dry nitrogen for shipment back to the Tinker Station on Feb. 18, 2012.

VIII. SUMMARY

Based on inspection data and repair work performed on this unit, the Tinker Unit 5A rotor and exciter are ready for continued operation.

APPENDIX A

TINKER 5A GENERATOR ROTOR

2011 REWIND PHOTOGRAPHS

DESCRIPTION **PAGE**

APPENDIX A

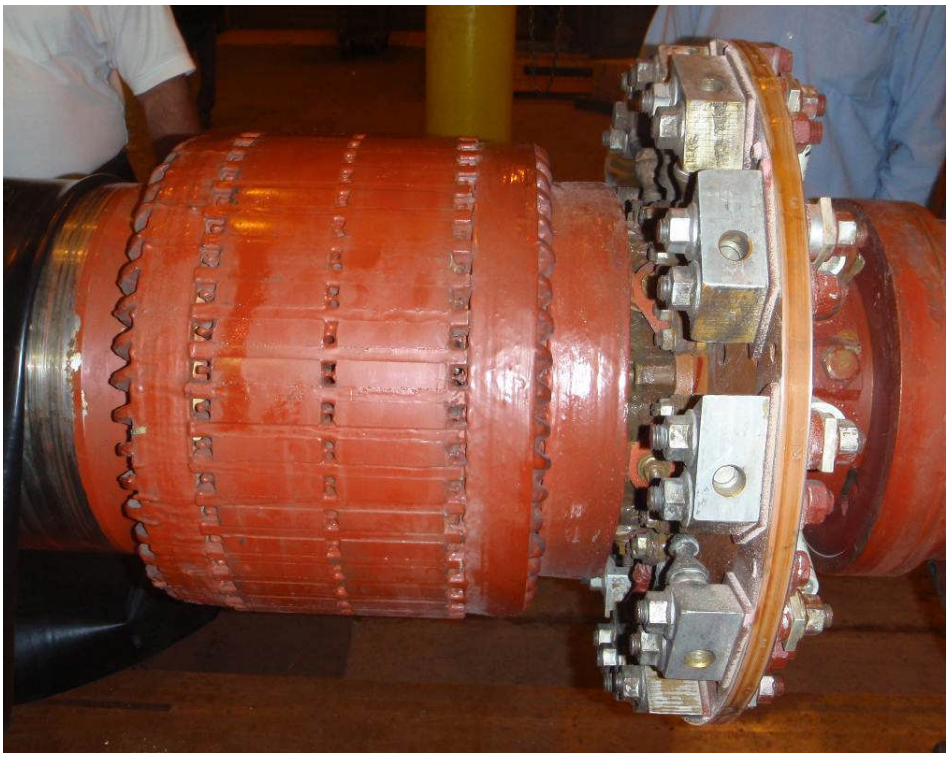


Figure 1: General Condition of Exciter upon Receipt

Figure 2: Missing Insulating Bushing; Replaced with Electrical Tape

APPENDIX A

Figure 3: Worn Insulating Components

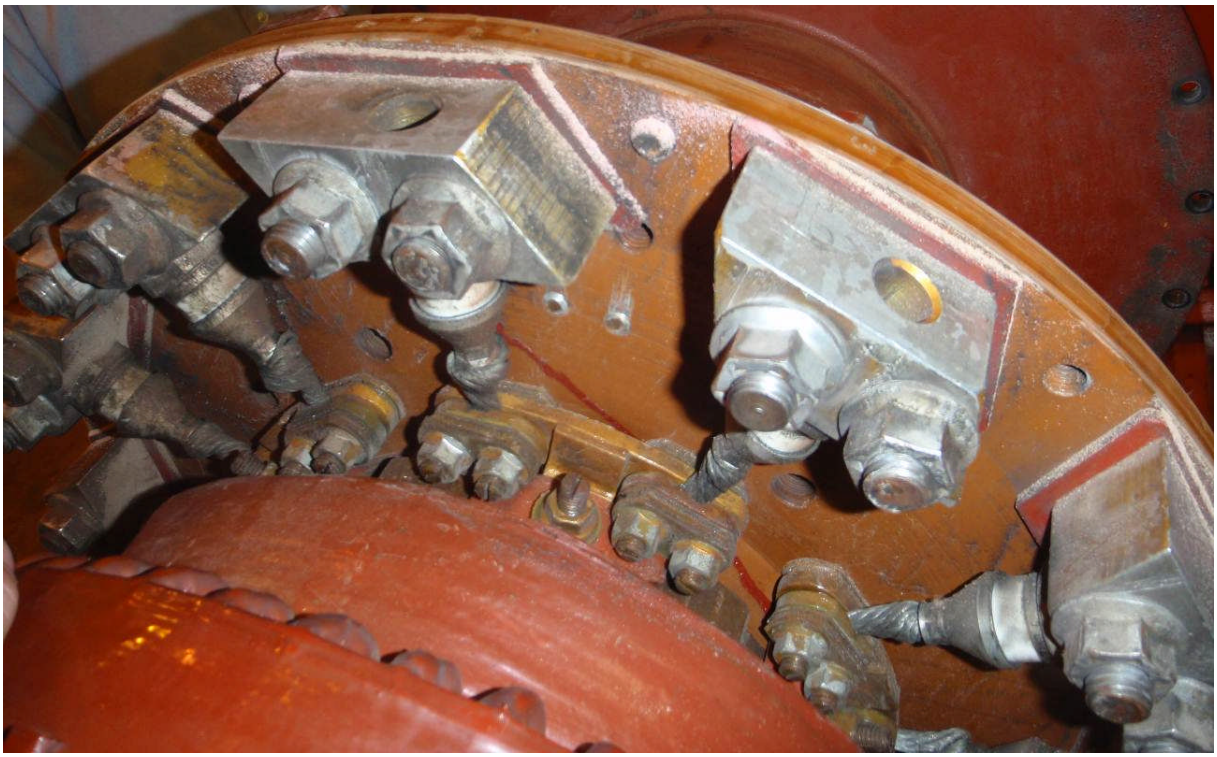


Figure 4: Diodes Found with Twisted and Deformed Flexible Connectors

APPENDIX A

Figure 5: Wire Tied around Ends of Flexible Connectors

Figure 6: Properly Manufactured Diode for an EM Diode Wheel

APPENDIX A

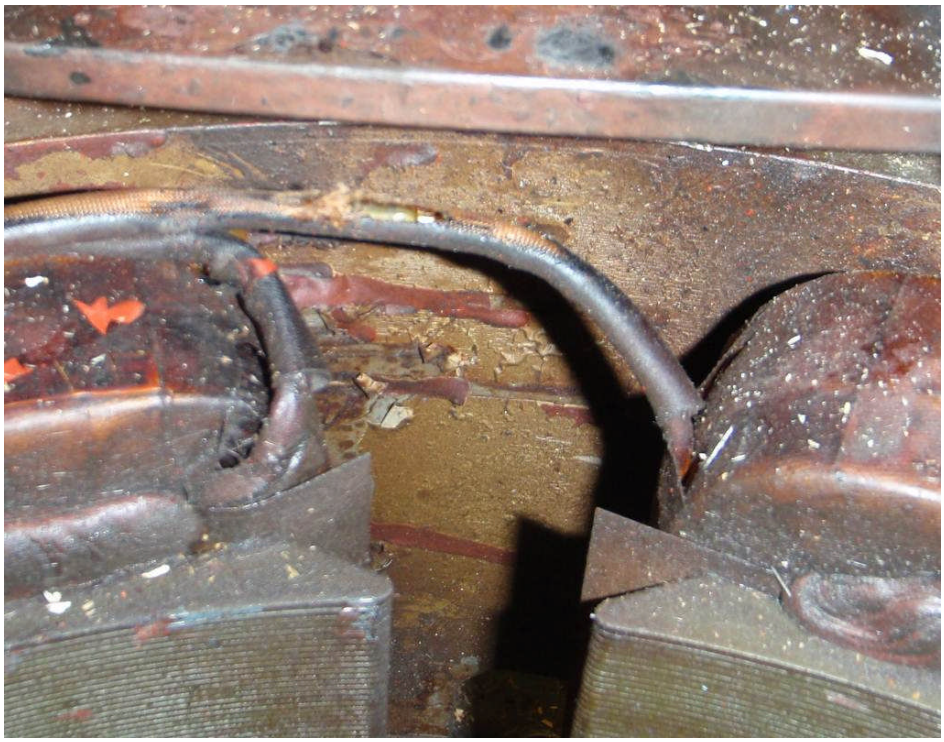


Figure 7: Cracked and Brittle Insulation

Figure 8: Ground Detector Unit as Found

APPENDIX A

Figure 9: Minor Damage Found on Outboard Band

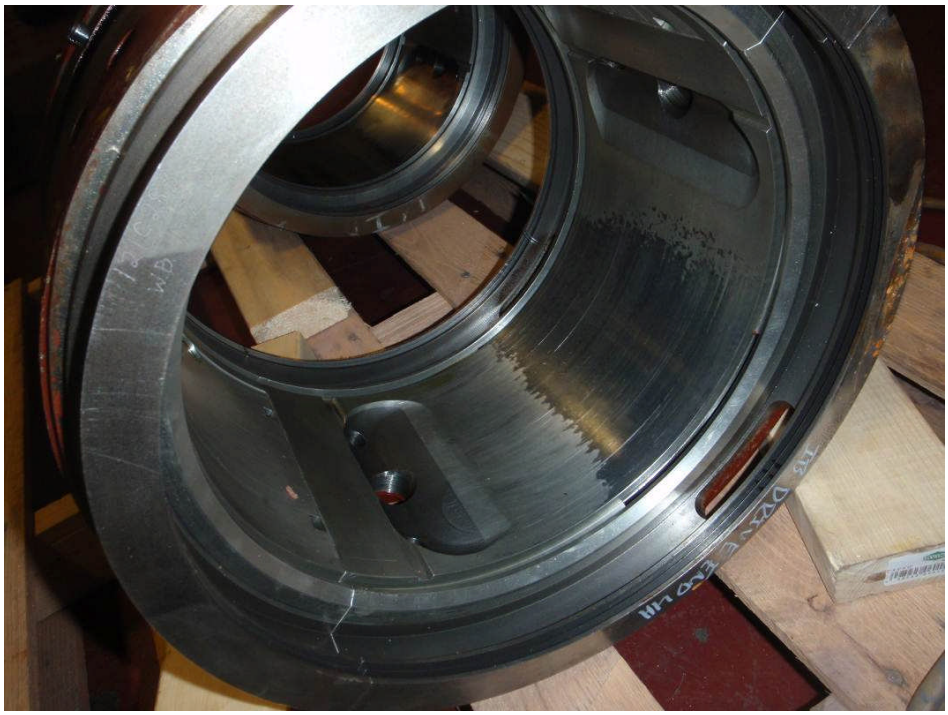


Figure 10: Condition of Drive End Bearing

Figure 11: Cracking in End Winding Blocking

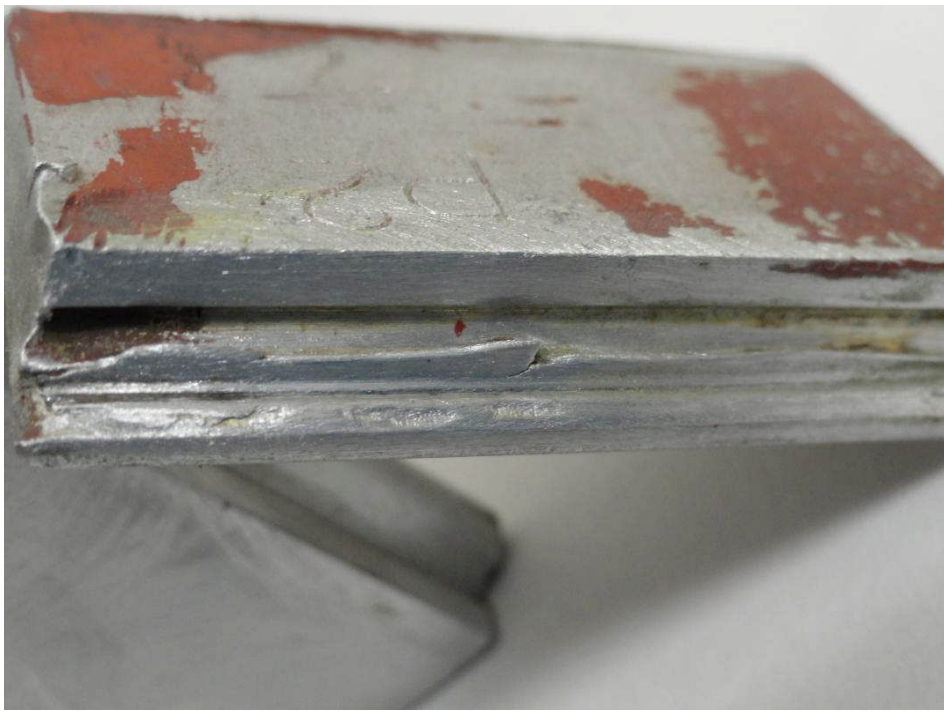


Figure 12: J-Lead Wedge in Poor Condition as found

Figure 13: Crack Found on Top Turn of Coil 5, Exciter End

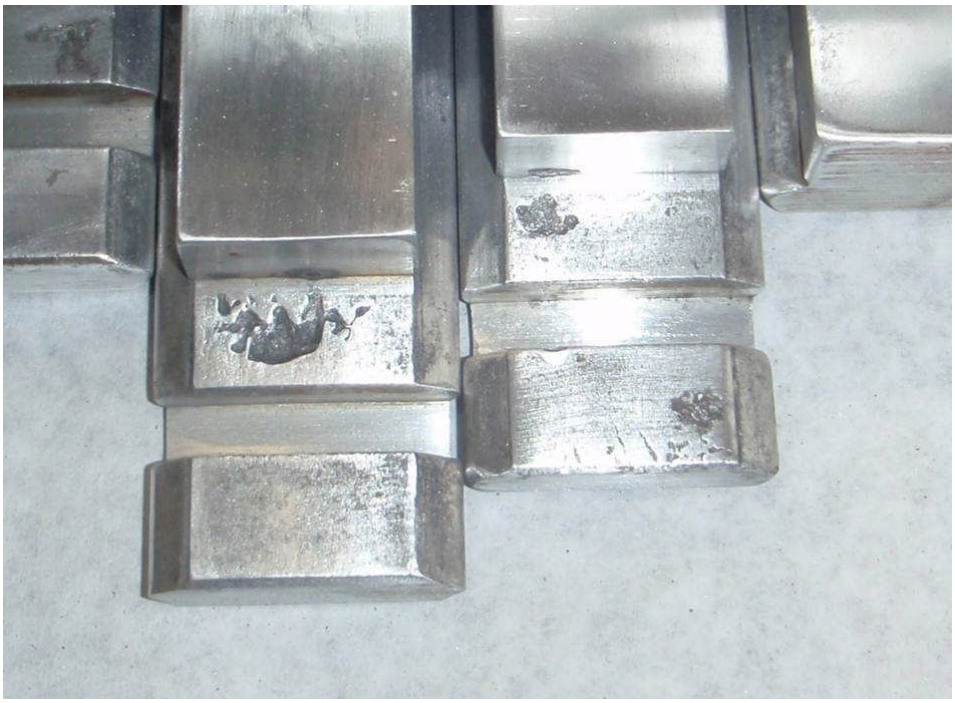


Figure 14: Arcing Damage to Slot Wedges

Figure 15: Aluminum on Retaining Ring Fit Area

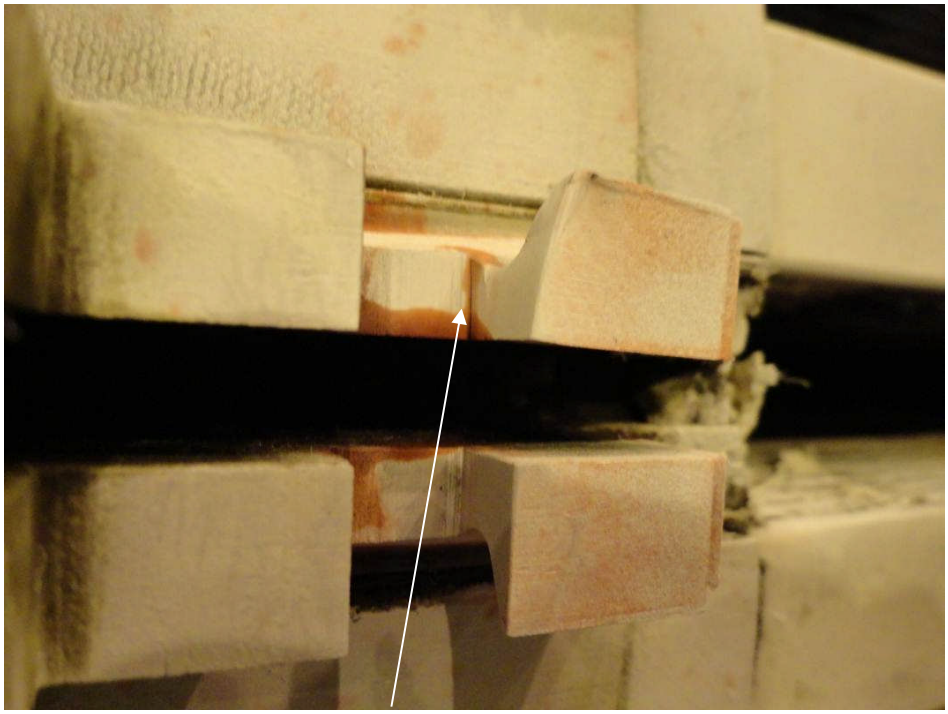


Figure 16: Tooth-Top Indication at Root of Tooth

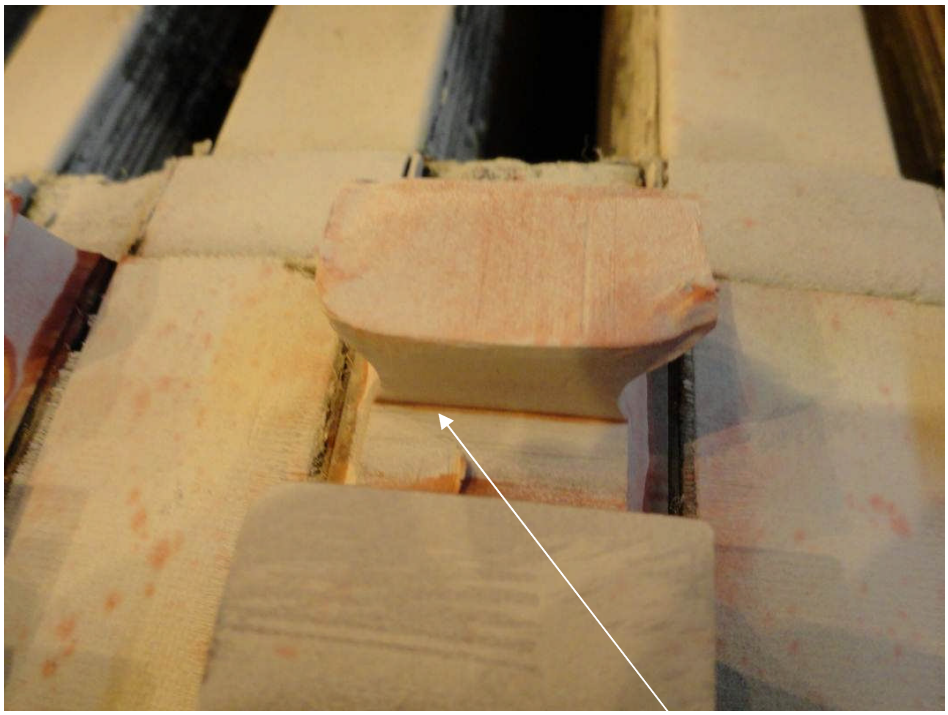


Figure 17: Tooth-Top Indication at Root of Tooth

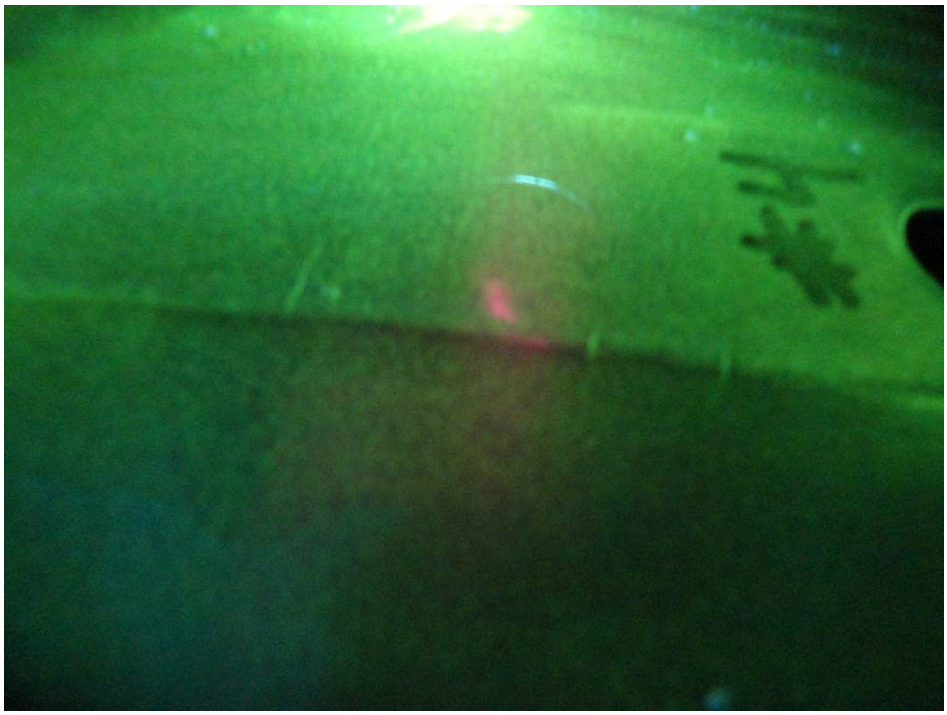


Figure 18: Magnetic Particle Test Indications on EE Retaining Ring

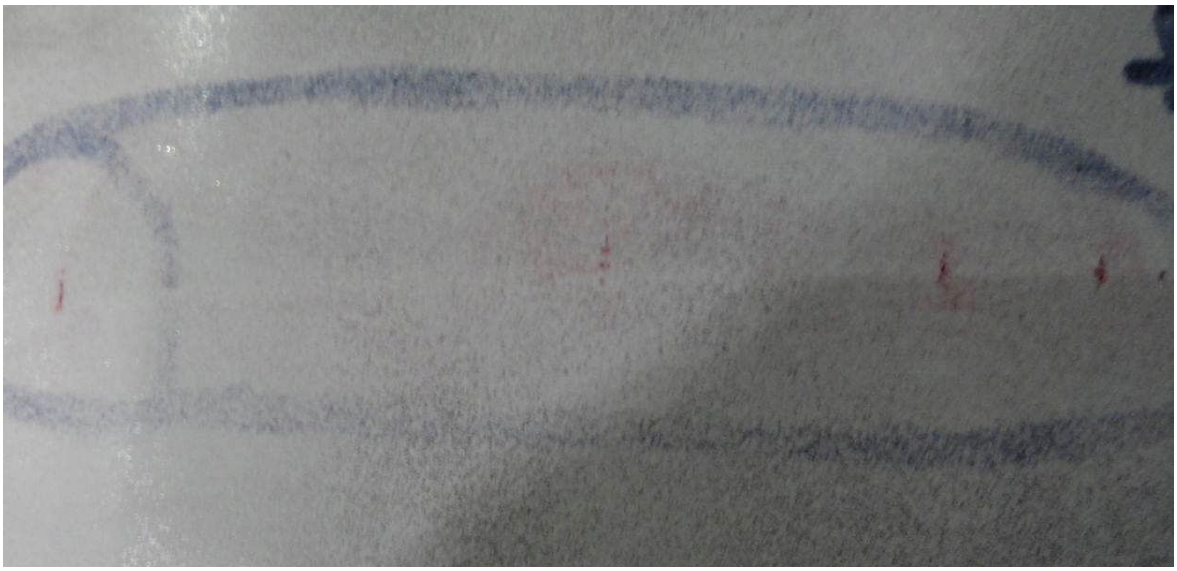


Figure 19: Dye Penetrant Test Indications on EE Retaining Ring

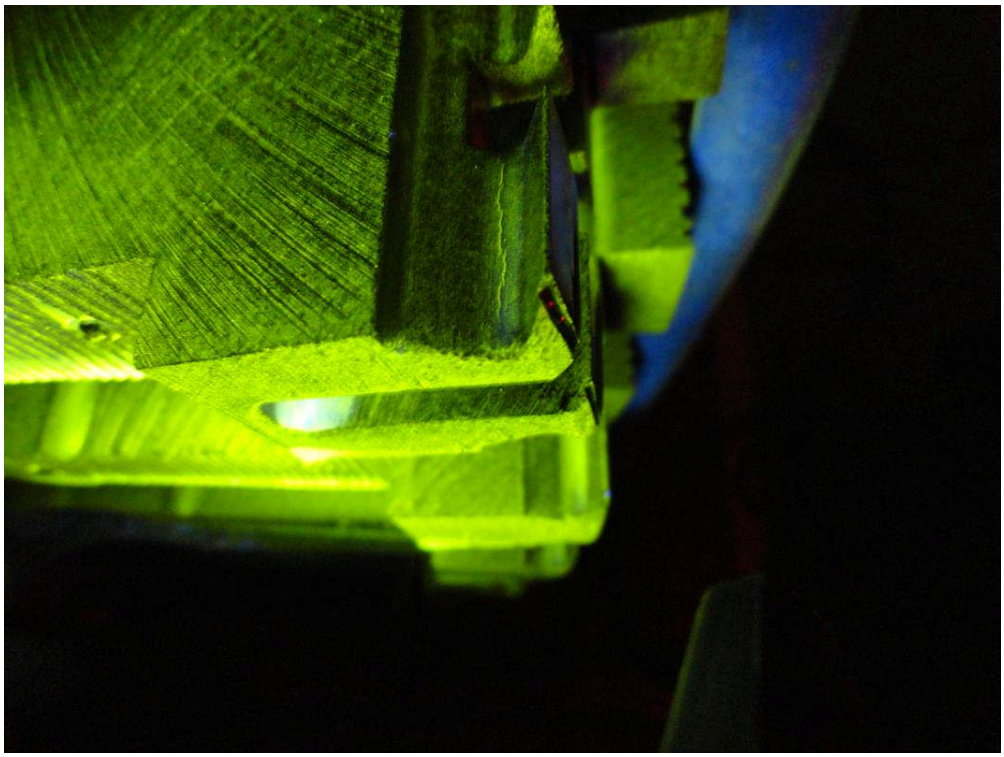


Figure 20: Tooth Top Cracking

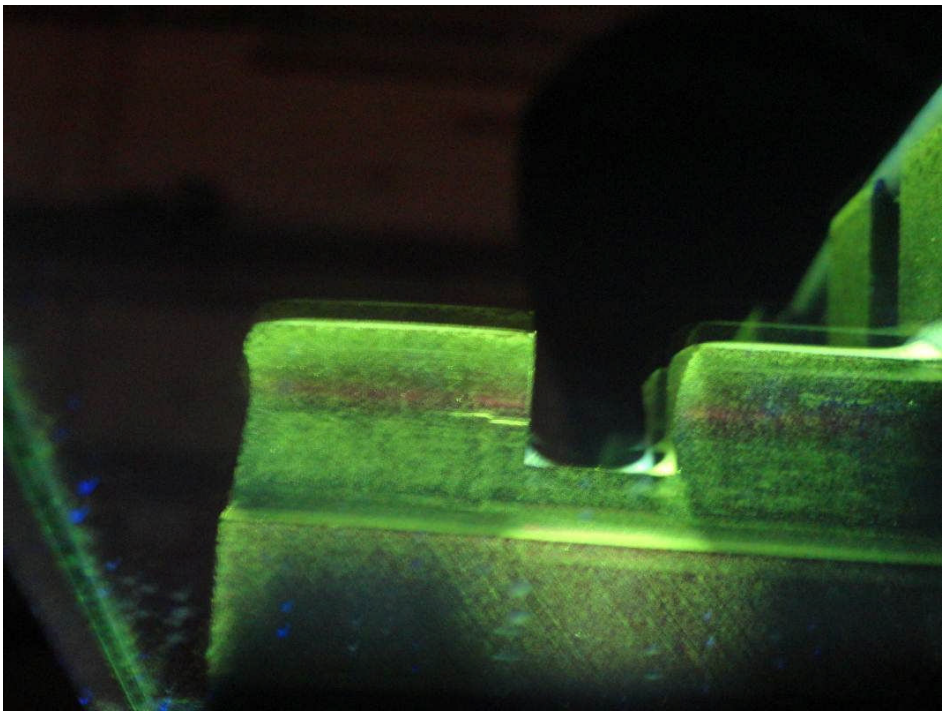


Figure 21: Tooth Top Cracking

Figure 22: Initiation of Rotor Rewind Process

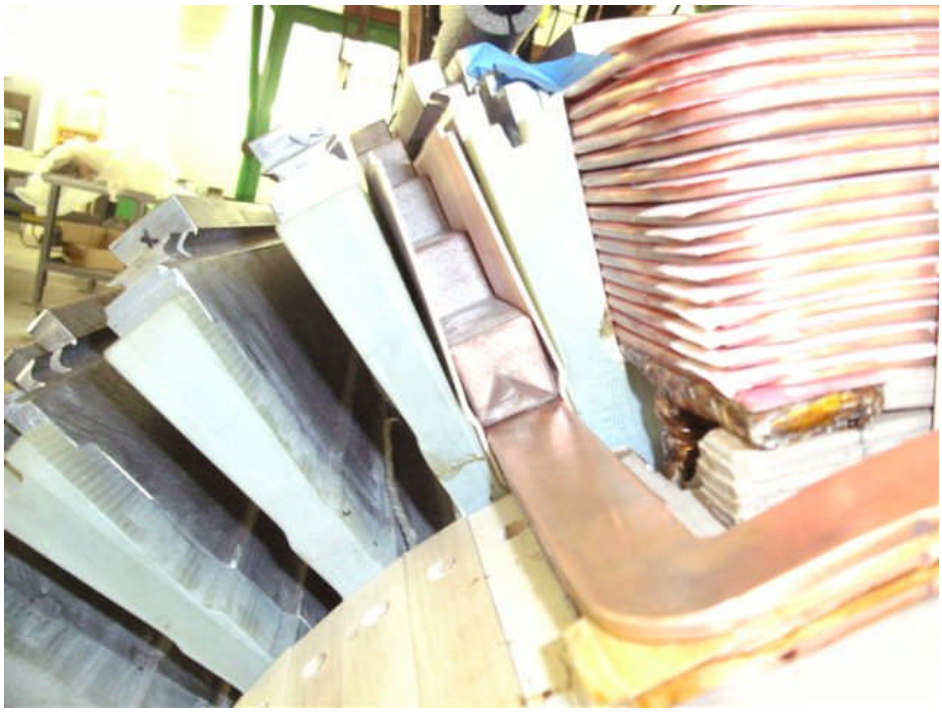


Figure 23: Rotor Rewind in Process

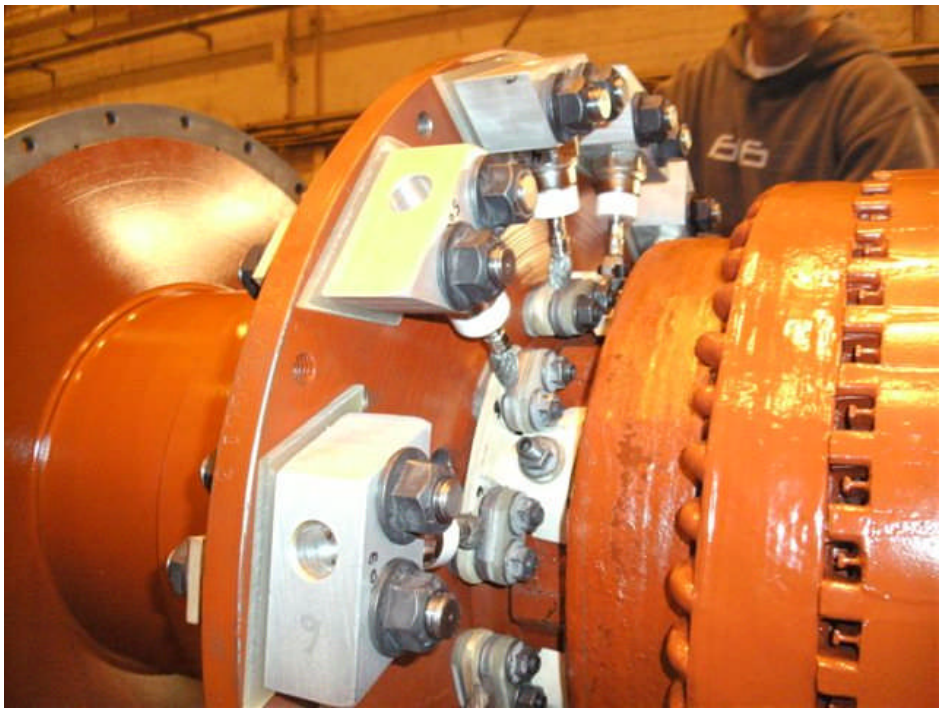


Figure 24. Installing New Diodes on Diode Wheel

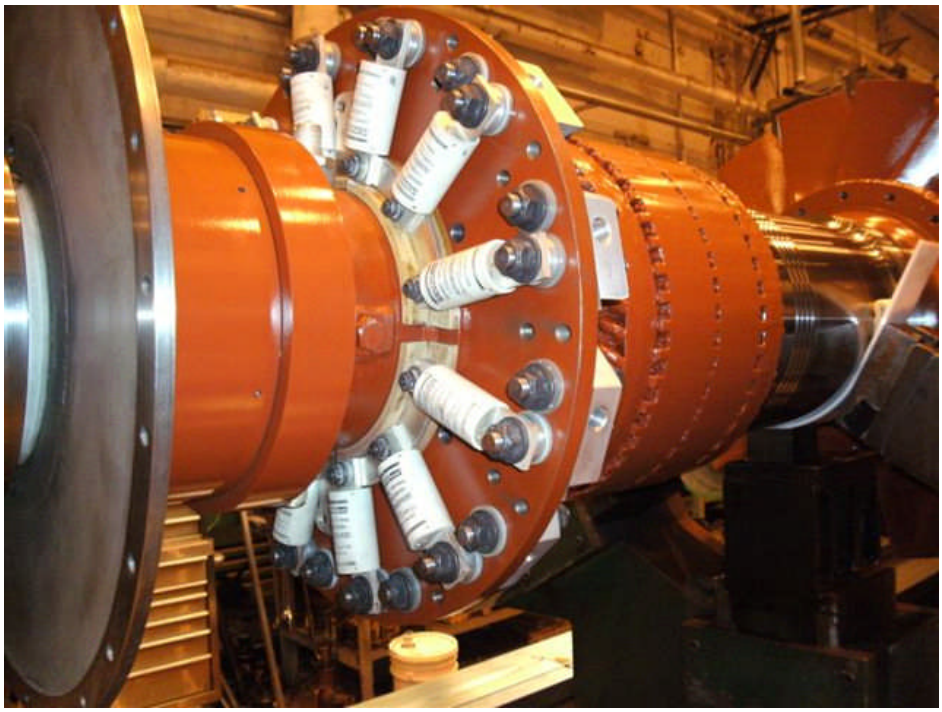


Figure 25. Installing Fuses on Diode Wheel

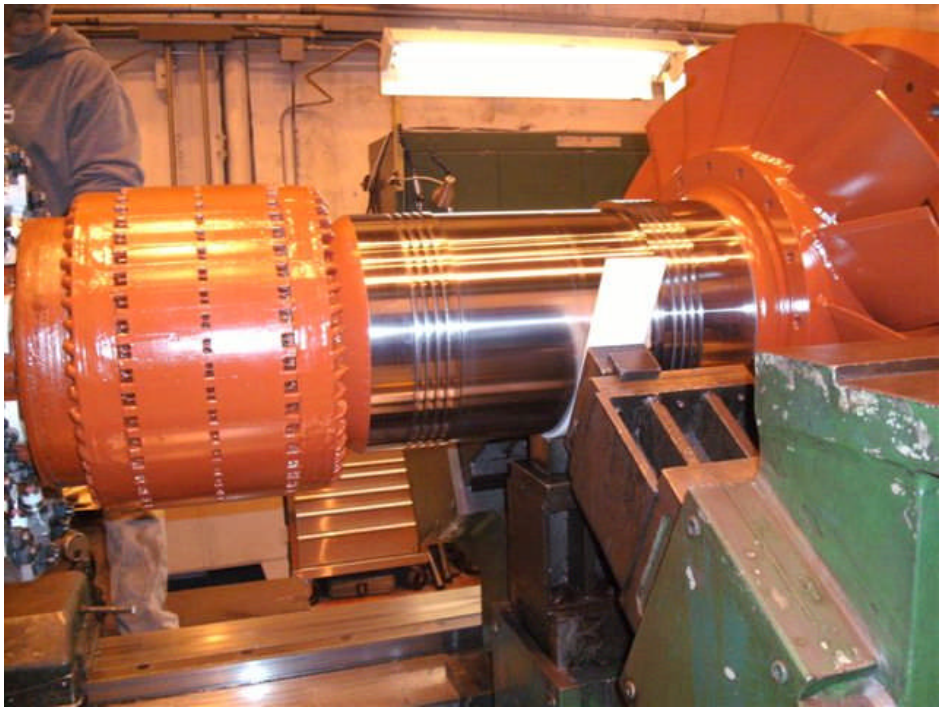


Figure 26. Final Cleanup of Journals and Seal Areas

APPENDIX B

TINKER AFB ROTOR TEST DATA

INCOMING ROTOR ELECTRICAL TESTING

Customer: **Oklahoma Gas & Electric** Test Date: **10-13-11**
