Instruction Manual

Installation
Operation
Maintenance

Traction Alternator
Separately Excited

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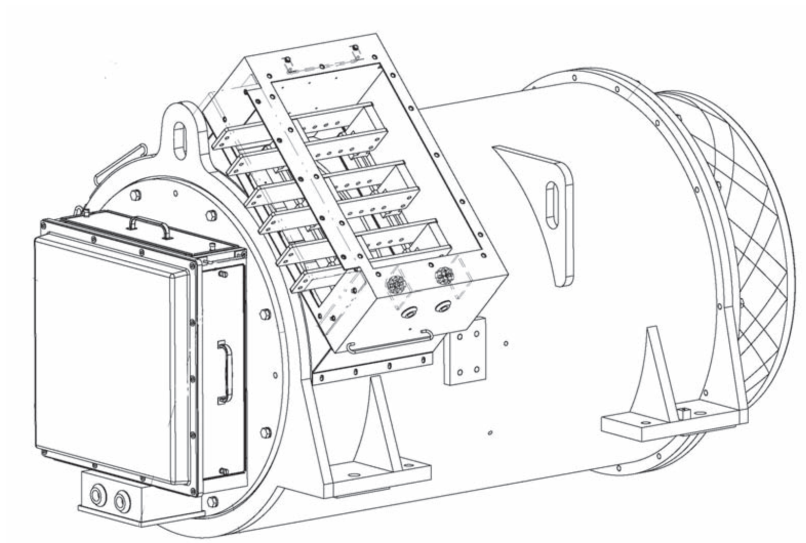

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GENERAL

The products described in this instruction manual are manufactured by Kato Engineering Company.

This manual provides information necessary for a traction alternator removal, installation, preliminary start-up, lubrication, preventive maintenance, disassembly and assembly.

The alternator is directly connected to the diesel engine and converts mechanical power from the engine into electrical energy to drive the two traction motors.

The alternator is an eight pole horizontal-shaft, two bearing AC machine, rectified to direct current. Principal parts of the alternator are the frame and wound stator assembly, wound rotor shaft assembly with slip ring and bearings.

TRACTION ALTERNATOR DATA

Approximate shipping weight - 13,300 pounds

BRUSH
Brush holder clearance to slip ring - .12 to .19 inch.
Pressure per brush - 1.25-2.00 PSI
Brush size - 0.75 x 1.25 x 2.75 inches long
Brush quantity - 6
Minimum length (worn) - 1.38 inch

SLIP RING
Diameter - new - 11.00 inches
Must be replaced at 10.75 inch diameter.
Slip ring run out not to exceed .002 inch

LUBRICATION
Alternator bearings - Klubersynth BHP 72-102

		Code	8P6.5-3000	PrimeMover	Diesel
KW	3400	Volts	1135/1966	Manufacturer	Caterpillar
KVA	3578.95	Connect	Wye	Model	C175-20
P.F.	0.95	Phase	3	Turbo-Charged	Yes
Wire	3	Pole	8	NOMSAEHSG	00
Hertz	120	RPM	1800	NOMSAECLUTCH	
Enclosure	ODP/IP23	TempRise	IEEEStd11-1980	ShaftHeight	12.195"

SECTION 1 INTRODUCTION AND DESCRIPTION

1.1 INTRODUCTION

This manual contains instructions for installation, operation, maintenance, and assembly/disassembly of Kato Brush Type AC Rectified DC Dual Traction /Companion Alternator.

Electrical connection drawings, dimensional drawings, and parts listings for specific model, type and serial number are contained as supplementary information in a separate excerpt of the alternator manual. *These drawings are the official source of information* for making electrical connections or ordering replacement parts.

1.2 GENERAL DESCRIPTION

The Kato Traction Alternator is a two bearing, eight pole, synchronous alternator complete with brushes and slip ring.

The Alternator / Companion is cooled by an internal shaft driven fan at the drive end.

1.3 CONSTRUCTION

The alternator is an eight pole horizontal-shaft, two bearing AC machine. Principal parts of the alternator are the frame and wound stator assembly, wound rotor shaft assembly, slip rings and bearings

1.3.1 Frame and Stator
The alternator stator core is built of laminated electrical grade steel. Laminations are secured under pressure and clamped to steel endrings. The alternator frame is fabricated from steel bars welded to the end rings. The feet are welded to the frame to simplify installation and alignment with the prime mover. Lifting eyes are welded to the generator frame to enable lifting of the alternator only. Windings are inserted into the stator slots and the entire assembly is vacuum pressure impregnated with 100 percent epoxy resin (see Figure 1). The phase leads are brought out to standard connection lugs which are fastened to the bus bar.

Figure 1-1
Wound Frame and stator

1.3.2 The alternator rotor consists of the shaft, spider, field poles, windings, and fan.

1.3.2.1 The shaft is machined from high strength steel stock.

1.3.2.2 The spider is laminated with individual dovetails punched to anchor the field poles. The spider laminations are held under pressure and riveted.

1.3.2.3 The poles are individually punched laminations which are held together with bolts. The field windings use insulated copper wire which are layered wound on the poles. The wound poles are anchored to the spider with two tapered keys. “V” shaped blocks are placed between adjacent field windings and are bolted to the spider. The entire spider and pole winding assembly is vacuum pressure impregnated with 100% epoxy resin.

The rotor assembly is shrunk and keyed on the shaft. Two balancing rings are bolted to each end of the field pole coil support shelves. (See Figure 1-2)

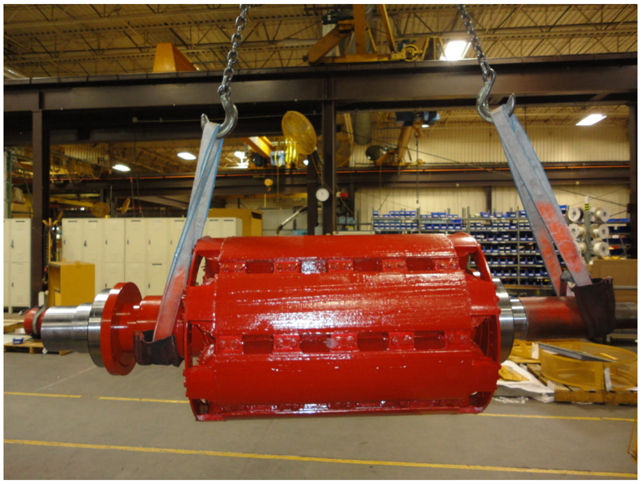


Figure 1-2
Rotor Assembly

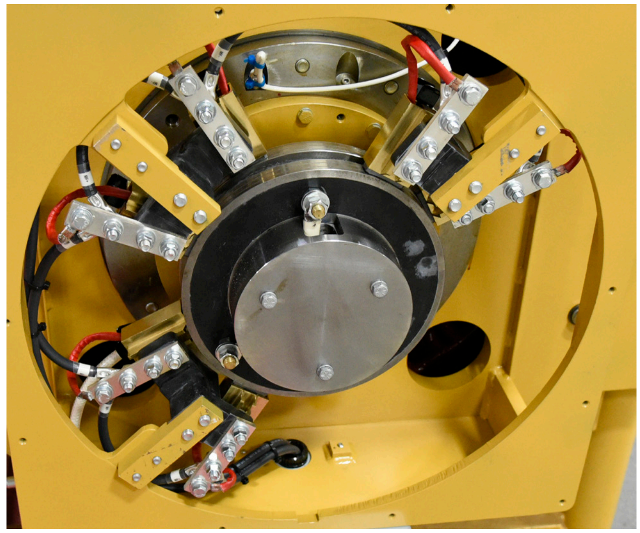


Figure 1-4
Brush Assembly

1.3.4 Bearing

1.3.4.1 Both bearings require periodic lubrication with Klubersynth BHP 72-102 grease (Kluber Lubrication). See Maintenance Schedule section for further details.The non drive end bearing housing is insulated to prevent the flow of stray shaft currents.

Figure 1-3
Ball Bearing

1.3.10 Brush Assembly

The brush assembly provides excitation for the traction alternator. It consists of 6 brushes and brush holders, and an 11 inch slipring.
Connection details can be found in the lead termination drawing in the drawings section of this manual. See Figure 1-4.

SECTION 2
INSTALLATION

2.1 RECEIVING INSPECTION

The two-bearing alternators are shipped completely assembled.Depending on the mounting configuration, the drive end fan assembly may be shipped loose or mounted to the drive end hub. Fan assemblies that are shipped loose are mounted to the engine flywheel.

NOTE: Prior to accepting shipment from the transportation company, examine crating or pallet for any damage which might have occurred during transit. Report any evidence of crating damage to transportation company claims office and Kato Engineering.

If the alternator is received during cold weather, allow the unit to reach room temperature before removing the protective packing material. This will reduce the condensation of moisture on cold surfaces and prevent early failures due to wet windings and insulating materials

2.2 UNPACKING AND STORAGE

2.2.1 Moving Alternator

Unpack the equipment with care to avoid scratching painted surfaces. Move the unit to the mounting location either by attaching an overhead hoist to the eye bolts installed on the alternator frame or by lifting the alternator form underneath the skid with a forklift. Hoist and hoist cables should have a rating of not less than 1-1/2 times the weight of the alternator. When moving unit with forklift, make certain it is completely onto and balanced on the forklift tines.

WARNING
Apply lifting force to structural points specifically provided for that purpose. DO NOT USE enclosure lifting holes to lift the whole unit, ONLY the alternator. Use lifting means adequate for the weight. Failure to observe these Instructions can result In Injuries to personnel and damage to the alternator.

2.2.2 Short Term Storage

If the alternator is not to be installed in its operating location immediately, it is recommended that it be stored in a clean dry area not affected by rapid changes in temperature and humidity. If space heaters are supplied, they should be energized to keep condensation from the windings. All accessory equipment supplied with the unit should be stored with the alternator, and the combined unit covered with durable cover for protection against dust, dirt, moisture and other airborne contaminants.

2.2.3 Long Term Storage

Units which are to be in storage for a period longer than six months should be prepared for storage as follows:
a. Install desiccant bags in the exciter cover and inside the fan screen.
b. Vacuum seal the unit in a covering of plastic or other material designed for that purpose.
c. Adequately tag the alternator to insure that preservative greases and desiccant bags are removed before the unit is placed in operation.

2.2.4 Bearing Inspection

Grease used in ball bearing alternators is subject to time deterioration. If the alternator is stored for one year or longer, it is recommended that new ball bearings be installed and regreased to the proper level before putting into operation. If inspection indicates that bearings are free of rust or corrosion, and no noise or excessive vibration appear on start-up, replacement is not necessary, but regreasing is recommended.

