



**OPERATION,  
PREVENTIVE MAINTENANCE,  
TROUBLESHOOTING  
AND SERVICE GUIDE**

**MODELS 488L and 488-6  
WITH CONTROL HANDLE**



**NOTICE**

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

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Revision 2, December 2007**

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# **SAFETY PRECAUTIONS AND GUIDELINES**

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## **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**

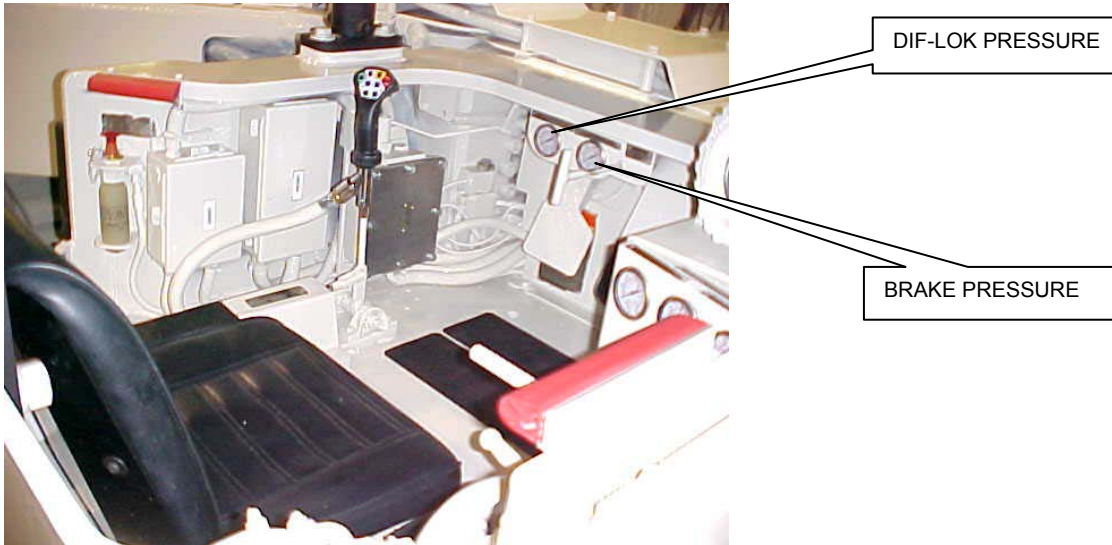
ALWAYS make sure that no person or obstruction is in your line of travel BEFORE starting the unit into motion or in the articulation area when steering the unit.

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).

<b>HYDRAULIC CONTROL PANEL GAUGES</b>	
<b>GAUGE</b>	<b>PRESSURE READING</b>
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).**

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## TOWING A DISABLED MACHINE

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**WARNING**

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.



**WARNING**

**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 chocked in both directions at all four wheels for additional stability. The brake is "set" by opening the valve on the hand-pump.



**WARNING**

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

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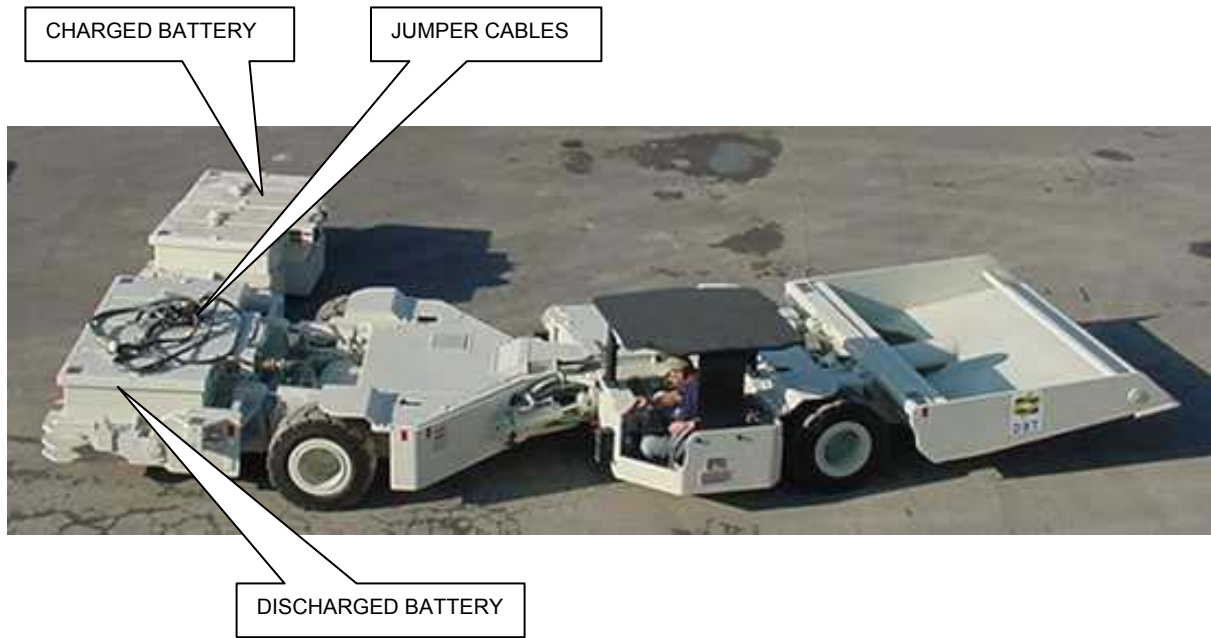
## **BATTERY CHANGE PROCEDURE (GROUND LEVEL)**