Station: **Mustang - Tinker AFB** Tester: **W. Kokocinski**
Mfg. & S/N: **EM B123A493VA1**

1. ROTOR INSULATION RESISTANCE

Instrument Used: **AYO** Excitation Voltage: V_{DC}
Instrument S/N: **GMS-131** Test Voltage: **500** V_{DC}
Calibration Due: **9-20-12** Acceptance Criteria: **50 MΩ , PI > 2**

TIME	MEGOHMS
15 Sec.	**0**
30 Sec.	**0**
45 Sec.	
1 Min.	
1½ Min.	
2 Min.	
2½ Min.	
3 Min.	

TIME	MEGOHMS
4 Min.	
5 Min.	
6 Min.	
7 Min.	
8 Min.	
9 Min.	
10 Min.	
PI = $R_{10\ Min.}$ / $R_{1\ Min.}$ =	

Note: Rotor, as received has a ground wall short and can't be tested using a Megger.

2. D.C. ROTOR WINDING RESISTANCE

MEASURED (R_m, Ohms)	CORRECTED TO ($R_{25°C}$, Ohms)	($R_{75°C}$, Ohms)	PREVIOUS (Ohms)
.3912	0.3942	0.5462	NA

Micro-ohmmeter: **DLRO**
Instrument No.: **GMS-082**
Calibration Due: **2-3-12**
Temperature: **23** °C

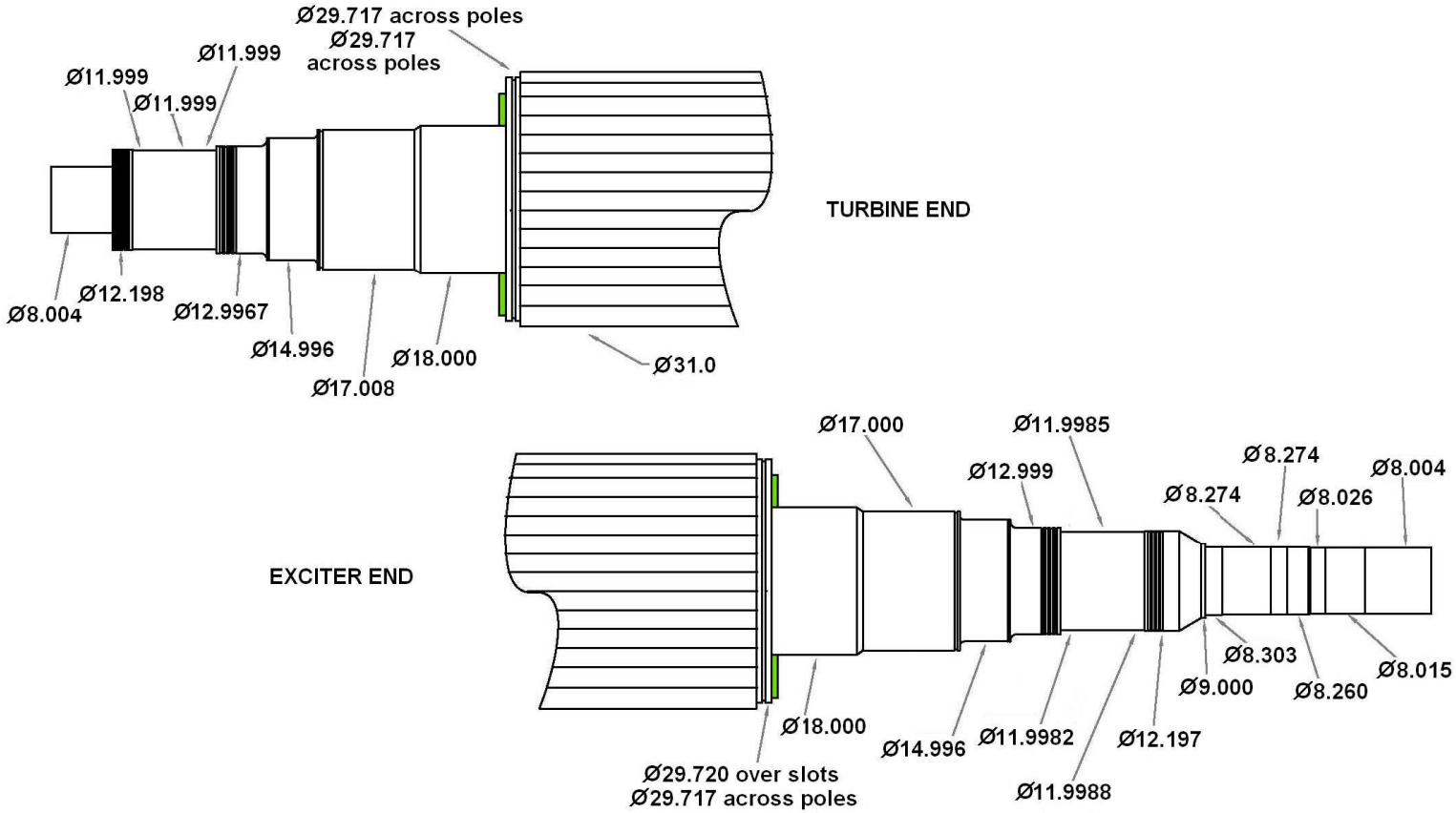
$$*R_{25\,°C} = R_m \left[\frac{259.5}{234.5 + T}\right] \qquad **R_{75\,°C} = R_m \left[\frac{309.5}{234.5 + T}\right]$$

$R_{25°C}$ = Winding Resistance Corrected to 25ºC; R_m = Measured Winding Resistance
$R_{75°C}$ = Winding Resistance Corrected to 75ºC; T = Temperature of Winding, ºC

ROTOR SURFACE DIAMETERS (Incoming)

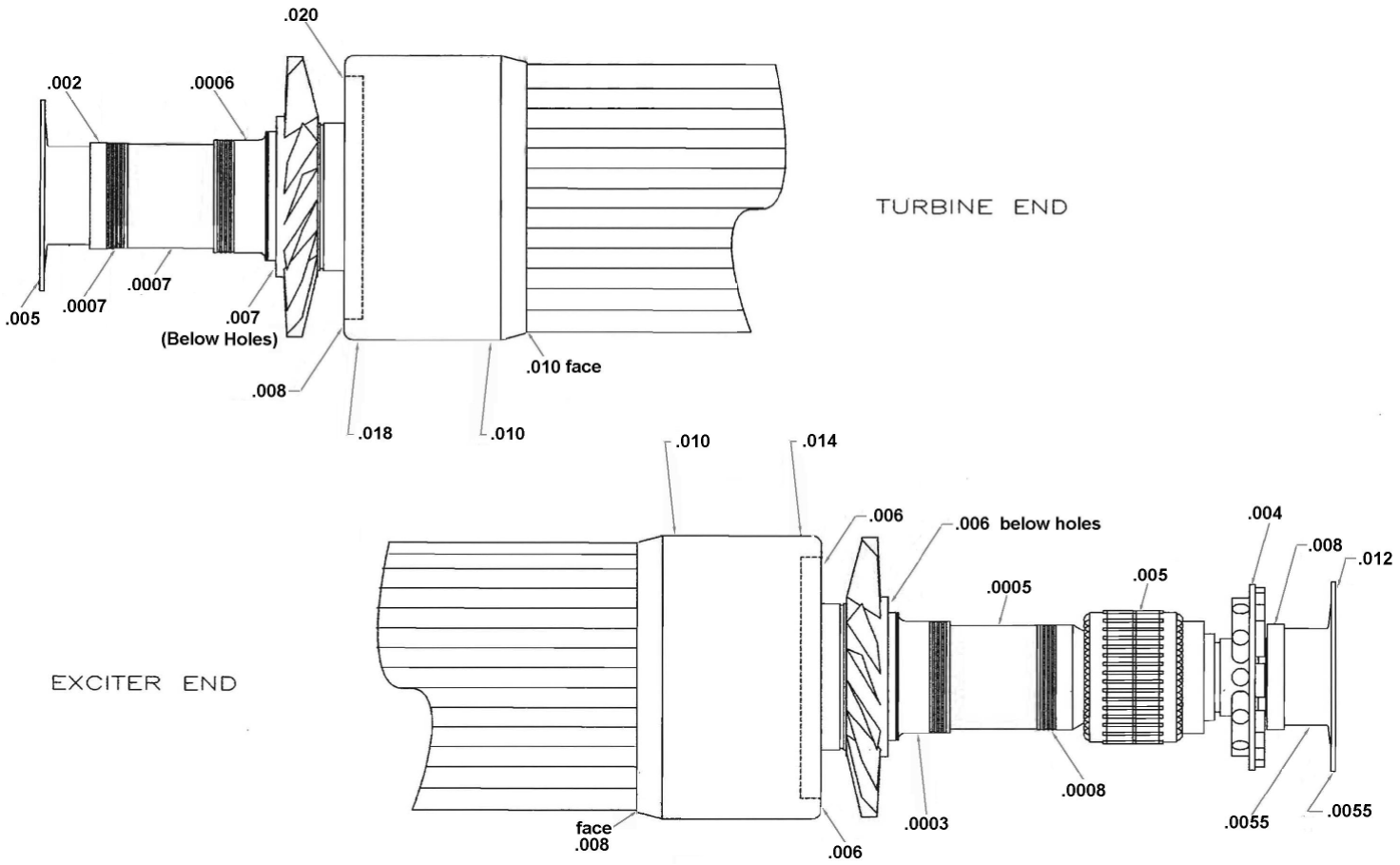
Customer: **Oklahoma Gas & Electric**
Station/Unit: **Mustang - Tinker AFB**
Mfg. & S/N: **EM B123A493VA1**

Test Date: **10/14/11**
Machinist: **Mark Benson**
Shop Order: **11G779**



ROTOR SHAFT TOTAL INDICATED RUN-OUT (Incoming)

Customer:	**Oklahoma Gas & Electric**	Test Date:	**10/13/11**
Station/Unit:	**Mustang - Tinker AFB**	Machinist:	**Mark Benson**
Mfg. & S/N:	**EM B123A493VA1**	Shop Order:	**11G779**



EXCITER INCOMING ELECTRICAL TESTS
INSULATION & WINDING RESISTANCES

Customer: **Oklahoma Gas & Electric**
Station: **Mustang - Tinker AFB**
Mfg. & S/N: **EM B123A493VA1**

Megger Used: **AVO Megger**
Megger S/N: **GMS-131**
Cal. Due Date: **9-20-2012**

1. INSULATION RESISTANCE TESTS

Test	Test Voltage	Resistance (Megohms)		Tester	Date
		Acceptance	Measured		
Exciter Rotor Winding	500 V_{DC}, 1 min.	R>1	20,000	A. Kiefer	10-18-11
Diode Wheel-to-Wheel	500 V_{DC}, 1 min.	R>1	N/A – Single Wheel		
IB Diode Wheel-to-Shaft	500 V_{DC}, 1 min.	R>1	N/A – Single Wheel		
OB Diode Wheel-to-Shaft	500 V_{DC}, 1 min.	R>1			
Heat Sinks-to-Diode Wheel (disconnect fuses)		R>.5			
Exciter Stator	500 V_{DC}, 1 min.	R>1	20,000	A. Kiefer	10-18-11
PMG Stator	500 V_{DC}, 1 min.	R>1			
Bearing Pedestal	500 V_{DC}, 1 min.	R>1			

Notes: All values satisfactory.