2.3 TWO BEARING CLOSE COUPLED ALIGNMENT

2.3.1 Pre-Alignment Checks:
During runout measurements, corrections for axial movement of the alternator and engine must be accounted for.

2.3.1.1
Check runout of engine flywheel housing face and pilot (radial).
Mount a dial indicator on the flywheel and measure to the housing face.
Mount a dial indicator on the flywheel and measure to the housing pilot.
Refer to Table 2-1 for the limits. Figure 2-1

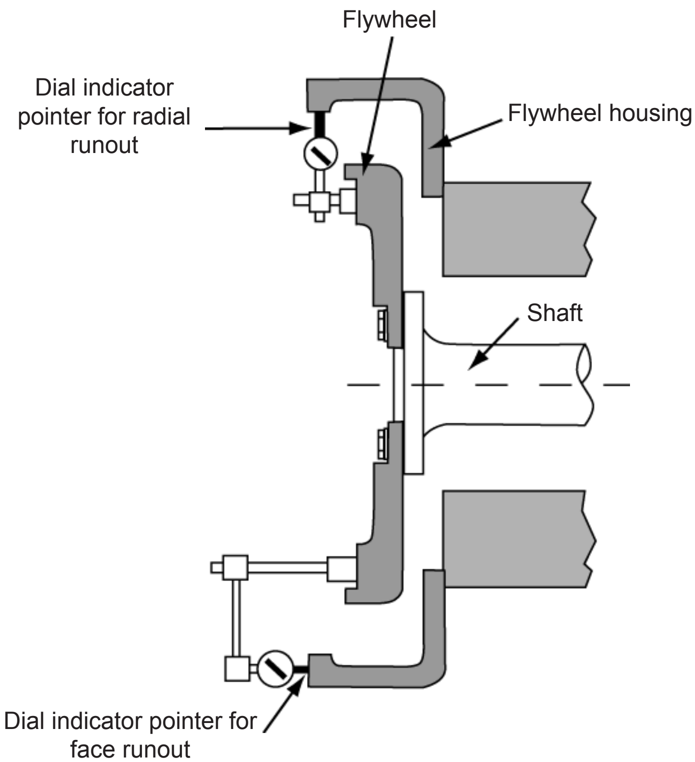


Figure 2-1: Flywheel housing check

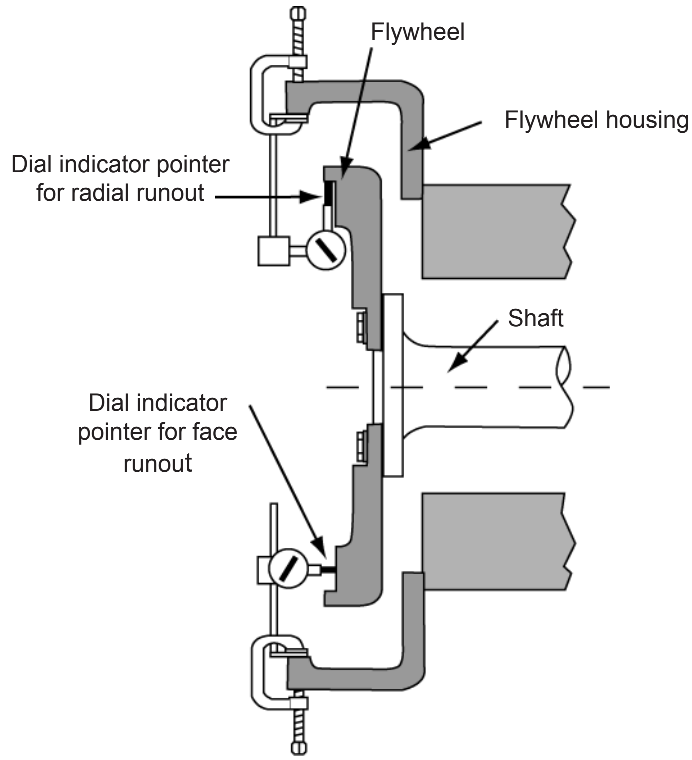


Figure 2-2: Flywheel check

SAE housing number	Housing inside dia.	Allowable runout (TIR)
6	10.500	0.002
5	12.375	0.003
4	14.250	0.003
3	16.125	0.004
2	17.625	0.004
1	20.125	0.005
0.5	23.000	0.005
0	25.500	0.006
00	31.000	0.007

Table 2-1: Maximum allowable flywheel housing runout (inches)

Pilot diameter	Allowable runout (TIR)
6.5	0.002
7.5	0.002
8	0.002
10	0.003
11.5	0.003
14	0.004
16	0.005
18	0.005
21	0.006
24	0.007

Table 2-2: Maximum allowable flywheel runout (inches)

2.3.1.2
Check runout of engine flywheel face and pilot (radial).
Mount a dial indicator on the flywheel housing and measure to the flywheel face.
Mount a dial indicator on the flywheel housing and measure to the flywheel pilot.
Refer to Table 2-2 for the limits. Figure 2-2

2.3.1.3
Check runout of alternator adaptor face and pilot (radial).
Mount a dial indicator on the alternator shaft and measure to the adaptor face.
This measurement should be taken at a diameter smaller than the bolt circle of the flywheel housing mounting bolts.
The face runout should not exceed 0.015 inch TIR (total indicated runout)
Mount a dial indicator on the alternator shaft and measure to the adaptor pilot.
The initial pilot runout should be approximately 0.010 inch TIR.

In order the make this adjustment, the bolts securing the adaptor to the alternator frame need to be loosened. Figure 2-3

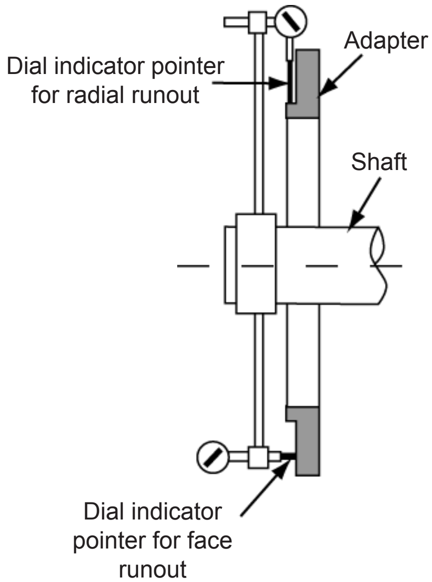


Figure 2-3: Generator adapter check

2.3.1.4
Check runout of alternator coupling hub face and pilot (radial).
Mount a dial indicator on the alternator adaptor and measure to the hub face.
Mount a dial indicator on the alternator adaptor and measure to the hub pilot.
The hub face and pilot runout should not exceed 0.003 inch TIR.

2.3.1.5
Check axial endplay of alternator and engine and nominal offset engine flywheel
The alternator shaft endplay can be measured with a dial indicator and by prying the rotor shaft in both directions.
The alternator shaft endplay is 0.020 inch.
The alternator has a drive end bearing that is is fixed axially that restrict the free-play of the alternator shaft.

The 3 wavey washers provide an axial pre-load on the opposite drive-end bearing, applying an axial force towards the direction of the engine.

2.3.1.6
Check axial endplay of engine crankshaft and nominal offset flywheel.
The axial endplay of the engine crankshaft is typically within the range of 0.015 to 0.020 inch.
The crankshaft endplay can be measured with a dial indicator and by prying the crankshaft in both directions.
The nominal axial position of the flywheel face can be measured with a straight edge and a depth micrometer. The nominal position of the flywheel should be within + or – 0.005 inch of the flywheel housing face.
Consult with the engine manufacture(s) for exact limits and procedure.

2.3.1.7
Install coupling components following recommend procedures furnished by the coupling manufacture in accordance with engine manufacturer's specifications.

2.3.2 Installing Alternator to Engine and Skid

The torsional coupling should be secured to the appropriate components (engine or alternator).
The primer mover (engine) should be properly aligned and secured to the skid.

Shims will be required to shim between the alternator mounts and skid mounts during the alignment process to achieve proper radial and angular alignment. Shims are to be supplied by the locomotive OEM.

The alternator is ready to be assembled to the engine and skid.

Position alternator to the skid and bring towards the engine.

Move the alternator towards the engine and carefully engage the inner element of the torsional coupling into the outer element of the coupling.
When the adaptor recess is near flywheel housing pilot, install 16x bolts to fully engage the adaptor into the flywheel housing pilot. Lower the alternator to the skid mount surfaces.
Alignment is ready to be performed.

2.3.3 Aligning and Mounting Alternator to Engine and Skid

In this step, alignment of alternator to engine, there may not be adequate room to install alignment equipment. In such cases, alignment of the assembled unit (alternator/engine) is not possible. Therefore the following steps may not be able to be performed. However, "Soft Foot" can still be verified.

Additional dial indicator(s) may be required to measure the amount of axial movement of the alternator shaft or engine crankshaft while taking runout measurements. These axial readings will be used to make corrections to the misalignment TIR readings.

Alignment (TIR) measurements need to be taken only at 4 positions, to speed up the alignment process. One measurement can be at the top or 12 o'clock position and the remaining locations at 3, 6, and 9 o'clock positions. Alignment measurements are made by rotating the engine and alternator 360 degrees. The TIR measurements should be taken with the alternator tightly secured to skid and engine flywheel housing.

The final alignment (TIR) measurements must be taken after the power module (alternator and engine mounted to skid) is installed onto the locomotive chassis.

To make alignment adjustments in the vertical direction, jacking screws (thread holes) may be used on alternator. Shims will need to be placed under the alternator mounting pads as required to achieve alignment limits. To make alignment adjustments in the lateral direction, the alternator must be moved laterally with respect to the skid.

Kato Engineering alignment (TIR) limits are more restrictive than the coupling manufacture's limits. Please consult with Kato Engineering if the following alignment limits are not followed.

Parallel Offset Alignment (radial misalignment)
Measures the centerline offset (in the radial direction) between the alternator shaft and engine crankshaft
Measure the radial misalignment with the base of the dial indicator mounted on the fan (or some part of the alternator rotating body) and the dial contacting the outside diameter of the torsional coupling.
The maximum Parallel Offset (radial misalignment) is 0.005 inch TIR.

