210-S437UUT-579

NATIONAL OILWELL

BAYLOR GENERATORS

SPECIFICATION FOR ALTERNATING CURRENT BRUSHLESS GENERATOR TWO BEARING CONSTRUCTION

MODEL: S437UUT-579

REFERENCE:
CATERPILLAR
3701 STATE ROAD 26 EAST
LAFAYETTE, IN 47905

P.O. # SAHB59269

EQUIPMENT FURNISHED
BY

National Oilwell
500 INDUSTRIAL BLVD.
SUGAR LAND TEXAS 77478-2898
TELEPHONE: (281) 240-6111
FAX: (281) 240-5074

S.O. #G02-2191

NATIONAL OILWELL

SPECIFICATIONS

TABLE OF CONTENTS

NATIONAL OILWELL

SPECIFICATIONS

1.1 GENERATOR TECHNICAL DESCRIPTION

1.1.1 Application

MODEL S437UUT-579 GENERATOR

1.1.2 Ratings

1,750 Kilowatts
600 Volts
0.7 Power Factor
2,406 Amperes
60 Hertz
3 Phase
1,800 RPM

Refer to the electrical specification provided in this manual for more detailed electrical rating information.

1.1.3 Bearing

This generator is of two bearing construction. The rotating field and shaft assembly is supported by a self aligning spherical roller bearing installed at each end. The bearings are grease lubricated with lip seals and include provisions for re-greasing during operation.

1.1.3.1 Bearing Lubrication

Grease lubricated anti-friction bearings (NGLI #3)
A high quality NGLI #3 grease is recommended, with the following physical properties:

Soap Base ..... Lithium
Dropping Point ..... 300ºF to 450ºF
Worked Penetration Per ASTM D217 ..... 238 NGLI #3
Operating Temperature Range ..... 0ºF to 275ºF
Oxidation Inhibited ..... YES
Corrosion Inhibited ..... YES

The use of the following grease is recommended:
Shell Oil Company - Alvania 3 - Product Code 71013

The generator is furnished with the bearing already packed with the correct amount of grease for initial operation. Every 2000 hours of operation or 3 months, whichever is sooner, grease should be added to the bearing to insure prolonged life of the bearing. The bearing housing is equipped with a grease zerk and a grease vent to facilitate the addition of grease to the bearing. Approximately two shots from a grease gun should be added to the bearing at each re-lubrication. Caution should be taken to avoid over greasing the bearing,

1.1.3.1 Bearing Lubrication (Cont'd)

as this can cause the bearing to overheat and result in excessive wear on the seals of the bearing housing.

Should it become necessary to remove the bearing from the generator, it should be thoroughly inspected for wear or damage prior to re-installation, and replaced if necessary. The seals of the bearing housing should also be inspected for wear or damage and replaced if necessary. When re-installing the bearing, the bearing should be hand packed with grease and the bearing housings should be packed 1/2 to 2/3 full with grease.

Care should be taken to insure that no foreign material is allowed into the grease, bearing or bearing housing.

1.1.3.2 Bearing Operating Temperature

Monitoring of bearing temperature can provide a warning of an impending failure of a bearing and prevent costly mechanical damage resulting from bearing failure. The operating temperature of a bearing can vary depending on load, speed and the amount of grease in the bearing. Monitoring of bearing temperature should focus on a sudden increase in bearing operating temperature, over temperatures which have been observed as normal for a specific generator. A bearing should be closely monitored if its operating temperature exceeds 210°F (99°C). The generator should be shut down and the bearing inspected or replaced if the operating temperature of the bearing reaches 225°F (107°C). The above desired limits are to be determined by measurement of the temperature of the bearing housing.

1.1.4 Fixed Two Bearing Generator Alignment Procedure

1.1.4.1 General

Accurate alignment of the generator to the prime mover is essential to insure proper generator bearing operation and life expectancy. Excessive misalignment causes vibration, noisy operation, coupling wear, and premature bearing failure. The following general recommendations are provided to assure that all aspects of alignment of the generator to the prime mover are considered.

1.1.4.2 Coupling Recommendations

This generator is equipped with a fixed axial location bearing that is not capable of absorbing axial thrust. The coupling selected for use in connecting the generator to the prime mover must be capable of absorbing axial movement and eliminating the application of axial forces to the fixed axial location bearing of the generator. A flexible type coupling is recommended to compensate for slight parallel, angular, and axial misalignment of the shafts. Solid couplings are not recommended.

It is the responsibility of the prime mover/generator packager to select a suitable coupling which meets the recommendations of the generator and prime mover manufacturers. The coupling manufacturers and prime movers

1.1.4.2 Coupling Recommendations (Cont'd)

recommendations and tolerances for alignment of the coupling should be adhered to when less than the tolerances specified in Table 1.

Thermal growth vertically and horizontally with respect to the shaft system and supporting skid that result from the temperature differential between cold and hot operating conditions must be considered when selecting and aligning the coupling. Thermal growth may cause undue stress, hot misalignment, and vibration.

The skid and/or foundation for the prime mover and generator must be rigid enough to minimize vibration and maintain alignment between the prime mover and generator shafts within the specified limits. Reactions and displacements between no load and full load must be considered when selecting and aligning the coupling. These displacements may cause misalignment, vibration, and extreme reaction forces on bearings.

National Oilwell in Sugar Land, Texas should be consulted regarding coupling alignment forces resulting from changes in alignment between the cold and hot operating conditions or mounting reactions of the structure and the effects of those forces on bearing operation and life expectancy.

The parallel, angular and axial alignment of the coupling are all effected concurrently and should be checked any time the generator frame is moved during the alignment process. Once the Prime Mover/Generator are at final location and coupling alignment is within specification, it is recommended that the generator frame be doweled or chocked to the mounting base to insure that no movement in the alignment occurs during operation.

1.1.4.3 Misalignment Definitions

There are three basic dimensions of alignment, which are parallel, angular, and axial. Misalignment can be parallel, angular, axial, or any combination of the three. An explanation of each type of misalignment follows.

1.1.4.3.1 Parallel

Parallel (radial) misalignment, Figure 1, is the difference in position of the center of rotation of one shaft with respect to the center of rotation of the other shaft.

