OPERATION, PREVENTIVE MAINTENANCE, TROUBLESHOOTING AND SERVICE GUIDE

MODELS 488L and 488-6 WITH CONTROL HANDLE

THIS GUIDE CONTAINS IMPORTANT OPERATION AND SAFETY INFORMATION AND SHOULD BE KEPT AVAILABLE TO THOSE PERSONNEL INSTALLING AND OPERATING THIS EQUIPMENT.

P/N A6474X235
Revision 3, March 2008

SAFETY PRECAUTIONS AND GUIDELINES

OVERVIEW

Before you operate, maintain or in any other way, use this unit -

READ and STUDY this guide. KNOW how to safely use the unit's controls and what you must do for safe maintenance.

ALWAYS wear or use the proper safety items required for your personal protection.

If you have ANY QUESTIONS about the safe use or maintenance of this unit:
ASK YOUR SUPERVISOR - NEVER GUESS - ALWAYS CHECK

PRE-START INSPECTION

Read this entire guide BEFORE attempting to operate this unit. You should be familiar with the controls and their functions before the unit is energized.

INSPECT your machine by doing a pre-operational inspection. Have any malfunctioning, broken or missing parts corrected or replaced before use.

VERIFY that all maintenance has been performed.

VERIFY that all the instruction and safety labels are in place and readable. These are as important as any other equipment on the machine.

CLEAN any foreign material from the operator's compartment.

THIS Model 488 Series UN-A-TRAC® was shipped from the factory equipped with a protective canopy. This canopy MUST be securely in place before operating the unit.

STARTING

DO NOT operate any levers or pedals from outside the operator's compartment to keep the machine from hitting you or other personnel.

FOLLOW the instructions in the STARTING PROCEDURES section of this guide (page 23).

DO NOT operate any levers or pedals if anyone is in the Hazard Zone (page 21).

BE familiar with the operation of the tape switches and be prepared for the sudden stop when the tape switches are struck.

OPERATING

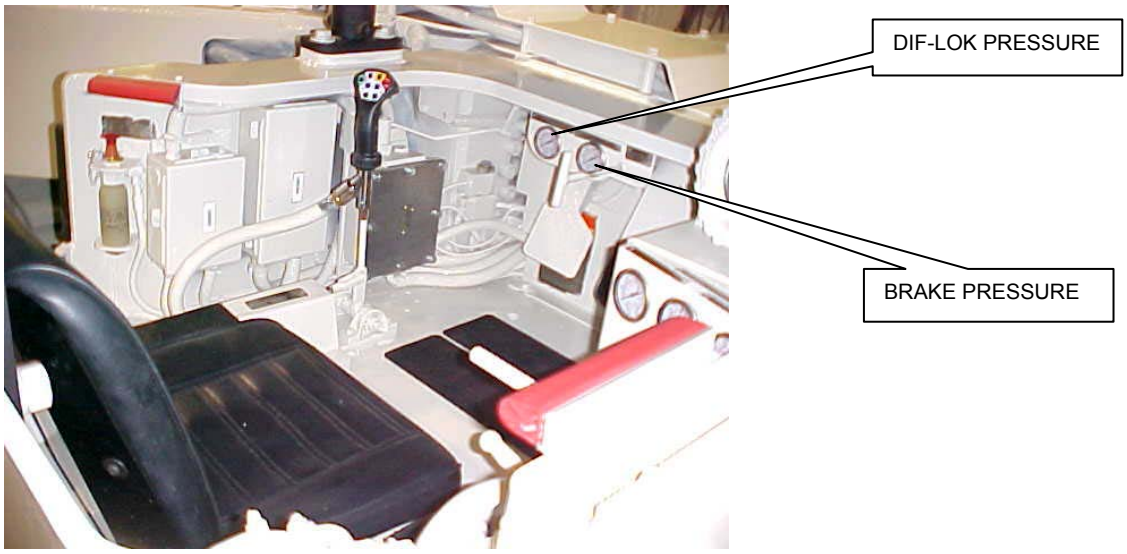
ALWAYS make sure that no person or obstruction is in your line of travel BEFORE starting the unit into motion or in the articulation area when steering the unit.

NEVER climb onto, or climb out of the machine while it is in motion.

DO NOT operate the machine with any part of your body outside of the operator's compartment in order to prevent body parts from being crushed between the machine and objects outside.

USE extreme caution and be observant when working in close quarters or in congested or blind-travel areas. The warning gong should be sounded to alert personnel of your movement.

FIGURE 9 – GAUGE PANEL



GENERAL HYDRAULIC CONTROL SYSTEM INFORMATION

In the operator's compartment located to the right of the operator's seat is a group of control levers and gauges (Figure 10). These levers control the steering, bucket position, ejector blade position, winch operation and battery changer system by means of a hydraulic valve bank located behind the panel to the operator's right. The gauges include emergency brake, accumulator, and system pressure. The hydraulic system pressure relief valve is set at the factory at 2000 psi (138 bar), and should not be changed. Should the "SYSTEM PRESSURE" gauge (Figure 10) read more than 2250 psi (155 bar), SHUTDOWN the Model 488-6 and call a maintenance person (see page 29 for Shutdown Procedure).

HYDRAULIC CONTROL PANEL GAUGES	
GAUGE	**PRESSURE READING**
Emergency Brake	1500 – 1800 psi (103 –124 bar)
Accumulator	1500 – 1875 psi (103 – 129 bar)
System Pressure	2250 psi (155 bar)

WARNING

SHOULD EITHER GAUGE SHOW ABOVE OR BELOW THE PRESSURES LISTED ABOVE, SHUTDOWN THE UN-A-TRAC® AND CALL A MAINTENANCE PERSON (SEE PAGE 29 FOR SHUTDOWN PROCEDURE).