The adjustment can be made by adding or removing shims between the alternator and skid. (for 12 and 6 o'clock adjustments. For the 3 and 9 o'clock adjustments, the alternator must be moved laterally with respect to the skid. Figure 2.4

Angular Alignment (face misalignment)
Measures the centerline angular misalignment between the alternator shaft and engine crankshaft
Measure the face misalignment with the base of the dial indicator mounted on the fan (or some part of the alternator rotating body) and the dial contacting on the face of the torsional coupling near the outside diameter.
The maximum angular misalignment is 0.012 inch TIR measured on a 25 inch diameter, which can be stated as 0.0005 inch TIR per inch of diameter.
The adjustment can be made as stated in the radial alignment process. Figure 2.4

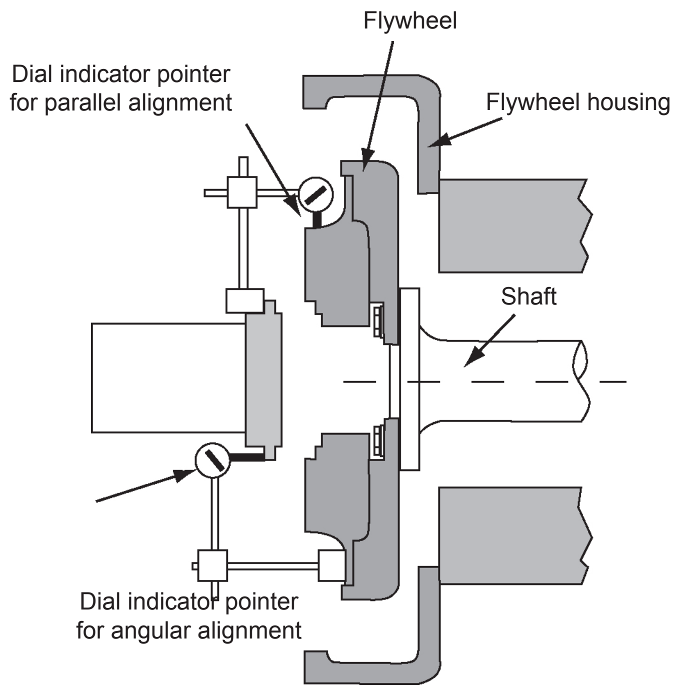
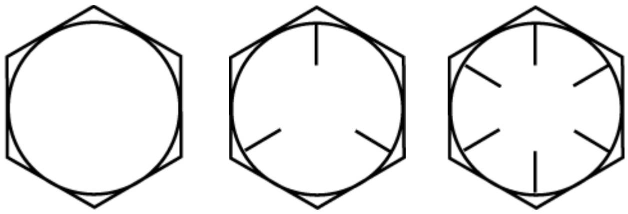


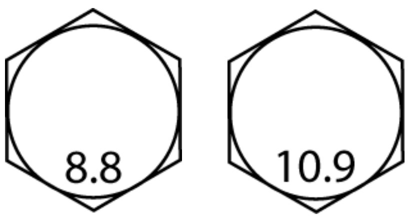
Figure 2-4: Alignment check

2.3.4 Soft Foot
Soft foot condition must be inspected prior to completing the alternator mounting to skid.
With all four alternator mounting bolts tightened, place a dial indicator on the top of one of the mounting pads (next to the bolt) and then loosen the mounting bolt. The deflection of the alternator-mounting pad must not exceed 0.003". Add/remove necessary shims and repeat this measurement for the remaining mounting pads.



Grade 2 Grade 5 Grade 8

ASTM & SAE grade markings



Class 8.8 Class 10.9

Metric grade markings

1-NM = 0.737 ft-lbs. = 8.85 in-lbs.

Grade 2						
Size	**in-lbs.**		**ft-lbs**		**N-M**	
	Min.	Max.	Min.	Max.	Min.	Max.
4-40	3.3	4.7			0.4	0.5
6-32	6.1	8.7			0.7	1.0
8-32	12.5	17.8	1.0	1.5	1.4	2.0
10-32	20.8	29.7	1.7	2.5	2.3	3.4
1/4-20	50.4	72.0	4.2	6.0	5.7	8.1
5/16-18	92.4	132.0	7.7	11.0	10.4	14.9
3/8-16	159.6	228.0	13.3	19.0	18.0	25.8
7/16-14	252.0	360.0	21.3	30.0	28.5	40.7
1/2-13	378.0	540.0	31.5	45.0	42.7	61.0
9/16-12			46.2	66.0	62.6	89.5
5/8-11			65.1	93.0	88.3	126.1
3/4-10			105.0	150.0	142.4	203.4
7/8-9			141.4	202.0	191.7	273.9

Grade 5						
Size	**in-lbs.**		**ft-lbs**		**N-M**	
	Min.	Max.	Min.	Max.	Min.	Max.
1/4-20	60	84	5	7	6.8	9.5
5/16-18	120	192	10	16	13.5	21.7
3/8-16	228	336	19	28	25.8	38
7/16-14	360	528	30	44	40.7	59.7
1/2-13	540	804	45	67	61	90.8
9/16-12	792	1152	66	96	89.5	130.2
5/8-11	1104	1608	92	134	124.7	181.7
3/4-10	2052	2724	171	227	231.8	307.8
7/8-9	3372	4368	281	364	381	493.5
1-8	5160	6432	430	536	583	726.7

Grade 8						
Size	**in-lbs.**		**ft-lbs**		**N-M**	
	Min.	Max.	Min.	Max.	Min.	Max.
10-32	36	49			4.1	5.5
1/4-20	72	144	6	12	8.1	16.3
5/16-18	156	276	13	23	17.6	31.2
3/8-16	324	444	27	37	36.6	50.2
7/16-14	480	720	40	60	54.2	81.3
1/2-13	780	1020	65	85	88.1	115.2
9/16-12	1140	1500	95	125	128.3	169.5
5/8-11	1560	2040	130	170	176.8	230.5
3/4-10	2760	3600	230	300	311.8	406.7
7/8-9	4320	5760	660	480	488.1	650.8
1-8	6720	8640	560	720	759.3	976.2

Class 8.8						
Size	**in-lbs.**		**ft-lbs**		**N-M**	
	Min.	Max.	Min.	Max.	Min.	Max.
M4	20	32	1.7	2.7	2.3	3.6
M5	40	64	3.3	5.4	4.5	7.3
M6	65	113	5.4	9.4	7.3	12.8
M8	168	264	14	22	20	30
M10	324	516	27	43	38	58
M12	612	900	51	75	69	101
M14	960	1428	80	119	109	161
M16			126	184	170	250
M18			183	243	248	330
M20			263	341	357	463
M22			367	457	497	619

Class 10.9						
Size	**in-lbs.**		**ft-lbs**		**N-M**	
	Min.	Max.	Min.	Max.	Min.	Max.
M4	22	36	1.8	3	2.5	4.1
M5	46	74	3.8	6.2	5.2	8.4
M6	77	122	6.4	10.2	8.7	13.8
M8	192	288	16	24	22	32
M10	384	576	32	48	43	66
M12	672	996	56	83	77	112
M14	1080	1554	90	132	122	179
M16			140	206	190	279
M18			205	271	277	368
M20			294	381	398	517
M22			409	510	554	691

Table 2-3: Recommended lubricated torque values. (If no lubricant is used, increase values by 25%.)

SECTION 3 OPERATION

3.1 PRE-OPERATION CHECKS

After the alternator is installed and wired, and before operating for the first time, perform the following checks:

3.1.1 Double-check all wiring against the connection diagrams. Inspect rectifier assembly, make sure all connections are tight and leads in place and in good condition with proper labels.

3.1.2 Check all mounting bolts for proper torque.

3.1.3 Make certain no restrictive material or objects are lodged in the alternator. Remove desiccant bags if unit has been in long-term storage. Place all covers and guards that have been removed and all safety devices are functional.

3.2 INITIAL START-UP

WARNING

BEFORE RUNNING MACHINE, MAKE SURE GUARDS, SHIELDS, AND SCREENS PROVIDED ARE PROPERLY INSTALLED. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

The alternator has been test run at the factory. However, after rebuild or any type of servicing proceed cautiously, possibility of errors and omissions always exist.

3.2.1 Start the alternator slowly and check for proper direction of rotation.

3.2.2 Bring alternator to normal operating speed and during the first minutes check for excessive noise, vibration or bearing temperature. High vibration, noise or temperature calls for **immediate shut down.**

3.2.3 During the first 50 hours of operation check for vibration with and without load. A slight increase with load and temperature is normal. However, the vibration levels should stabilize after 2-3 hours.

3.2.4 Check for bearing temperatures. A properly operating ball or roller bearing should not operate above 212^{o} F (100^{O} C) as measured at the bearing housing. A common cause of high bearing temperature is over greasing or high ambient temperature. Make sure that hot air discharged from the alternator is not recirculating to the intake of the alternator.

3.2.5 Recheck all exposed bolts (including mounting bolts) and re-torque.

SECTION 4
MAINTENANCE

Rotating electric machines are complex structures that are subjected to mechanical, electrical, thermal and environmental stresses of varying magnitude. Of the various components, the insulation systems are the most susceptible to aging or damage due to these stresses. The service life of an electric machine will, therefore, largely depend on the serviceability of the insulations systems. Adequate inspection and testing programs are advocated to assure that the equipment is maintained in satisfactory condition to minimize the possibility of in-service failure.

A regular maintenance and inspection program can provide an evaluation of the present condition of the equipment and indicate potential long term problems. The extent to which a maintenance program is pursued will depend on application, environmental conditions, and the operator’s own experience and philosophy. A regular maintenance program involving periodic disassembly and knowledgeable visual examination of the equipment, together with the application of electrical tests is strongly recommended. It should be recognized that over potential tests can damage insulation that is contaminated or in marginal condition. Where there is uncertainty, refer to I.E.E.E. Standard 432-1992 or consult with Kato Engineering Co.

SERVICE CONDITIONS REDUCING INSULATION LIFE

Electric machines and their insulation systems are subjected to mechanical, electrical, thermal and environmental stresses that give rise to many deteriorating influences. The most significant of these are the following:

THERMAL AGING:
This is the normal service temperature deteriorating influence on insulation.

OVER-TEMPERATURE:
This is the unusually high temperature of operation caused by conditions such as overload, high ambient temperature, restricted ventilation, foreign materials deposited on windings or winding faults.

OVERVOLTAGE:
This is an abnormal voltage higher than the normal service voltage such as caused by switching or lightning surges. Operating above rated nameplate voltage will reduce insulation life.

CONTAMINATION:
This deteriorates electrical insulation by conducting current over insulated surfaces or by attacking the material reducing electrical insulation quality or physical strength or by thermally insulating the material that causes the material to operate at higher than normal temperatures. Such contaminants include the following:

(A) Water or extreme humidity

(B) Oil or grease including unstable anti-wear and extreme pressure lubricants

(C) Conducting and nonconducting dusts and particles

(D) Industrial Chemicals such as acids; solvents and cleaning solutions.

PHYSICAL DAMAGE:
This contributes to electrical insulation failure by opening leakage paths through the insulation. Physical damages includes the following:

(A) Physical shock

(B) Vibration

(C) Over-speed

(D) Short-circuit forces or line starting

(E) Erosion by foreign matter

(F) Damage by foreign objects

(G) Thermal cycling

IONIZATION EFFECTS:
Ionization (corona), which may occur at higher operating voltages is accompanied by several undesirable effects such as chemical action, heating and erosion.