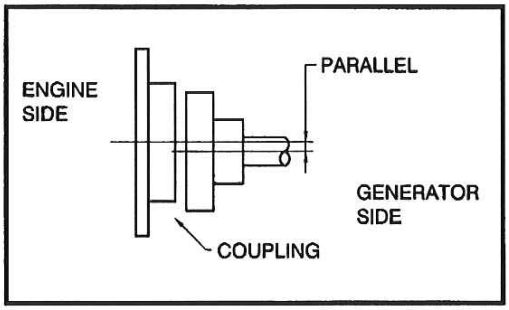


Figure 1 - Parallel Misalignment

1.1.4.3.2 Angular

Angular (face) misalignment, Figure 2, is the angle one shaft centerline makes with the other shaft centerline at the coupling connection.

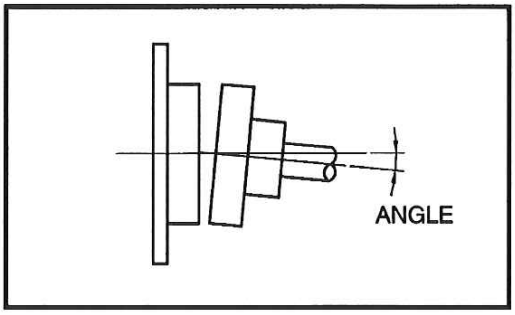


Figure 2 - Angular Misalignment

1.1.4.3.3 Axial

Axial misalignment, Figure 3, is the end position of one shaft in relation to the end position of the other shaft.

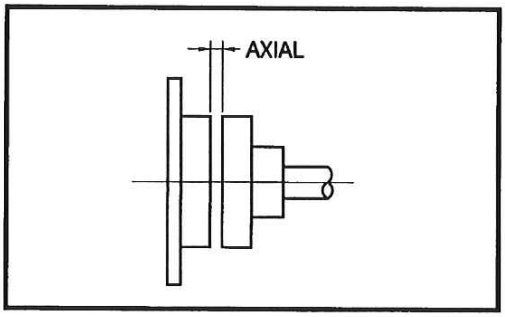


Figure 3 - Axial Misalignment

1.1.4.4 Alignment Procedure

There are several methods to measure the alignment of two connected shafts. Two methods are:

(a) Two dial indicators.
(b) Dial indicator and micrometer.

The two dial indicator method is recommended and is described in the following procedure.

1.1.4.4.1 Initial Considerations

The generator and prime mover should be located and leveled on the mounting skid. Care should be taken to eliminate **"Soft Foot Condition."**

Soft Foot is the condition where the generator does not sit flat on its' base and only three of the four mounting points support the generator. When the fourth point is clamped down the generator frame or mounting skid is distorted causing possible vibration or erroneous alignment information. Soft Foot can be

1.1.4.4.1 Initial Considerations (Cont'd)

corrected by loosening each mounting point one at a time, measuring the relative movement with a dial indicator, and shimming under the foot to eliminate that relative movement. The relative movement should not exceed 0.005 inch. Shims with burrs on the edges can contribute to the soft foot condition.

1.1.4.4.2 Alignment Measurement

Attach the dial indicator bases to one of the coupling halves and locate the dial indicators to measure as shown in Figure 4. The indicator plunger for one indicator should be located on the outside diameter, perpendicular to the shaft. The indicator plunger of the other indicator should be located on the coupling face as close to the outside diameter as possible. Set the plunger at about half travel. Rotate the indicators so that they are at the top location. It is suggested to zero the dial indicator when at the top location for convenience. The coupling hub should be marked at 0, 90, 180, and 270° and a stationary reference mark placed or identified on the equipment so that when the shafts are rotated, they can be indexed through 90° increments. Both shafts should be rotated together. An easy way to record the measurements is to draw two circles on paper, one for parallel and one for angular measurements. Also, record the radius of the measurement point for the angular (face) measurement.

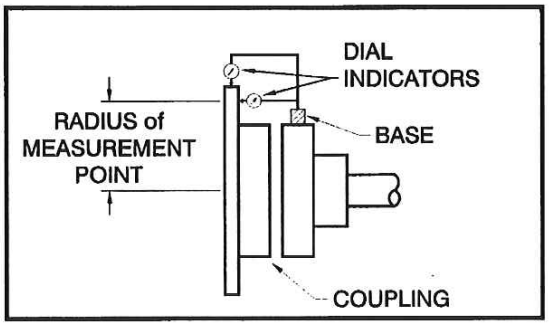


Figure 4 - Dial Indicator Setup

Rotate the shafts one-quarter turn and record the dial indicator measurements. Take measurements at 90, 180, 270 and 360 (0°) locations. The dial indicators should read zero when returning to the top (starting or 0°) location. If the indicators do not read zero, disregard the measurements and repeat the procedure. Figure 5 and 6 shows a typical set of measurements and their corresponding Total Indicator Readings (TIR). Once these measurements are recorded, the relationship of the measurements to the allowable misalignment in Table 1 can be determined by subtracting measurements in each plane to find the Total Indicator Reading (TIR) value.

1.1.4.4.2 Alignment Measurement (Cont'd)

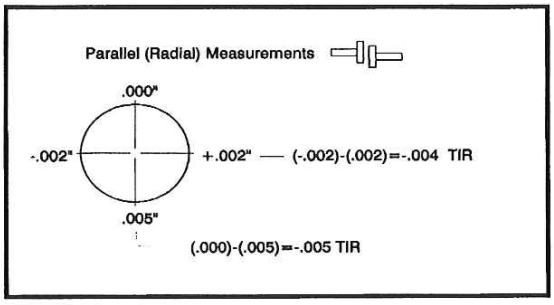


Figure 5 - Typical Parallel (Radial) Measurements

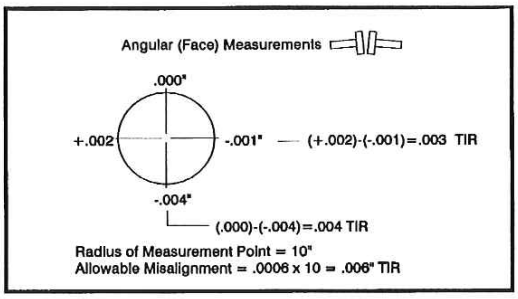


Figure 6 - Typical Angular (Face) Measurements

Table 1 lists maximum allowable parallel and angular misalignment for National Oilwell two bearing generators. After the initial measurements are taken, the generator must be aligned and shimmed to achieve the acceptable alignment measurements.