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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)**



**WARNING**

**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.

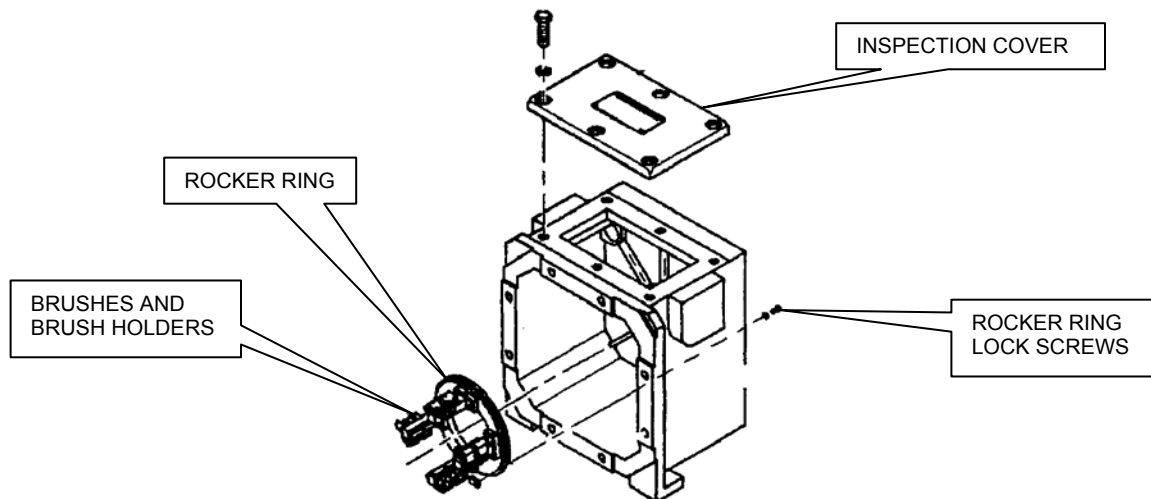
## ONCE PER MONTH

### 1. Inspect the drive motor (Figure 44).

- 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 44 – 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 44).
- 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
<b>FOREIGN MATTER SOURCES IN THE CIRCUIT</b>	<ol style="list-style-type: none"> <li>1. Sealing compound (pipe dope, teflon tape).</li> <li>2. Burrs inside piping components.</li> <li>3. Tag ends of packing coming loose.</li> <li>4. Lines left unprotected and dirty, repaired components.</li> <li>5. Repair parts not properly protected while stored.</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean or replace seals.</li> <li>2. Disassemble piping components and remove any burrs.</li> <li>3. Remove old packing and replace with new.</li> <li>4. Drain and replace oil.</li> <li>5. Clean parts thoroughly before installation.</li> </ol>