TOWING A DISABLED MACHINE

IT IS NOT POSSIBLE, WITHIN THE SCOPE OF THIS GUIDE, TO ANTICIPATE ALL POSSIBLE ARRANGEMENTS FOR TOWING A DISABLED UNIT. BEFORE ATTEMPTING TO TOW ANY VEHICLE, YOU MUST TAKE ALL POSSIBLE PRECAUTIONS TO PROTECT THE OPERATORS AND ANY ONE AROUND BOTH VEHICLES FROM BEING INJURED BY EITHER THE TOWING VEHICLE, THE TOWING DEVICES OR THE VEHICLE BEING TOWED. THE PRIMARY TOWING DEVICE USED (CABLES, BARS, ETC.) AND THE TOWING VEHICLE (SCOOP, TRACTOR, ETC.) MUST BE STRONG AND HEAVY ENOUGH TO MAINTAIN CONTROL OF BOTH VEHICLES THROUGH ALL BOTTOM CONDITIONS TO BE ENCOUNTERED AT ALL TIMES. SAFETY CHAINS OR OTHER SAFETY DEVICES MUST BE USED IN CASE OF FAILURE OF THE PRIMARY TOWING DEVICE. ALL OPERATORS MUST BE ALERT AT ALL TIMES TO PREVENT EITHER UNIT FROM "RUNNING AWAY" OR RUNNING OUT OF CONTROL DURING TOWING. THE VEHICLE TO BE TOWED MUST BE SECURELY COUPLED TO THE TOWING VEHICLE BEFORE THE BRAKES ARE RELEASED ON THE DISABLED UNIT. THE OPERATOR OF THE TOWING VEHICLE MUST BE IN PLACE IN THE TOWING VEHICLE WITH THE BRAKES APPLIED BEFORE THE BRAKES OF THE DISABLED VEHICLE ARE RELEASED.

1. Couple the towing vehicle securely to the disabled vehicle.

2. Close the valve to tank circuit that is on the hand pump. This isolates the park brake solenoid from the circuit.

3. Begin pumping the hand pump. The building pressure moves the shuttle valve and allows the Automatic (Park) Brake system to be pressurized.

4. The Automatic (Park) Brake is "released" as indicated by the Brake Release gauge.

AT NO TIME DURING TOWING SHOULD ANYONE RIDE IN OR ON THE VEHICLE BEING TOWED OR STAND IN BETWEEN THE TOWING VEHICLE AND THE DISABLED VEHICLE.

5. Begin towing the vehicle.

6. Once the destination is reached, stop both vehicles and set the parking brake on the disabled vehicle before removing the towing devices. The disabled vehicle should be choked in both directions at all four wheels for additional stability. The brake is "set' by opening the valve on the hand-pump.

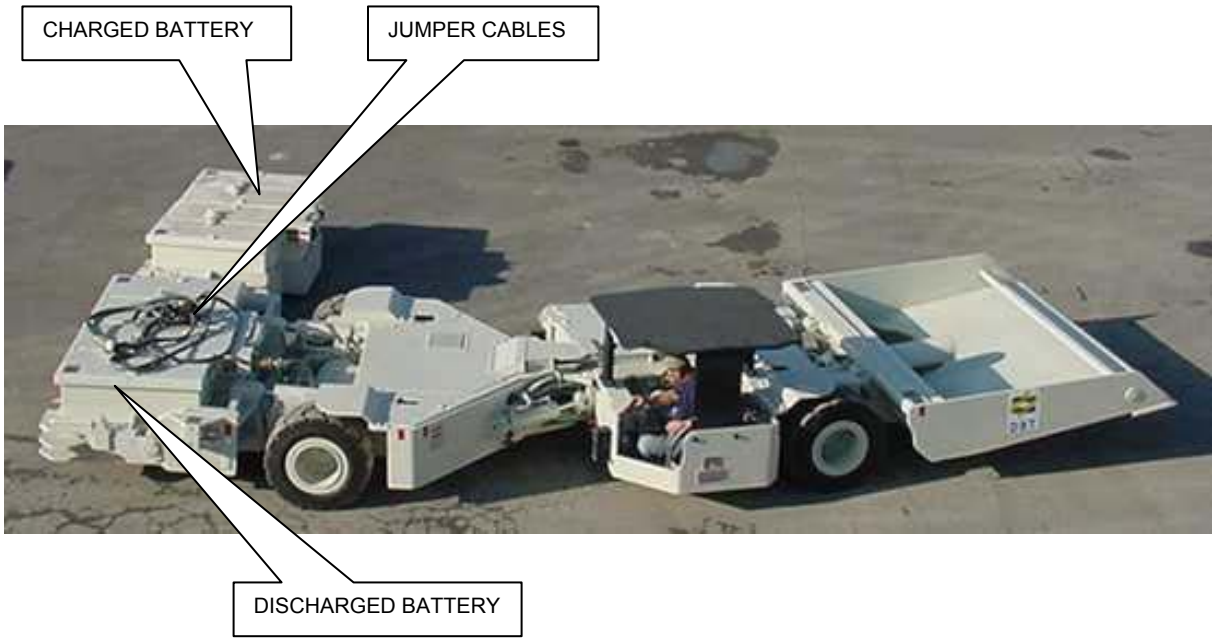
FAILURE TO SET THE PARKING BRAKE ON THE DISABLED VEHICLE BEFORE REMOVING THE TOWING DEVICE COULD ALLOW THE DISABLED VEHICLE TO ROLL AWAY UNCONTROLLED.

BATTERY CHANGE PROCEDURE (GROUND LEVEL)

Two people are needed to change the battery in the UN-A-TRAC®. Since one person may step into the Hazard Zone, the other person (operating the UN-A-TRAC®) must be very careful and look each time before moving any levers or pedals. Take time now to refamiliarize yourself with the Hazard Zone (page 21).

1. Line up the battery end of the UN-A-TRAC® with the place where the battery is to be deposited (Figure 25) (see Starting Procedure, page 23).

FIGURE 25 – BATTERY CHANGE PROCEDURE (GROUND LEVEL)



THE "BATTERY" CHANGE CONTROL LEVER SHOULD NEVER BE OPERATED EXCEPT AT A BATTERY CHANGE STATION OR WHEN ITS NECESSARY TO ADJUST THE BATTERY'S TERRAIN CLEARANCE. IF THE "BATTERY" CHANGE CONTROL LEVER IS OPERATED IN A LOW ROOF AREA, THE BATTERY MAY BE DAMAGED.

2. Unlatch both battery latch pins before placing the battery on the ground (Figure 26). If difficulty is encountered in unlatching the latch pins, it may be necessary to gently shake the battery up and down by using the battery "LIFT" control lever.

CRITICAL TORQUE VALUES

Torque values are expressed in lubricated and dry thread values. Lubricated thread torque values should be used any time the bolt threads are covered with oil, grease, anti-seize or thread-locking compounds. Dry thread torque values should be used when threads are completely clean and dry.