Allowable Misalignment		
Speed (RPM)	Parallel TIR (inch)	Angular TIR (inch)
750 or 900	.010	.0006 in. / in. radius to measurement point
1000 or 1200	.008	.0006 in. / in. radius to measurement point
1500 or 1800	.005	.0006 in. / in. radius to measurement point

Table 1 - Maximum Allowable Shaft Misalignment for Two Bearing Generators

It is a good practice to first correct the parallel and angular misalignment in the horizontal plane. Jack screws attached to the skid can be used to adjust the location in the horizontal plane. Once corrections are made, a new set of alignment measurements should be taken.

1.1.4.4.2 Alignment Measurement (Cont'd)

If the alignment in the horizontal plane is within limits, then proceed with correction in the vertical plane. The proper corrections can be determined through careful evaluations of the measurements. Corrections for parallel and angular misalignment may be made together. After any corrections are made in the alignment, new measurements must be repeated.

Axial alignment depends on the coupling type. The generator and prime mover should be located so that no axial force can be transmitted to the generator. Refer to the coupling manufacturer or prime mover/generator packagers' recommendations for axial alignment specifications.

Once alignment is complete, it is a good practice to record measurements for future reference.

1.1.5 Space Heater

This generator has been provided with space heaters to prevent moisture absorption in the generator windings when the machine is out of service. The space heaters require 500 watts of 115 or 230 Volt AC, single phase power. The space heaters should be energized whenever the generator is not in use. This includes generator storage and all other cases when the generator is not operating. If the generator is in a humidity controlled environment, then the space heaters do not need to be energized. When the generator is in storage, provisions shall be made to allow adequate air circulation for moisture removal and prevention of overheating.

1.1.6 Electrical Connection Junction Box

The generator is equipped with a removable drip proof electrical junction box located on the non drive end of the generator. The generator stator leads are terminated in the junction box to copper bus connections which provide facilities for the customer connection of the generator power output leads.

1.1.7 Permanent Magnet Generator (PMG)

The permanent magnet generator consists of a stator assembly and permanent magnet field assembly, installed adjacent to the exciter assembly on the non drive end of the generator. The permanent magnet generator stator is stationary and secured to the generator end frame. The permanent magnet generator stator consists of AC coils installed within a laminated steel core. The permanent magnet generator field is installed on the shaft supporting the rotating field assembly. The permanent magnet generator field consists of permanent magnets secured to a central hub.

NATIONAL OILWELL

1.2 ELECTRICAL SPECIFICATIONS

1.2.1 Generator Electrical Data Sheet

Model: S437UUT-579 Date: 05/01/03

RATED CONDITIONS, CONTINUOUS

KVA	PF	KW	RPM	PHASE	HERTZ	VOLTS	AMPS	AMB °C
2500	0.70	1750	1800	3	60	600	2406	50

PHYSICAL CHARACTERISTICS

ENCLOSURE	POLES	LEADS	CONNECTION	STATOR INSULATION	ROTOR INSULATION
Drip Proof	4	6	WYE	H	H

TOTAL WEIGHT (LB.)	ROTOR WEIGHT (LB.)	WK^2 ($LB\text{-}FT^2$)	MAX OVERSPEED	AMORTISSEUR WINDING
11,000	4218	1752	25%	Copper Connected Pole to Pole

NOMINAL EFFICIENCY, %

RATED LOAD	3/4 LOAD	1/2 LOAD
95.5	95.5	94.8

TEMPERATURE RISE BY RESISTANCE, °C

GEN ARMATURE	GEN FIELD	EXC ARMATURE	EXC FIELD
90	90	90	90

EXCITATION REQUIREMENTS, EXCITER FIELD

RATED LOAD		3/4 LOAD		1 /2 LOAD		300% SHT CKT		PMG	
VDC	ADC	VDC	ADC	VDC	ADC	VDC	ADC	VAC	HZ
89	2.6	68	2.0	44	1.3	180	6.0	240	240

MACHINE RESISTANCES @ 25°C, OHMS

STATOR L - L	GEN FIELD	EXC ARMATURE	EXC FIELD	PMG
0.0016	1.90	0.086	21.5	3.6

DIELECTRIC TEST, VAC FOR 1 MIN

GEN ARMATURE	GEN FIELD	ALL OTHERS
2200	1500	1500

MACHINE CONSTANTS, PER UNIT

X_d	X'_d	X''_d	X_q	SCR	X''_q	X_0	X_2	Z_d
2.175	0.274	0.146	1.474	0.548	0.137	0.011	0.141	2.175