**BRAKES (SERVICE) WET DISC**

<b>INSUFFICIENT BRAKING</b>	<ol style="list-style-type: none"> <li>1. No gas charge in accumulator.</li> <li>2. Defective brakes.</li> <li>3. Hydraulic lines or fittings leaking.</li> <li>4. Pedal linkage out of adjustment.</li> <li>5. Damaged hydraulic brake lines.</li> <li>6. Air in brake system.</li> <li>7. Brake seal or o-ring failure.</li> <li>8. No oil or low oil level in tank.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check gas charge.</li> <li>2. Check brakes.</li> <li>3. Check for leaks and repair.</li> <li>4. Adjust linkage.</li> <li>5. Check lines for dents that restrict flow.</li> <li>6. Bleed brakes.</li> <li>7. Replace seal or o-ring.</li> <li>8. Bring oil up to proper level.</li> </ol>
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A most common problem with tire/wheel installations is the incorrect tightening of wheel bolts or studs. Threaded fasteners perform their 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.

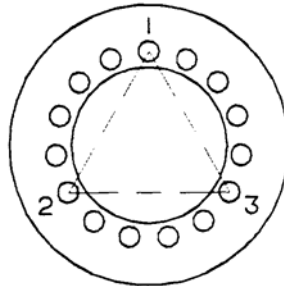
### WHEEL MOUNTING TIPS

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.

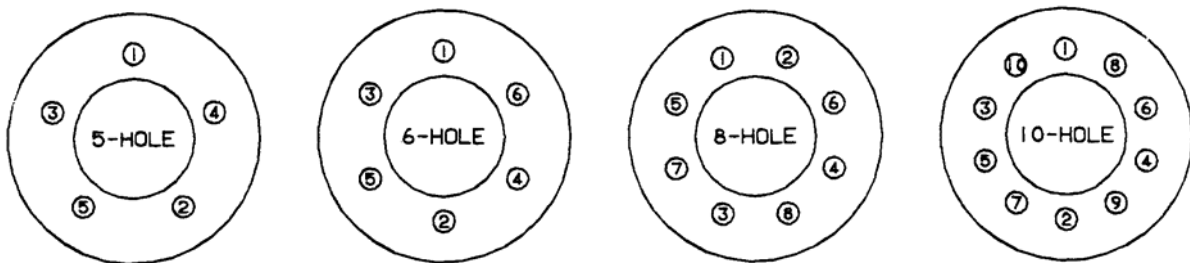
Another area of concern is cleanliness. All mating surfaces should be free of rust, dirt, oil, paint, etc. Also no paint of any kind should exist between a fastener and wheel disc surface. Any form of contamination between these surfaces will most likely lead to serious wheel problems.

**FIGURE 49 – WHEEL TORQUING PATTERN**



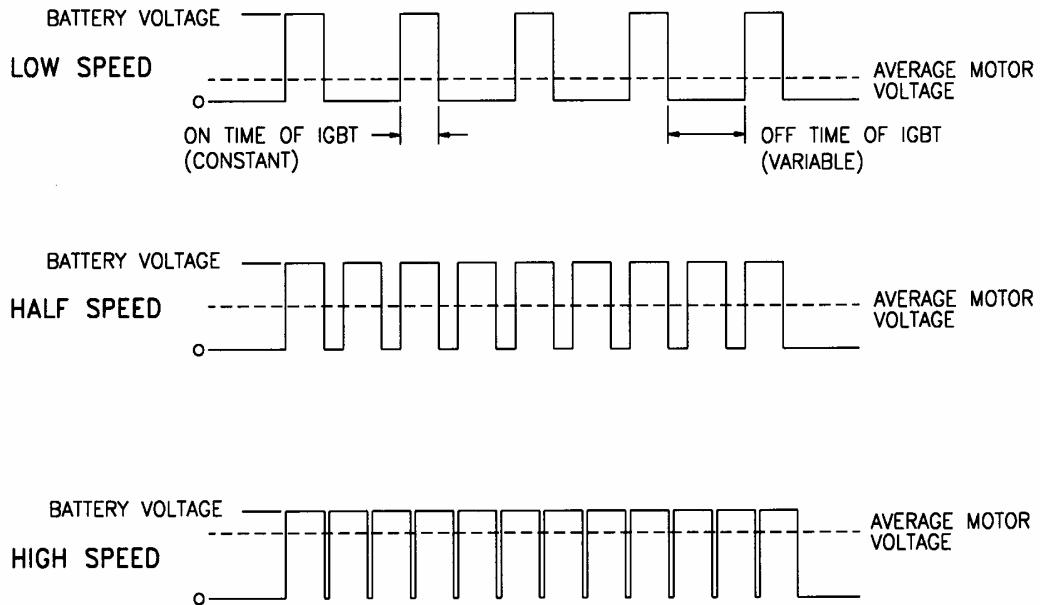
WHEN TORQUING ANY WHEEL BOLT PATTERN, ALWAYS TORQUE IN A TRIANGULAR PATTERN.