CRITICAL BOLT TORQUE VALUES (ft./lbs.) (m-n)				
LOCATION	**BOLT SIZE**	**GRADE**	**DRY**	**LUBRICATED**
Steering Cylinder Pins	7/8 NC	Grade 8	N/A	460
Tire-Wheel Mounting Bolts (John Deere Axle)	3/4-16UNF X 2-1/2”	Grade 8	390 (529 m-n)	300 (407 m-n)
Tire-Wheel Mounting Bolts (Meritor Axle)	9/16 NC X 2-1/4”	Grade 8	160 (217 m-n)	120 (163 m-n)
Tire-Wheel Mounting Bolts (Kessler)	M16 X 1.5 X 60	Class 10.9	232	217
Drive Motor-to-Gearbox Mounting Bolts	3/4NC X 2-3/4”	Grade 5	285 (387 m-n)	170 (231 m-n)

LUBRICANTS, FLUIDS AND CAPACITIES

LOCATION	**TYPE OF LUBRICANT**	**APPROXIMATE CAPACITY**	**NOTES**
Hydraulic Oil	Spec. 100-1 (John Deere or Meritor) Spec. 100-12 (Kessler)	40 Gallons (151.5 l)	1
Speed Reducer (Gearbox)	Spec. 100-6	As Required	
Axle Housing (Meritor) (Kessler)	Spec. 100-6	As Required	2
Planetary Wheel Ends (Meritor) (Kessler)	Spec. 100-6	As Required Each Wheel end	2
Wet Disc Brakes (Meritor) (Kessler)	Spec. 100-12	As Required For Each Brake	2
John Deere Axle	John Deere Hy-Gard Oil	20 Qt. (18.9 l)	5
Winch	API GL-4 or (140) Worm Gear Oil Peragma Grade 8	5 pints (2.36 l)	
SROIB Park Brake	SROIB Oil	2 Qt. (1.89 l)	4
Wet Disc Brake (PT Tech)	Spec. 100-1	As Required	
Multi-Purpose Grease	Spec. 100-3	As Required	3

Notes:

1. With ejector blade completely retracted.
2. The axle housing, brake cooling sumps, and planetary wheel end assemblies do not have a common oil source. Each assembly must be filled separately.

   Make sure the level and fill hole in the planetary wheel end cover is in the proper position. Rotate the wheel end as required to bring the fill hole to either the 3 o'clock or 9 o'clock position.

   When filling the axle housing and planetary wheel ends, allow enough time for the lubricant to fill the various cavities and around component parts in each assembly. Continue adding oil into each assembly until the required oil level is reached
3. Pump grease into fitting until old grease can be observed coming out of component.
4. If the SROIB brake is used as a service brake, sump oil capacity is 4 qt (3.78 l).
5. When bleeding brakes, bleed both ports at the same time.

ONCE PER MONTH

1. Inspect the drive motor (Figure 45).

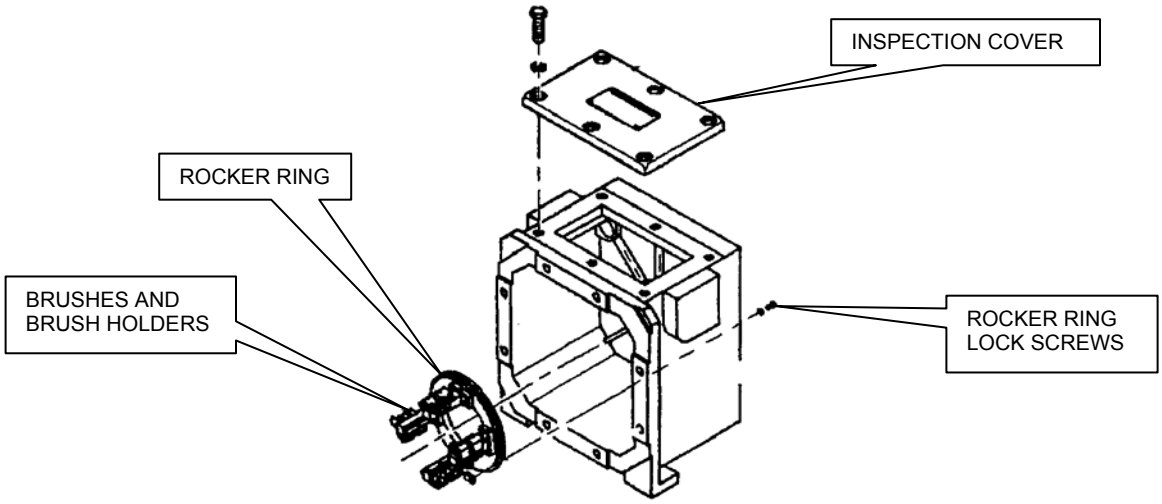
   A. Be sure that the machine circuit breaker lever is in the "OFF" position.
   B. Remove the inspection covers.
   C. Inspect the windings, commutators, brushes, armature, and terminal leads.

      1. Windings should be dry and free of dust, grease, oil, and dirt.
      2. The commutator should be clean and smooth with a medium polish and a light brown color.
      3. Brushes and brush holders should be clean so that the brushes are free to move in the holders and are properly seated. Brushes should be replaced before wear permits the rivets to score the commutator. (See replacement procedure below)
      4. The armature and field leads should be undamaged.
      5. Terminal leads should be tight.

   D. Replace the inspection plate being sure it is securely tightened.

THE DRIVE AND PUMP MOTORS DO NOT REQUIRE PERIODIC LUBRICATION. THE PUMP MOTOR BEARINGS ARE SEALED. THE DRIVE MOTORS HAVE ONE BEARING SEALED AND THE OTHER BEARING RECEIVES LUBRICATION FROM THE GEARCASE OIL.

FIGURE 45 – ROCKER RING AND BRUSHES



2. Drive Motor Brush Replacement (if necessary):

   A. Remove power from the unit by moving the machine or battery circuit breaker lever to "OFF" or by unplugging the battery.
   B. Remove inspection cover (Figure 45).
   C. Mark the brush holder (rocker ring) neutral setting by scratching or painting two aligning marks, one on the brush holder (rocker ring) and one on the motor end bell.
   D. Loosen (BUT DO NOT REMOVE COMPLETELY) the two rocker ring lock screws.
   E. Rotate the rocker ring until one of the brushes comes up on top. Disconnect the brush lead and remove the old brush. Replace the old brush with a new one and reconnect the lead wire.
   F. Repeat this procedure until all the old brushes have been replaced.
   G. Rotate the rocker ring until the neutral marks are aligned.
   H. Retighten the two lock screws.

HYDRAULIC SYSTEM (GENERAL) (CONT.)