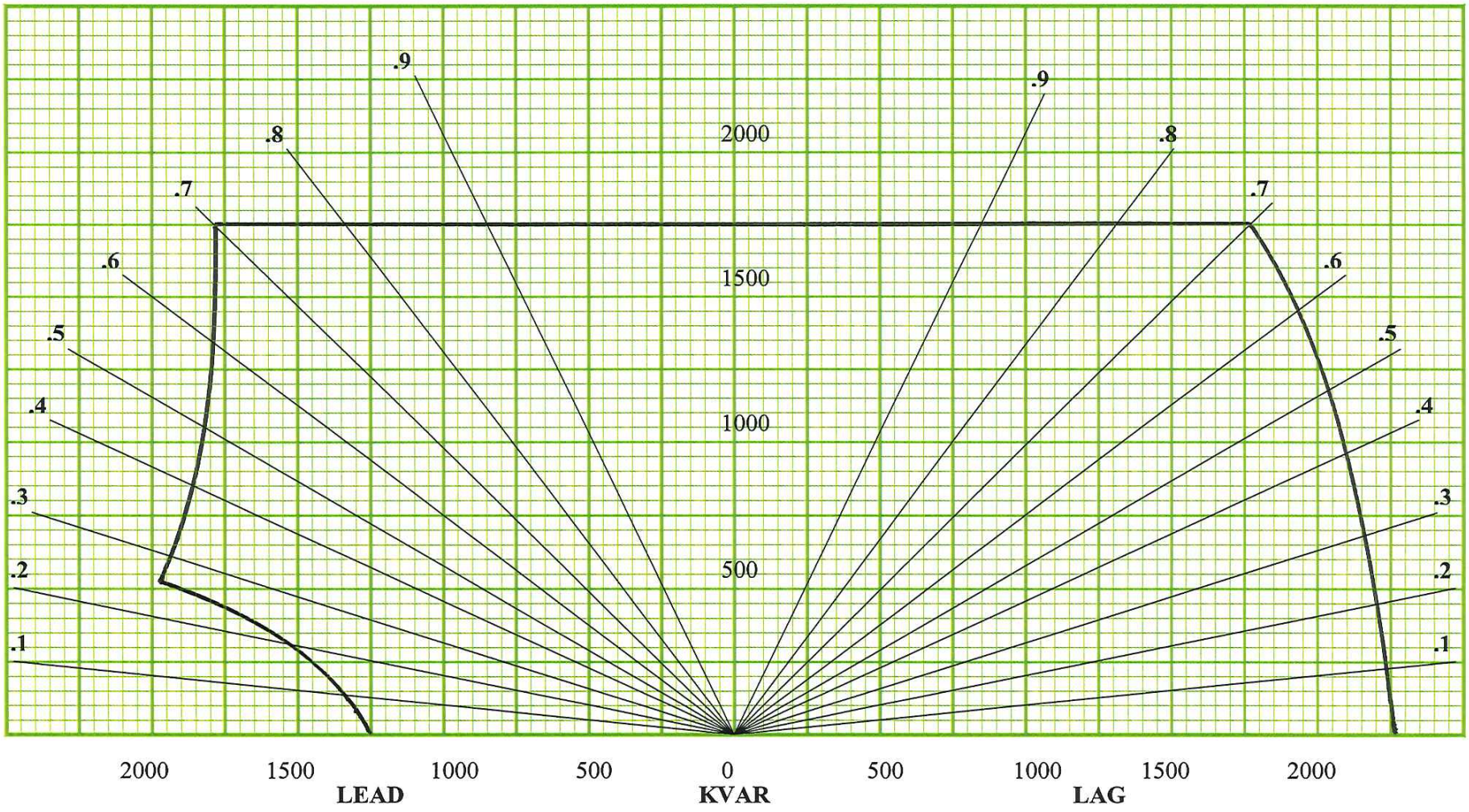
T'_{do} (SEC)	T'_d (SEC)	T''_d (SEC)	T_a (SEC)	INH REG (%)	P_r (KW / RAD)	RATED LOAD VOLTAGE TRANSIENT	
						% DIP	% RISE
1.83	0.32	0.02	0.05	37.3	3912	21.5	24.7