VISUAL INSPECTION METHODS

To achieve maximum effectiveness, a visual inspection program should be directed initially to those areas that have been shown by previous experience to be most prone to the forms of damage or degradation caused by the influences listed. The most suspect areas for deterioration or damage to which inspection should be directed are:

GROUND INSULATION:
Ground insulation is generally defined as that insulation intended to isolate the current carrying components from the noncurrent bearing components.

SUPPORT INSULATION:
Support insulation, such as block, slot wedges, etc. are usually made from compressed laminates of fibrous materials, polyester or similar felt pads impregnated with various types of bonding agents.

DETERIORATION OR DEGRADATION OF INSULATION FROM THERMAL AGING:
Examination of coils reveal general puffiness, swelling into ventilation ducts or a lack of firmness of the insulation, suggesting a loss of bond with consequent separation of the insulation layers from themselves or from the winding conductors or turns.

ABRASION:
Coil and connection surfaces may be damaged by abrasion or contamination from other sources, such as chemicals or abrasive or conducting substances.

CRACKING:
Cracking or abrasion of insulation may result from prolonged or abnormal mechanical stress. In stator windings, looseness of the bracing structure is a certain guide to such phenomena and can itself cause further mechanical or electrical damage if allowed to go unchecked.

EROSION:
Erosion may be caused by foreign substances impinging against coil insulation surfaces.

INSULATION MAINTENANCE TESTS

Insulation tests are conducted for two reasons:

(1) To discern existing weakness or faults

(2) To give some indication of expected service reliability

INSULATION RESISTANCE TESTS AT LOW VOLTAGE

These tests are usually made on all or parts of an armature or field circuit to ground. They primarily indicate the degree of contamination of the insulating surfaces or solid insulation by moisture and other conducting influences and will not usually reveal complete or uncontaminated ruptures.

Insulation resistance tests are based on determining the current through the insulation and across the surface when a direct voltage is applied. The current is dependent on the voltage and time of application, the area and thickness of the insulation and on temperature and humidity conditions during the test.
The insulation resistance test is used to determine the insulation condition prior to application of more extensive testing measures. Refer to the following electrical measurement procedures for testing detail. Contact Kato Engineering when more extensive insulation tests are required.

Alternator Rotor Winding

1. Connect the positive and negative leads to one clamp of the 500 volt megger and connect the other clamp to the shaft.

2. Record the megohm reading after one minute of applying 500 volts.

3. One minute reading must be a minimum of 1 megohm. If not, refer to dry out procedures.

4. Ground the field leads to the shaft after disconnecting the megger.

Alternator Stator

1. Disconnect power connections and all control apparatus from the alternator terminals.

2. Measure insulation resistance of each phase separately with the two other phases shorted to the frame.

3. Use a 500 volt megger connected between the lead of the phase to be measured and alternator frame. The minimum one minute insulation resistance (corrected to 40° C) should not be less than that given by the following formula:

$$\text{Resistance in megohms} = \frac{\text{Rated alternator voltage} + 1000}{1000}$$

If less than above, refer to dry out procedure.
4. Ground the leads to the frame after the one minute megger test.

NOTE: The insulation resistance value increases with decreasing winding temperatures. All readings must be referenced to winding temperatures.

NOTE: 3-wire machines cannot separate the neutral terminal. Keep all three phases ungrounded and test all three phases together.

Drying Methods

If the insulation resistance readings are below the recommended minimum values specified previously, use one of the dry out methods described below. The method selected should be based on the size and location of the unit, and available equipment with experienced personnel.
Remove voltage regulator and cover all inlet and discharge openings. Provide an opening at the top of the machine, preferably at the fan end, for moisture to evaporate. Monitor winding temperatures. DO NOT APPLY HEAT TOO RAPIDLY. Winding temperature should be raised gradually at a rate of 10° C per hour up to 93°C (200°F). Measure insulation resistance at one hour intervals. Typically the insulation resistance will slowly drop while the temperature is coming up, and then gradually increase and level out.

CLEANING INSTRUCTIONS

Proper maintenance of electrical equipment requires periodic visual examination of the machine and windings and appropriate electrical and thermal checks. Insulation surfaces should be examined for cracks and accumulations of dirt and dust to determine required action. Lower than normal insulation resistance can be and indication that conductive contaminant is present. The contaminant may be carbon, salts, metal dusts or virtually any dirt saturated with moisture. These contaminants develop a conductive path to produce shorts or grounds with subsequent failure. Cleaning is also advisable if heavy accumulation of dirt and dust can be seen or are suspected to be restricting ventilation as manifested by excessive heating.

Caution:
Without visual, electrical or thermal evidence that dirt is present, cleaning should not be initiated since unnecessary winding deterioration may occur.

If harmful dirt accumulations are present, a variety of cleaning techniques are available. The one selected will depend on;

(1) The extent of the cleaning operation to be undertaken

(2) The type of enclosure and the voltage rating of the machine involved.

(3) The type of dirt to be removed

FIELD SERVICE CLEANING — ASSEMBLED MACHINES

Where cleaning is required at the installation and complete disassembly of the machine is unnecessary or not feasible, dry dirt, dust or carbon should first be picked up by a vacuum cleaner to prevent the redistribution of the contaminant. A small nonconducting nozzle or tube connected to the vacuum cleaner may be required to reach dusty surfaces or to enter into narrow openings. After most of the dust has been removed, a small brush can be affixed to the vacuum nozzle to loosen and allow removal of dirt more firmly attached.
After the initial cleaning with vacuum, compressed air may be used to remove the remaining dust and dirt. Compressed air used for cleaning should be clean and free of moisture or oil. Air pressure or velocity should be adequately controlled to prevent mechanical damage to the insulation.
Disassembly of the machine and more effective cleaning by a qualified Kato Technician may be required if the above described field service cleaning procedure don't yield effective results.

DISASSEMBLED MACHINES

An initial insulation-resistance reading should be taken on the machine to check electrical integrity. A minimum reading of one to five megohms would be expected with severely contaminated machines. A zero reading may indicate an insulation breakdown requiring repair, not just cleaning.

The high pressure hot water wash method of cleaning, which sprays a high velocity jet of hot water and water containing a mild detergent is normally effective in cleaning windings including those subjected to flooding or salt contamination. The detergent spray is followed by multiple sprays with clean water to remove or dilute the detergent. The machine should then be dried until normal insulation resistance values are obtained at room temperature. Solvents are effective for removing oil or grease and may be required if water or detergent is not adequate.

MAINTENANCE SCHEDULES

DAILY CHECKS

1. Check and record operating temperatures on alternator bearings.

2. Check and record operating temperatures on alternator stator windings.

EVERY 3000 HOURS OR 6 MONTHS OF OPERATION

1. Slip Rings

A. Look for burned or discolored slip ring surface. Polish if necessary.

B. Inspect the slip ring surface for possible minor flash over damage, or other signs of distress.

2. Brushes

A. Inspect for wear, and replace brushes which have reached their minimum permissible length of 1 -3/8 inches, or which may be too short to run until next inspection. When checking brush length, measure the shortest vertical side of the brush.

B. Look for chipped or broken brushes, brushes with loose or frayed pigtails, and replace such brushes as necessary.

C. Move brushes up and down several times in the brush holders to release carbon dust or foreign matter from the brush holders.

3. Brush Holders

A. Inspect for flash over damage. Repair or replace all damaged parts.

B. Check for loose pigtail lug screws and/or broken brush strings. Tighten all loose screws and replace brush holders which have broken springs.

C. Clean holders if necessary.

D. Check the brush holder to slip ring clearance .012 to 0.19 inch.

4. Bus Rings and Field Leads

A. Check for cracked, frayed, or damaged insulation.

B. Check all lead connections.

5. Bearing Lubrication

A. Both bearings require re-greasing every 3000 hours or 6 months.

B. The drive end bearing requires 3.5 ounces [100 grams] and the non-drive end bearing requires 1.0 ounces [30 grams] of grease.

Note: Do not over grease the bearing. It may cause the bearing to operate at an elevate temperature, possibly damaging the bearing.

EVERY 6000 HOURS OR YEARLY

1. Remove alternator outlet box cover.

2. Visually inspect stator output leads, protective sleeving and insulation for cracking or physical damage.

3. Check all exposed electrical connections for tightness.

4. Check all lead wires and electrical connections for proper clearance and spacing.

5. Check insulation resistance to ground on all alternator windings:

A. Main rotating assembly

B. Main stator assembly

EVERY 15,000 HOURS OR 3 YEARS OF OPERATION

1. Remove alternator outlet box cover.
Visually inspect stator output leads\

2. Visually inspect stator output leads, protective sleeving and insulation for cracking or physical damage. (Same as 9000 hour check).

3. Check all exposed electrical connections for tightness.

4. Check all lead wires and electrical connections for proper clearance and spacing.

5. Check insulation resistance to ground on all alternator windings.

A. Main rotating assembly

B. Main stator assembly

6. Visually inspect alternator windings for oil; grease, or dirt contamination. Excessive contamination may necessitate surface cleaning with compressed air and electrical solvent.

EVERY 30,000 HOURS OR 6 YEARS

1. Disassemble alternator including rotor removal.

2. Check insulation resistance to ground on all alternator windings.

A. Main rotating assembly

B. Main stator assembly

3. Clean alternator windings using compressed air and electrical solvent or de-greaser and high pressure hot water wash dependent upon severity of contamination.