TROUBLE, SYMPTOM OR CONDITION	PROBABLE CAUSE	TEST, CHECK AND/OR REMEDY
FOREIGN MATTER SOURCES IN THE CIRCUIT	1. Sealing compound (pipe dope, teflon tape).	1. Clean or replace seals.
	2. Burrs inside piping components.	2. Disassemble piping components and remove any burrs.
	3. Tag ends of packing coming loose.	3. Remove old packing and replace with new.
	4. Lines left unprotected and dirty, repaired components.	4. Drain and replace oil.
	5. Repair parts not properly protected while stored.	5. Clean parts thoroughly before installation.

BRAKES (SERVICE) WET DISC

INSUFFICIENT BRAKING	1. No gas charge in accumulator.	1. Check gas charge.
	2. Defective brakes.	2. Check brakes.
	3. Hydraulic lines or fittings leaking.	3. Check for leaks and repair.
	4. Pedal linkage out of adjustment.	4. Adjust linkage.
	5. Damaged hydraulic brake lines.	5. Check lines for dents that restrict flow.
	6. Air in brake system.	6. Bleed brakes.
	7. Brake seal or o-ring failure.	7. Replace seal or o-ring.
	8. No oil or low oil level in tank.	8. Bring oil up to proper level.

A most common problem with tire/wheel installations is the incorrect tightening of wheel bolts or studs. Threaded fasteners perform there function of holding things together better when torque control is used in their tightening. Using an accurate torque wrench correctly is the best and most practical way of securing fasteners, Although torque value charts are available as a reference guide to proper tightening, OEM specifications should always be followed when tightening fasteners. However, proper torque values are of little benefit if certain other factors are not considered.

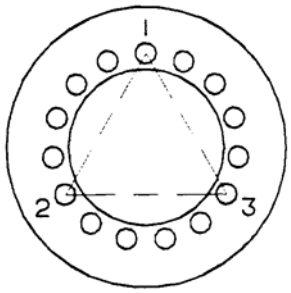
WHEEL MOUNTING TIPS

All fasteners should be examined before use. Any fastener that is worn, bent or has damaged threads should be replaced. Fastener threads should also be lightly coated with a protective substance, such as residual oils, wax or loctite, because any oxidation or rust will upset the torque-to-tension relationship.

Mating surface conditions should also be considered. The tightening surface under the bolt or nut should be carefully inspected. A fastener, when tightened against a softer material, will gall under these conditions, and much of the applied torque may be lost through head friction. It is very important when using higher strength fasteners to have a smooth, even surface under the bolt head. In some cases, hard flat washers and most lockwashers will provide a good tightening surface.

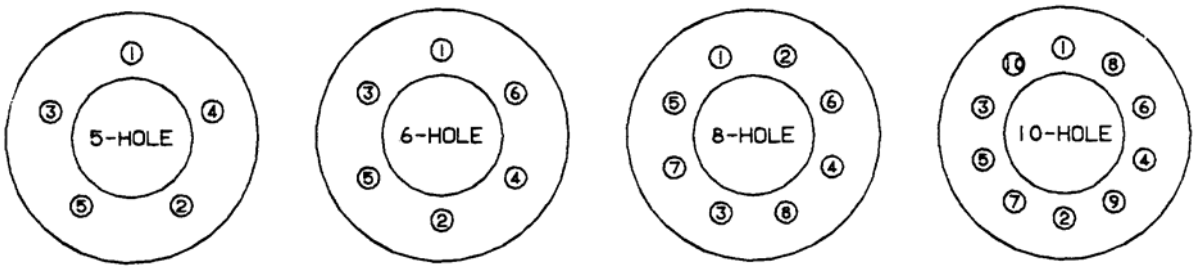
Another area of concern is cleanliness. All mating surfaces should be free of rust, dirt, oil, paint, etc. Also no paint of any kind should exist between a fastener and wheel disc surface. Any form of contamination between these surfaces will most likely lead to serious wheel problems.

FIGURE 50 – WHEEL TORQUING PATTERN



WHEN TORQUING ANY WHEEL BOLT PATTERN, ALWAYS TORQUE IN A TRIANGULAR PATTERN.

FIGURE 51 –TORQUE PATTERNS



MAJOR HAZARDS

AREA WHERE HAZARD CAN OCCUR	HAZARD WHAT CAN HAPPEN IF PRECAUTIONS AND SAFEGUARDS ARE NOT OBEYED	SAFEGUARDS HOW TO AVOID THE HAZARD
ENTIRE BATTERY	Mine service batteries can weigh several thousand pounds and could cause severe injury or death should the battery fall on persons or body parts	Batteries must be resting securely in a machine, on battery tables, or platforms capable of supporting the weight while performing maintenance or service on battery.
ELECTRICAL	Electrical shock could cause death or serious injury. The battery produces lethal amounts of current whether connected to a machine or not.	Batteries should be maintained and serviced by qualified personnel. The battery should be disconnected before servicing.
EXPLOSIVE GASES	Batteries produce explosive gases that could be ignited causing burns or explosions.	Batteries should be well vented before servicing, particularly if welding or burning on the battery. Batteries should be maintained by qualified personnel.
CORROSIVE ACIDS	Batteries contain strong acid that could cause severe burns if spilled or splashed on body parts or in the eyes.	Protective clothing, gloves, and eyewear must be worn when working on batteries. Batteries should be maintained by qualified personnel.
COVERS	Battery covers could fall, crushing hands, arms, or fingers.	Battery covers must be secured with the cover supported when working under the covers.

recommended that a battery be restricted to one full cycle per 24 hour day or fewer than 300 cycles per year. Other factors which most often adversely influence service life are:

1. Abnormally high or low electrolyte temperatures.
2. Frequent overdischarging.
3. Failure to add water regularly.
4. Frequent overcharging.
5. Poor, or high, resistance, connections or contacts.
6. Adding too much water.

1-13. Effect of Temperature

The normal operating characteristics of a storage battery are modified by unusually low or high cell temperatures.

a. Low Temperature - Available battery power is reduced by low temperature because electrolyte viscosity and resistance is increased and diffusion throughout the pores of the active material is retarded. For example, a fully charged battery (1.280 to 1.295 specific gravity at 77 degrees F.), when its electrolyte temperature is about 32 degrees F., will deliver only 75% of the capacity which would be available at normal room temperature. This drops to 40% at 0 degrees F. The electrolyte could freeze if a discharged battery were exposed to very cold temperatures for several hours. (See Table 1 for freezing points of various electrolyte concentrations.)