**FIGURE 50 –TORQUE PATTERNS**

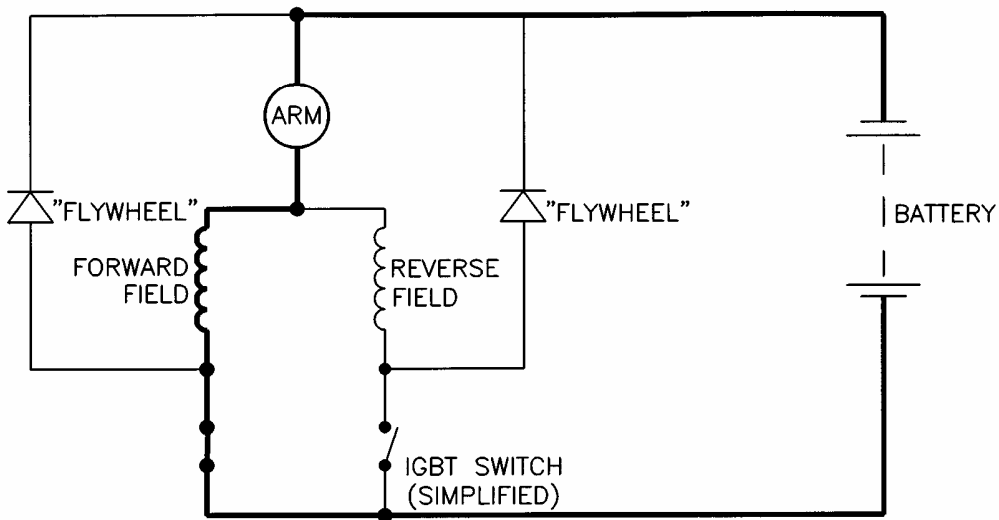


Since the windings of the motor are inductive, the current in the motor cannot change quickly. When the IGBT switch is closed, the current builds up slowly and when the switch opens, the inductance wants to keep the current flowing. For this reason, the "flywheel" diode is provided. Figures 3 and 4 illustrate the current paths with the switch closed in both forward (Figure 3) and reverse (Figure 4) modes.

**FIGURE 2**



**FIGURE 3**



## Optional Hand Held Diagnostics/Calibrator Unit

### Security Levels:

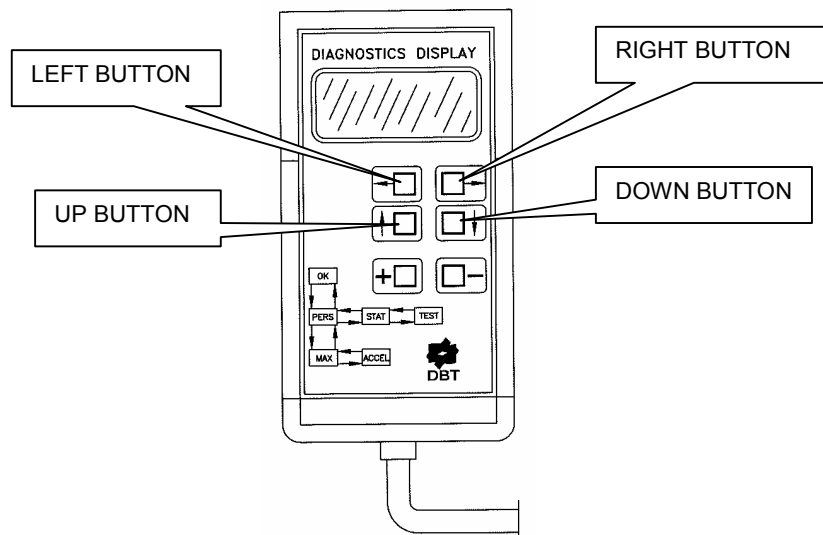
1. Customer level
2. Service Level
3. Advanced Level
4. Engineering Level