4. Dry windings to acceptable resistance levels.

5. Remove bearings.

6. Measure shaft bearing surfaces, endbell bearing wells and housings for roundness and proper size.

7. Install new factory replacement bearings.

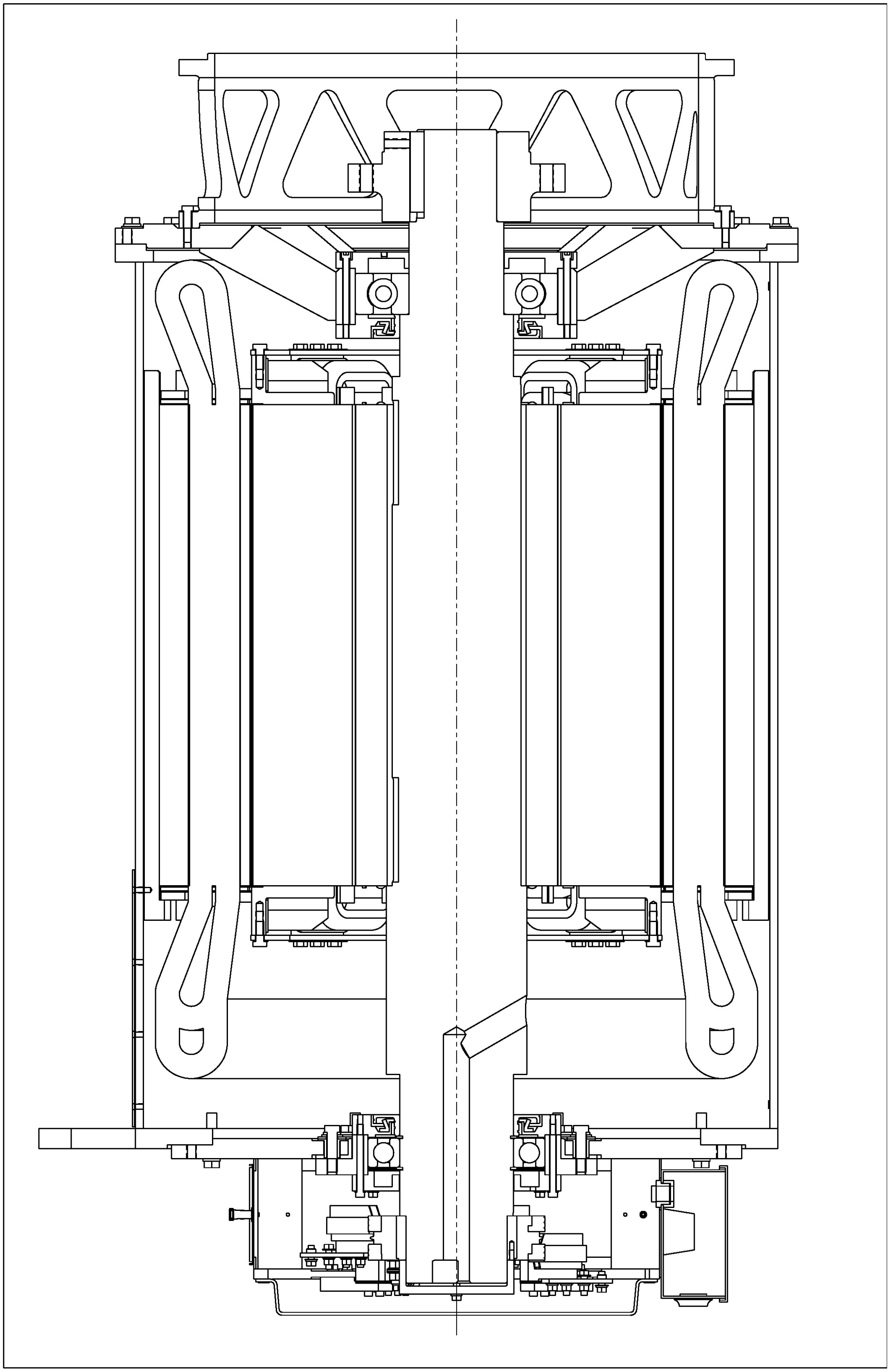


Figure 5-1 Cut Away View Of Traction Alternator

SECTION 5 DISASSEMBLY

5.1 TRACTION ALTERNATOR

Utilization of a clean work area around alternator will enable workers to keep parts clean and in proper order for reassembly. Keep in mind that many parts go back together in reverse order of disassembly. Use wooden blocks, pallets or skids for storing.

5.1.1 Rotating Field Assembly Removal

5.1.2 Heat the Coupling Hub with a torch to 300 degrees F. It is best to do this quickly with two torches so the shaft does not expand along with the hub. Use a puller to remove the hub.

CAUTION
COUPLING HUB WILL SUDDENLY DISENGAGE FROM SHAFT AND FALL IF PROPER CARE IN HANDLING IS NOT OBSERVED

5.1.3 Rotating field assembly is removed with alternator in horizontal position from opposite drive end.

5.1.4 Remove the brush holder cover from the brushholder frame.

5.1.5 Remove the six brushes from their brush holder assemblies.

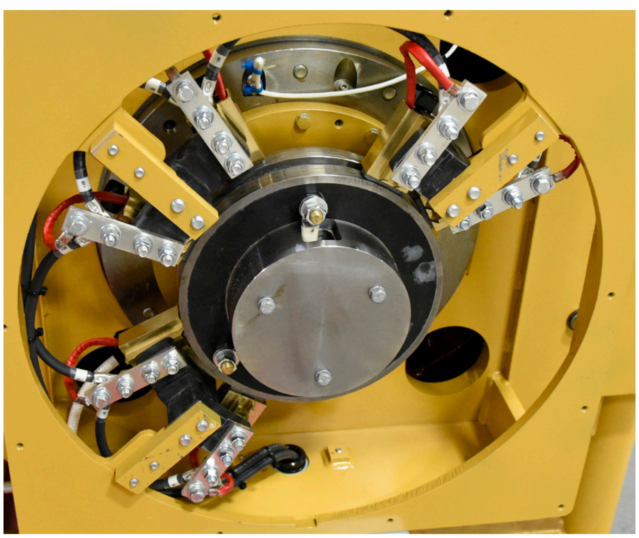


Figure 5-2: Brush Assembly

5.1.6 Remove leads MF+ amd MF- from each of the six brusholder assemblies.

5.1.7 Remove the six brush holder assemblies from the brushholder frame on the endbell.

5.1.8 Remove the + and - leads from the slip ring**.**

5.1.9 Pull the slip ring from the shaft using the puller holes and threaded rod.

5.1.10 Remove the bearing RTD from its holder.

5.1.11 Rotate the rotor so the two poles are at 5 and 7 o'clock. Place shims between the rotor and the staor to take up the air gap.

5.1.12 Remove the 12 bolts from the outside bearing cap and remove the bearing cap and 3 wave washers.

5.1.13 Loosen the 8 bolts holding the endbell to the frame. Support the endbell with a strap and hoist through the brushholder frame.

5.1.14 Using the 5/8" pusher holes and threaded rod, remove the endbell from the frame. Set aside.

5.2 Non drive end Bearing Removal

Note: If the rotor is being removed from the frame, it is not necessary to remove the bearings from the shaft.

5.2.1 Remove the snap ring in front of the bearing.

5.2.2 Heat the bearing to 250° F and pull the bearing with a bearing puller.

Note: Do not apply direct heat to the rear bearing slinger to avoid daminging the seal.

5.3 Drive end bearing removal

5.3.1 Support the drive end adaptor with a strap and hoist. Loosen the 30 M12 bolts connecting the adaptor to the frame. Using the 5/8' push holes and threaded stock, remove the adaptor and set aside.

5.3.2 Remove the grease hose from the bearing cap.

5.3.3 Remove the 12 bolts from the outside bearing cap and remove the cap.

5.3.4 Remove the bearing RTD.

5.3.5 Suport the endbell with a hoist and strap.

5.3.6 Loosen the 14 5/8 bolts from the endbell.

5.3.7 With rotor supported by the shims installed earler, remove the endbell. Set aside.

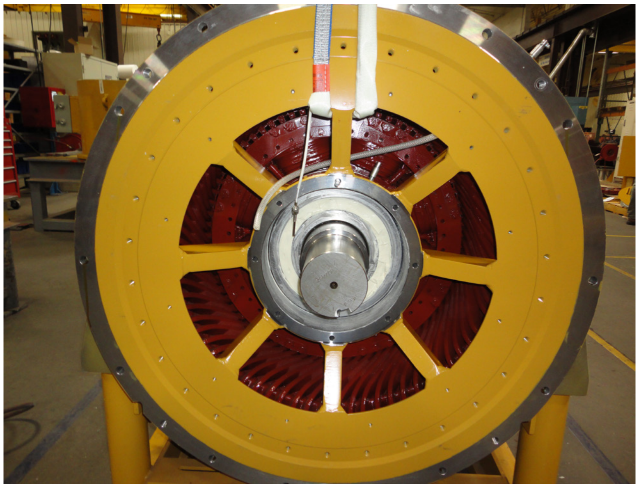


Figure 5-3: Drive End Adaptor

5.3.9 Heat the bearing to 250° F and pull the bearing with a bearing puller.

5.4 Bearing Replacement

Note: Kato Eng does not recommend reusing a pulled bearing.

Note: Klubersynth BHP 72-102 grease (Kluber Lubrication) must be used for lubricating the bearings.

5.4.1 Drive end bearing

Install the inboard slinger
Apply a light coating of grease to lubricate the inboard slinger.

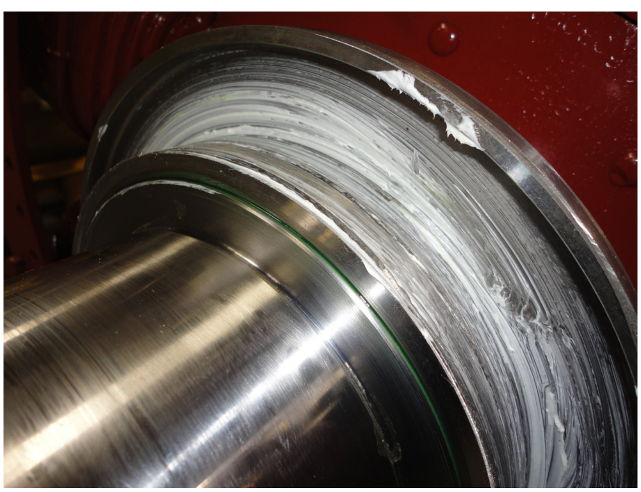


Figure 5-4: Inboard slinger

Apply 7 oz [200 g] of grease behind the v-ring seal on the inboard bearing cap.

Figure 5-5: Applying grease

Apply a light coating of grease to the lip of the v-ring seal.

Apply 23 oz [650 grams] of grease to the outboard side of bearing.

Heat bearing to 250°F and install components to the shaft.

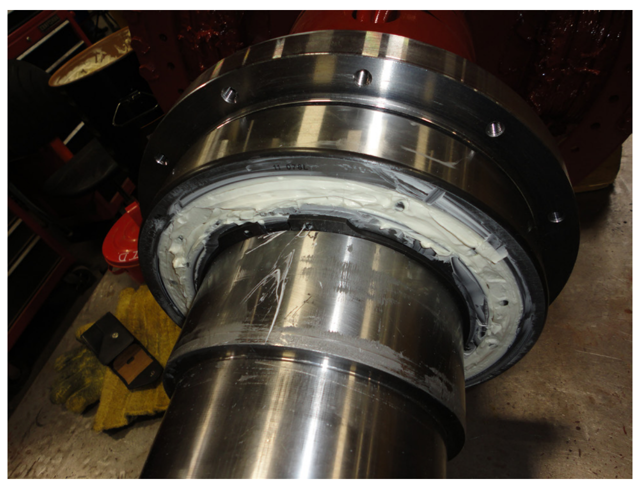


Figure 5-6: Bearing Installed on Shaft

For the outboard bearing cap, do not apply any grease into the grease cavity.
(Note: During initial operation, extra grease from the bearing will flow into this cavity.)