Form No. 232-B

1.2.2 REACTIVE CAPABILITY CURVE

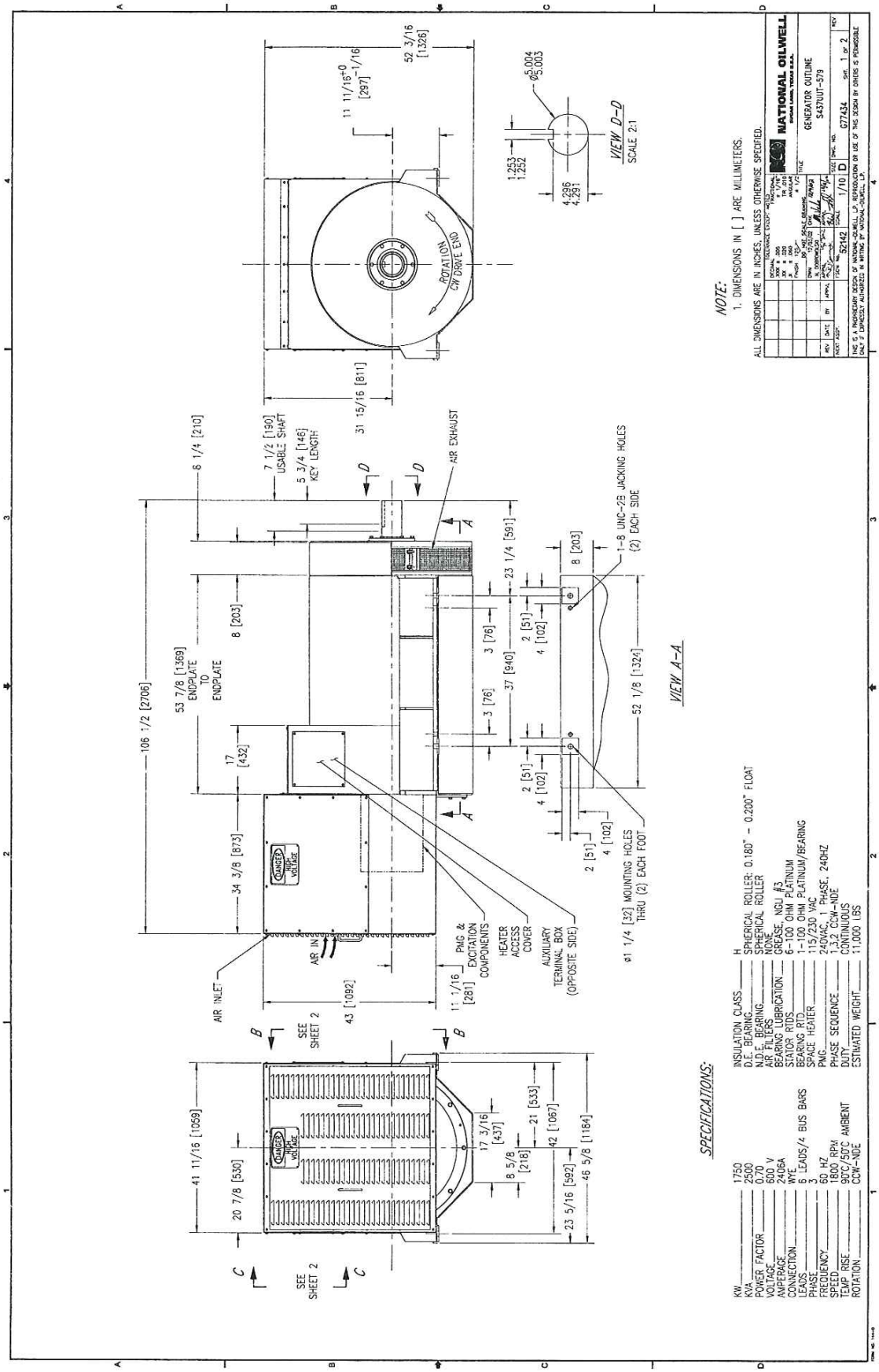
MODEL: S437UUT-579

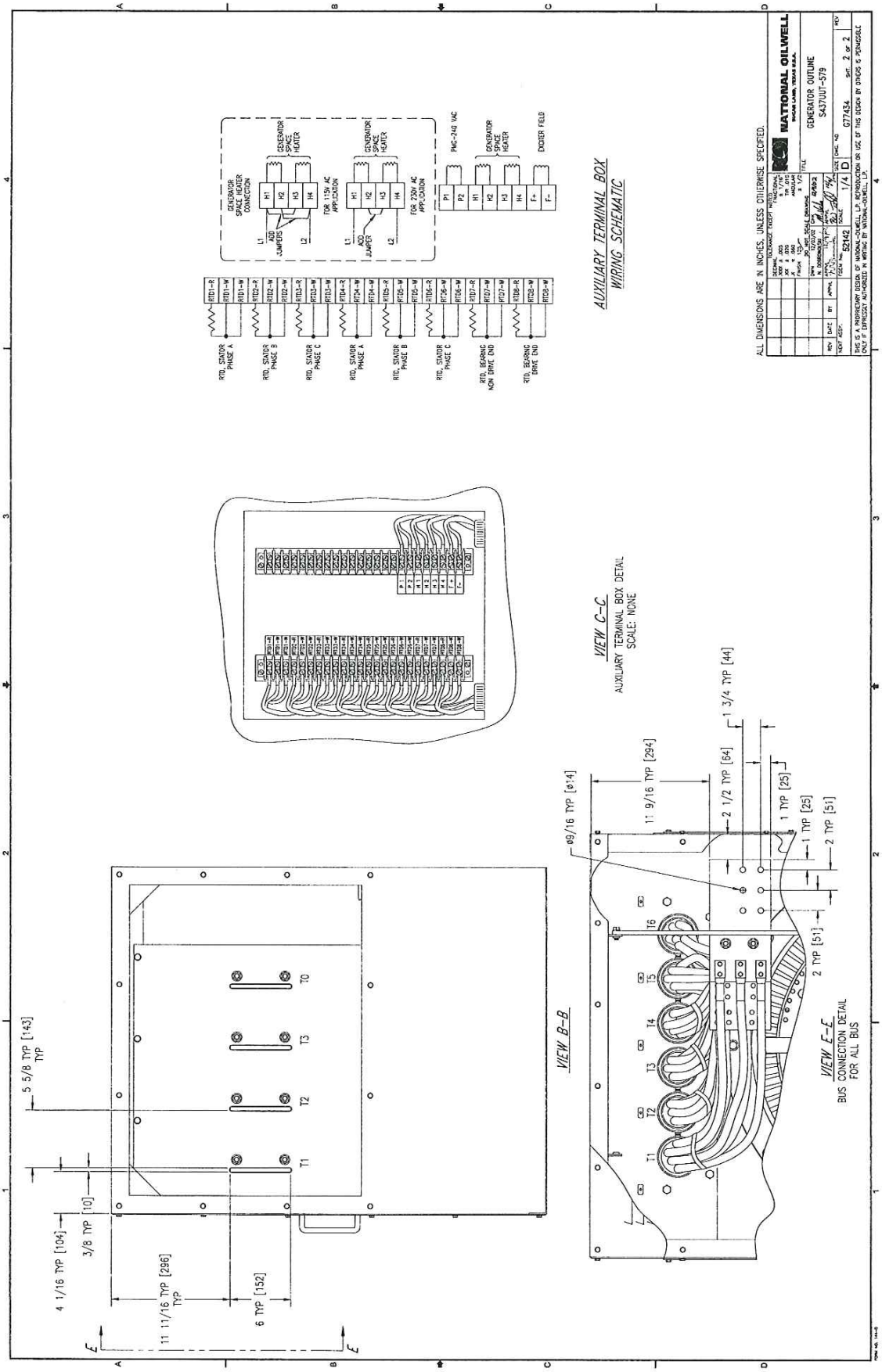
RATING: 1750 KW, 0.7 PF, 600 VOLTS, 60 HZ, 3 PHASE, 1800 RPM