In addition to the discharge-related problems, the charge acceptance of a lead-acid battery is impaired when electrolyte temperatures drop below 60 degrees F. As a result, batteries should always be kept fully charged, especially in cold weather. They should be heated, even during operation or storage, if exposure is severe enough to cause the temperature of the electrolyte to approach 32 degrees F.

b. High Temperatures - Although high temperatures (up to 110 degrees F.) do not cause a reduction in available capacity, battery operation is adversely affected. Because most chemical reactions are accelerated at high temperatures, the rate of corrosion of the positive grid is increased and the active material is shed more rapidly. Even electrolyte temperatures above 90 degrees F. will cause some reduction in service life and should be avoided whenever possible. Cell temperatures should never be allowed to exceed 110 degrees F.

TABLE 1
FREEZING POINTS OF VARIOUS ELECTROLYTE CONCENTRATIONS

State of Charge-Approximate (Percent)	Specific Gravity	Freezing Point (Degrees Fahrenheit)
100	1.280	-95
75	1.250	-62
50	1.220	-31
25	1.160	+ 1
10	1.130	+10

CHAPTER 3 – FIELD SERVICING AND REPAIR

Section I. Troubleshooting

3-1. General

In addition to the required routine maintenance described in Chapter 2, Section III, storage batteries may, at some time during their service life, require more extensive or unusual care. Such care should be given as soon as it has been determined that a problem exists or that trouble may be developing. This section deals with the means of identifying existing or impending problems and offers possible solutions.

The Troubleshooting Chart, Table 4, defines the most common problems which could occur during a battery's lifetime. If the suggested operational remedies are ineffective, it may be assumed that there is an internal problem and it will be necessary to disassemble the cell or cells to inspect the elements and sediment well. If the cause of the problem can only be corrected by completely replacing cells or the battery, this information should be reported to the person in authority.

3-2. Restoring a Sulfated Battery

Continued undercharging a battery, even to a small degree, leads to excessive "sulfation." The same is true of batteries which have been left standing in an uncharged state for an extended period. High temperatures rapidly accelerate sulfation when batteries are left standing in a partially charged condition. The cells of a sulfated battery will give low specific gravity and voltage readings. The battery will not become fully charged after a single normal charging when sulfation has taken place over a prolonged period.

If the sulfation has not progressed too far, it may be possible to restore the battery to a serviceable condition by using the following special procedures:

1. Thoroughly clean the battery. (See Paragraph 2-14.)

2. Bring the electrolyte level up to a point which is just visible over the separator-protector by adding approved water.

3. Put the battery on charge at the prescribed finishing rate until the rated ampere-hour capacity has been returned to the battery. Record the voltage and specific gravity readings. Correct the specific gravity readings for temperature by using Table 3. If the temperature at any time during these procedures exceeds 110 degrees F., stop the charge and allow the battery to cool to 90 degrees F. or below before continuing. Charge the battery until the specific gravity shows no change during a 4 hour period while taking hourly readings. With automatic charging equipment, the battery may have to be placed on equalizing charge two or three times. If a battery is badly sulfated, the specific gravity may rise only 30 to 40 points (.030 to .040) during the first charge.

4. Place the battery into service and discharge it to a fully discharged condition.

5. Charge the battery again until the specific gravity shows no change during a 4 hour period.
6. Repeat the cycling process until the specific gravity rises to within 30 points of a normal fully charged battery, then place the battery back in routine service. Even though specific gravities may be lower than normal, they should not vary much from cell to cell. If they do, problems other than sulfation may be present. If the spread between the highest and the lowest gravity reading is 50 points or more, refer to the Troubleshooting Chart for help in identifying the problem. If the battery still has not responded to treatment, it should be replaced.

CHAPTER 4 – HEALTH AND SAFETY

Section I. Battery Hazards

4-1. General

A lead-acid battery can be very useful, safe source of electrical power. While installing, using, maintaining, or repairing a motive power battery, opportunities exist, however, for exposure to potentially dangerous situations. This section identifies those hazards which could result from improper handling or use.

4-2. Hazards

a. **A sulfuric acid** solution is used as the electrolyte in lead-acid batteries and has a concentration of approximately 37% by weight of sulfuric acid in water. In this diluted state, it is not as hazardous as strong or concentrated sulfuric acid, but it acts as an oxidizing agent and can burn the skin or eyes and destroy clothing made of many common materials such as cotton or rayon.

b. **An explosive mixture** of hydrogen and oxygen is produced in a lead-acid battery while it is being charged. The gases can combine explosively if a spark or flame is present to ignite them. Because hydrogen is so light, it normally rises and diffuses into the air before it can concentrate in any explosive mixture. If it accumulates into gas pockets, as can occur within a cell, it might explode if ignited.

c. **Electricity** is produced by the batteries on discharge and, while most persons cannot "feel" voltages below 35 to 40 volts, all mine power batteries should be regarded as potentially dangerous. A lead-acid battery is capable of discharging at extremely high rates and, under conditions of direct shorting, can cause damage and serious injury.

d. **The weight** of these heavy batteries can easily cause painful strains or crushed hands or feet if improperly lifted or handled. Batteries can be damaged if dropped. The average mine power battery weighs more than one ton, so proper equipment must be provided when changing or handling batteries.

e. **Burns** can result from contact with molten lead or hot compound while repairing a battery. Lead can splash when intercell connectors are being reburned and hot compound can be spilled when resealing covers to jars. The protective gear provided, if worn, will prevent such burns.

Section II. Safety Procedures

4-3. Federal Standards

In 1970, Congress passed the Occupational Safety and Health Act (OSHA). This act established the minimal acceptable standards for safe and healthful working conditions. The safety procedures suggested in this manual have been compiled from standards developed over the years by professional and technical organizations and by battery manufacturers and users. Experience has shown them to be the most effective safety standards. In all cases, they exceed the minimum standards of OSHA for personal safety and include procedures for safeguarding equipment as well.

The safety procedures have been grouped by functional area of most logical application or need.

GENERAL INFORMATION

TO ENSURE SAFE INSTALLATION AND OPERATION, THE INFORMATION GIVEN IN THIS INSTRUCTION MANUAL SHOULD BE READ AND UNDERSTOOD BEFORE INSTALLING OR USING THE EQUIPMENT.