2. EXCITER WINDING RESISTANCES

Tester: **A. Kiefer**
Test Date: **10-18-2011**

MicroOhmmeter: **Biddle**
Ohmmeter S/N: **GMS-082**
Cal. Due Date: **2-3-2012**

Phase	Resistance	Deviation from Average	
	Milliohms	Milliohms	Pct.
B-B	10.14	-0.010	-0.1
B-C	10.16	0.010	0.1
C-A	10.15	0.000	0.0
Average	10.150		

Notes: All test results satisfactory.

EXCITER INCOMING ELECTRICAL TESTS
STATOR & PMG RESISTANCE, POLE DROP

Customer:	**Oklahoma Gas & Electric**	MicroOhmeter:	**Biddle**
Station:	**Mustang - Tinker AFB**	Instrument S/N:	**GMS-082**
Mfg. & S/N:	**EM B123A493VA1**	Cal. Due Date:	**2-3-2012**

1. EXCITER STATOR RESISTANCE

Tester: **A. Kiefer** Date: **10-18-11**

	Temp. **(ºC)**	Measured **(R_m, Ohms)**	**Corrected to 25ºC ($R_{25°C}$, Ohms)**	**Corrected to 75ºC ($R_{75°C}$, Ohms)**
a. Field Resistance:	20	2.429	2.477	2.954
b. Field Limiting Resistor 1:		N/A		
c. Field Limiting Resistor 2:		N/A		

2. PMG STATOR RESISTANCE

Tester: _____ Date: _____

Phase	Measured (R_m, Ohms)	Corrected to ($R_{25°C}$, Ohms)	($R_{75°C}$, Ohms)
T10-20			
T20-30			
T30-10			
Average			

DLRO Used: _____
DLRO S/N: _____
Cal. Due Date: _____
Temperature _____

3. FIELD COIL POLE DROP TEST

Tester: A. Kiefer Date: 10-18-11

Pole	Resistance (mΩ)
1	303.6
2	304.7
3	303.1
4	304.6
5	302.8
6	302.9
7	301.5
8	300.3
Avg.	302.9

Total Applied Voltage: 120.5 V_{AC}
Measured Current: 1.3 Amps
Overall Impedance: 92.7 Ohms
Pole Drop Acceptability Limit: ±5% of Avg.
Pole Drop High Limit:: 318.0 mΩ
Pole Drop Low Limit:: 287.8 mΩ

4. REMARKS

(1) All measured values within specification limits.
(2) PMG stator not shipped with rotor.

EXCITER INCOMING ELECTRICAL TESTS

DIODE WHEEL FUSE RESISTANCES

Customer:	**Oklahoma Gas & Electric**	Instrument:	**Biddle DLRO**
Station:	**Mustang - Tinker AFB**	Instr. S/N:	**GMS-082**
Mfg. & S/N:	**EM B123A493VA1**	Cal. Due:	**2-3-2012**
Inspector:	**A. Kiefer**	Fuse Dwg:	
Date:	**10-18-11**	Fuse Style:	**A060AGH400**
		Specification:	**264 µohms (max.) See (2)**

Ambient Temp. 20 °C

OUTBOARD (PMG) SIDE				INBOARD (COUPLING) SIDE			
Fuse No.	Resistance (microhms)			Fuse No	Resistance (microhms)		
	As Read, R_m		Corrected to 25°C		As Read, R_m		Corrected to 25°C
1	257		262	**1**			
2	249		254	**2**			
3	251		256	**3**			
4	246		251	**4**			
5	248		253	**5**			
6	245		250	**6**			
7	252		257	**7**			
8	243		248	**8**			
9	244		249	**9**			
10	259		264	**10**			
11	251		256	**11**			
12	247		252	**12**			
13				**13**			
14				**14**			
15				**15**			
16				**16**			
17				**17**			
18				**18**			
19				**19**			
20				**20**			
21				**21**			
22				**22**			
23				**23**			
24				**24**			
25				**25**			
26				**26**			
27				**27**			
28				**28**			
29				**29**			
30				**30**			

Note: All fuses resistances are satisfactory.

EXCITER ELECTRICAL TESTS

DIODE HI-POT LEAKAGE (PIV)

Customer:	**Oklahoma Gas & Electric**	Instrument:	**Basler Tester**
Station:	**Mustang - Tinker AFB**	Instr. S/N:	**GMS-091**
Mfg. & S/N:	**EM B123A493VA1**	Cal. Due Date:	
Inspector:	**A. Kiefer**	Diode P/N	
Date:	**10-18-11**	Test Voltage:	**1000 V_{DC}**
		Specification:	**45 mA maximum**

[X] **As Received**
[ ] **In-Process Inspection**
[ ] **Final Inspection**

OUTBOARD (PMG SIDE)				**INBOARD (GENERATOR SIDE)**			
DIODE P/N		COLOR		DIODE P/N		COLOR	
Diode No.	Leakage Current (milliamps)	Diode No.	Leakage Current (milliamps)	Diode No.	Leakage Current (milliamps)	Diode No.	Leakage Current (milliamps)
1	.18	25		1		25	
2	.18	26		2		26	
3	.19	27		3		27	
4	.18	28		4		28	
5	.18	29		5		29	
6	.19	30		6		30	
7	.19	31		7		31	
8	.19	32		8		32	
9	.19	33		9		33	
10	.18	34		10		34	
11	.18	35		11		35	
12	.18	36		12		36	
13		37		13		37	
14		38		14		38	
15		39		15		39	
16		40		16		40	
17		41		17		41	
18		42		18		42	
19		43		19		43	
20		44		20		44	
21		45		21		45	
22		46		22		46	
23		47		23		47	
24		48		24		48	

Notes: All electrical values acceptable. Mechanical condition of all diodes unacceptable.

EXCITER ELECTRICAL TESTS

FORWARD AND REVERSE DIODE RESISTANCES

Customer:	**Oklahoma Gas & Electric**	Instrument:	**Simpson**
Station:	**Mustang - Tinker AFB**	Instr. S/N:	**GMS-114**
Mfg. & S/N:	**EM B123A493VA1**	Cal. Due Date:	**11-30-11**
Inspector:	**A. Kiefer**	Forward Spec:	**5 – 10 ohms**
Date:	**10-18-11**	Reverse Spec:	**30 kilohms, min.**

[X] **As Received (after Hi Pot)**

[ ] **In-Process Inspection**

[ ] **Final Inspection**

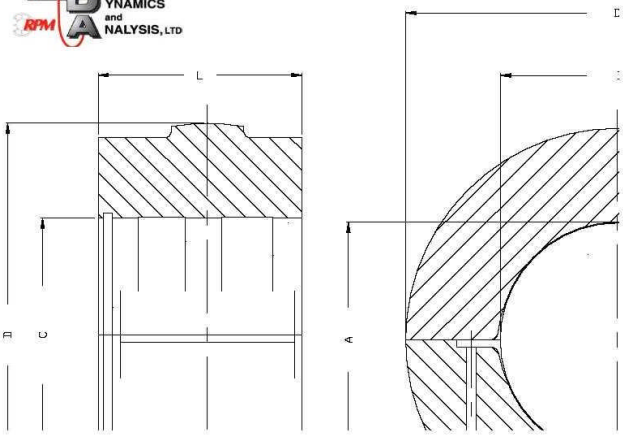
OUTBOARD (PMG SIDE)						INBOARD (GENERATOR SIDE)					
DIODE P/N			COLOR			DIODE P/N			COLOR		
No.	**Forward (ohms)**	**Reverse (kohms)**	**No.**	**Forward (ohms)**	**Reverse (kohms)**	**No.**	**Forward (ohms)**	**Reverse (kohms)**	**No.**	**Forward (ohms)**	**Reverse (kohms)**
1	5.5	∞	**25**			**1**			**25**		
2	5.5	∞	**26**			**2**			**26**		
3	5.5	∞	**27**			**3**			**27**		
4	5.5	∞	**28**			**4**			**28**		
5	5.5	∞	**29**			**5**			**29**		
6	5.5	∞	**30**			**6**			**30**		
7	6.0	∞	**31**			**7**			**31**		
8	5.5	∞	**32**			**8**			**32**		
9	6.0	∞	**33**			**9**			**33**		
10	6.0	∞	**34**			**10**			**34**		
11	6.0	∞	**35**			**11**			**35**		
12	6.0	∞	**36**			**12**			**36**		
13			**37**			**13**			**37**		
14			**38**			**14**			**38**		
15			**39**			**15**			**39**		
16		Infinity	**40**			**16**			**40**		
17		Infinity	**41**			**17**			**41**		
18		Infinity	**42**			**18**			**42**		
19		Infinity	**43**			**19**			**43**		
20		Infinity	**44**			**20**			**44**		
21		Infinity	**45**			**21**			**45**		
22		Infinity	**46**			**22**			**46**		
23		Infinity	**47**			**23**			**47**		
24		Infinity	**48**			**24**			**48**		

Notes: All electrical values acceptable. Mechanical condition of all diodes unacceptable.

INSPECTION REPORT

REFURBISHED DE JOURNAL BEARING

Renewal Parts Maintenance



Inspection Report
Journal Bearing
RPM Job# 0502489-1-1

Customer: GMS International					Plant/Unit:		
OEM/Design: Elliptical					Comments:		
Work Scope: Centrifugal Cast Repair							
P/N DE		As Received Date: 11/9/11			As Shipped Date: 1/26/12		
		Vert	Horz	Horz	Vert	Horz	Horz
Inside Diameter	Inboard	12.015	12.030	12.033	12.014	12.029	12.029
	Midboard						
	Outboard	12.016	12.0315	12.033	12.014	12.029	12.0285
Seal Diameter	Inboard	12.0145	12.029	12.031	12.014	12.029	12.029
	Outboard	12.016	12.030	12.050	12.014	12.0285	12.0285
Deflector	Inboard	12.231	12.247	12.250		A S	
	Outboard	13.032	13.053	13.052	R E	C E I	V E D
Outside Diameter	Inboard	15.600	15.603	15.600	15.600	15.598	15.599
	Midboard						
	Outboard	15.600	15.603	15.599	15.599	15.599	15.599
Length		Babbitt: 8.593 OAL: 11.790			Babbitt: 8.587 OAL: 11.792		
Dowels		(2) Not Acceptable			(2) Refit		
Joints		In .000 Out .005 Contact 65%			In .000 Out .005 Contact 65%		
Babbitt Bond		N/A			UT/PT>95% Adhesion		

"100% Customer Satisfaction is always our Goal."
If you have any questions concerning this report or any of our services, please call us.
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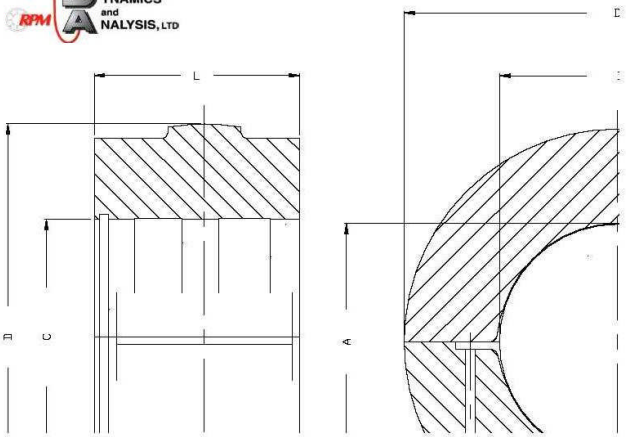
INSPECTION REPORT

REFURBISHED EE JOURNAL BEARING

Renewal Parts Maintenance



Inspection Report
Journal Bearing
RPM Job# 0502489-2-1

Customer: GMS International					Plant/Unit:		
OEM/Design: Elliptical					Comments:		
Work Scope: Centrifugal Cast Repair							
P/N EE		As Received Date: 11/9/11			As Shipped Date: 1/26/12		
		Vert	Horz	Horz	Vert	Horz	Horz
Inside Diameter	Inboard	12.0165	12.039	12.039	12.015	12.030	12.030
	Midboard						
	Outboard	12.014	12.037	12.039	12.015	12.030	12.030
Seal Diameter	Inboard	12.0165	12.036	12.036	12.015	12.030	12.030
	Outboard	12.013	12.037	12.039	12.015	12.030	12.030
Bolt On	Inboard	12.236	12.255	12.256	12.336	12.255	12.256
Deflector	Outboard	13.030	13.054	13.052	13.030	13.054	13.052
Outside Diameter	Inboard	15.5985	15.602	15.599	15.599	15.598	15.599
	Midboard						
	Outboard	15.599	15.601	15.598	15.599	15.599	15.598
Length		Babbitt: 8.590 OAL: 11.800			Babbitt: 8.500 OAL: 11.788		
Dowels		(2) Acceptable			(2) Refit		
Joints		In .000 Out .003 Contact 70%			In .000 Out .000 Contact 75%		
Babbitt Bond		N/A			UT/PT>95% Adhesion		

"100% Customer Satisfaction is always our Goal."
If you have any questions concerning this report or any of our services, please call us.
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EXCITER FINAL ELECTRICAL TESTS
REPLACEMENT DIODE HI-POT LEAKAGE (PIV)

Customer:	**Oklahoma Gas & Electric**	Instrument:	**Basler Tester**
Station:	**Mustang - Tinker AFB**	Instr. S/N:	**GMS-091**
Mfg. & S/N:	**EM B123A493VA1**	Cal. Due Date:	
Inspector:	**Walt Kokocinski**	Diode P/N	
Date:	**1-13-12**	Test Voltage:	**1000 V_{DC}**
		Specification:	**45 mA maximum**

- [ ] **As Received**
- [ ] **In-Process Inspection**
- [X] **Final Inspection**

OUTBOARD (PMG SIDE)				**INBOARD (GENERATOR SIDE)**			
DIODE P/N		COLOR		DIODE P/N		COLOR	
Diode No.	Leakage Current (milliamps)	Diode No.	Leakage Current (milliamps)	Diode No.	Leakage Current (milliamps)	Diode No.	Leakage Current (milliamps)
1	.22	25		1		25	
2	.22	26		2		26	
3	.22	27		3		27	
4	.22	28		4		28	
5	.22	29		5		29	
6	.22	30		6		30	
7	.22	31		7		31	
8	.22	32		8		32	
9	.22	33		9		33	
10	.22	34		10		34	
11	.22	35		11		35	
12	.22	36		12		36	
13		37		13		37	
14		38		14		38	
15		39		15		39	
16		40		16		40	
17		41		17		41	
18		42		18		42	
19		43		19		43	
20		44		20		44	
21		45		21		45	
22		46		22		46	
23		47		23		47	
24		48		24		48	

Notes: All electrical values acceptable.

EXCITER ELECTRICAL TESTS

REPLACEMENT DIODE RESISTANCES

Customer:	**Oklahoma Gas & Electric**	Instrument:	**Simpson**
Station:	**Mustang - Tinker AFB**	Instr. S/N:	**GMS-114**
Mfg. & S/N:	**EM B123A493VA1**	Cal. Due Date:	**11-15-12**
Inspector:	**Walt Kokocinski**	Forward Spec:	**5 – 10 ohms**
Date:	**1-13-12**	Reverse Spec:	**30 kilohms, min.**

[ ] **As Received (after Hi Pot)**
[ ] **In-Process Inspection**
[X] **Final Inspection**

OUTBOARD (PMG SIDE)						INBOARD (GENERATOR SIDE)					
DIODE P/N			COLOR			DIODE P/N			COLOR		
No.	**Forward (ohms)**	**Reverse (kohms)**	**No.**	**Forward (ohms)**	**Reverse (kohms)**	**No.**	**Forward (ohms)**	**Reverse (kohms)**	**No.**	**Forward (ohms)**	**Reverse (kohms)**
1	7.6	∞	**25**			**1**			**25**		
2	7.6	∞	**26**			**2**			**26**		
3	7.6	∞	**27**			**3**			**27**		
4	7.6	∞	**28**			**4**			**28**		
5	7.6	∞	**29**			**5**			**29**		
6	8.0	∞	**30**			**6**			**30**		
7	7.6	∞	**31**			**7**			**31**		
8	7.2	∞	**32**			**8**			**32**		
9	7.4	∞	**33**			**9**			**33**		
10	7.5	∞	**34**			**10**			**34**		
11	7.4	∞	**35**			**11**			**35**		
12	7.4	∞	**36**			**12**			**36**		
13			**37**			**13**			**37**		
14			**38**			**14**			**38**		
15			**39**			**15**			**39**		
16		Infinity	**40**			**16**			**40**		
17		Infinity	**41**			**17**			**41**		
18		Infinity	**42**			**18**			**42**		
19		Infinity	**43**			**19**			**43**		
20		Infinity	**44**			**20**			**44**		
21		Infinity	**45**			**21**			**45**		
22		Infinity	**46**			**22**			**46**		
23		Infinity	**47**			**23**			**47**		
24		Infinity	**48**			**24**			**48**		

Notes: All electrical values acceptable.

FINAL ROTOR ELECTRICAL TESTING

Customer: **Oklahoma Gas & Electric** Test Date: **2-15-12**
Station: **Mustang - Tinker AFB** Tester: **W. Kokocinski**
Mfg. & S/N: **EM B123A493VA1**

1. ROTOR INSULATION RESISTANCE

Instrument Used: **AYO** Excitation Voltage: V_{DC}
Instrument S/N: **GMS-131** Test Voltage: **500** V_{DC}
Calibration Due: **9-20-12** Acceptance Criteria: **50 MΩ , PI > 2**

TIME	MEGOHMS
15 Sec.	**1,500**
30 Sec.	**2,500**
45 Sec.	**3,500**
1 Min.	**4,500**
1½ Min.	**6,000**
2 Min.	**6,000**
2½ Min.	**7,000**
3 Min.	**7,000**

TIME	MEGOHMS
4 Min.	**8,000**
5 Min.	**8,000**
6 Min.	**9,000**
7 Min.	**10,000**
8 Min.	**10,000**
9 Min.	**11,000**
10 Min.	**11,000**
PI = $R_{10\ Min.}$ / $R_{1\ Min.}$ =	**2.4**

Note: All values acceptable.

2. D.C. ROTOR WINDING RESISTANCE

MEASURED (R_m, Ohms)	CORRECTED TO ($R_{25°C}$, Ohms)	($R_{75°C}$, Ohms)	PREVIOUS (Ohms)
.393	0.3945	0.5466	.391

Micro-ohmmeter: **DLRO**
Instrument No.: **GMS-082**
Calibration Due: **9-23-12**
Temperature: **24** °C

$$*R_{25\,°C} = R_m \left[\frac{259.5}{234.5 + T}\right] \qquad **R_{75\,°C} = R_m \left[\frac{309.5}{234.5 + T}\right]$$

$R_{25°C}$ = Winding Resistance Corrected to 25ºC; R_m = Measured Winding Resistance
$R_{75°C}$ = Winding Resistance Corrected to 75ºC; T = Temperature of Winding, ºC

Note: Q-Meter data verified that the rotor was free of turn-to-turn shorts.