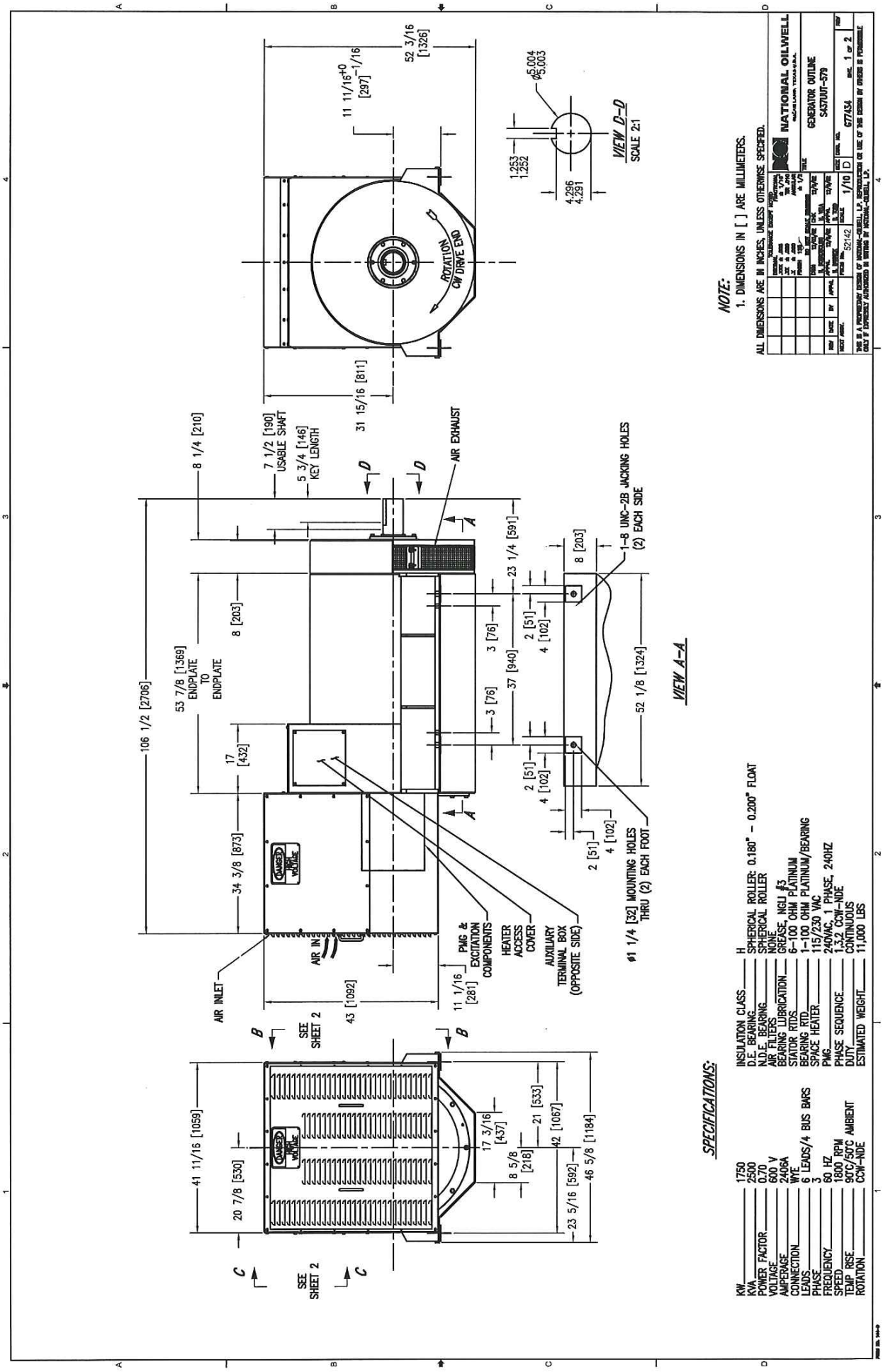


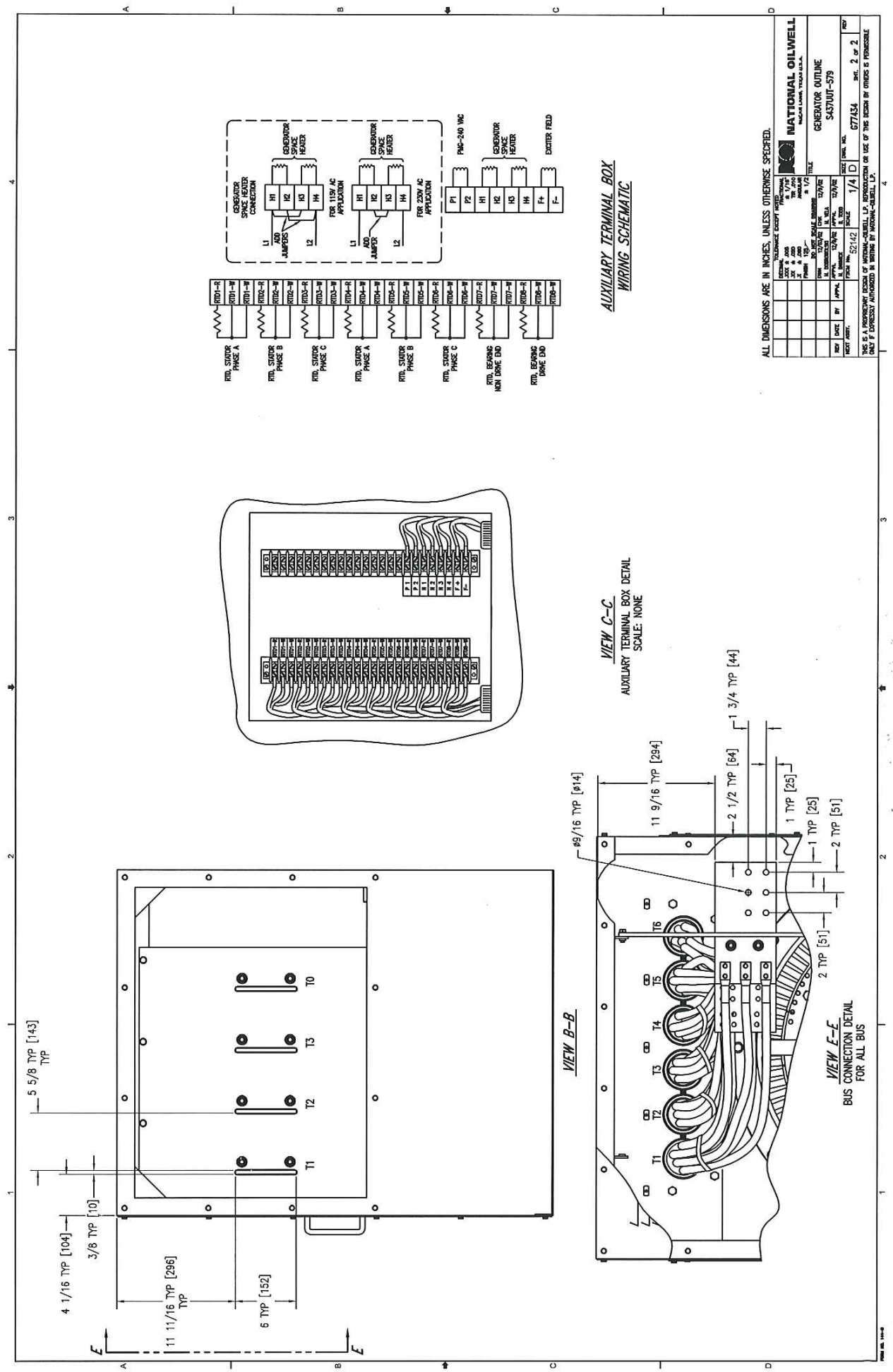
1.3 Parts List for Generator Model No. S437UUT-579