**SECURITY LEVELS 2-4 ARE ONLY ACCESSIBLE BY ENTERING THE APPROPRIATE PASSWORDS.**

**NOTICE**

**FIGURE 10 – OPTIONAL HAND HELD DIAGNOSTICS/CALIBRATOR UNIT**



### Connecting for Operation:

1. Turn the machine "OFF".
2. Turn the main circuit breaker to the "OFF" position to de-energize power on machine.
3. Remove the main controller cover.
4. Connect the hand held diagnostics/calibrator unit to the CAN Communication Input Port of the logic card.
5. Turn the main circuit breaker to the "ON" position.
6. Leave the "Park Brake Set".

The hand held diagnostics/calibrator unit is now operational.

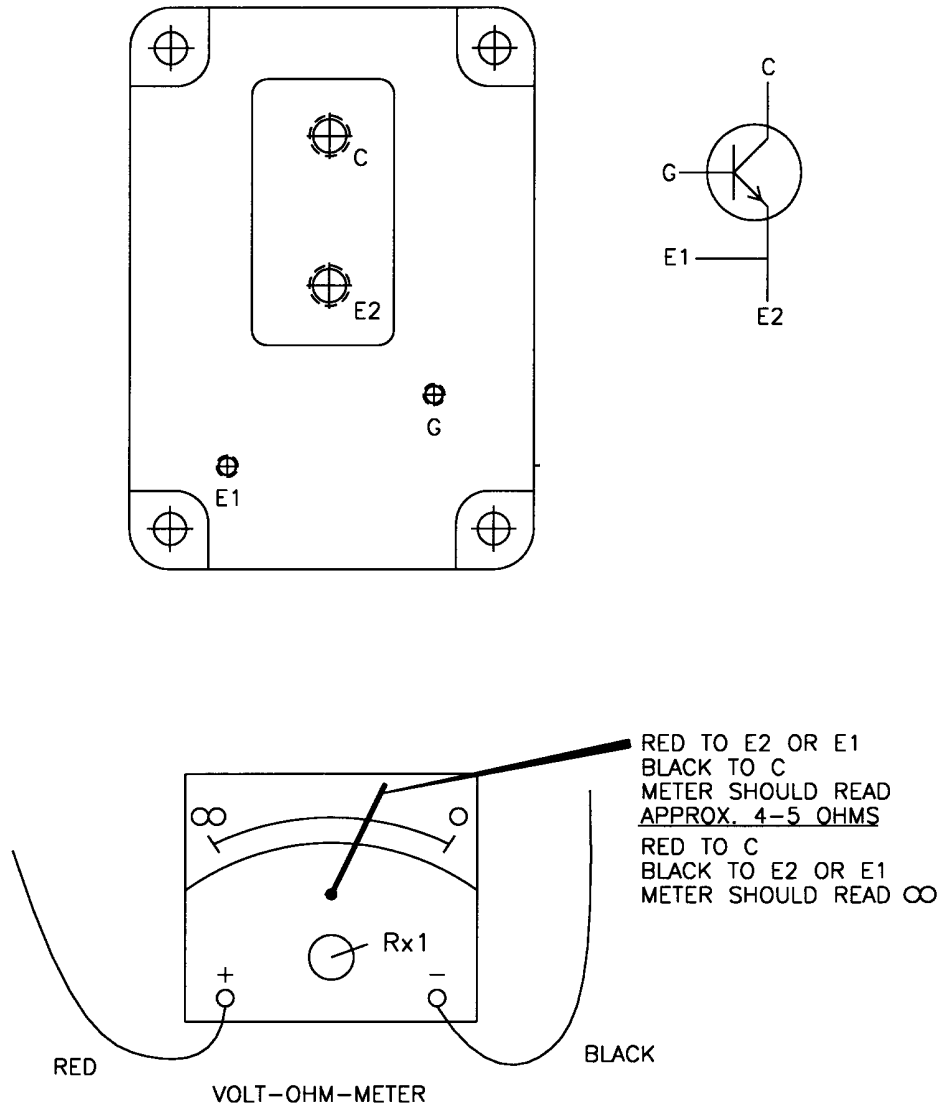
### Operation:

Upon power-up of the hand held diagnostics/calibrator unit, before pressing any buttons, a top level display is visible to provide diagnostic information as follows:

**See list on page # 19 and 20**

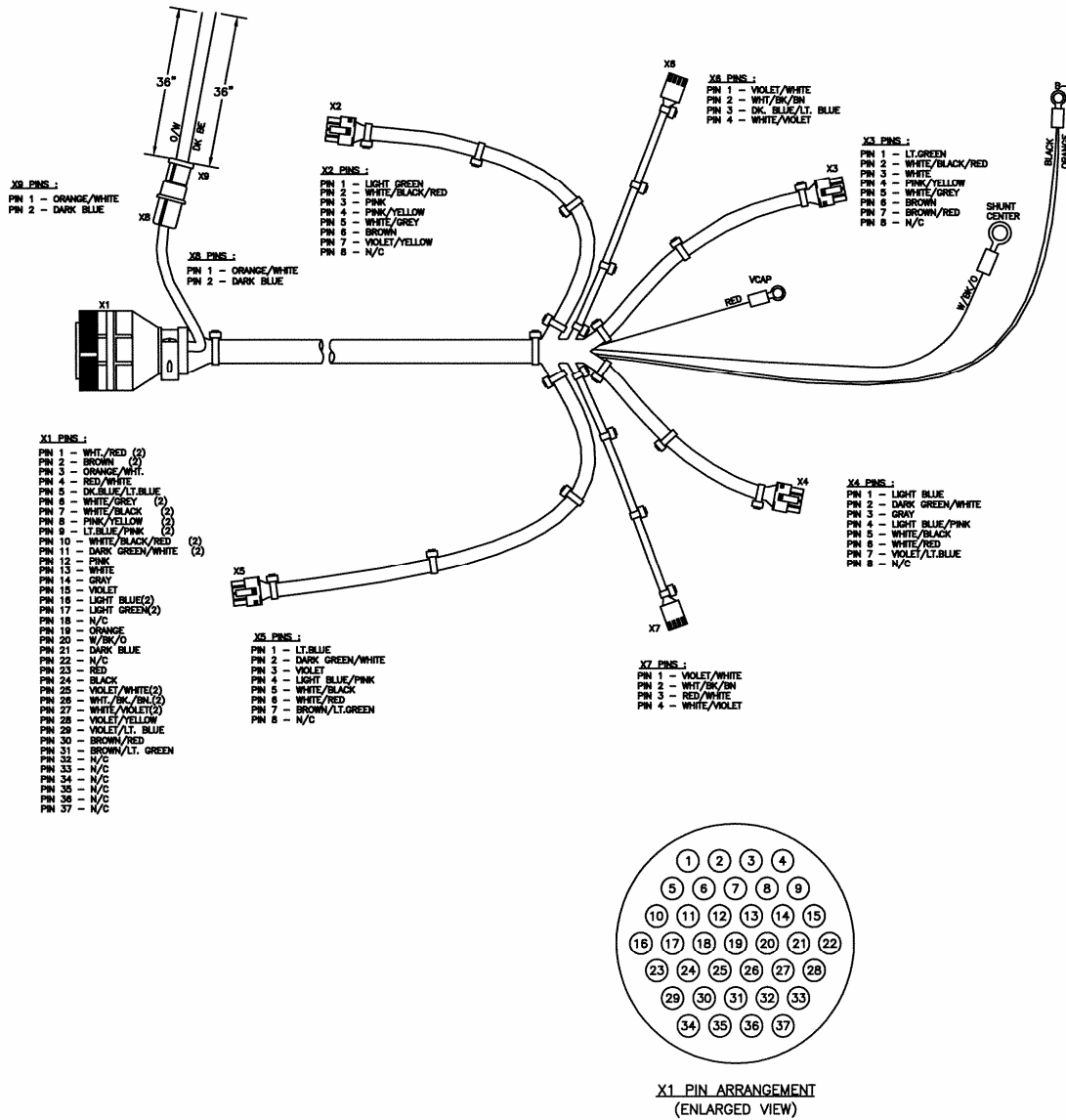
### Individual IGBT Measurements

FIGURE 12



## Dual Motor Panel Harness Assembly

FIGURE 20



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## **SYMBOLS AND SPECIAL NOTATIONS**

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Throughout this manual there are specific notations that are either **UPPERCASE BOLD**, UNDERLINED or *ITALICIZED* for the primary purpose of emphasis. Please pay special attention to such statements as they regard safety or critical maintenance installation information.