EXCITER FINAL ELECTRICAL TESTS
INSULATION & WINDING RESISTANCES

Customer: **Oklahoma Gas & Electric**
Station: **Mustang - Tinker AFB**
Mfg. & S/N: **EM B123A493VA1**

Megger Used: _____
Megger S/N: _____
Cal. Due Date: _____

1. INSULATION RESISTANCE TESTS

Test	Test Voltage	Resistance (Megohms)		Tester	Date
		Acceptance	Measured		
Exciter Rotor Winding	500 V_{DC}, 1 min.	R>1	20,000		11-8-11
Diode Wheel-to-Wheel	500 V_{DC}, 1 min.	R>1	N/A Single Wheel		
IB Diode Wheel-to-Shaft	500 V_{DC}, 1 min.	R>1	N/A Single Wheel		
OB Diode Wheel-to-Shaft	500 V_{DC}, 1 min.	R>1			
Heat Sinks-to-Diode Wheel (disconnect fuses)		R>.5			
Exciter Stator	500 V_{DC}, 1 min.	R>1	20,000	A. Kiefer	11-8-11
PMG Stator	500 V_{DC}, 1 min.	R>1			
Bearing Pedestal	500 V_{DC}, 1 min.	R>1			

Notes:

2. EXCITER WINDING RESISTANCES

Tester: **Walt Kokocinski**
Test Date: _____

MicroOhmmeter: _____
Ohmmeter S/N: _____
Cal. Due Date: _____

Phase	Resistance	Deviation from Average	
	Milliohms	Milliohms	Pct.
B-B			
B-C			
C-A			
Average			

Notes:

APPENDIX C

Oklahoma Gas & Electric / TINKER AFB

NON DESTRUCTIVE EXAMINATION
TEST RESULTS

LIQUID PENETRANT NDE INSPECTION
J-LEAD WEDGES

Customer:	**Oklahoma Gas & Electric**	Date:	**10/25/2011**
Station:	**Tinker AFB**	Job No:	**11G779**
Mfg. & S/N:	**EM B123A493VA1**	Heat Number:	**N/A**
Procedure:	**E-165-02**	Heat Code:	**N/A**
Specification:	**N/A**	Quantity:	**14 total**
Scope:	**Liquid Penetrant Inspection of J-Lead Wedges**		

TEST PARAMETERS

☐ **Fluorescent** ☒ **Visible**

Manufacturer: _____ Manufacturer: _____

	Penetrant	Remover	Developer
Type:	**N/A**	**N/A**	**N/A**
Batch:	**N/A**	**N/A**	**N/A**
Time:	**N/A**	**N/A**	**N/A**

	Penetrant	Remover	Developer
Type:	**SKL-SP1**	**SKC-S**	**SKD-S2**
Batch:	**10E03K**	**10A01K**	**10E10K**
Time:	**20 Minutes**	**N/A**	**N/A**

Ultraviolet Light Data:

U.V. Light Mfg.:	**N/A**	Model No.:	**N/A**
Serial No.:	**N/A**	Intensity @ 15":	**N/A**

Ultraviolet Light Meter Data:

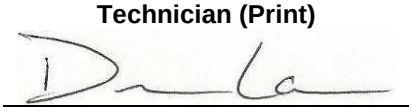
Meter Mfg.:	**N/A**	Model No.:	**N/A**
Serial No.:	**N/A**	Calibration Due:	**N/A**

INSPECTION RESULTS

Acceptable: _____ **Unacceptable:** **Yes**

Remarks: **1. Mechanical damage found on wedge lands prevented meaningful results from a Penetrant Inspection. See Page C-2.**

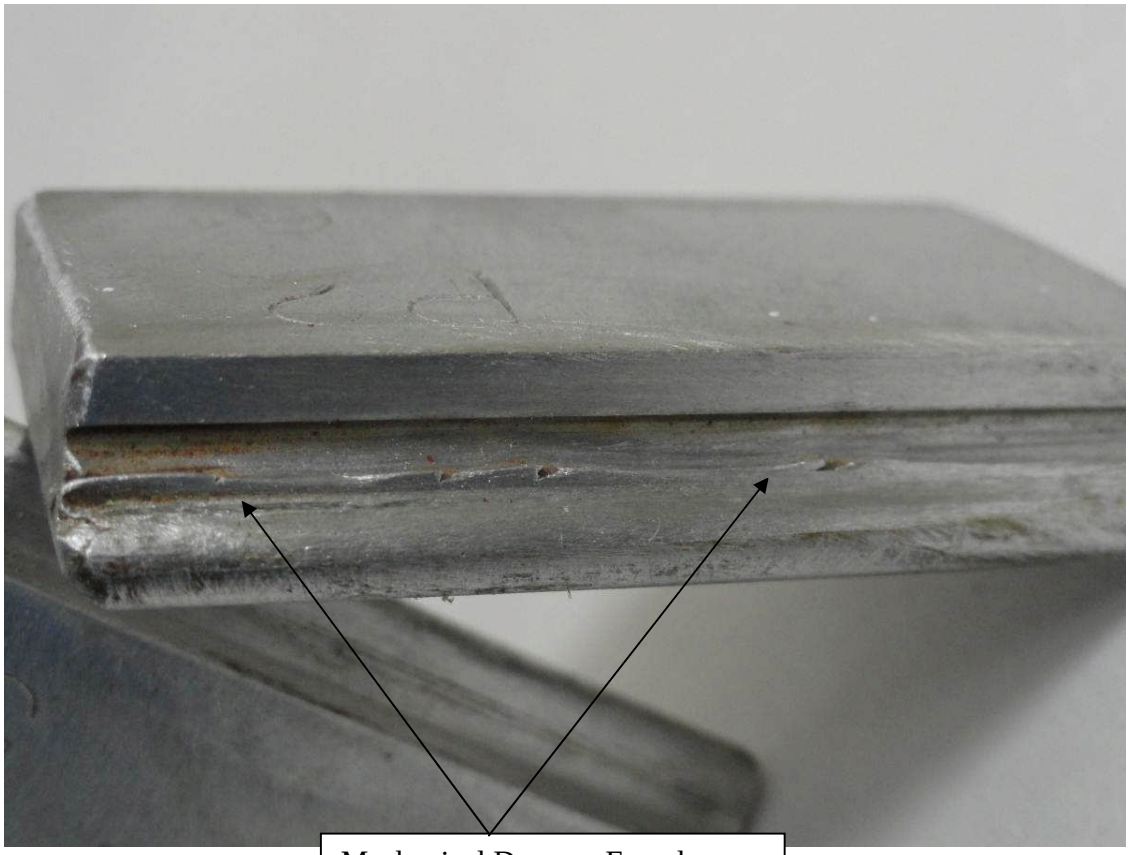
Dennis Lavelle
Technician (Print)



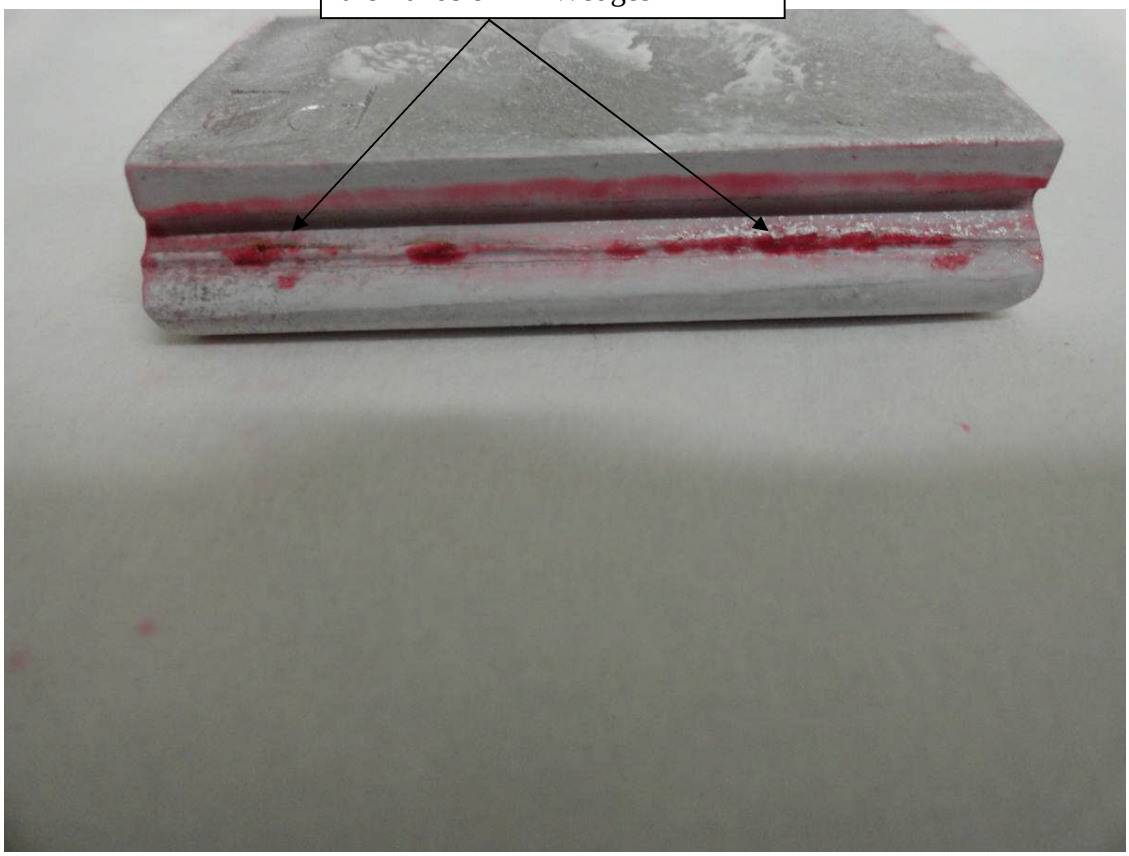
Technician (Signature) **LEVEL ☒II ☐III**

Assistant (Print)

Assistant (Signature) **LEVEL ☐I ☐II**



Mechanical Damage Found on the Lands of All Wedges



LIQUID PENETRANT NDE INSPECTION
ROTOR BODY WEDGES

Customer:	**Oklahoma Gas & Electric**	Date:	**10/29/2011**
Station:	**Tinker AFB**	Job No:	**11G779**
Mfg. & S/N:	**EM B123A493VA1**	Heat Number:	**N/A**
Procedure:	**E-165-02**	Heat Code:	**N/A**
Specification:	**N/A**	Quantity:	**Sample of 20**
Scope:	**Liquid Penetrant Inspection of Rotor Body Wedges**		

TEST PARAMETERS

☐ **Fluorescent** ☒ **Visible**

Manufacturer: _____ Manufacturer: _____

	Penetrant	Remover	Developer
Type:	**N/A**	**N/A**	**N/A**
Batch:	**N/A**	**N/A**	**N/A**
Time:	**N/A**	**N/A**	**N/A**

	Penetrant	Remover	Developer
Type:	**SKL-SP1**	**SKC-S**	**SKD-S2**
Batch:	**10E03K**	**10A01K**	**10E10K**
Time:	**20 Minutes**	**N/A**	**N/A**

Ultraviolet Light Data:

U.V. Light Mfg.:	**N/A**	Model No.:	**N/A**
Serial No.:	**N/A**	Intensity @ 15":	**N/A**

Ultraviolet Light Meter Data:

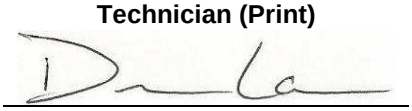
Meter Mfg.:	**N/A**	Model No.:	**N/A**
Serial No.:	**N/A**	Calibration Due:	**N/A**

INSPECTION RESULTS

Acceptable: _____ **Unacceptable:** **Yes**

Remarks: **1. The extent of corrosion / degradation found throughout the all rotor wedges was such that it was not possible to get accurate results by using Penetrant Inspection techniques. See Page C-4.**

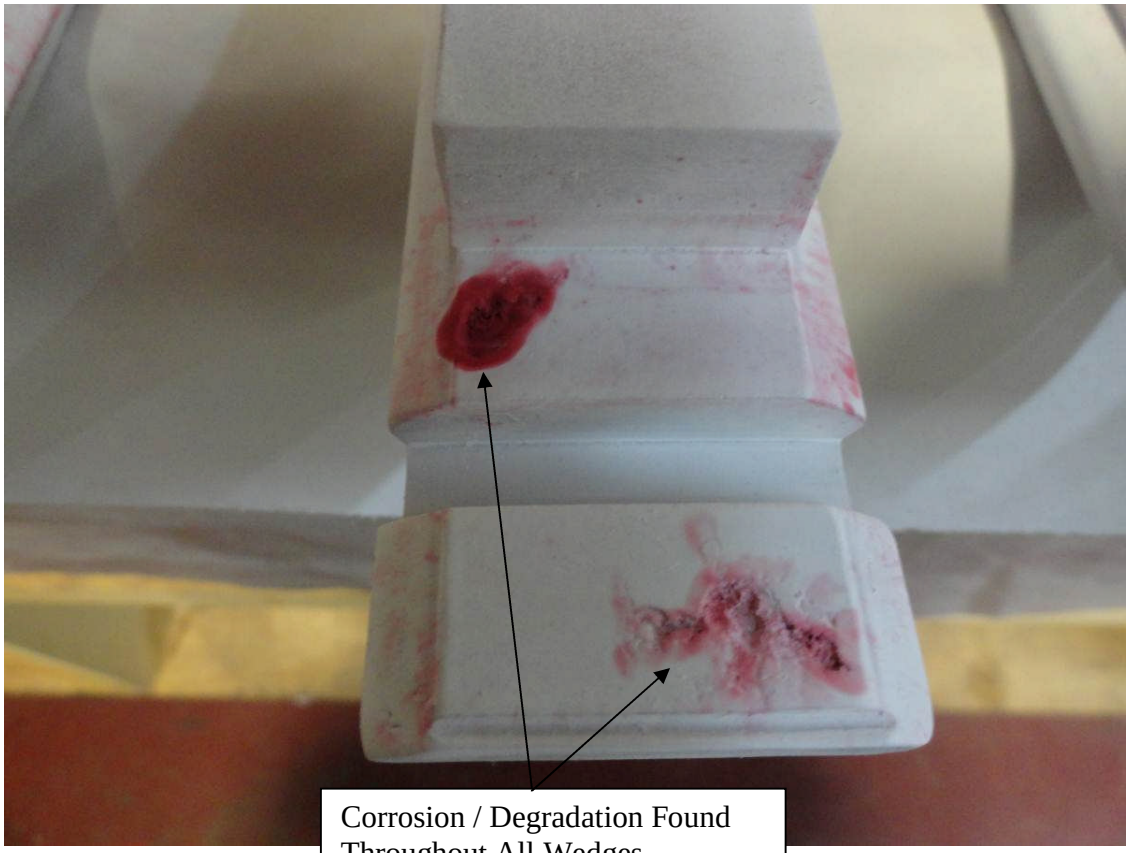
Dennis Lavelle
Technician (Print)



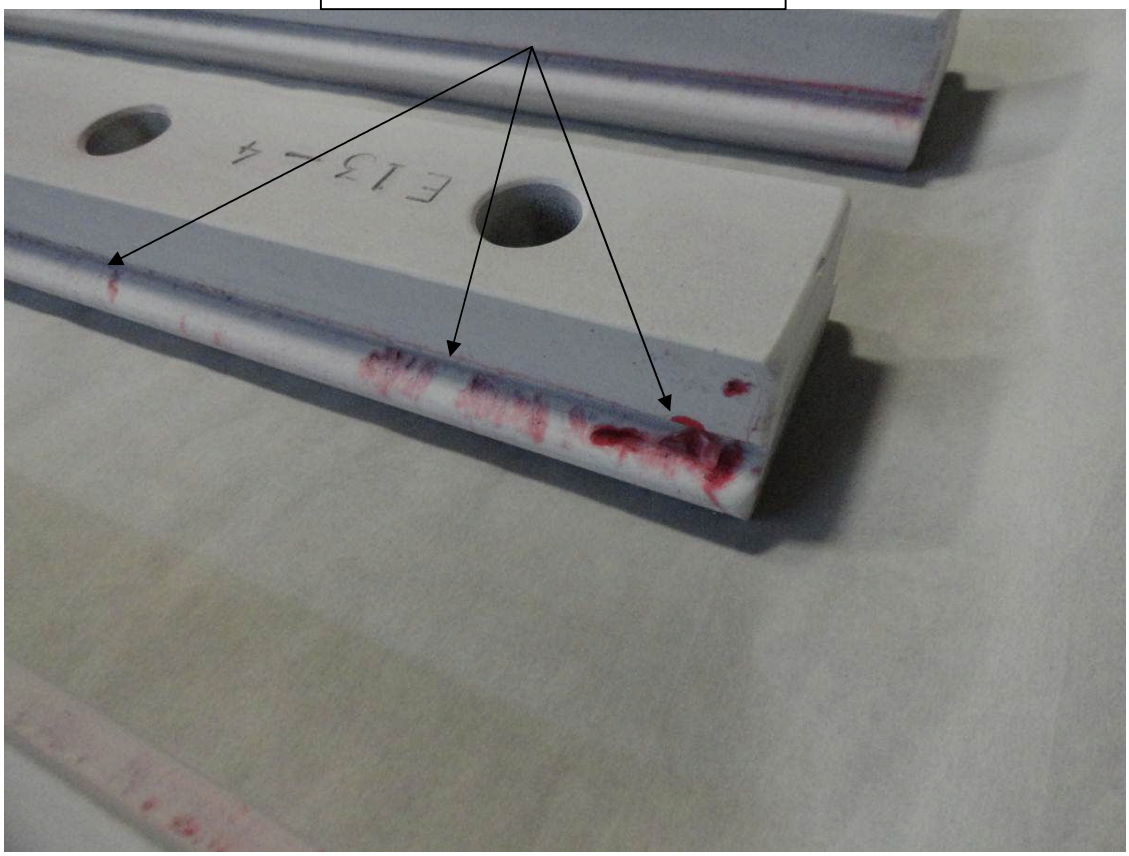
Technician (Signature) **LEVEL** ☒**II** ☐**III**

Assistant (Print)

Assistant (Signature) **LEVEL** ☐**I** ☐**II**



Corrosion / Degradation Found Throughout All Wedges



MAGNETIC PARTICLE NDE INSPECTION
SHAFTS, JOURNALS & COUPLING

Customer:	**Oklahoma Gas & Electric**	Date:	**10/28/2011**
Station/Unit:	**Tinker AFB**	Job No:	**11G779**
Mfg & S/N:	**EM B123A493VA1**	Heat Number:	**N/A**
Procedure:	**E-709-01**	Heat Code:	**N/A**
Specification:	**N/A**	Quantity:	**1 each**
Scope:	**Magnetic Particle Inspection of Shafts, Journals & Coupling**		

TEST PARAMETERS

☒ **Fluorescent**		☐ **Visible**	
Manufacturer:	**Magnaflux**	Manufacturer:	**N/A**
Type:	**14AM Prepared Bath**	Type:	**N/A**
Batch:	**10E09K**	Batch:	**N/A**

Ultraviolet Light Data:

Light Mfg.:	**Magnaflux**	Model:	**ZB-100F**
Serial No.:	**10960824**	Intensity @ 15”	**780 µW / cm²**

Ultraviolet Light Meter Data:

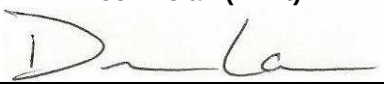
Meter Mfg.:	**Mannix Mfg.**	Model:	**UV-340**
Serial No.:	**AC.52890**	Calibration Due:	**8/23/2012**

INSPECTION RESULTS

Acceptable:	**Yes**	**Unacceptable:**	

Remarks: **1. No Linear Indications were found.**

Dennis Lavelle
Technician (Print)



Technician (Signature) **LEVEL ☒II ☐III**

MAGNETIC PARTICLE NDE INSPECTION

ROTOR BODY

Customer:	**Oklahoma Gas & Electric**	Date:	**10/28/2011**
Station/Unit:	**Tinker AFB**	Job No:	**11G779**
Mfg & S/N:	**EM B123A493VA1**	Heat Number:	**N/A**
Procedure:	**E-709-01**	Heat Code:	**N/A**
Specification:	**N/A**	Quantity:	**1**
Scope:	**Magnetic Particle Inspection of the entire Rotor Body**		

TEST PARAMETERS

☒ **Fluorescent**		☐ **Visible**	
Manufacturer:	**Magnaflux**	Manufacturer:	**N/A**
Type:	**14AM Prepared Bath**	Type:	**N/A**
Batch:	**10E09K**	Batch:	**N/A**

Ultraviolet Light Data:

Light Mfg.:	**Magnaflux**	Model:	**ZB-100F**
Serial No.:	**10960824**	Intensity @ 15”	**780 µW / cm²**

Ultraviolet Light Meter Data:

Meter Mfg.:	**Mannix Mfg.**	Model:	**UV-340**
Serial No.:	**AC.52890**	Calibration Due:	**8/23/2012**