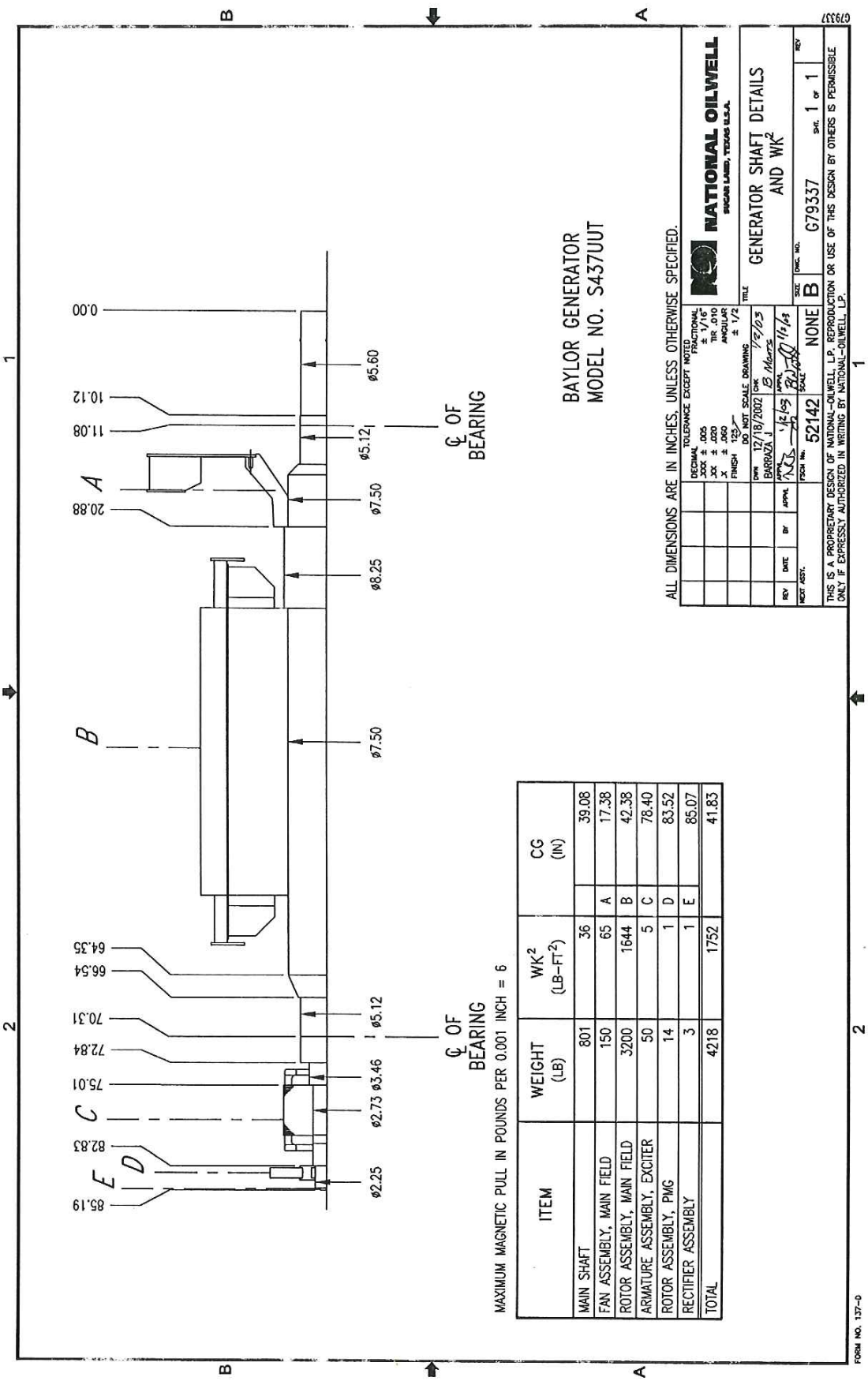
PART NUMBER	DESCRIPTION	QUANTITY PER GENERATOR	RECOMMENDED SPARES
1030-20-0073	Bearing, Roller NDE	1	1
1030-20-0073	Bearing, Roller DE	1	1
1885-05-0012	Grease, NGLI #3	2 lbs.	-
G54502	Rotating Rectifier	1	1
G5550438	Diode, 45A Cathode	3	-
G5550439	Diode, 45A Anode	3	-
G20700	Varistor	1	-
G82150	Exciter Field	1	-
G86189	Exciter Armature	1	-
G82025	PMG Stator	1	-
G82230	PMG Rotor	1	-
G21592	Heater, Space 250W 120V	2	-


NOTE:
1. DIMENSIONS IN [ ] ARE MILLIMETERS.
ALL DIMENSIONS ARE IN INCHES, UNLESS OTHERWISE SPECIFIED.
NATIONAL OILWELL
GENERATOR OUTLINE
S437UUT-579
SPECIFICATIONS:
KW 1750
KVA 2500
POWER FACTOR 0.70
VOLTAGE 600 V
AMPERAGE 2408A
CONNECTION WYE
LEADS 6 LEADS/4 BUS BARS
PHASE 3
FREQUENCY 60 HZ
SPEED 1800 RPM
TEMP RISE 90°C/50°C AMBIENT
ROTATION CCW-NDE
INSULATION CLASS H
D.E. BEARING SPHERICAL ROLLER: 0.180" - 0.200" FLOAT
N.D.E. BEARING SPHERICAL ROLLER
AIR FILTER NONE
BEARING LUBRICATION GREASE, NGLI #3
STATOR RTDS 6-100 OHM PLATINUM
BEARING RTD 1-100 OHM PLATINUM/BEARING
SPACE HEATER 115/230 VAC
PMG 240VAC, 1 PHASE, 240HZ
PHASE SEQUENCE 1,3,2 CCW-NDE
DUTY CONTINUOUS
ESTIMATED WEIGHT 11,000 LBS
VIEW A-A
VIEW D-D
SCALE 2:1
ROTATION CW DRIVE END
AIR INLET
AIR EXHAUST
AIR IN
PMG & EXCITATION COMPONENTS
HEATER ACCESS COVER
AUXILIARY TERMINAL BOX (OPPOSITE SIDE)
SEE SHEET 2
DANGER HIGH VOLTAGE
1-8 UNC-2B JACKING HOLES (2) EACH SIDE
ø1 1/4 [32] MOUNTING HOLES THRU (2) EACH FOOT
106 1/2 [2706]
53 7/8 [1369] ENDPLATE TO ENDPLATE
34 3/8 [873]
43 [1092]
41 11/16 [1059]
20 7/8 [530]
31 15/16 [811]
52 3/16 [1326]
11 11/16 [297]
7 1/2 [190] USABLE SHAFT
5 3/4 [146] KEY LENGTH
6 1/4 [210]
8 [203]
17 [432]
23 1/4 [591]
37 [940]
52 1/8 [1324]
11 1/16 [281]
17 3/16 [437]
8 5/8 [218]
21 [533]
42 [1067]
46 5/8 [1184]
23 5/16 [592]
ø5.004 ø5.003
1.253 1.252
4.296 4.291