5.4.2 Non-drive end bearing

Install inboard slinger
Apply a light coating of grease to lubricant the in-board slinger.

Apply 7 oz [200 g] of grease behind the v-ring seal on the inboard bearing cap
Apply a light coating of grease to the lip of the v-ring seal

Apply 6 oz [170 g] of grease into both sides of the bearing

Heat bearing to 250°F and install components to shaft with 2 snap-rings

For the outboard bearing cap, apply 7 oz [200 g] of grease, into the grease cavity, near the grease port and the install with the wavey washers

5.5 Remove the rotor

Float out the rotor. First attach a pipe over the shaft on the drive end. Attach slings around the pipe on one end and around the shaft on the opposite end. Lift up the rotor, and move it out, resting the rotor as the slings are moved down the pipe for the next lifting stage.

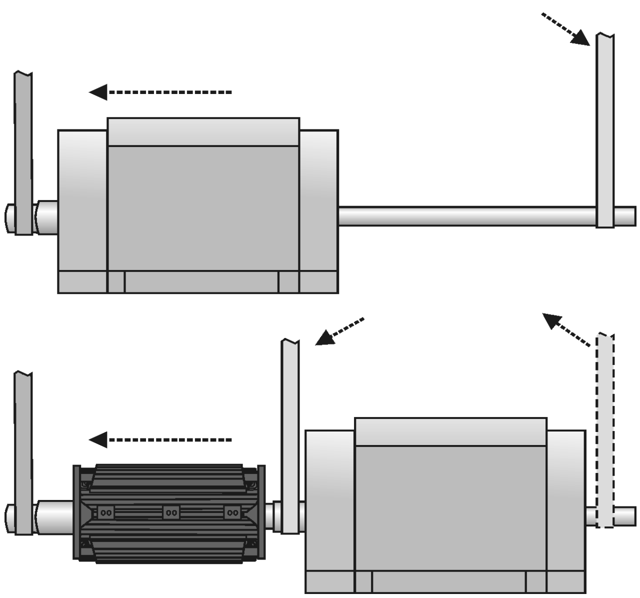


Figure 5-7:Rotor Removal

5.1.3 Assembly

Reassemble the traction alternator in the reverse order of disassembly.

SECTION 8
TROUBLESHOOTING

6.1 Troubleshooting is the process of recognizing malfunctions of the system, intelligently analyzing the malfunction, and making the necessary corrections to place the unit back into proper operation.

6.2 Between regular preventative maintenance inspections, be alert for any signs of alternator trouble. Common symptoms as well as the probable cause and possible remedies are listed in table 6-1. Correct any minor trouble immediately**. Minor defects left uncorrected can cause serious damage which can result in costly repairs and down time.**

TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	REMEDY
No voltage from AC generator.	No brush contact at slip rings.	Clean, adjust, or replace brushes. Clean and sand or turn slip rings.
	Short circuit on output.	Disconnect load leads from ± terminals of the output rectifier assembly. If voltage is normal, check for short or ground in the load. If no voltage, disconnect the generator leads from the rectifier assembly and check for short or ground in generator leads. If generator windings are normal, check the rectifier assembly for shorted diodes or connections.
	Field coils shorted or open.	Check continuity from slip rings to generator field. Check generator field resistance.

TROUBLESHOOTING CHART (continued)		
TROUBLESHOOTING CHART	**SYMPTOM**	**PROBABLE CAUSE**
Fluctuating voltage from AC generator with constant speed.	Excitation circuit not functioning properly	Refer to voltage regulator manual
	Defective bearing causing uneven air gap.	Replace bearing.
	Poor brush contact.	Clean, adjust or replace brushes. Check brush pressure.
	Slip rings out of round or pitted.	Turn slip rings on a lathe concentric with center of generator shaft.
	Loose terminals or load connection.	Tighten or replace defective connectors.

SECTION 9
RENEWAL PARTS ORDERING INFORMATION

Refer to parts list for parts identification. Renewal part must be of the same physical construction and have the same operating characteristics as parts installed in the motor-generator at the factory. Do not attempt to substitute “similar” parts. Order parts by part name and part number. As additional information, always include the serial number, type and model numbers. For fastest service, direct parts order to:

KATO ENGINEERING,
Product Service Department,
P.O. Box 8447, Mankato, Minnesota,
56002-8447.
(507) 625-4011
(507) 345-2798 (FAX)

SECTION 10
ASSORTED DRAWINGS AND PHOTOS

This section contains drawings that may be useful. They do not replace the regular drawing section under a separate tab in your manual