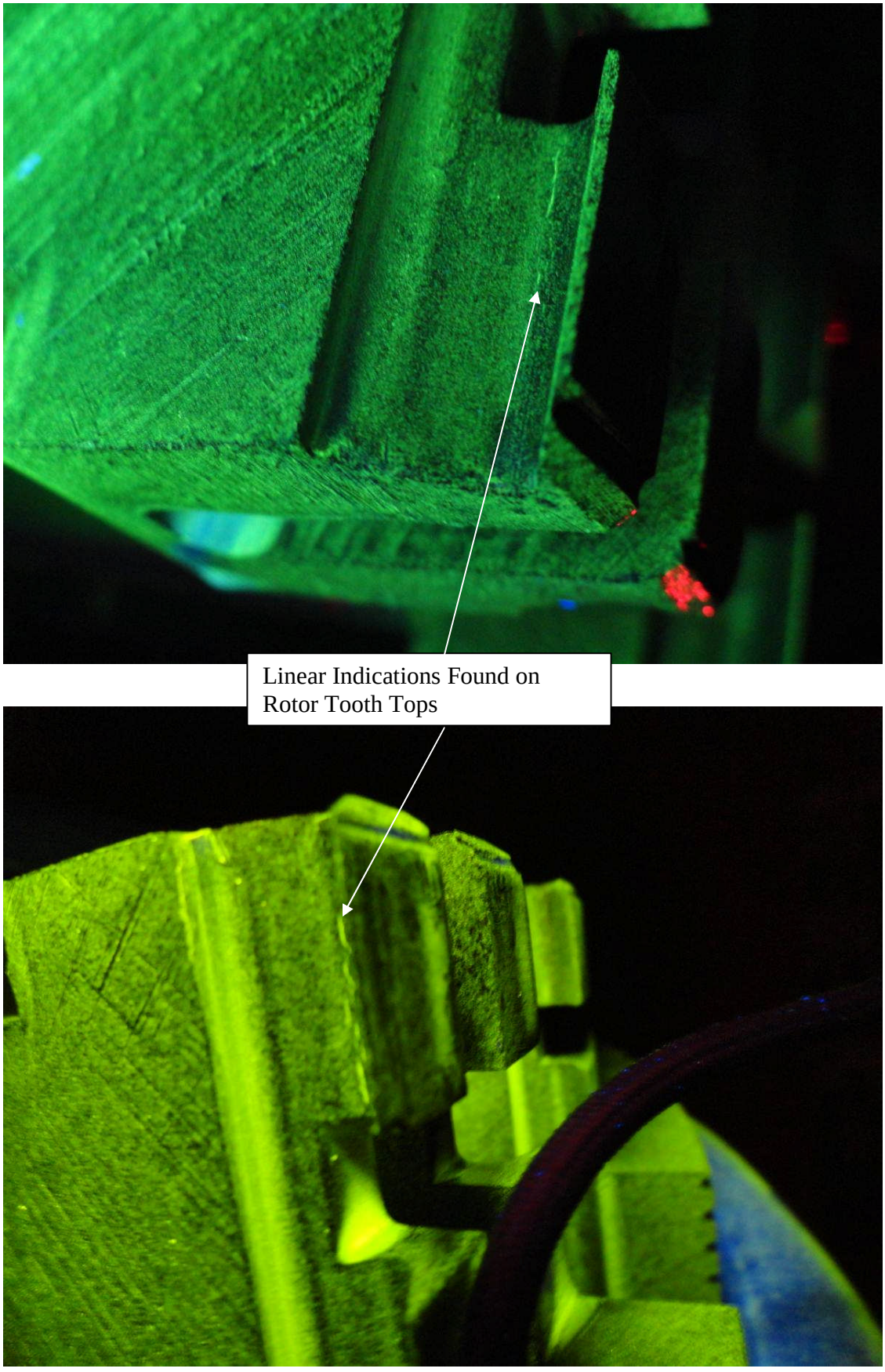
INSPECTION RESULTS

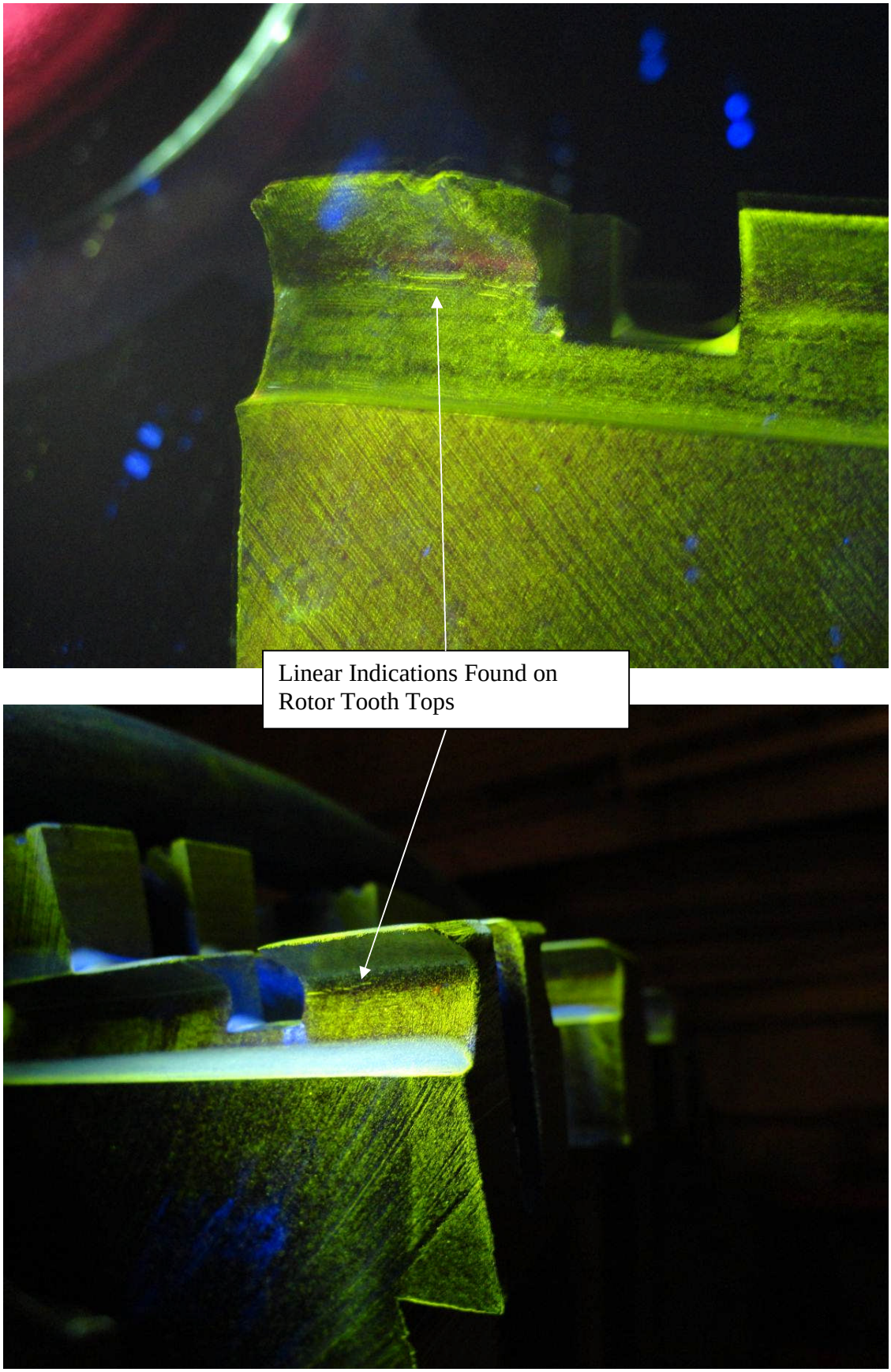
Acceptable:		**Unacceptable:**	**Yes**

Remarks: **1. Linear Indications were found on 34 tooth tops. See Pages C-7 and C-8.**

Dennis Lavelle
Technician (Print)

Technician (Signature) **LEVEL** ☒**II** ☐**III**


Linear Indications Found on
Rotor Tooth Tops


Linear Indications Found on
Rotor Tooth Tops

MAGNETIC PARTICLE NDE INSPECTION

RETAINING RINGS

Customer:	**Oklahoma Gas & Electric**	Date:	**10/25/2011**
Station/Unit:	**Tinker AFB**	Job No:	**11G779**
Mfg & S/N:	**EM B123A493VA1**	Heat Number:	**N/A**
Procedure:	**E-709-01**	Heat Code:	**N/A**
Specification:	**N/A**	Quantity:	**2**
Scope:	**Magnetic Particle Inspection of the Retaining Rings**		

TEST PARAMETERS

☒ **Fluorescent**		☐ **Visible**	
Manufacturer:	**Magnaflux**	Manufacturer:	**N/A**
Type:	**14AM Prepared Bath**	Type:	**N/A**
Batch:	**10E09K**	Batch:	**N/A**

Ultraviolet Light Data:

Light Mfg.:	**Magnaflux**	Model:	**ZB-100F**
Serial No.:	**10960824**	Intensity @ 15"	**780 µW / cm²**

Ultraviolet Light Meter Data:

Meter Mfg.:	**Mannix Mfg.**	Model:	**UV-340**
Serial No.:	**AC.52890**	Calibration Due:	**8/23/2012**

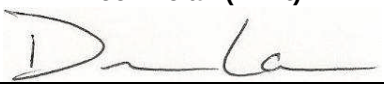
INSPECTION RESULTS

Acceptable: _____ **Unacceptable:** **Yes**

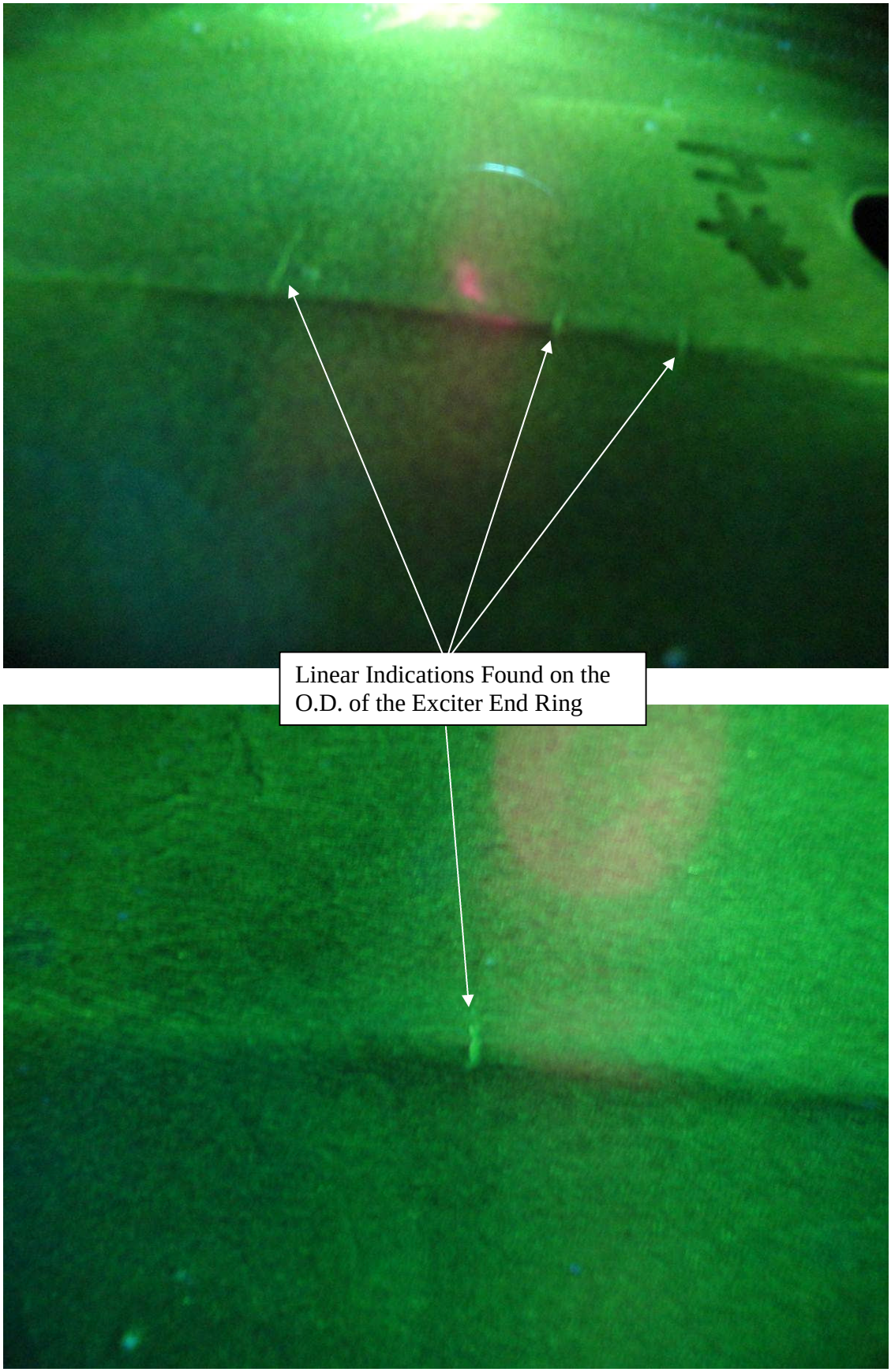
Remarks:

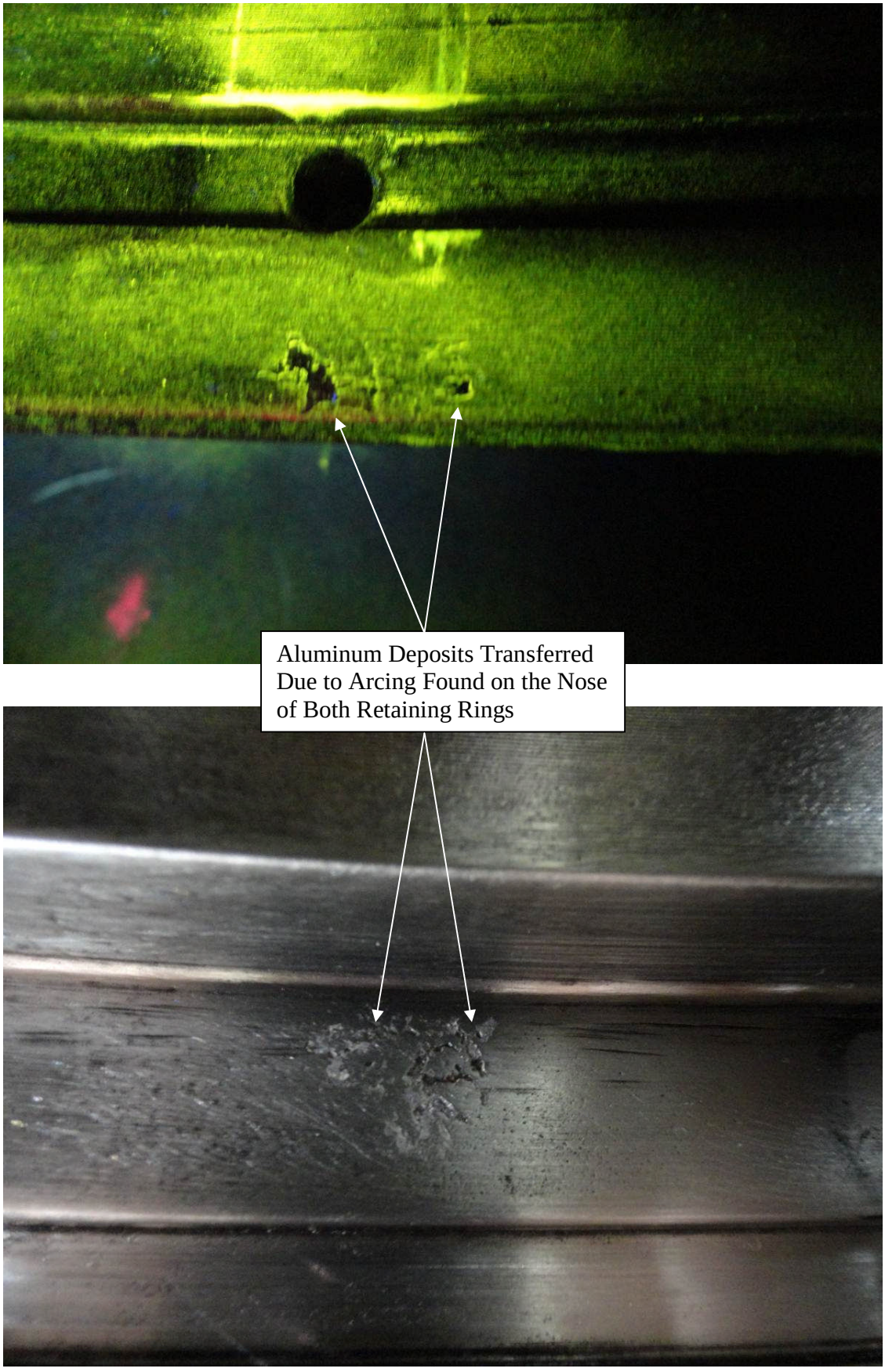
1. **Linear Indications were found on the O.D. of the exciter end retaining ring. See Figure C-10.**
2. **Aluminum deposits transferred during arcing were found on the nose of the retaining ring. See Page C-11.**

Dennis Lavelle
Technician (Print)



Technician (Signature) **LEVEL ☒II ☐III**


Linear Indications Found on the
O.D. of the Exciter End Ring



Aluminum Deposits Transferred Due to Arcing Found on the Nose of Both Retaining Rings

NDE HARDNESS TESTING

RETAINING RINGS

Customer:	**Oklahoma Gas & Electric**	Date:	**10/25/2011**
Station:	**Tinker AFB**	Job No:	**11G779**
Mfg. & S/N:	**EM B123A493VA1**	Description:	**O.D. of Retaining Rings**
Specification:	**Hardness Testing**	Material:	**Steel**
Scale:	**Hardness Rockwell C**	Quantity:	**2**
Scope:	**Hardness Testing of the O.D. of the Retaining Rings**		

Hardness Scope Data:

Scope Mfg.:	**Phase II**	Model:	**PHT-3500**
Serial No.:	**HL0108123122**	Sensor Type:	**Dynamic**
		Calibration Due:	**7/2/2012**

Calibration Block Data:

Block Mfg.:	**Phase II**	Accuracy:	**HRC 57.9 (+/-1)**
Serial No.:	**0812299**		

Results:

Turbine End Retaining Ring					
0°	*Hole # 1*	*Hole # 2*	*Hole # 3*	*Hole # 4*	*Hole # 5*
1	*40.7*	*40.7*	*43.2*	*40.6*	*39.9*
2	*48.8*	*37.8*	*42.7*	*42.5*	*38.1*
3	*43.4*	*42.3*	*43.3*	*40.9*	*42.8*
Avg.	*44.3*	*40.3*	*43.1*	*41.3*	*40.3*
Average of Area at 0° - 41.9					

Turbine End Retaining Ring					
90°	*Hole # 1*	*Hole # 2*	*Hole # 3*	*Hole # 4*	*Hole # 5*
1	*37.5*	*40.7*	*41.2*	*41.6*	*39.6*
2	*40.0*	*45.6*	*37.2*	*41.0*	*40.5*
3	*40.5*	*40.0*	*35.4*	*40.1*	*41.9*
Avg.	*39.3*	*42.1*	*37.9*	*40.9*	*40.7*
Average of Area at 90° - 40.2					

Turbine End Retaining Ring					
180°	Hole # 1	Hole # 2	Hole # 3	Hole # 4	Hole # 5
1	41.2	36.3	37.7	42.7	40.2
2	40.8	36.5	37.7	41.9	39.2
3	38.4	35.0	37.5	43.2	40.1
Avg.	40.1	35.9	37.6	42.6	39.8
Average of Area at 180° - 39.2					

Turbine End Retaining Ring					
270°	Hole # 1	Hole # 2	Hole # 3	Hole # 4	Hole # 5
1	40.3	41.5	39.4	38.8	39.4
2	39.4	40.0	39.5	39.7	39.5
3	40.7	40.3	39.2	39.0	39.2
Avg.	40.1	40.6	39.4	39.2	39.4
Average of Area at 270° - 40.2					

Exciter End Retaining Ring					
0°	Hole # 1	Hole # 2	Hole # 3	Hole # 4	Hole # 5
1	42.5	40.0	40.9	38.7	40.3
2	41.6	38.8	40.2	36.6	40.2
3	42.7	39.5	39.1	41.7	39.1
Avg.	42.3	39.4	40.1	39.0	40.1
Average of Area at 0° - 40.2					

Exciter End Retaining Ring					
90°	Hole # 1	Hole # 2	Hole # 3	Hole # 4	Hole # 5
1	38.5	39.8	38.4	38.9	42.2
2	40.1	38.5	36.1	40.1	40.3
3	41.2	41.7	38.4	38.9	39.0
Avg.	39.9	40.0	37.6	39.3	40.5
Average of Area at 90° - 39.5					

Exciter End Retaining Ring					
180°	Hole # 1	Hole # 2	Hole # 3	Hole # 4	Hole # 5
1	38.1	38.5	37.6	38.3	39.3
2	43.7	37.2	40.8	38.8	39.7
3	39.1	38.4	37.1	40.6	38.5
Avg.	40.3	38.0	38.5	39.2	39.2
Average of Area at 180° - 39.0					

Exciter End Retaining Ring					
270°	Hole # 1	Hole # 2	Hole # 3	Hole # 4	Hole # 5
1	38.2	40.6	40.1	40.1	38.0
2	43.3	37.2	39.2	39.1	39.7
3	40.3	38.1	42.1	38.7	40.3
Avg.	40.6	38.6	40.5	39.3	39.3
Average of Area at 270° - 39.7					

INSPECTION RESULTS

Acceptable: _____ **Unacceptable:** Yes

Remarks: 1. All hardness values above specification limits

Dennis Lavelle
Technician (Print)

Technician (Signature) **LEVEL** ☒**II** ☐**III**

MAGNETIC PARTICLE NDE INSPECTION

BLOWER FANS

Customer:	**Oklahoma Gas & Electric**	Date:	**10/29/2011**
Station/Unit:	**Tinker AFB**	Job No:	**11G779**
Mfg & S/N:	**EM B123A493VA1**	Heat Number:	**N/A**
Procedure:	**E-709-01**	Heat Code:	**N/A**
Specification:	**N/A**	Quantity:	**2**
Scope:	**MagnetiC Particle Inspection of the Blower Fans**		

TEST PARAMETERS

☒ **Fluorescent**		☐ **Visible**	
Manufacturer:	**Magnaflux**	Manufacturer:	**N/A**
Type:	**14AM Prepared Bath**	Type:	**N/A**
Batch:	**10E09K**	Batch:	**N/A**

Ultraviolet Light Data:

Light Mfg.:	**Magnaflux**	Model:	**ZB-100F**
Serial No.:	**10960824**	Intensity @ 15”	**780 µW / cm²**

Ultraviolet Light Meter Data:

Meter Mfg.:	**Mannix Mfg.**	Model:	**UV-340**
Serial No.:	**AC.52890**	Calibration Due:	**8/23/2012**

INSPECTION RESULTS

Acceptable:	**Yes**	**Unacceptable:**	

Remarks: **1. No Linear Indications were found.**

Blower Fans

Dennis Lavelle
Technician (Print)

Technician (Signature) **LEVEL ☒II ☐III**

ULTRASONIC NDE INSPECTION REPORT

J-LEADS

Customer:	**Oklahoma Gas & Electric**	Date:	**10/30/2011**
Station:	**Tinker AFB**	Job No.:	**11G779**
Mfg. & S/N:	**EM B123A493VA1**	Heat Number:	**N/A**
Procedure:	**E-587**	Heat Code:	**N/A**
Specification:	**N/A**	Quantity:	**2**
Scope:	**Ultrasonic Inspection of the J-Leads**		

TEST PARAMETERS

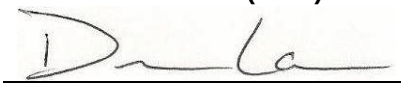
Flaw Detector:	**Sonotest**	Type:	**Sitescan 123W**	Serial #:	**I002716**
Cal. Block:	**IIW Block**	Ref. Block:	**N/A**	Couplant:	**Sonotech UTX**
Procedure:	**Sonomatic**	Spec:	**Customer**	Temperature:	**Ambient**

Transducer	S/N	Type	Angle	Size	Frequency	Primary Gain	Additional Gain	Total Gain
Sonotest	**5025**	**POC**	**0**	**.5”**	**2.25**	**54**	**6**	**60**
Sonotest	**5025**	**POC**	**45**	**.5”**	**2.25**	**62**	**6**	**68**

Acceptable: **Yes** Unacceptable: _____

Remarks: **1. No Indications were found.**

Dennis Lavelle
Technician (Print)



Technician (Signature) **LEVEL ☒II ☐III**

_____
Assistant (Print)

_____
Assistant (Signature) **LEVEL ☐I ☐II**

LIQUID PENETRANT NDE INSPECTION
REPLACEMENT J-LEAD WEDGES

Customer:	**Oklahoma Gas & Electric**	Date:	**11/15/2011**
Station:	**Tinker AFB**	Job No:	**11G779**
Mfg. & S/N:	**EM B123A493VA1**	Heat Number:	**N/A**
Procedure:	**E-165-02**	Heat Code:	**N/A**
Specification:	**N/A**	Quantity:	**14 total**
Scope:	**Liquid Penetrant Inspection of 14 Replacement J-Lead Wedges**		

TEST PARAMETERS

☐ **Fluorescent**

Manufacturer: _____

	Penetrant	Remover	Developer
Type:	**N/A**	**N/A**	**N/A**
Batch:	**N/A**	**N/A**	**N/A**
Time:	**N/A**	**N/A**	**N/A**

☒ **Visible**

Manufacturer: _____

	Penetrant	Remover	Developer
Type:	**SKL-SP1**	**SKC-S**	**SKD-S2**
Batch:	**10E03K**	**10A01K**	**10E10K**
Time:	**20 Minutes**	**N/A**	**N/A**

Ultraviolet Light Data:

U.V. Light Mfg.: **N/A** Model No.: **N/A**

Serial No.: **N/A** Intensity @ 15": **N/A**

Ultraviolet Light Meter Data:

Meter Mfg.: **N/A** Model No.: **N/A**

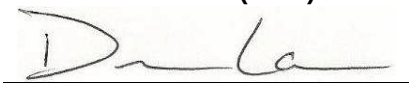
Serial No.: **N/A** Calibration Due: **N/A**

INSPECTION RESULTS

Acceptable: **Yes** **Unacceptable:** _____

Remarks: **1. No Linear Indications were found.**

Dennis Lavelle
Technician (Print)



Technician (Signature) **LEVEL** ☒**II** ☐**III**

MAGNETIC PARTICLE NDE INSPECTION

REPLACEMENT RETAINING RINGS

Customer:	**Oklahoma Gas & Electric**	Date:	**2/7/2012**
Station/Unit:	**Tinker AFB**	Job No:	**11G779**
Mfg & S/N:	**EM B123A493VA1**	Heat Number:	**N/A**
Procedure:	**E-709-01**	Heat Code:	**N/A**
Specification:	**N/A**	Quantity:	**2**
Scope:	**Magnetic Particle Inspection of Replacement Retaining Rings**		