RECEIVING INSTRUCTIONS

Unpacking and Inspection:
Examine the shipping crate upon arrival. If there is obvious damage, describe on the receiving documents. Within a few days after delivery, the equipment should be uncrated and carefully inspected for hidden damages. When removing packaging material, be careful not to discard any equipment, parts, or manuals

HANDLING

EQUIPMENT CAN BE VERY HEAVY, AND TOP HEAVY. USE ADEQUATE MANPOWER OR EQUIPMENT FOR HANDLING. UNTIL THE EQUIPMENT IS SECURELY MOUNTED, CARE MUST BE USED TO PREVENT THE EQUIPMENT FROM BEING ACCIDENTALLY TIPPED OVER.

NOMENCLATURE PLATES

Each Bucyrus Series Charger shipped is identified by part number on the nomenclature plate.

ADJUSTMENTS

All equipment is shipped from the factory fully checked and adjusted. Do not make any adjustments unless the equipment has been powered-up and the settings have been determined to be incorrect.

SPARE PARTS

To minimize downtime during installation or normal service, it is advisable to purchase spare fuses, circuit boards and other recommended components. Please refer to the parts manual for parts numbers. It is recommended that spare fuses be ordered for all systems.

During shipping, an a.c. wire may rub against the d.c. lugs, terminals, etc. and cause a short. These problems may be eliminated by very carefully inspecting the wiring to make certain the a.c. wires are not touching the d.c. wiring. If no wires are touching, then it is possible that the primary and secondary of the transformer is shorted. Disconnect the secondary of the transformer from the diodes. Measure with ohmmeter from input terminal to one of the isolated secondary leads. If there is an ohmmeter indication, there is an insulation breakdown between primary and secondary windings. The transformer should be replaced.

4. Check the input terminals to ground and check the output terminals ground. If the meter indicates full scale deflection, a wire is touching a metal part of the unit. Look for wires that are near any metal part and inspect for possible breakdown caused by shipping. The heatsink of the diodes and the control unit are insulated from ground through the mounting legs.

Troubleshooting and Replacing Power Silicon Diodes

If a portable multimeter is used, set the switches on "ohms", "d.c.", and " Rx1 " scale.

1. Isolate one end of the diode by disconnecting the wires attached to the nipple (or pigtail) end of the diode (only one end of the diode must be disconnected).
2. Clip one lead of the ohmmeter to the anode lead of the diode. Clip the other ohmmeter lead to the cathode.
3. Note the ohmmeter reading. Then reverse the leads to the diode. Again, note the ohmmeter reading. If the diode is good, the meter will indicate a high resistance in one direction, and a low resistance with the leads reversed. If the diode is shorted, the meter will read full scale, or zero ("O") resistance with the leads in either direction. If the diode is "open", the ohmmeter needle will not indicate or it will show infinite resistance in either direction, indicating an open circuit.
4 All diodes must be checked in the event that more than one diode is defective.
5. If the diode is defective, remove it from the heatsink. Clean and smooth the heatsink surface, then using an electrically conductive grease, apply to the new diode and replace it in the heatsink.

Checking Capacitors

When checking capacitors, be sure all power is turned off and the battery is disconnected. Momentarily short circuit the capacitor leads to assure complete discharge. Connect the meter test leads to the capacitor leads or terminals and observe indicated resistance.

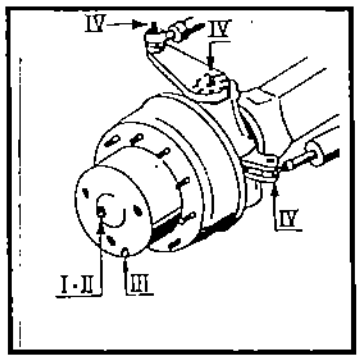
A good capacitor will indicate an initial low resistance and gradually increase as the capacitor charges. The final resistance of a good capacitor is usually several hundred thousand ohms approaching a megohm.

Initial high resistance approaching infinity indicates an open capacitor.

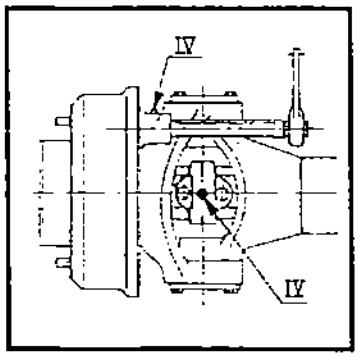
Initial and continued low resistance readings indicate a shorted capacitor.

When ordering replacement parts, drawings, or schematics, always give model number, serial number and a.c. input voltage.

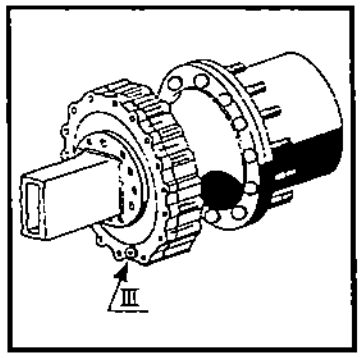
Lubrication points



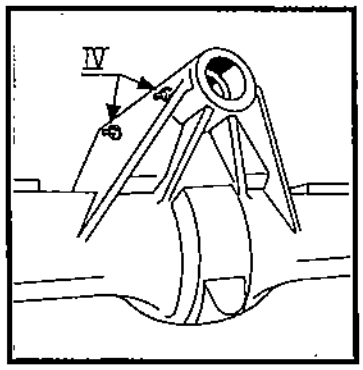
Hub assembly with planetary gear drive



Lubrication points at universal joint and brake shaft .
(if not maintenance - free)



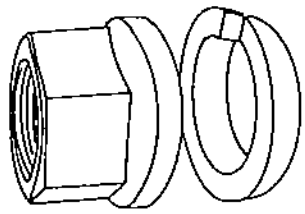
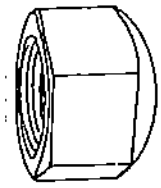
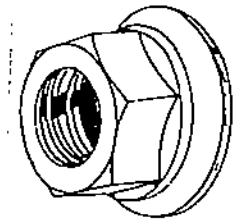
Hub assembly with wet disk brake



Tumbler bearing

I = Oil fill plug
II = Oil level control plug
III = Oil drain plug
IV = Grease nipple