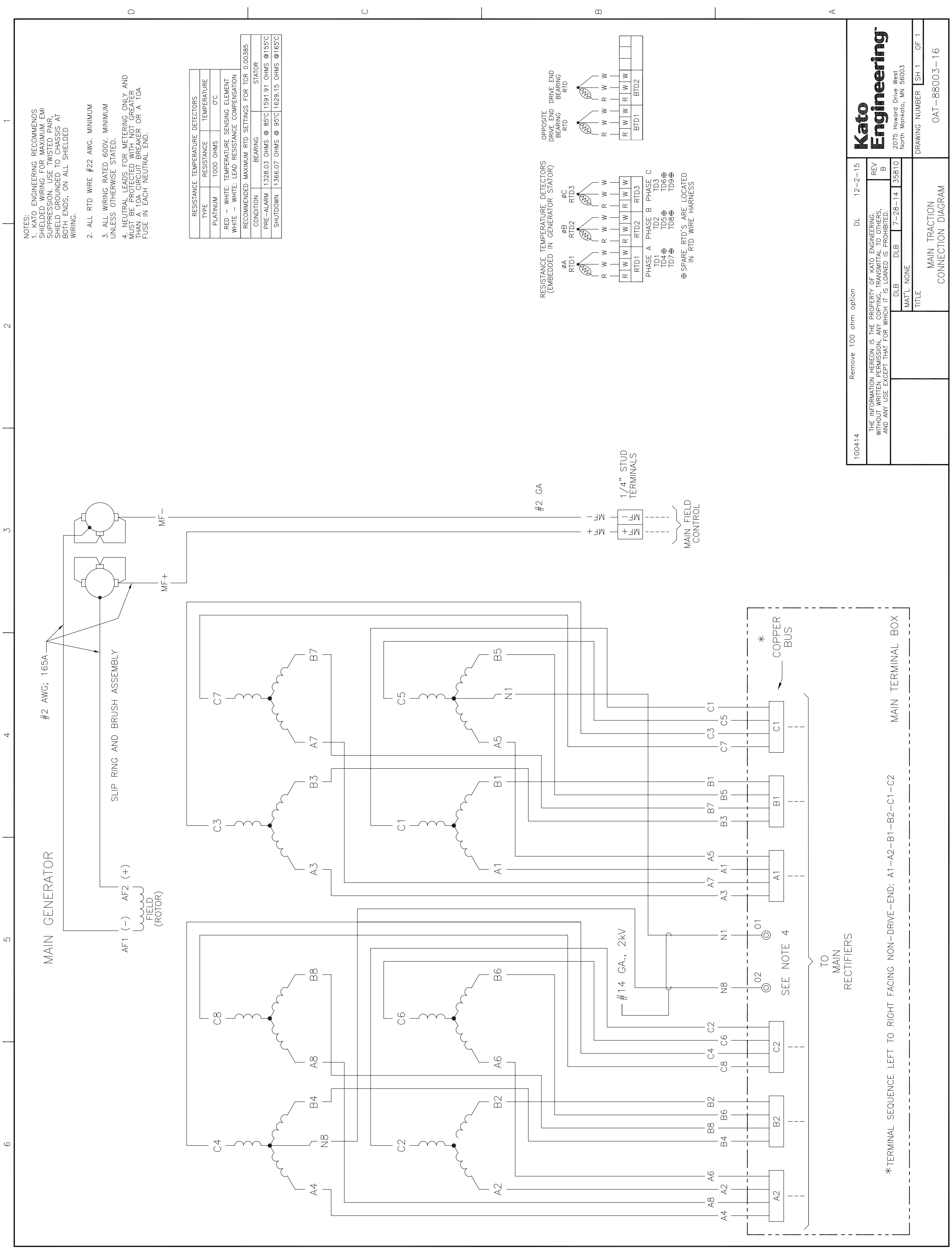


Figure 10-1 Connection Diagram

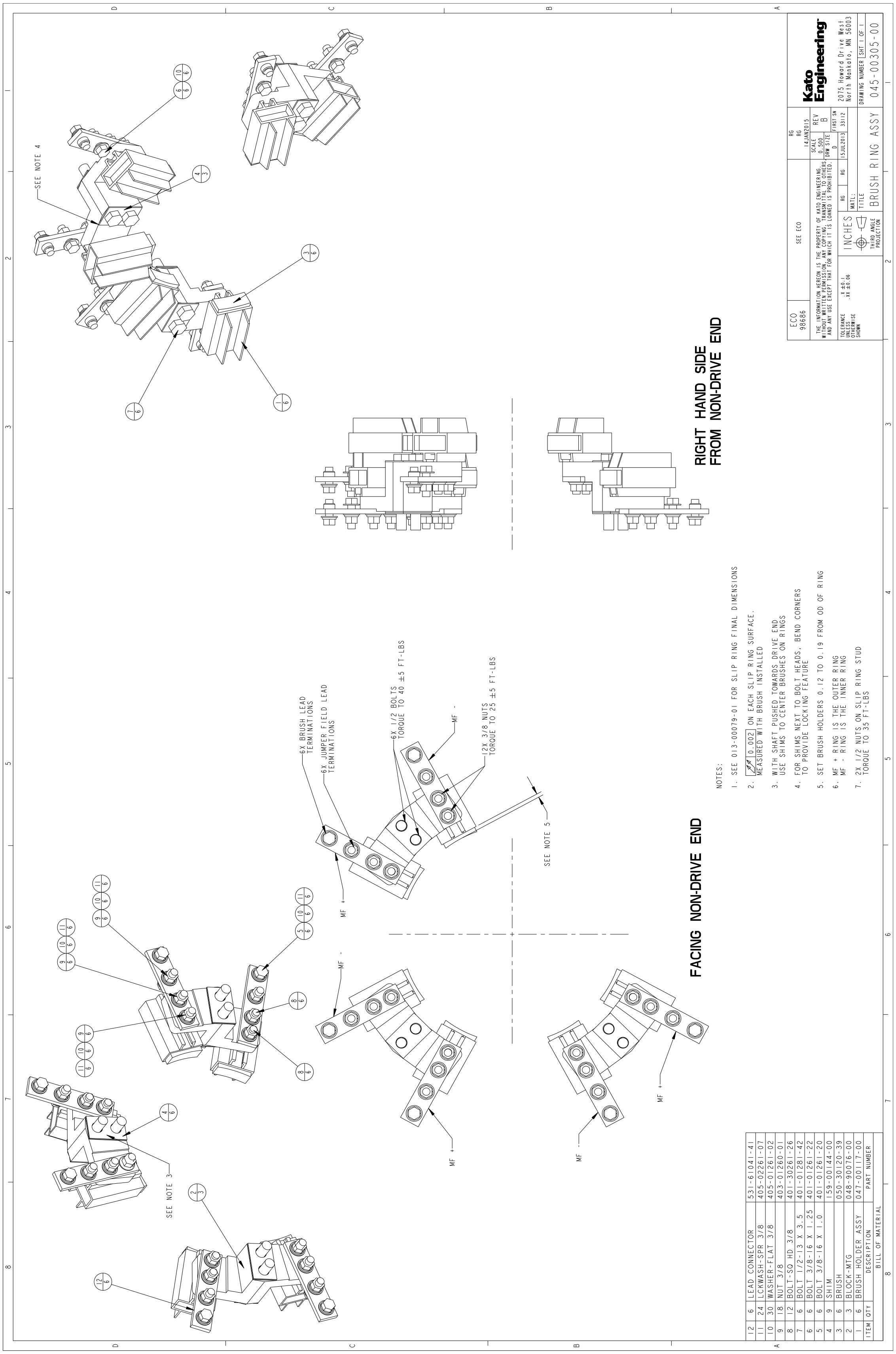


Figure 10-2 Brush Assembly

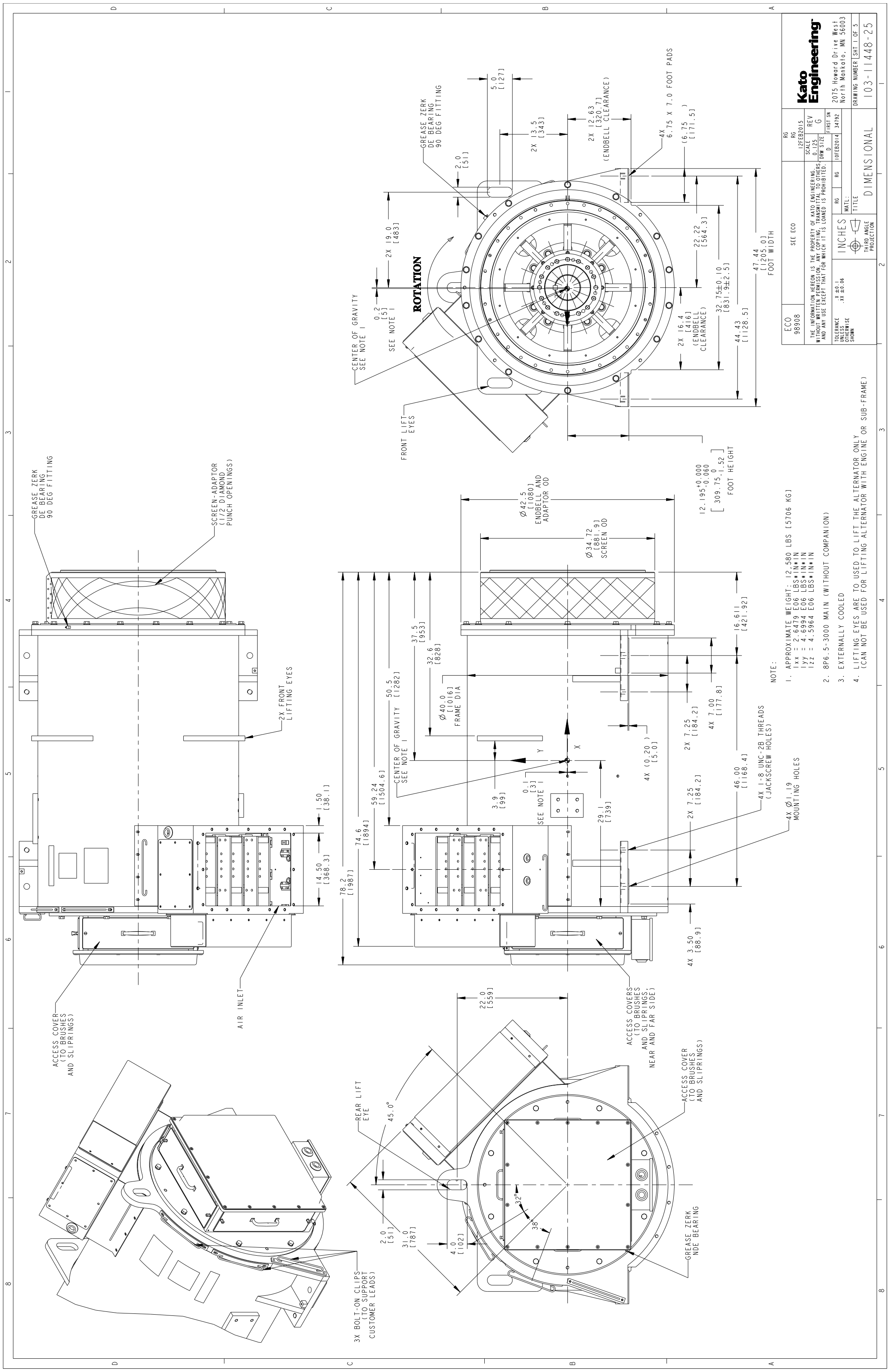


Figure 10-3 Dimensional Page 1

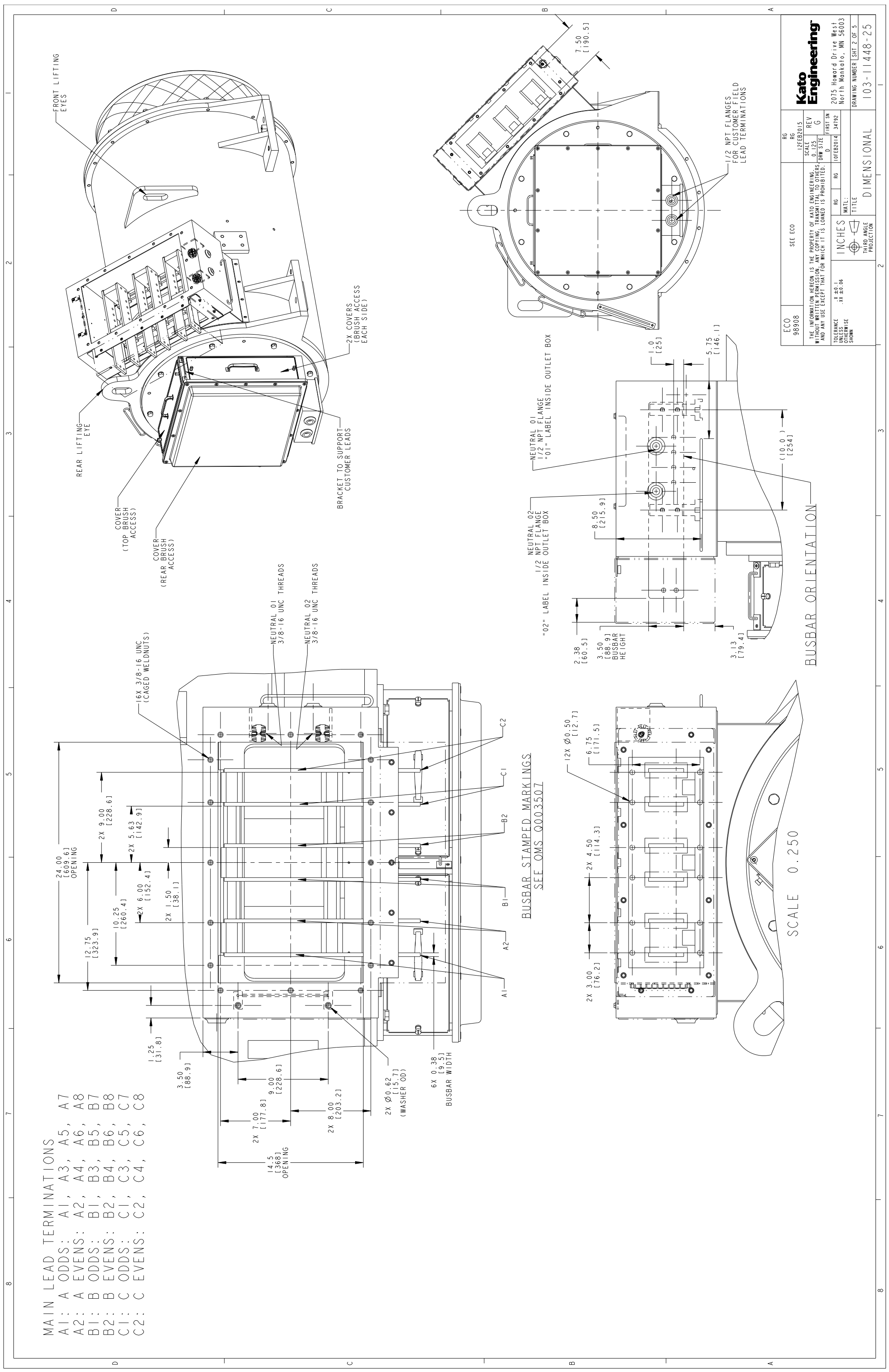


Figure 10-4 Dimensional Page 2

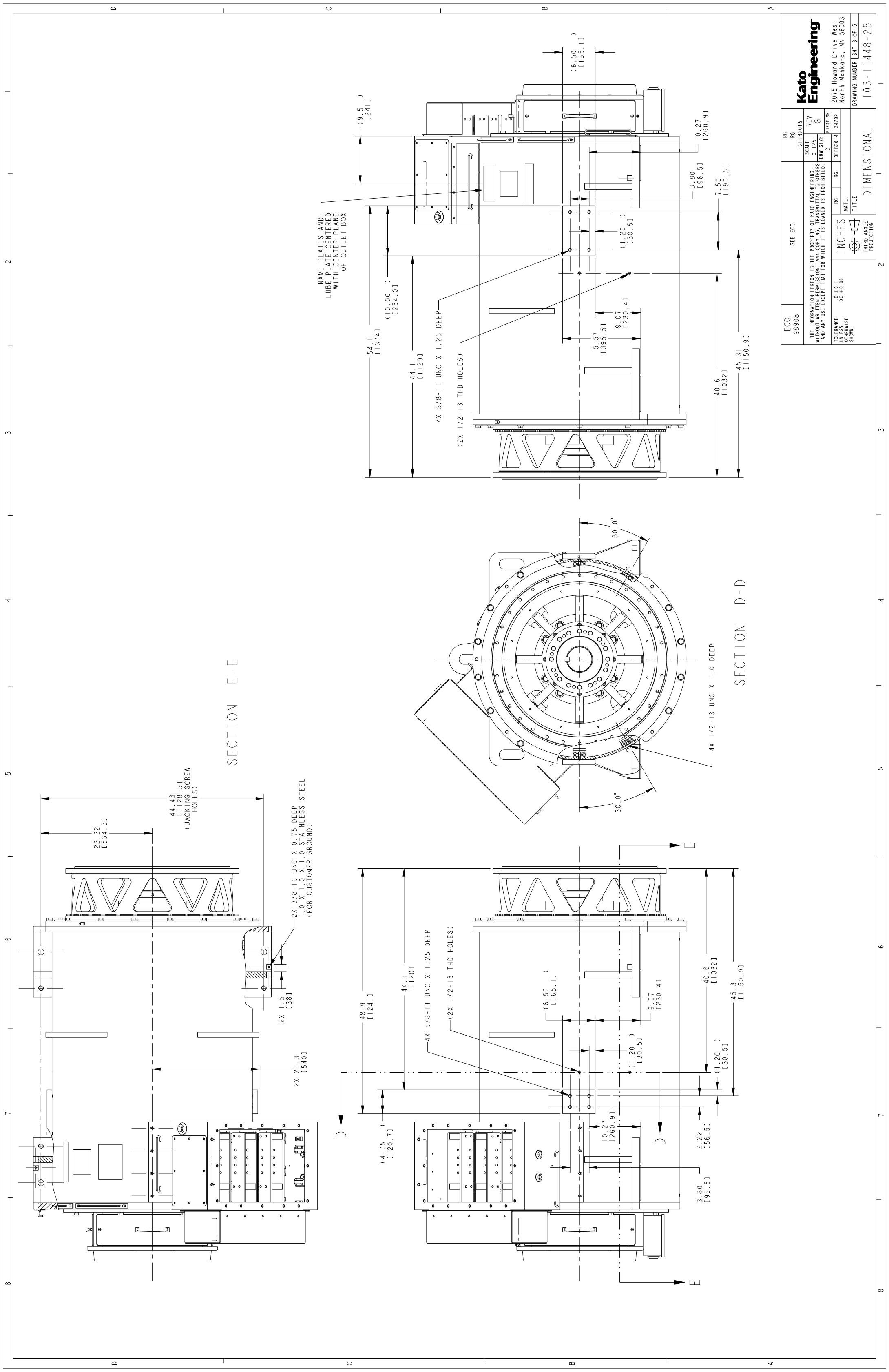


Figure 10-5 Dimensional Page 3

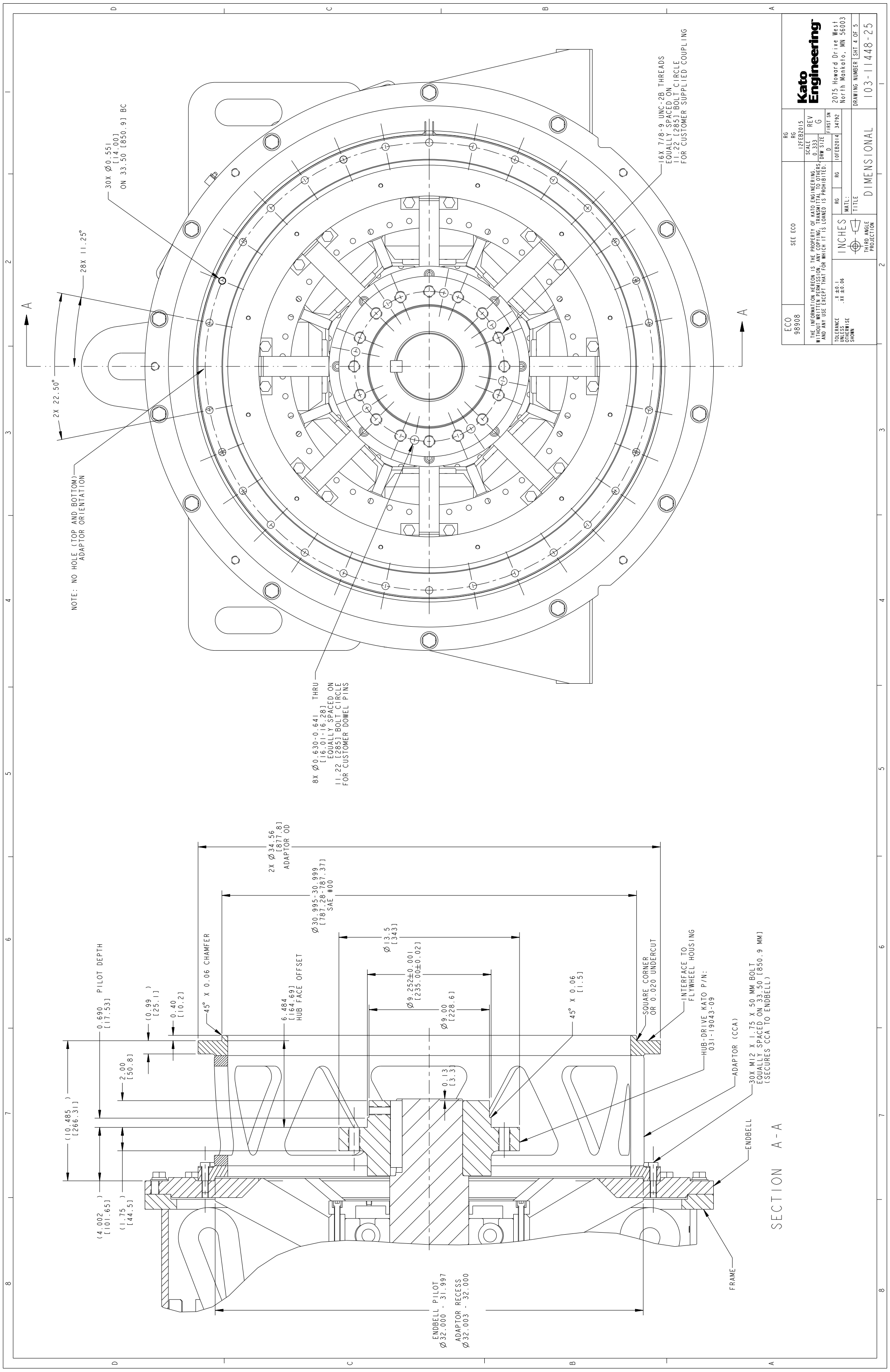


Figure 10-6 Dimensional Page 4