TEST PARAMETERS

☒ **Fluorescent**		☐ **Visible**	
Manufacturer:	**Magnaflux**	Manufacturer:	**N/A**
Type:	**14AM Prepared Bath**	Type:	**N/A**
Batch:	**10E09K**	Batch:	**N/A**

Ultraviolet Light Data:

Light Mfg.:	**Magnaflux**	Model:	**ZB-100F**
Serial No.:	**10960824**	Intensity @ 15”	**780 µW / cm²**

Ultraviolet Light Meter Data:

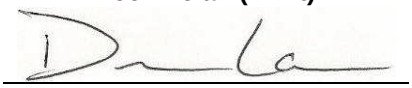
Meter Mfg.:	**Mannix Mfg.**	Model:	**UV-340**
Serial No.:	**AC.52890**	Calibration Due:	**8/23/2012**

INSPECTION RESULTS

Acceptable:	**Yes**	Unacceptable:	

Remarks: **1. No Linear Indications were found.**

Dennis Lavelle
Technician (Print)



Technician (Signature) **LEVEL ☒II ☐III**

LIQUID PENETRANT NDE INSPECTION
REPLACEMENT BODY WEDGES

Customer:	**Oklahoma Gas & Electric**	Date:	**2/7/2012**
Station:	**Tinker AFB**	Job No:	**11G779**
Mfg. & S/N:	**EM B123A493VA1**	Heat Number:	**N/A**
Procedure:	**E-165-02**	Heat Code:	**N/A**
Specification:	**N/A**	Quantity:	**14 total**
Scope:	**Liquid Penetrant Inspection of 25% of Replacement Body Wedges**		

TEST PARAMETERS

☐ **Fluorescent**

Manufacturer: _____

	Penetrant	Remover	Developer
Type:	**N/A**	**N/A**	**N/A**
Batch:	**N/A**	**N/A**	**N/A**
Time:	**N/A**	**N/A**	**N/A**

☒ **Visible**

Manufacturer: _____

	Penetrant	Remover	Developer
Type:	**SKL-SP1**	**SKC-S**	**SKD-S2**
Batch:	**10E03K**	**10A01K**	**10E10K**
Time:	**20 Minutes**	**N/A**	**N/A**

Ultraviolet Light Data:

U.V. Light Mfg.:	**N/A**	Model No.:	**N/A**
Serial No.:	**N/A**	Intensity @ 15":	**N/A**

Ultraviolet Light Meter Data:

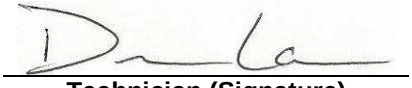
Meter Mfg.:	**N/A**	Model No.:	**N/A**
Serial No.:	**N/A**	Calibration Due:	**N/A**

INSPECTION RESULTS

Acceptable: **Yes** Unacceptable: _____

Remarks: **1. No Linear Indications were found.**

Dennis Lavelle
Technician (Print)



Technician (Signature) **LEVEL** ☒**II** ☐**III**

APPENDIX D

OKLAHOMA GAS & ELECTRIC

TINKER 5A RETAINING RING FORGINGS

CERTIFICATIONS

Prepared by

Scot Forge

Jerry Giessinger

Spring Grove, Illinois

APPENDIX D

CHEMICAL CERTIFICATIONS

SCOT FORGE
8001 Winn Rd., Box 8
Spring Grove, IL 60081
847/587-1000
FAX 847/587-2000

PO # 11G779

MATERIAL CERTIFICATION

G01045 3 SS
Heat # Y8220

SOLD	Shipping Information	Material Cert Number
BRUSH/GMS 601 BRADDOCK AVE TURTLE CREEK, PA 15145-2069	DATE Shipped: 01/11/2012 Via: CCX Bill: 3-96469	730021 w2274R0
		Revision Date 01/10/2012

Item 1 of 1	
Material	ASTM A-288-91 Class 6
Heat Treat	per Specification
Destructive Test	per Specification *Remnant test material to be included with shipment.
Finish	Rough Machine to sizes shown
Other	Ultrasonic examination per ASTM A 531-91 (2006), Magnetic Particle examination per ASTM A-275 with ASTM A788 Supplement S18
Size	OD: 33.5 ID: 27.5 Length: 23.6 (inches)
Surface	125 RMS 125 RMS 125 RMS

Heat Number	# of Pieces	(MILL - EQS-ELLWOOD QUALITY)
Y8220	2	MSDS Previously Sent

Note:Additional prefix letter stamped on product with heat number is for our inventory purposes only and not relevant to heat number.

Chemical Composition (Wt. %)

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Al	V
0.31	0.96	0.007	0.013	0.23	1.73	0.92	0.39	0.16	0.010	0.086
H	As	B	Ca	Cb	Co	N	Pb	Sb	Sn	
0.00010	0.005	0.0001	0.0006	0.003	0.010	0.0091	0.0029	0.001	0.007	

Austenite grain size 7/8

Jominy Hardenability

(In.)	1	2	3	4	5	6	7	8	9	10	11	12	13
(HRC)	51	51	51	51	51	50	50	50	50	50	50	50	50
14	15	16	18	20	22	24	26	28	30	32			
50	50	50	50	50	50	50	50	50	49	49			

Note: The recording of false, fictitious or fraudulent statements or entries on this document may be punishable as a felony under Federal Statute.

Jerry Glessinger
Corporate Quality Assurance Manager
This certification has been created and reviewed in compliance with the Scot Forge QMS

APPENDIX D

MECHANICAL CERTIFICATIONS

SCOT FORGE

8001 Winn Rd., Box 8
Spring Grove, IL 60081
847/587-1000
FAX 847/587-2000

PO # 11G779

MATERIAL CERTIFICATION

G01045 3 SS
Heat # Y8220

BRUSH/GMS

Material Cert Number
730021 w2274R0

Mechanical Properties:

Pcs	Tensile PSI	Yield[1] PSI	Elongation %	Reduction of Area %	Comments
1	157,026	141,555	16.9	56.2	LONGITUDINAL
1	151,749	139,451	17.4	55.4	LONGITUDINAL

[1](Offset: .02%)

Charpy Impact Results:

Temp	1st	2nd	3rd	Comments
72 F	59 Ft/Lbs	51 Ft/Lbs	55 Ft/Lbs	LONGITUDINAL
72 F	61 Ft/Lbs	60 Ft/Lbs	58 Ft/Lbs	LONGITUDINAL

Brinell Hardness Results:

Pcs	3000 Kg Load	
1	341	1 HB[HLD]OK
1	331	2 HB[HLD]OK

Other Testing or Inspections:

Normalize at 1650 degrees F for 6.5 hours
Austenitized at 1550 degrees F for 11.25 hours and quenched
Temper at 1125 degrees F for 10 hours

Note: The recording of false, fictitious or fraudulent statements or entries on this document may be punishable as a felony under Federal Statute.

Jerry Giessinger
Corporate Quality Assurance Manager
This certification has been created and reviewed in compliance with the Scot Forge QMS

APPENDIX D

MAGNETIC PARTICLE INSPECTION

SCOT FORGE
8001 Winn Rd., Box 8
Spring Grove, IL 60081
847/587-1000
FAX 847/587-2000

PO # 11G779

MATERIAL CERTIFICATION

G01045 3 SS
Heat # Y8220

BRUSH/GMS

Material Cert Number
730021 w2274R0

Magnetic Particle Testing

ASTM A-275 with ASTM A788 Supplement S18

Test Number	Test Date	Make	Serial No	Model
18-001	01/09/2012	MagnaFlux	205125	D-2100XL

Batch	Particle Type	Vehicle	Concentration	Application
10G078	14A/Wet Fluores	Water Plus Conditioners	.1 - .4	Spray

Material Condition	Circular Magnetization	Longitudinal Magnetization	Residual Field	Method
Machined 125 RMS or Better	DC Current: 2500 AMPS	DC Current: 2500 AMPS	+/-3 Gauss	Continuous

Qty Tested	Remarks
2	No reportable indications/acceptable S/N: 730021-1 & -2

Nathan Woodruff
LEVEL II
Exp: 10/11/2014

Note: The recording of false, fictitious or fraudulent statements or entries on this document may be punishable as a felony under Federal Statute.

Jerry Giessinger
Corporate Quality Assurance Manager
This certification has been created and reviewed in compliance with the Scot Forge QMS

APPENDIX D

ULTRASONIC TEST RESULTS

SCOT FORGE
8001 Winn Rd., Box 8
Spring Grove, IL 60081
847/587-1000
FAX 847/587-2000

PO # 11G779

MATERIAL CERTIFICATION

G01045 3 SS
Heat # Y8220

BRUSH/GMS

Material Cert Number
730021 w2274R0

Ultrasonic Testing - Reference Block Technique
ASTM A 531-91 (2006)
RADIAL STRAIGHT BEAM TEST
CALIBRATION STANDARD S/N: SB1337A

Test Number	Test Date	Make	Serial No	Model
19-001	01/09/2012	Krautkramer	11050093	USM-GO

Material Condition	Sensitivity	Couplant	Transducer	Reference Standard
Machined 125 RMS or Better	80% Full Screen Height	Esgard PL-2	1.00" Round 5.00 MHZ	Hole Size: .125" FBH Metal Path: 2.5" Alloy: A350LF2

Qty Tested	Remarks
2	No reportable indications/acceptable S/N: 730021-1 & -2

Nathan Woodruff
LEVEL II
Cert Exp: 12/07/2013

Ultrasonic Testing - Back Reflection Technique
ASTM A 531-91 (2006)
AXIAL STRAIGHT BEAM TEST

Test Number	Test Date	Make	Serial No	Model
19-002	01/09/2012	Krautkramer	11050093	USM-GO

Material Condition	Sensitivity	Couplant	Transducer	DB Gain
Machined 125 RMS or Better	80% Full Screen Height	Esgard PL-2	1.00" Round 5.00 MHZ	21

Qty Tested	Remarks
2	No reportable indications/acceptable S/N: 730021-1 & -2

Nathan Woodruff
LEVEL II
Cert Exp: 12/07/2013

Note: The recording of false, fictitious or fraudulent statements or entries on this document may be punishable as a felony under Federal Statute.

Jerry Giessinger
Corporate Quality Assurance Manager
This certification has been created and reviewed in compliance with the Scot Forge QMS

APPENDIX D

CERTIFICATE OF COMPLIANCE

SCOT FORGE
8001 Winn Rd., Box 8
Spring Grove, IL 60081
847/587-1000
FAX 847/587-2000

PO # 11G779

MATERIAL CERTIFICATION

G01045 3 SS
Heat # Y8220

BRUSH/GMS

Material Cert Number
730021 w2274R0

Ultrasonic Testing - Reference Block Technique
ASTM A 531-91 (2006)
RADIAL AND AXIAL ANGLE BEAM TEST

Test Number	Test Date	Make	Serial No	Model
19-003	01/09/2012	Krautkramer	11050093	USM-GO

Material Condition	Sensitivity	Couplant	Transducer	Reference Standard
Machined 125 RMS or Better	80% Full Screen Height	Esgard PL-2	.50" X 1" 2.25 MHZ	Hole Size: 1% Notch Metal Path: Alloy: 4330VBE

Qty Tested	Remarks
2	No reportable indications/acceptable S/N: 730021-1 & -2

Nathan Woodruff
LEVEL II
Cert Exp: 12/07/2013

Compliance Statements:

We certify that the material listed was not processed with mercury bearing instruments and/or equipment which might cause contamination, nor was mercury handled in the immediate vicinity during the manufacturing process. We also certify that the material was not processed or cleaned with low melting point materials as alloying constituents, i.e. lead, zinc, cadmium, tin, antimony, bismuth, sulfur, or their compounds.

In accordance with the requirements of the Pressure Equipment Directive, all testing, inspection, and documentation is produced in accordance with EN 10204:2004 Type 3.1 and ISO 10474 Type 3.1.B

Material provided has been produced by Scot Forge under an approved quality program as defined within the Scot Forge QA Manual, Revision 3, Dated 08/17/11.

The products supplied are in compliance with the quantity and quality requirements of the purchase order and specifications noted. The test reports represent the actual attributes of the items furnished and the test results are in full compliance with all applicable specifications and order requirements.

Note: The recording of false, fictitious or fraudulent statements or entries on this document may be punishable as a felony under Federal Statute.

Jerry Giessinger
Corporate Quality Assurance Manager
This certification has been created and reviewed in compliance with the Scot Forge QMS

APPENDIX E

HIGH SPEED BALANCE REPORT

FOR

Brush GMS

Tinker

Generator Rotor

PROJECT NO. J11-05627

February 16th, 2012

DOC000260-12

Prepared By **David Schafer**

Dynamic Analysis Engineer

Approved By **Herb Jerke**

Project Manager

Table of Contents

COMMENTS

On February 16th, 2012 this rotor was balanced to 3600 RPM and over-sped to 3960 RPM.

Rotor balance weight data is included along with resonance data and bearing cap seismic data from all bearing pedestals. Shaft vibrations on Bode plots are in mils peak-to-peak per division. Pedestal seismic data are inches per second peak per division. Tabulated vibration measurements are in mils peak to peak.

The following chart displays the bearing relative vibration at operating speed (3600 RPM) after balancing.

	After Balance	
	mils	deg
Journal 1 Vertical	0.73	281
Journal 1 Horizontal	0.329	346
Journal 2 Vertical	0.37	180
Journal 2 Horizontal	0.149	117

HIGH SPEED OPERATIONAL DATA

Rotor Data

Rotor Weight:	34,000 lbs.	Ped. 1: Brg. Type:	Elliptical Sleeve
Overall Length:	253.6"	Running Clearance:	.019 to .021" (V)
Bearing Span:	200.0" (test set-up)		.040 to .042" (H)
Body Diameter:	31.0"	Ped. 2: Brg. Type:	Elliptical Sleeve
		Running Clearance:	.020 to .022" (V)
			.035 to .037 " (H)

Operational Data

- Normal Operating Speed: 3600 rpm
- Overspeed Planned: 3960 rpm
- Balance Speed: 3600 rpm
- Overspeed Level Attained: 3960 rpm for 1 minute

ELECTRICAL TEST DATA

Electrical Tests Prior to Balance

- Insulation Resistance at 500 VDC
  1 minute IR = 3.42 GΩ
  10 minute IR = 4.18 GΩ
  Polarization Index = 1.22

- Total Winding Impedance

  V = 110.02 VAC
  A = 4.26 A
  Z = 25.8 Ω

- DC Winding Resistance
  Rf = 0.385 Ω at 16° C average temperature (measured)
  Rf = 0.422 Ω at 40° C average temperature (calculated)

AC Impedance Test

The running impedance was measured from 0 RPM to 3600 RPM to 0 RPM with 120 VAC applied across the collector rings. The Running Impedance Data and Graph are included in this report.

Flux Probe Testing

The rotor was tested using the "Generatortech" flux probe and analysis software. Copies of Generatortech flux probe data graph, turn short analysis summary and turn short data table at 3600 RPM are included in this report. The rotor shafts' physical Pole 1 corresponds to the Generatortech analysis designation of "Pole B".

Running Insulation Resistance

The insulation resistance was measured at 500 VDC while the rotor was rotated at 3600 RPM.

After Balance

- IR = 244 MΩ, 0 RPM
- IR = 177 MΩ, 3600 RPM
- IR = 167 MΩ, 0 RPM

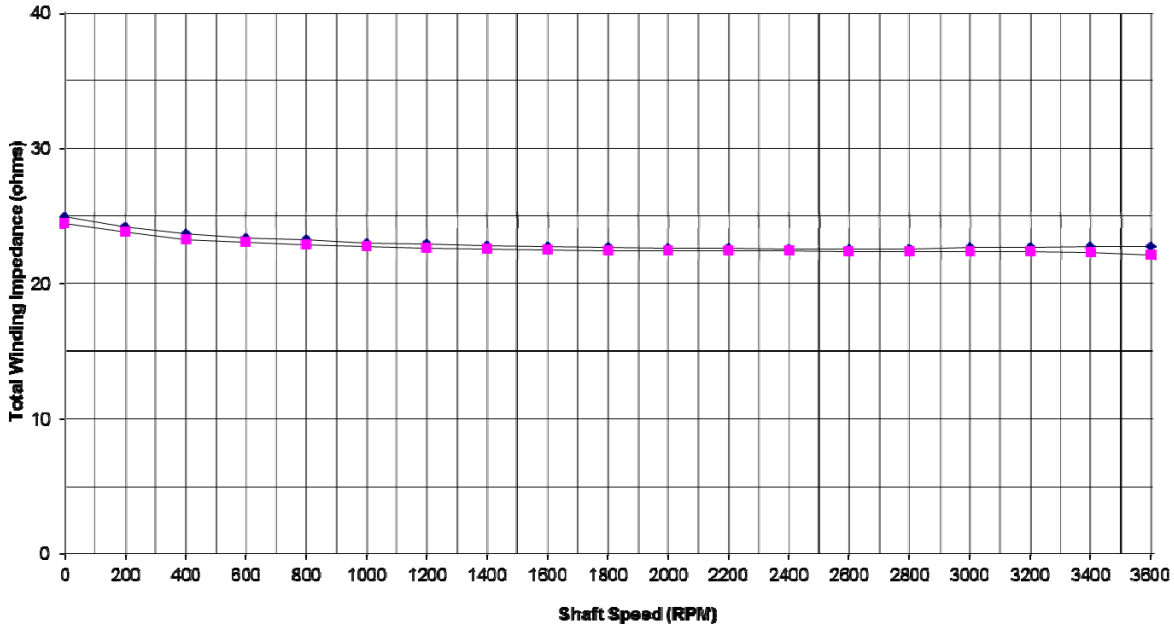
NOTE:Running insulation resistance (in bunker) values are typically lower than out of bunker measurements due to the inclusion of brush rigging and cable length in the measurement circuit.

B.O.B Running Impedance Data Input
At ReGENco Rotor Balance Facility

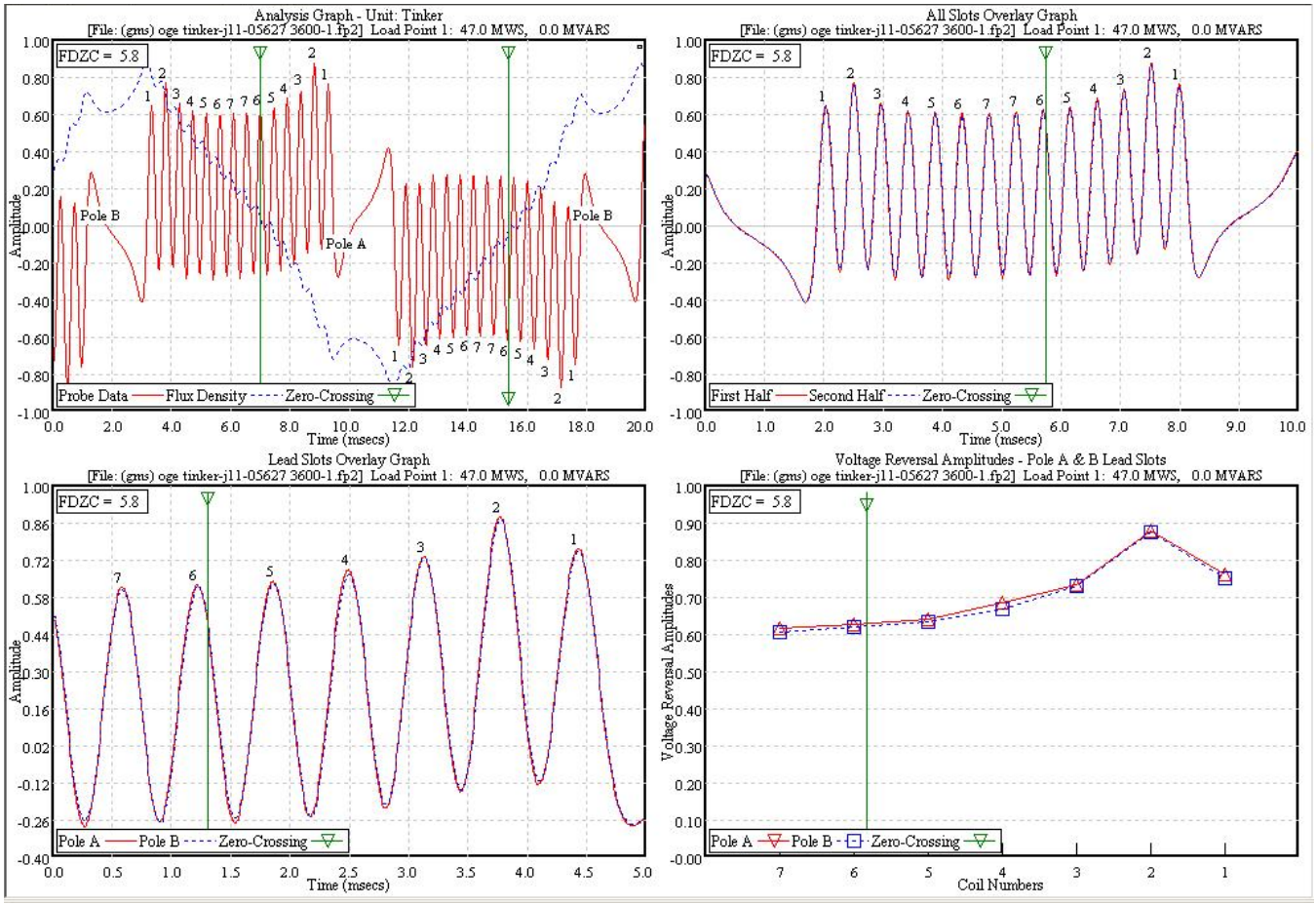
Job #: **J11-05627**
Station Name **(GMS) OGE**
Unit Number **Tinker**
Customer **(GMS) OGE Tinker**
ate Performed **02/16/12**
Tested by: **C Witry**