Tightening torques of wheel nuts

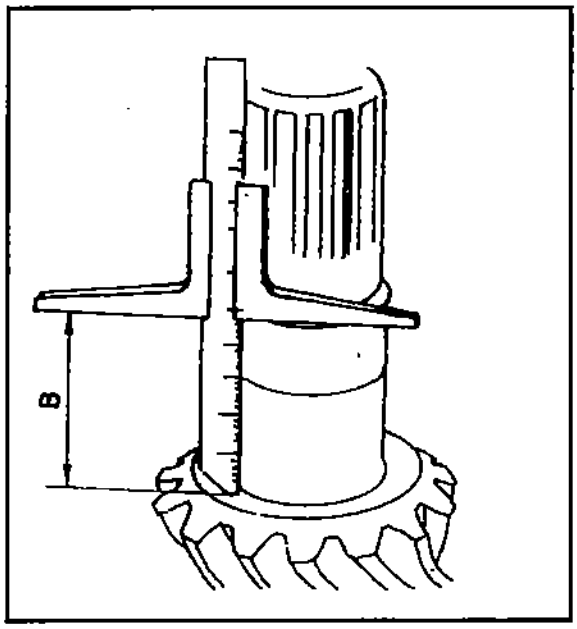
		
Wheel nut with spring lock washer	Wheel nut with clamp (for clamp fixation)	Wheel nut with thrust collar (for rims with centerring)

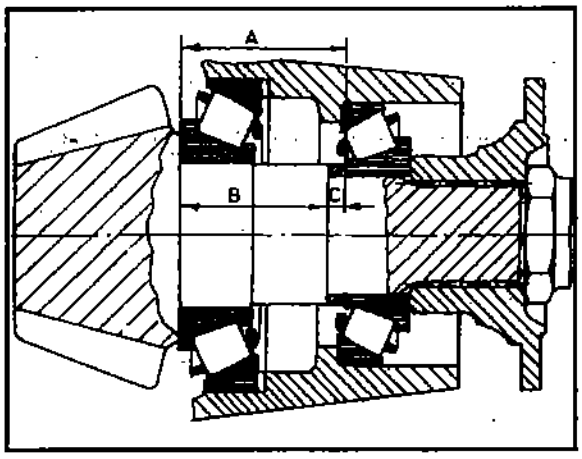
Wheel nut with spring lock washer		
Dimensions	Phosphourus darkened	Galvanized
M 18 x 1,5	270 Nm	250 Nm
M 22 x 1,5	450 Nm	350 Nm

Wheel nut with thrust collar		
Dimensions	Phosphourus darkened	
M 22 x 1,5	650 Nm	

Wheel nut with clamp		
Dimensions	Galvanized	
M 18 x 2	350 Nm	

Assembly of drive pinion bearing





1. Insert the two outer rings of the taper roller bearings into the differential carrier.

2. Calculate the thickness C of the spacer ring.
   a) Place the two inner rings of the taper roller bearings in their outer rings. Measure A.
   b) Measure the dimension B of the drive pinion.
   c) Thickness of the spacer ring C = A - B.

3. Heat the drive pinion side taper roller bearing to about 100 ° C and install it on the drive pinion shaft. (Drive on completely after it cools).

4. Install the spacer ring on the pinion shaft.

5. Install the drive pinion into the differential carrier. Heat the taper roller bearing inner ring at undersize to about 100 ° C and install it with a tube onto the drive pinion shaft.

6. Install the drive flange onto the drive pinion shaft. Tighten the safety nut according sheet 3.5. For tightening fix the differential carrier and block the drive flange.

7. Measure the resistance of the bearings by using a torque wrench. If the measured value is not the prescribed 0,8 to 1,2 Nm, adjust the resistance by modification of the thickness of the spacer ring. After arriving at the adjustment of the bearing, back - off the safety nut and draw off the drive flange.

8. Install the radial seal ring with Loctite 572 applied. Fill the radial seal ring with bearing grease. Fit the carrier of the parking brake (if present) on the differential carrier and tighten the screws. Slip on the drive flange, screw on the safety nut with sealing compound between the contact surfaces. Tighten the safety nut according sheet 3.5. Lock the nut by striking the nut brim into the slot of the pinion.

Adjustment of wheel bearings

Tightening torque of the wheel safety nut

Series	Nm
41 51	300 350
61, 71 81	400 450
91 109 116	500
106 L101 L102 D / LT 101 / 102	500 550 650
111 112	750 1000

Adjusting of wheel bearings

The temperature of the axle parts should be between 0 and + 20° C at the bearing adjustment .
Screw on the wheel safety nut (Loctite- resp. Molykote- using see page 5.7.2) and adjust and secure as following described :
Screw on the wheel safety nut and tighten it with a 1,5 to 2 times higher tightening torque than the finish tightening torque . During the tightening , turn the wheel hub a few times and knock it with a plastic hammer . Untighten the wheel safety nut (about 180° back rotation) , then tighten the wheel safety nut to the tightening torque according to the table . At this tightening turn the wheel hub also a few times , if there is no possibility for securing , the wheel safety nut has to be turned back to next securing possibility .

Adjustment of the axial clearance

The axial clearance between sun gear and thrust disk (27) in the planetary housing must be 0,3 - 0,7 mm.

Measure distances :

Dimension A =

Dimension B =

Calculate required thickness, take the axial clearance (0,3 to 0,7 mm) into consideration.

Mount the correctly dimensioned thrust disk (if necessary, make final correction on a lathe) into the planetary housing. Secure with Loctite 270.

Assembly of the planetary housing

Place o - ring (30) into the slot of the planetary housing. Install the preassembled planetary housing and bolt it, secure with Loctite 262.

Tightness checking instruction for brake hydraulic system and cooling oil room

Check brake hydraulic system for leaks

Before conducting the test , bleed the brake hydraulic system .
The pressure drop after applying pressure corresponding the working pressure of the brake for a period of 15 minutes must not exceed 2% .
Test medium : Motor oil SAE 10 W corresponding to MIL - L 2104 .

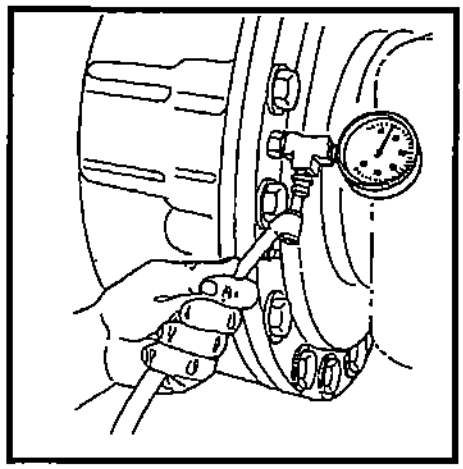
Check cooling oil room for leaks

Brake with external cooling :

After assembly of the wheel hub with the face seal and adjusting of the wheel bearings check the tightness of the cooling oil room .
Install a air pressure gauge with shutoff valve .
Beload the hub assembly with 1,5 bar pressure air .
Turn the hub assembly several times .
The pressure drop after a period of 10 minutes must not exceed 0,1 bar .