AUXILIARY TERMINAL BOX
WIRING SCHEMATIC
VIEW C-C
AUXILIARY TERMINAL BOX DETAIL
SCALE: NONE
VIEW B-B
VIEW E-E
BUS CONNECTION DETAIL
FOR ALL BUS
NATIONAL OILWELL
GENERATOR OUTLINE
S437UUT-579
G77434
ALL DIMENSIONS ARE IN INCHES, UNLESS OTHERWISE SPECIFIED.


NOTE:
1. DIMENSIONS IN [ ] ARE MILLIMETERS.
ALL DIMENSIONS ARE IN INCHES, UNLESS OTHERWISE SPECIFIED.
NATIONAL OILWELL
GENERATOR OUTLINE
SA57UUT-579
677434
1/10
SPECIFICATIONS:
KW 1750
KVA 2500
POWER FACTOR 0.70
VOLTAGE 600 V
AMPERAGE 2406A
CONNECTION WYE
LEADS 6 LEADS/4 BUS BARS
PHASE 3
FREQUENCY 60 HZ
SPEED 1800 RPM
TEMP RISE 90°C/50°C AMBIENT
ROTATION CCW-NDE
INSULATION CLASS H
D.E. BEARING SPHERICAL ROLLER: 0.180" - 0.200" FLOAT
N.D.E. BEARING SPHERICAL ROLLER
AIR FILTERS NONE
BEARING LUBRICATION GREASE, NGLI #3
STATOR RTDS 6-100 OHM PLATINUM
BEARING RTD 1-100 OHM PLATINUM/BEARING
SPACE HEATER 115/230 VAC
PMG 240VAC, 1 PHASE, 240HZ
PHASE SEQUENCE 1,3,2 CCW-NDE
DUTY CONTINUOUS
ESTIMATED WEIGHT 11,000 LBS
VIEW A-A
VIEW D-D
SCALE 2:1
ROTATION CW DRIVE END
AIR EXHAUST
AIR INLET
AIR IN
PMG & EXCITATION COMPONENTS
HEATER ACCESS COVER
AUXILIARY TERMINAL BOX (OPPOSITE SIDE)
1-8 UNC-2B JACKING HOLES (2) EACH SIDE
Ø1 1/4 [32] MOUNTING HOLES THRU (2) EACH FOOT
SEE SHEET 2
SEE SHEET 2
7 1/2 [190] USABLE SHAFT
5 3/4 [146] KEY LENGTH
53 7/8 [1369] ENDPLATE TO ENDPLATE
106 1/2 [2706]
52 3/16 [1326]
31 15/16 [811]
11 11/16 [297]
41 11/16 [1059]
20 7/8 [530]
34 3/8 [873]
43 [1092]
46 5/8 [1184]
42 [1067]
23 5/16 [592]
17 3/16 [437]
8 5/8 [218]
21 [533]
37 [940]
52 1/8 [1324]


AUXILIARY TERMINAL BOX
WIRING SCHEMATIC
GENERATOR SPACE HEATER CONNECTION
FOR 115V AC APPLICATION
FOR 230V AC APPLICATION
PMG-240 VAC
EXCITER FIELD
RTD, STATOR PHASE A
RTD, STATOR PHASE B
RTD, STATOR PHASE C
RTD, BEARING NON DRIVE END
RTD, BEARING DRIVE END
VIEW C-C
AUXILIARY TERMINAL BOX DETAIL
SCALE: NONE
VIEW B-B
VIEW E-E
BUS CONNECTION DETAIL
FOR ALL BUS
ALL DIMENSIONS ARE IN INCHES, UNLESS OTHERWISE SPECIFIED.
NATIONAL OILWELL
GENERATOR OUTLINE
S437UUT-579
677434
SHT. 2 OF 2
1/4
52142



MAXIMUM MAGNETIC PULL IN POUNDS PER 0.001 INCH = 6

ITEM	WEIGHT (LB)	WK^2 ($LB-FT^2$)		CG (IN)
MAIN SHAFT	801	36		39.08
FAN ASSEMBLY, MAIN FIELD	150	65	A	17.38
ROTOR ASSEMBLY, MAIN FIELD	3200	1644	B	42.38
ARMATURE ASSEMBLY, EXCITER	50	5	C	78.40
ROTOR ASSEMBLY, PMG	14	1	D	83.52
RECTIFIER ASSEMBLY	3	1	E	85.07
TOTAL	4218	1752		41.83

ALL DIMENSIONS ARE IN INCHES, UNLESS OTHERWISE SPECIFIED.

TOLERANCE EXCEPT NOTED: DECIMAL .XXX ± .005, .XX ± .020, .X ± .060, FINISH 125; FRACTIONAL ± 1/16, TWO PLACE DEC. ± .010, ANGULAR ± 1/2; DO NOT SCALE DRAWING

DWN BARBOZA J 12/18/2002 | CHK B Morris 12/19/02 | APPVL [illegible] | APPVL [illegible] | APPVL [illegible]

REV | DATE | BY | APPVL

NEXT ASSY: | ITEM NO. 52142 | SCALE NONE | SIZE B | DWG. NO. G79337 | SHT. 1 OF 1 | REV

NATIONAL OILWELL
BAYTOWN LABS, TEXAS U.S.A.

TITLE: GENERATOR SHAFT DETAILS AND WK^2

G79337

FORM NO. 137-0