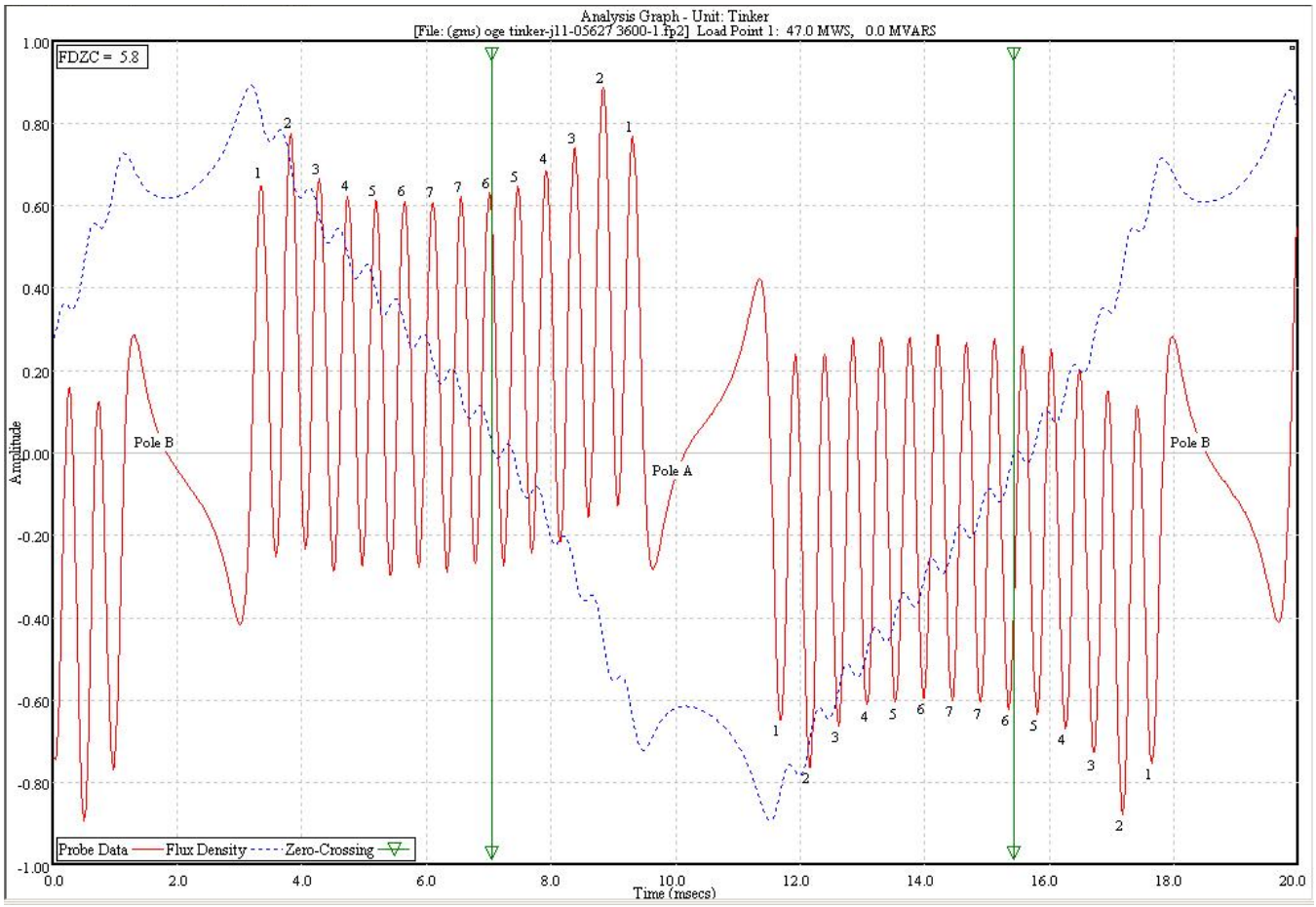
Speed Incr:	Applied Voltage	Meas. Current	Impedance	Speed Decr:	Applied Voltage	Meas. Current	Impedance
0	121.4	4.87	24.93	3600	121.0	5.48	22.08
200	121.3	5.02	24.16	3400	121.0	5.42	22.32
400	121.3	5.12	23.69	3200	121.0	5.41	22.37
600	121.3	5.19	23.37	3000	121.0	5.41	22.37
800	121.3	5.22	23.24	2800	121.0	5.41	22.37
1000	121.3	5.28	22.97	2600	121.1	5.41	22.38
1200	121.3	5.29	22.93	2400	121.1	5.40	22.43
1400	121.3	5.32	22.80	2200	121.1	5.40	22.43
1600	121.3	5.33	22.76	2000	121.0	5.39	22.45
1800	121.3	5.35	22.67	1800	121.0	5.39	22.45
2000	121.3	5.36	22.63	1600	121.0	5.38	22.49
2200	121.3	5.37	22.59	1400	121.0	5.37	22.53
2400	121.3	5.38	22.55	1200	121.0	5.35	22.62
2600	121.3	5.38	22.55	1000	121.1	5.32	22.76
2800	121.3	5.37	22.58	800	121.1	5.30	22.85
3000	121.3	5.35	22.66	600	121.1	5.26	23.02
3200	121.3	5.34	22.71	400	121.1	5.21	23.24
3400	121.3	5.34	22.72	200	121.2	5.09	23.81
3600	121.1	5.32	22.76	0	121.0	4.95	24.44

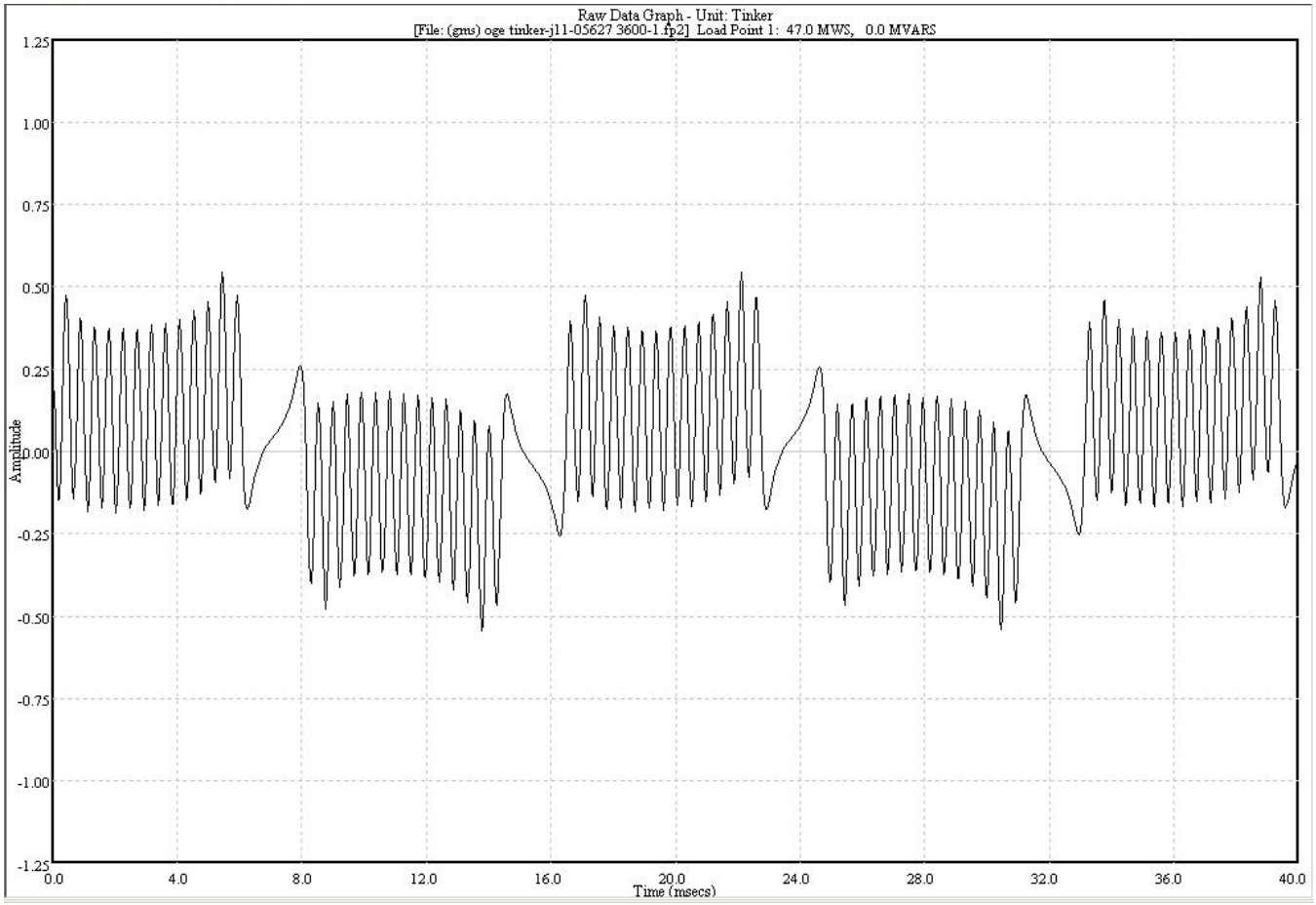
(GMS) OGE Tinker
B.O.B Running Impedance Data at 120 VAC
Test Performed at REGENCO Rotor Balance Facility, 2/16/12 Job #J11-05627



Flux Probe Test Data







Generatortech Shorted-Turn Data Table

FILE: (gms) oge tinker-j11-05627 3600-1.fp2 DATE: FEBRUARY 16, 2012 14:38:34
Path: C:\Documents and Settings\rettlerr\Desktop\(GMS) OGE Tinker-J11-05627

Unit Specific Data

Company: (GMS) OGE Station: Tinker
Unit History/Comments: Testing Preformed at REGENCO Balance Facility
Number of poles= 2 Coils/pole= 7 Max Load MWS= 0.0
Turns/Coil: 1=17 2=22 3=22 4=22 5=22 6=22 7=22

Load Point Data

Load Point= 1 MWS= 47.0 MVARs= 0.0 Field Amps= 66.9 Field Volts= 31.9
Flux Density Zero-Crossing= 5.8 Filter= none Rotor RPM= 3600.0 Peak Height= Modified

Coil	Pole A Peak Size	Pole B Peak Size	Ratio of Sizes A/B	Ratio of Sizes B/A	Pole A Shorted Turn Indication	Pole B Shorted Turn Indication
1	0.771	0.760	1.016	0.985	—	—
2	0.891	0.885	1.007	0.993	—	—
3	0.743	0.738	1.007	0.993	—	—
4	0.693	0.675	1.026	0.974	—	—
5	0.650	0.640	1.015	0.985	—	—
6	0.634	0.627	1.012	0.988	—	—
7	0.623	0.613	1.017	0.984	—	—

NOTE: Coils displaying the highest sensitivity for shorted turns are: Coil 5 Coil 6

OK

ROTOR RUNOUTS

Rotor: GMS OGE Tinker

Date: 2/14/2012

Job No.: J11-05627

Measurements made with rotor supported on journals.

Direction of Rotation as viewed from coupling end: _____

0 Degree Reference: _____

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

	Face																										
	A(RT)	A(L)	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	4	-1		20	10	5	0	0	30	-40	-20	-60	-100	20	10	-90	-55	-5	-10	-10	0	-2	0	10	10	10	-30
90	5	-1		40	0	-5	5	0	50	30	-35	-60	-110	35	0	-75	-50	-8	-15	0	0	-3	-3	-5	-10	-5	-50
135	2	0		40	0	5	5	0	40	30	-50	0	-70	40	-5	-30	10	-5	-25	10	0	-3	-5	10	0	-8	-15
180	2	0		42	0	0	0	0	35	20	-45	50	-10	40	-8	30	10	10	0	30	0	-3	0	10	-10	5	20
225	6	-3		30	-10	0	-2	0	20	40	-30	0	-70	20	0	-50	-30	10	10	30	0	-3	-1	10	-25	-10	45
270	2	-1		0	-10	-5	0	0	10	150	-10	-70	-80	-10	8	-50	-20	0	25	35	0	-5	-5	-10	-55	-40	50
315	0	-1		-20	-10	0	0	0	-10	50	0	-50	-70	-10	10	-46	0	0	10	20	0	-5	-5	-10	-60	-30	18
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min	0	-3	0	-20	-10	-5	-2	0	-10	-40	-50	-70	-110	-10	-8	-90	-55	-8	-25	-10	0	-5	-5	-10	-60	-40	-50

	Face																										
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	0.0000	0.0000	0.0020	0.0010	0.0005	0.0002	0.0000	0.0010	0.0040	0.0050	0.0070	0.0110	0.0010	0.0008	0.0090	0.0055	0.0008	0.0025	0.0010	0.0000	0.0005	0.0005	0.0010	0.0060	0.0040	0.0050
45	0.0005	0.0000	0.0040	0.0020	0.0010	0.0002	0.0000	0.0040	0.0000	0.0030	0.0010	0.0010	0.0030	0.0018	0.0000	0.0000	0.0003	0.0015	0.0000	0.0000	0.0003	0.0005	0.0020	0.0070	0.0050	0.0020
90	0.0006	0.0000	0.0060	0.0010	0.0000	0.0007	0.0000	0.0060	0.0070	0.0015	0.0010	0.0000	0.0045	0.0008	0.0015	0.0005	0.0000	0.0010	0.0010	0.0000	0.0002	0.0002	0.0005	0.0050	0.0035	0.0000
135	0.0002	0.0000	0.0060	0.0010	0.0010	0.0007	0.0000	0.0050	0.0070	0.0000	0.0070	0.0040	0.0050	0.0003	0.0060	0.0065	0.0003	0.0000	0.0020	0.0000	0.0002	0.0000	0.0020	0.0060	0.0032	0.0035
180	0.0002	0.0000	0.0062	0.0010	0.0005	0.0002	0.0000	0.0045	0.0060	0.0005	0.0120	0.0100	0.0050	0.0000	0.0120	0.0065	0.0018	0.0025	0.0040	0.0000	0.0002	0.0005	0.0020	0.0050	0.0045	0.0070
225	0.0009	0.0000	0.0050	0.0000	0.0005	0.0000	0.0000	0.0030	0.0080	0.0020	0.0070	0.0040	0.0030	0.0008	0.0040	0.0025	0.0018	0.0035	0.0040	0.0000	0.0002	0.0004	0.0020	0.0035	0.0030	0.0095
270	0.0003	0.0000	0.0020	0.0000	0.0000	0.0002	0.0000	0.0020	0.0190	0.0040	0.0000	0.0030	0.0000	0.0016	0.0040	0.0035	0.0008	0.0050	0.0045	0.0000	0.0000	0.0000	0.0000	0.0005	0.0000	0.0100
315	0.0001	0.0000	0.0000	0.0000	0.0005	0.0002	0.0000	0.0000	0.0090	0.0050	0.0020	0.0040	0.0000	0.0018	0.0044	0.0055	0.0008	0.0035	0.0030	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010	0.0068
0	0.0000	0.0000	0.0020	0.0010	0.0005	0.0002	0.0000	0.0010	0.0040	0.0050	0.0070	0.0110	0.0010	0.0008	0.0090	0.0055	0.0008	0.0025	0.0010	0.0000	0.0005	0.0005	0.0010	0.0060	0.0040	0.0050
Max	**0.0009**	**0.0000**	**0.0062**	**0.0020**	**0.0010**	**0.0007**	**0.0000**	**0.0060**	**0.0190**	**0.0050**	**0.0120**	**0.0110**	**0.0050**	**0.0018**	**0.0120**	**0.0065**	**0.0018**	**0.0050**	**0.0045**	**0.0000**	**0.0005**	**0.0005**	**0.0020**	**0.0070**	**0.0050**	**0.0100**

Evaluated Eccentricity

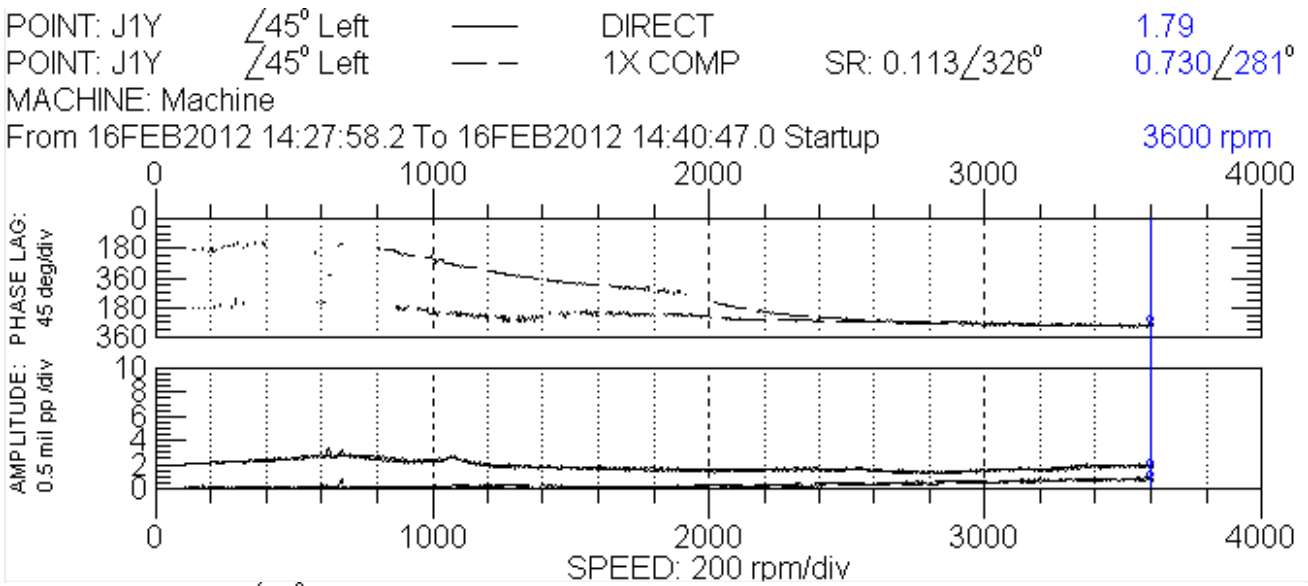
1X	**0.0001**	**0.0000**	**0.0029**	**0.0008**	**0.0002**	**0.0003**	**0.0000**	**0.0026**	**0.0049**	**0.0026**	**0.0030**	**0.0013**	**0.0028**	**0.0006**	**0.0018**	**0.0013**	**0.0007**	**0.0020**	**0.0022**	**0.0000**	**0.0001**	**0.0001**	**0.0008**	**0.0028**	**0.0016**	**0.0046**
Phase	171	0	140	79	102	99	0	127	255	329	179	272	134	333	216	232	232	278	234	0	54	73	143	92	96	255
2X	**0.0003**	**0.0000**	**0.0008**	**0.0003**	**0.0002**	**0.0002**	**0.0000**	**0.0008**	**0.0042**	**0.0000**	**0.0047**	**0.0049**	**0.0004**	**0.0005**	**0.0044**	**0.0032**	**0.0005**	**0.0004**	**0.0003**	**0.0000**	**0.0002**	**0.0003**	**0.0008**	**0.0019**	**0.0016**	**0.0006**
Phase	62	0	41	24	0	-61	0	71	-76	0	-2	-4	18	82	-11	-24	15	61	-59	0	14	24	20	19	19	15