Brake without external cooling :

After assembly of the planetary gear drive check the tightness of the cooling oil room .
Install a air pressure gauge with shutoff valve .
Beload the hub assembly with 0,5 bar pressure air .
Turn the hub assembly several times .
The pressure drop after a period of 15 minutes must not exceed 0,1 bar .



MAJOR HAZARDS

AREA WHERE HAZARD CAN OCCUR	HAZARD WHAT CAN HAPPEN IF PRECAUTIONS AND SAFEGUARDS ARE NOT OBEYED	SAFEGUARDS HOW TO AVOID THE HAZARD
MOTORS AND CONTROLLER	Electrical shock could cause irreparable injury or death.	All electrical systems should be maintained by certified electricians. The battery should be disconnected before servicing the motors or controller. When the controller cover is removed, wait for one minute for the capacitors to discharge.
BATTERY	The battery produces lethal amounts of power whether connected to the machine or charger, or not.	The battery should be maintained by qualified personnel. (Refer to Bucyrus America, Inc. "INSTALLATION, USE, MAINTENANCE, AND REPAIR OF MINE POWER STORAGE BATTERIES," PART NUMBER A6474X26, for complete instructions).
	Battery covers could fall crushing hands or arms.	Be sure cover supports are in place when working on battery.
	Battery hold-down clamps could crush fingers or hands.	Keep fingers and hands away from hold-down clamps.
	Batteries produce explosive gases that could be ignited causing burns or explosions.	Batteries should be well vented before servicing particularly if welding or burning on the battery. Batteries should be maintained by qualified personnel.
	Batteries contain strong acid that could cause severe burns if spilled or splashed on body parts or in the eyes.	Protective clothing, gloves, and eyewear must be worn when working on batteries. Batteries should be maintained by qualified personnel.

Configuration Jumper Table

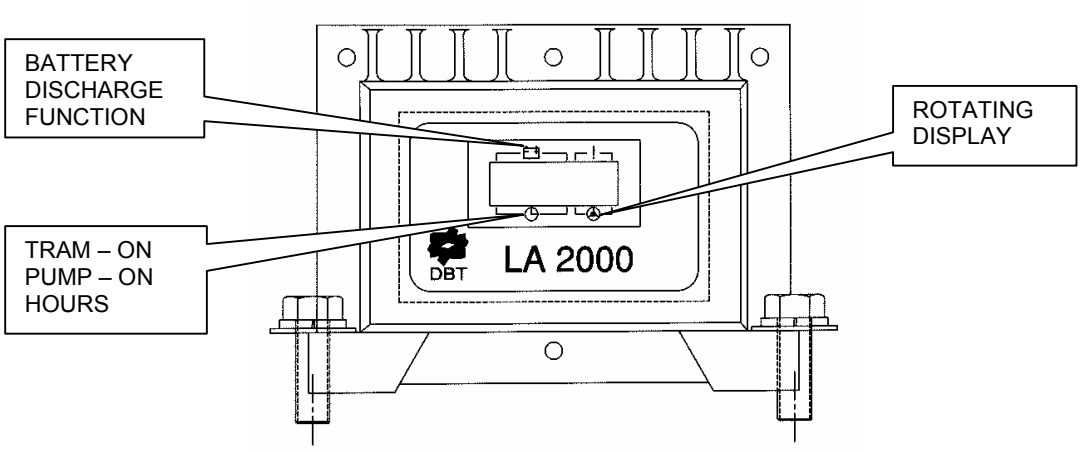
MAX. CURRENT CONFIG. LOGIC PIN 12	VEHICLE TYPE
OPEN	SINGLE MOTOR – 1200 AMP
GROUND (CLOSED)	SINGLE MOTOR – 1100 AMP
OPEN	DUAL MOTORS 1100 AMP PER MOTOR – ADJUSTABLE TO 1200 AMP
GROUND (CLOSED)	DUAL MOTORS 800 AMP PER MOTOR

OPTIONAL DASHBOARD DISPLAY FEATURES (See Figure 9)

- A battery discharge indicator
- An hour meter displaying tram-on hours
- An hour meter displaying pump-on hours
- A rotating display showing:

1. Battery voltage
2. Pump motor current
3. Diagnostic fault status, when applicable. Rotating display will lock on one of the following fault messages: (See Fault Message Chart, page 19)

FIGURE 9 – OPTIONAL DASHBOARD DISPLAY



Error Code Legend (Status Display)

ERROR CODE	DESCRIPTION
0	No Fault
1	Caps failed to change after power-up Check for shorted cap
2	Single Motor Block “0” Point “A” short Shorted IGBT or short between motor and ground
3	Dual Motor Block “0” Point “A” short Shorted Right IGBT or short between motor and ground
4	Dual Motor Block “0” Point “A” short Shorted Left IGBT or short between motor and ground
5	Vehicle configuration ID invalid
6	Diagnostic Point “A” trip failed to disable UVR Coil Replace logic assembly
7	Diagnostic Right FWD Point “A” trip failed to disable Replace logic assembly
8	Single Motor Point “A” trip failed to disable FWD IGBT Replace logic assembly
9	Diagnostic Right REV Point “A” trip failed to disable Replace logic assembly
10	Single Motor Diagnostic REV Point “A” trip failed to disable Replace logic assembly
11	Diagnostic Left FWD Point “A” trip failed to disable Replace logic assembly
12	Diagnostic Left REV Point “A” trip failed to disable Replace logic assembly
13	Diagnostic test to enable UVR Coil driver failed Fault in logic assembly or faulty UVR Coil
14	Diagnostic Right FWD Point “A” trip failed Replace logic assembly
15	Single motor diagnostic FWD Point “A” trip failed Replace logic assembly
16	Diagnostic Right REV Point “A” trip failed Replace logic assembly
17	Single motor diagnostic FWD Point “A” trip failed Replace logic assembly
18	Diagnostic Left FWD Point “A” trip failed Replace logic assembly
19	Diagnostic Left REV Point “A” trip failed Replace logic assembly
20	Breaker welded fault
21	Internal error (Software Only) Replace logic assembly

IGBT Single Motor Panel

FIGURE 17