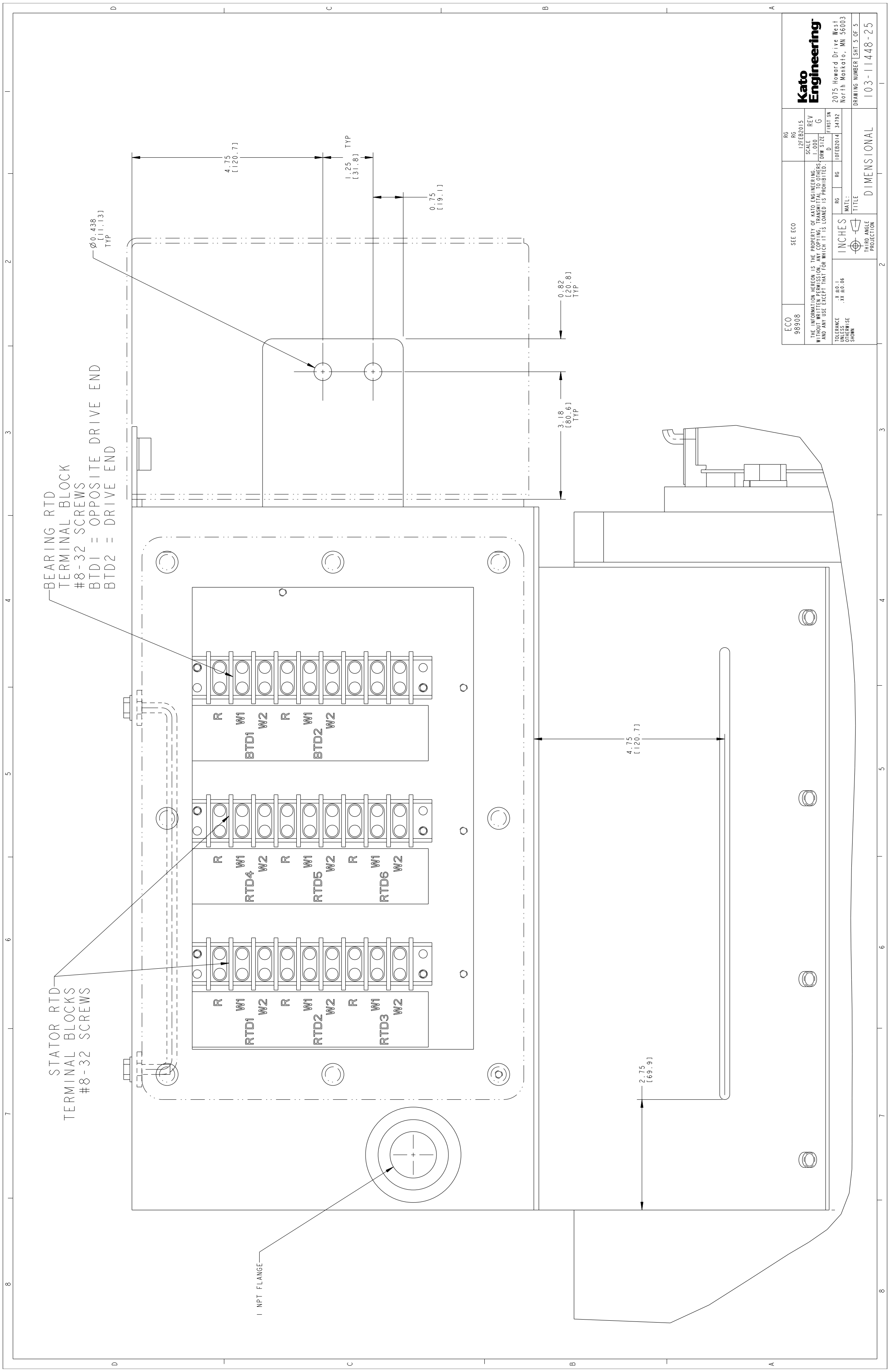


Figure 10-7 Dimensional Page 5

Kato Engineering Support

The brand you trust, the power you depend on. Include the serial number and model number for your machine in the email subject line.

Field Service	KatoService@mail.nidec.com
Parts	KatoParts@mail.nidec.com
Remanufacturing	KatoRemanufacturing@mail.nidec.com
Warranty/Quality Assurance	KatoWarranty@mail.nidec.com

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