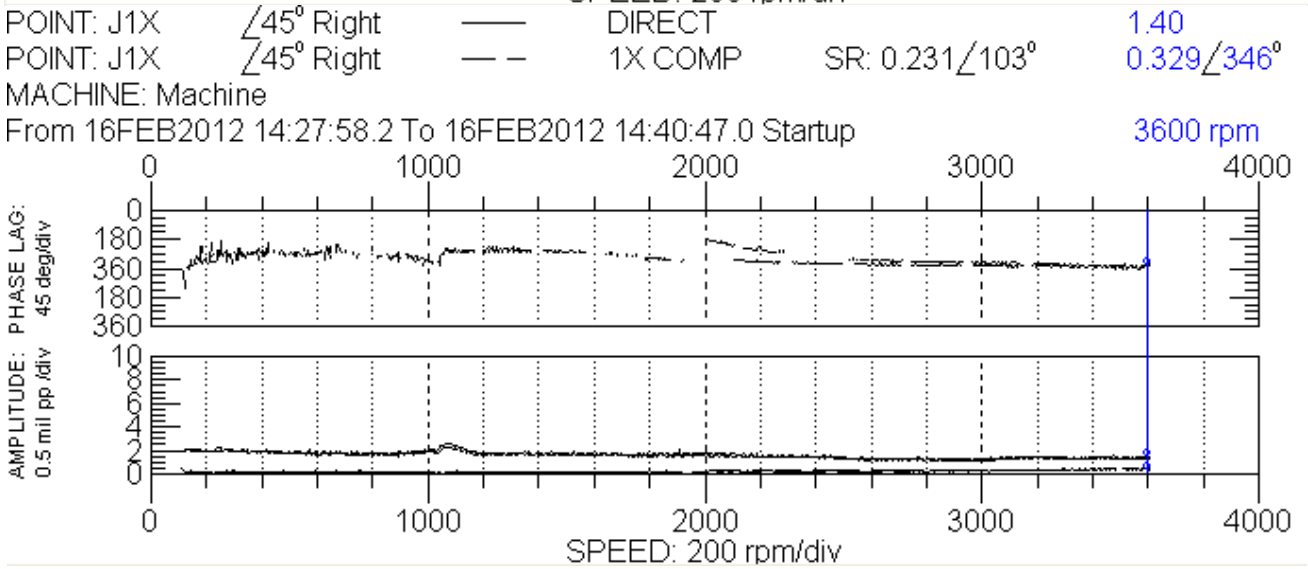
BALANCE RESULTS

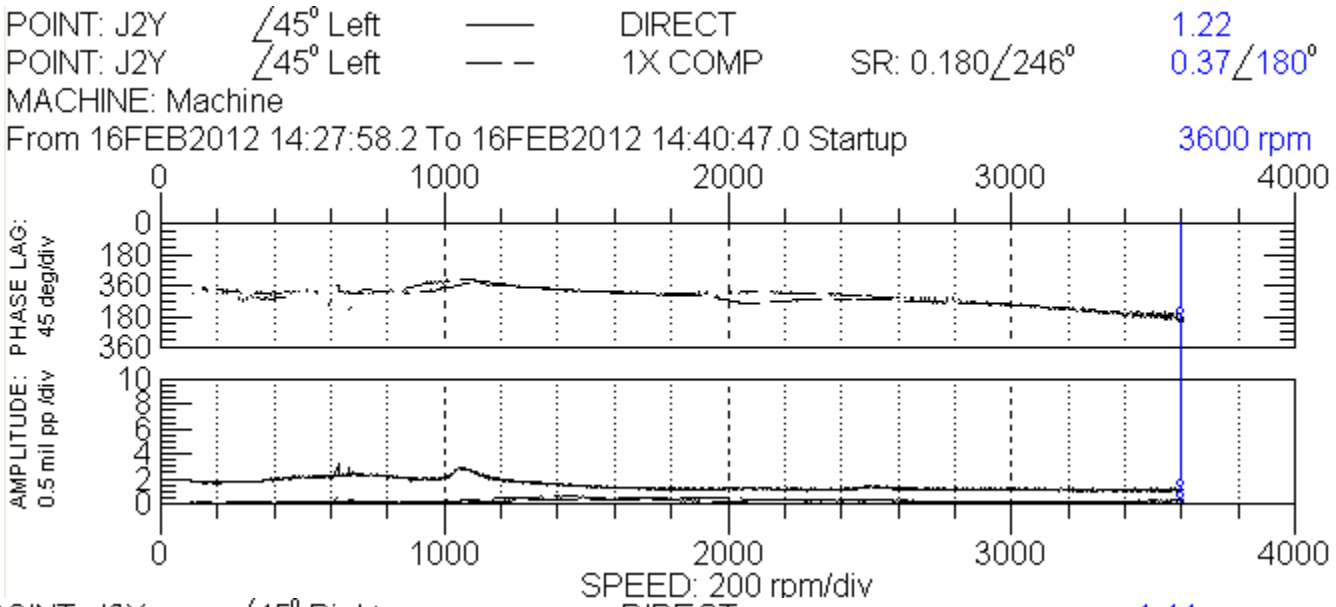
Brush GMS OGE Tinker			Rotor Resonance Summary						David Schafer				2/16/2012			
Speed	J1V		J1H		J2V		J2H		S1V		S1H		S2V		S2H	
RPM	Amplitude (mils)	Phase (deg)	Amplitude (mils)	Phase (deg)	Amplitude (mils)	Phase (deg)	Amplitude (mils)	Phase (deg)	Amplitude (ips)	Phase (deg)	Amplitude (ips)	Phase (deg)	Amplitude (ips)	Phase (deg)	Amplitude (ips)	Phase (deg)
600	0.139	216	0.164	263	0.159	342	0.19	161	0.007	0	0.009	344	0.007	0	0.007	353
700	0.021	63	0.175	264	0.195	32	0.195	165	0.007	0	0.009	344	0.007	0	0.007	353
800	0.093	117	0.18	263	0.128	29	0.185	157	0.007	0	0.007	344	0.007	0	0.007	353
900	0.123	215	0.082	300	0.103	0	0.2	142	0.007	0	0.007	344	0.007	0	0.007	353
1000	0.159	243	0.021	333	0.154	340	0.231	134	0.007	0	0.007	344	0.007	0	0.004	353
1100	0.303	290	0.144	249	0.385	328	0.324	151	0.004	0	0.004	344	0.004	0	0.004	353
1200	0.262	315	0.149	236	0.442	349	0.303	154	0.004	0	0.004	344	0.007	0	0.004	353
1300	0.272	347	0.144	240	0.55	9	0.308	156	0.007	0	0.004	344	0.007	0	0.004	353
1400	0.267	7	0.175	249	0.571	21	0.314	167	0.004	0	0.004	344	0.007	0	0.004	353
1500	0.216	35	0.185	261	0.56	35	0.298	170	0.004	0	0.004	344	0.004	0	0.009	353
1600	0.17	38	0.195	263	0.524	42	0.262	173	0.004	0	0.004	344	0.004	0	0.009	353
1700	0.134	58	0.18	278	0.493	48	0.236	167	0.004	0	0.004	344	0	0	0.004	353
1800	0.098	72	0.154	290	0.478	53	0.211	160	0.004	0	0.004	344	0.004	0	0.009	353
1900	0.087	90	0.098	302	0.463	61	0.226	153	0.009	0	0.004	344	0.004	0	0.009	353
2000	0.19	139	0.093	174	0.442	86	0.319	149	0.007	0	0.004	344	0.004	0	0.007	353
2100	0.226	180	0.247	218	0.334	106	0.334	175	0	0	0.004	344	0.004	0	0.007	353
2200	0.206	207	0.236	241	0.267	92	0.272	180	0.007	0	0	344	0.004	0	0.007	353
2300	0.226	227	0.226	262	0.252	81	0.211	180	0.009	0	0.004	344	0.004	0	0.007	353
2400	0.262	239	0.226	262	0.242	78	0.18	177	0.009	0	0.004	344	0.007	0	0.004	353
2500	0.303	246	0.221	262	0.262	79	0.185	170	0.013	0	0.009	344	0.007	0	0.007	353
2600	0.339	254	0.226	304	0.236	90	0.17	177	0.009	0	0.007	344	0.007	0	0.004	353
2700	0.36	263	0.226	313	0.236	95	0.134	180	0.009	0	0.007	344	0.007	0	0.004	353
2800	0.401	267	0.242	320	0.221	101	0.123	196	0.013	0	0.007	344	0.007	0	0.004	353
2900	0.452	271	0.262	321	0.195	108	0.108	141	0.018	0	0.013	344	0.009	0	0.004	353
3000	0.514	275	0.308	323	0.185	109	0.093	141	0.022	0	0.016	344	0.009	0	0.004	353
3100	0.571	283	0.365	331	0.185	117	0.093	119	0.027	0	0.016	344	0.013	0	0.009	353
3200	0.56	284	0.334	338	0.195	129	0.128	117	0.027	0	0.022	344	0.016	0	0.013	353
3300	0.601	284	0.334	342	0.216	145	0.108	109	0.031	0	0.029	344	0.016	0	0.013	353
3400	0.709	284	0.396	339	0.211	169	0.051	73	0.031	0	0.036	140	0.022	0	0.02	353
3500	0.699	290	0.437	352	0.2	156	0.149	72	0.036	277	0.04	139	0.027	0	0.022	353
3600	0.73	281	0.329	346	0.37	180	0.149	117	0.04	283	0.045	143	0.029	0	0.031	353

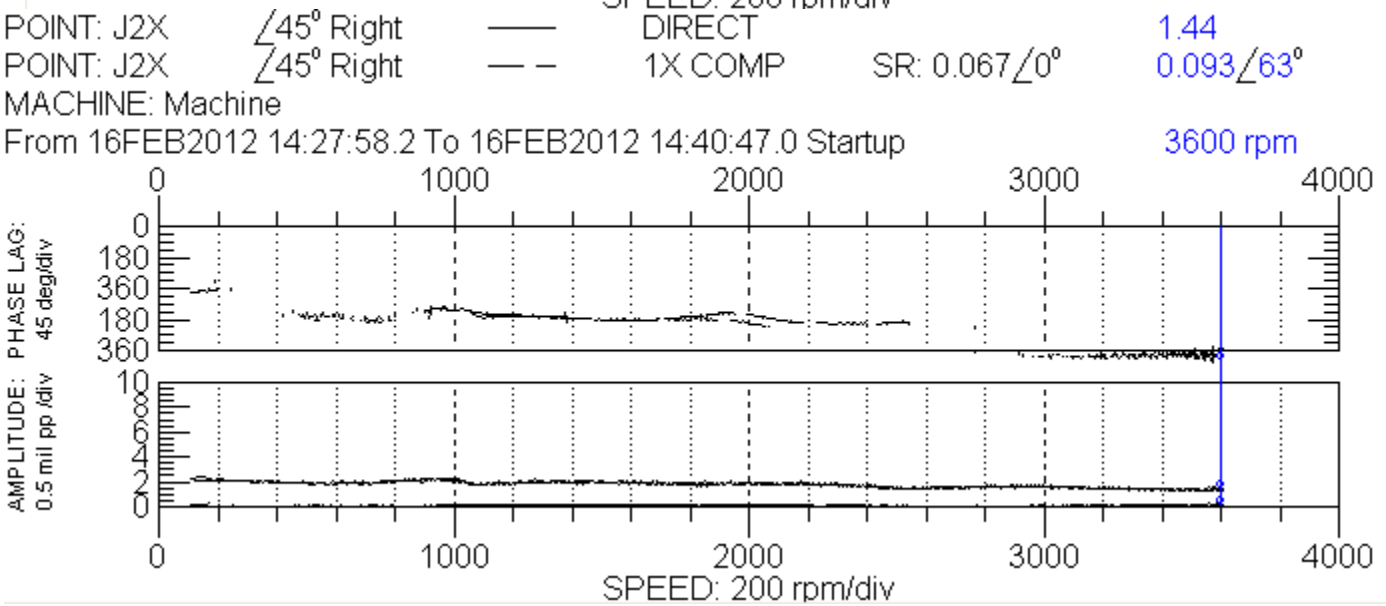
J1V = Journal 1 Vertical
J1H = Journal 1 Horizontal
J2V = Journal 2 Vertical
J2H = Journal 2 Horizontal
S1V = Seismic 1 Vertical
S1H = Seismic 1 Horizontal
S2V = Seismic 2 Vertical
S2H = Seismic 2 Horizontal

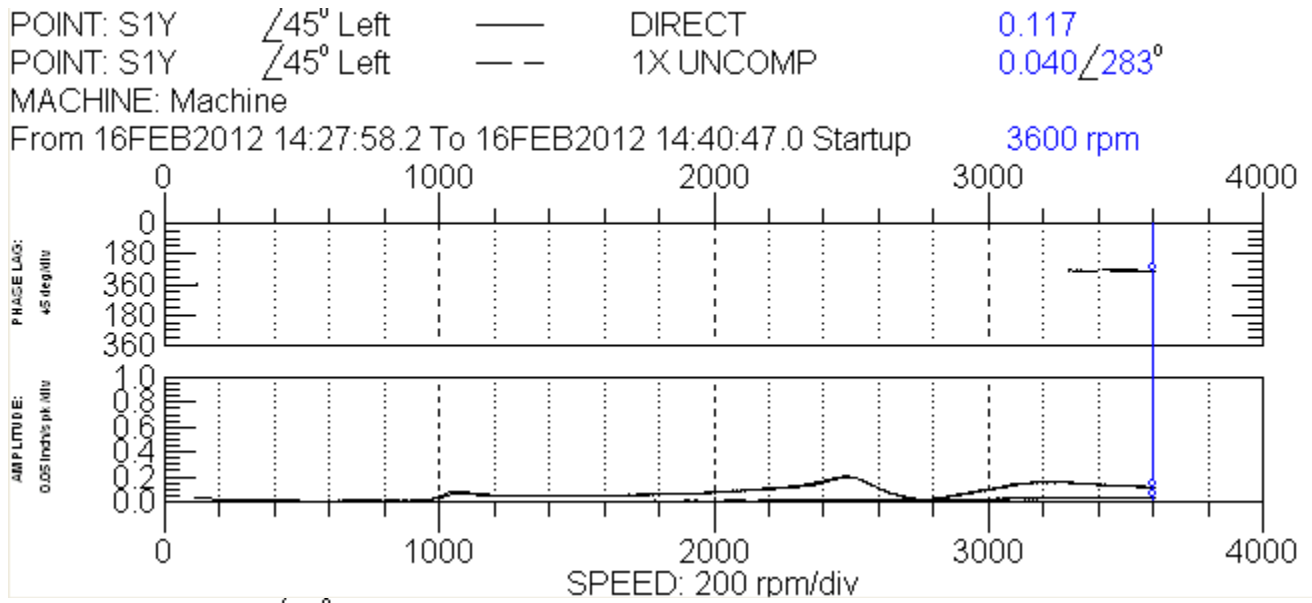
Bode Plots

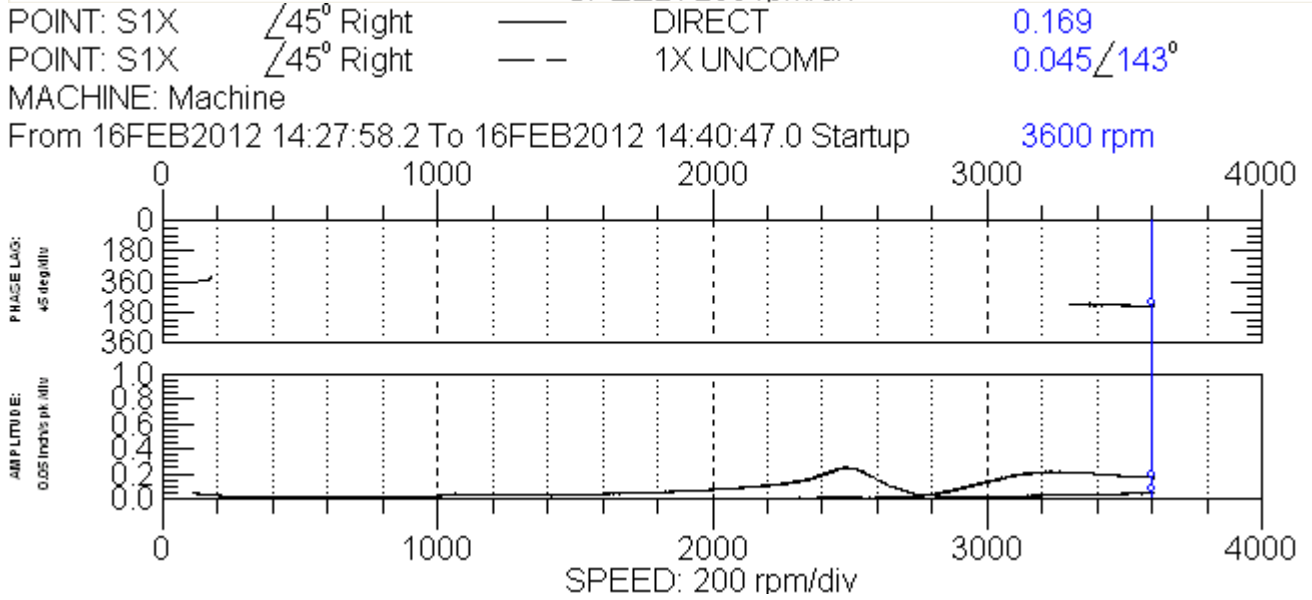


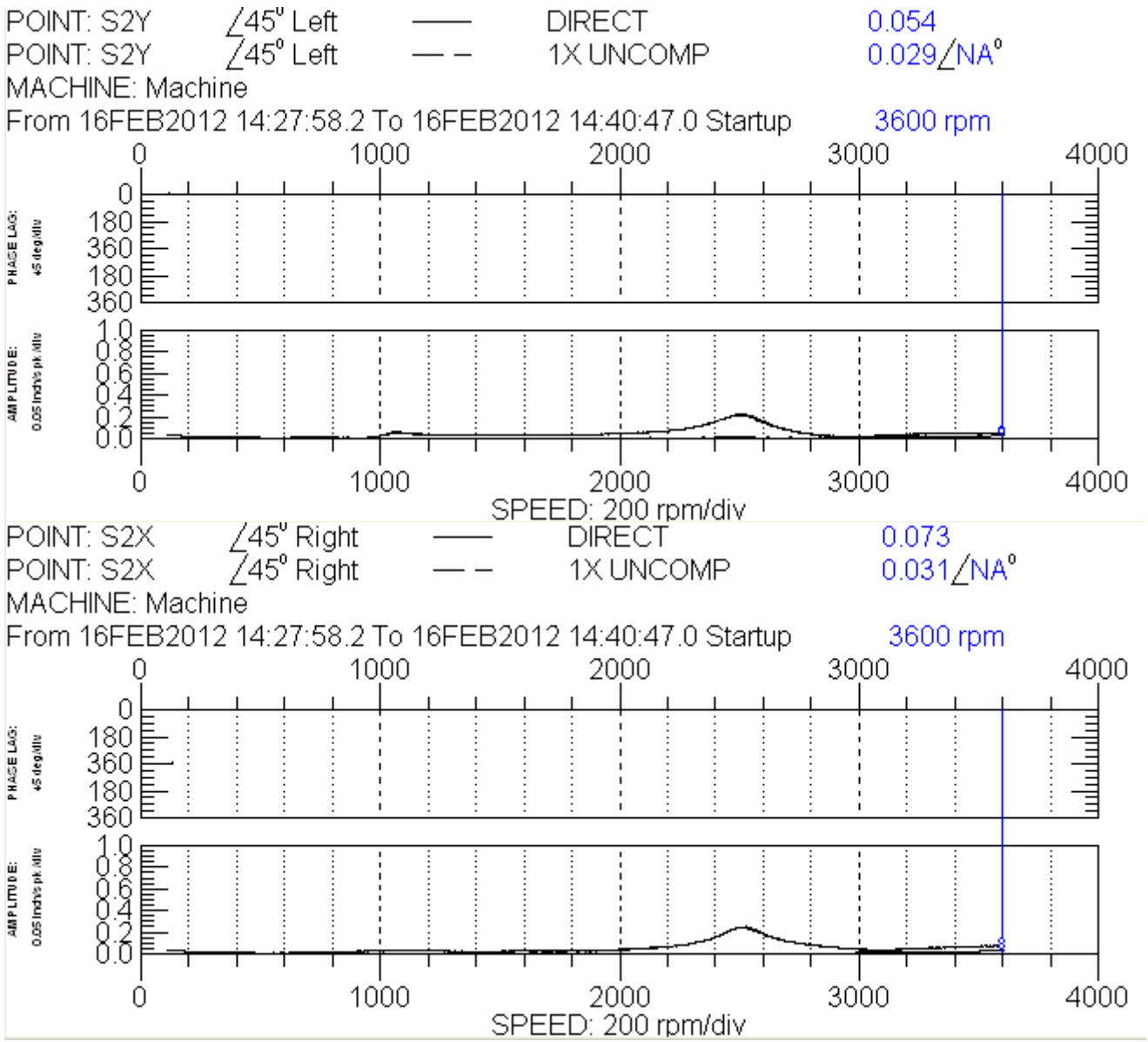




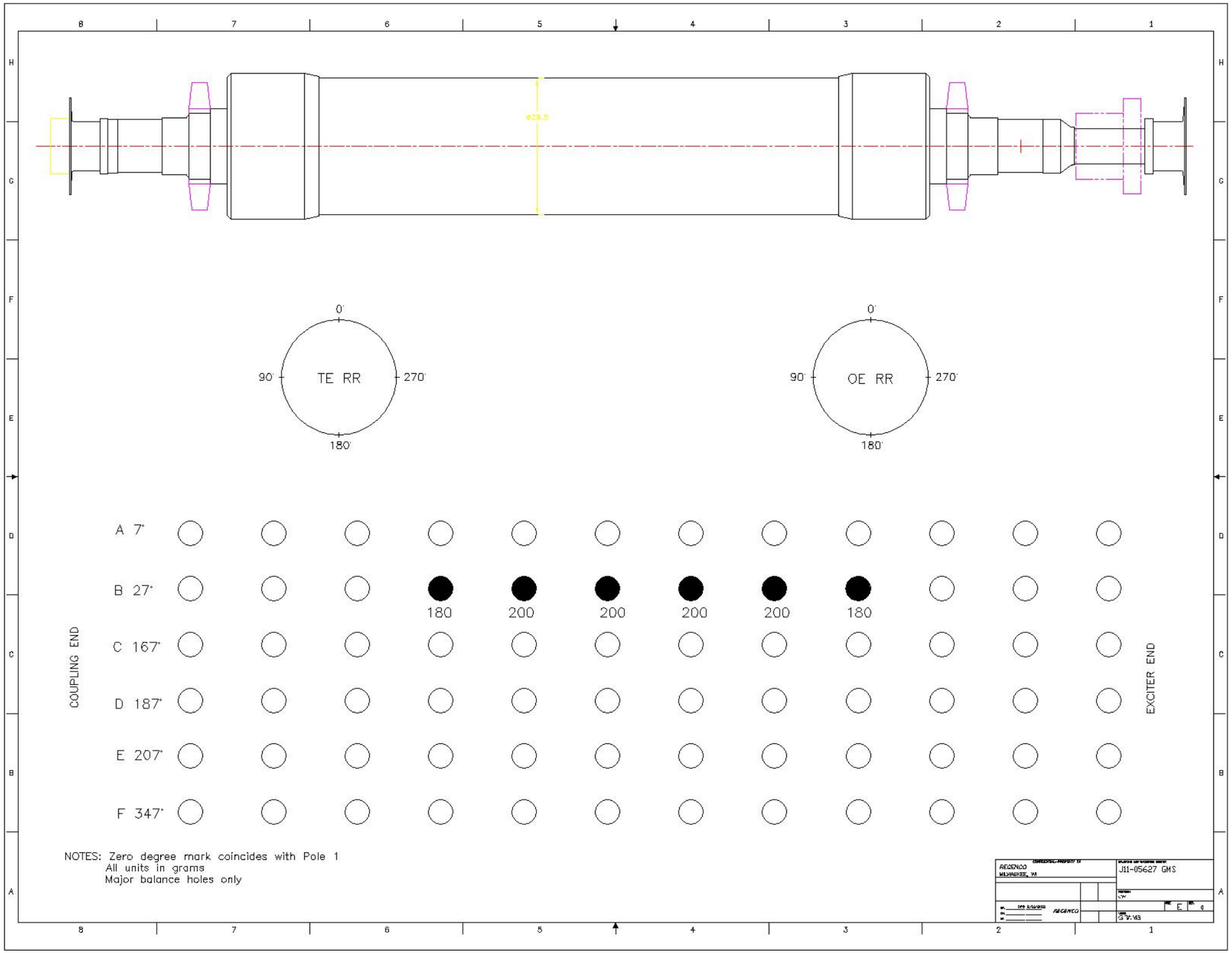


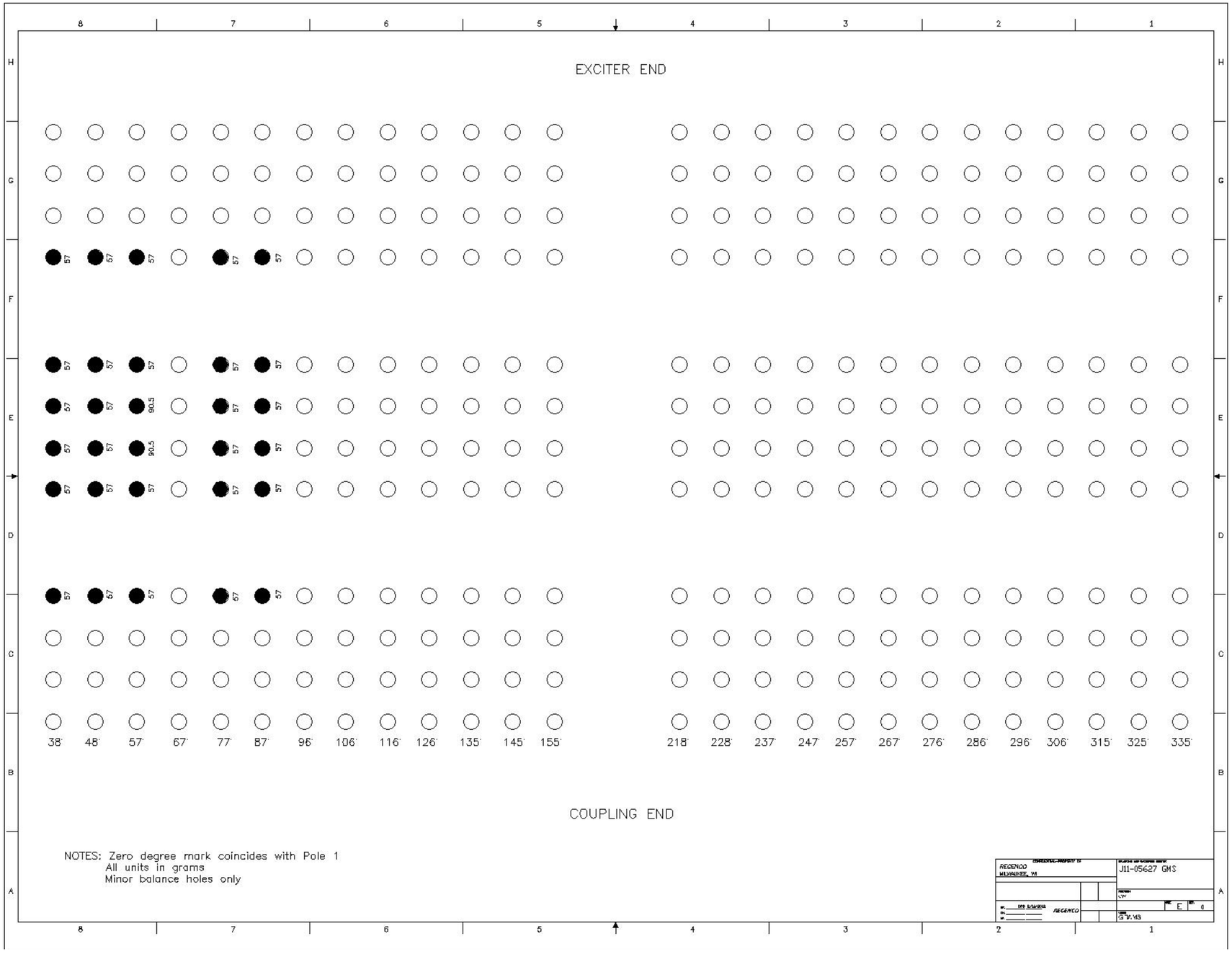






Rotor Balance Weight Map





Rotor Setup