You will also see the following:



**NOTICE**

**NOTICE:** *THIS NOTATION DENOTES A REFERENCE TO PREVIOUSLY STATED INSTRUCTIONS.*



**IMPORTANT**

**IMPORTANT:** *THIS SYMBOL DENOTES THAT SPECIAL ATTENTION MUST BE ADHERED TO IN THE ATTACHED STATEMENT.*



**CAUTION**

**CAUTION:** *THIS SYMBOL DENOTES THAT FAILURE TO COMPLY WITH THE ATTACHED STATEMENT COULD RESULT IN A CUT, BRUISE OR ABRASION.*



**WARNING**

**WARNING:** *THIS SYMBOL DENOTES THAT FAILURE TO COMPLY WITH THE ATTACHED STATEMENT COULD RESULT IN A LOST TIME ACCIDENT.*



**DANGER**

**DANGER:** *THIS SYMBOL DENOTES THAT FAILURE TO COMPLY WITH THE ATTACHED STATEMENT COULD RESULT IN A SERIOUS INJURY OR FATALITY.*

## Standard Features

### Input Protection

- A. A.C. fuses on each input leg.
- B. A.C. contactor to disconnect the unit from the a.c. line.
- C. A.C. fuse in one leg of control transformer.

### Meters

Digital Volt/Amp Meter – Standard (See OPERATION section)

### Output Protection

- A. D.C. output fuse.
- B. Current limiting automatically limits the d. c. output current of the charger to approximately 125% of its rating..

### Electronic Timer

8 hour timer with auto start/stop feature on battery connection. (See OPERATION section)

### Mounting

Low profile mine case with skids.

## Optional Ground Integrity

The Automatic Mine Recharger is designed to operate on a specific type of battery with a specified number of cells. The nameplate on the charger indicates the type of battery, number of cells, and the a.c. input voltage.

To energize the unit with optional ground integrity, the following procedure should be used:

1. Check a. c. input voltage with that specified on the nameplate. i.e.: chargers furnished with 480 volt and 575 volt power lines, are dual input units. Taps within the unit must be set on the 480 volt setting for 480 volt power lines, and 575 volt taps for 575 volt power systems. A schematic is provided with the unit which indicates how the a.c. power connections must be wired. Connect the power lines to the a.c. input terminals, the ground wire to the ground terminal bonded to the case near the input terminals.
2. A ground check wire supplied from the power center must be connected to terminal 3R, near the input terminals.
3. The battery, with a 4 wire plug, must be connected to the unit's output in order to energize the unit.
4. Ground integrity must be made on all systems to energize the unit. If the case ground is more than 5 ohms, the unit will not energize.
5. The emergency stop switch must be pulled out.
6. Push in the green button. The unit should energize, and the charger will automatically start to charge the battery at some rate up to its maximum capacity, depending upon the state of charge of the battery, and charge the battery to full charge, then shutdown to a trickle charge-preserving-charge. The charger will continue the trickle rate until the timer turns the unit completely off.

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- 1**      Important remarks
  
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- 3**      General instructions for correct assembly and disassembly  
Service tools
  
- 4**      Assembly drive assembly
  
- 5**      Assembly hub assembly
  
- 6**      Assembly planetary gear drive
  
- 7**      Assembly service brake
  
- 8**      Assembly parking brake

**Recomendable hypoid gear oils corresp .  
MIL - L 2105 B / API GL 5 resp. MIL - L 2105 C / D / API GL 5**

ARAL - Gearoil Hyp 90

AVIA - Gearoil Hypoid 90 EP

BP - Multiuse - Gearoil EP SAE 90

ELF - Tranself Typ B 90 / Tranself Typ B 80 W - 90

ESSO - Gearoil GX - D 90

FINA - Pontonic MP SAE 85 W - 90

FUCHS - Renogear Hypoid 90

MOBIL - HD 90 - A

SHELL - Spirax MB 90 / HD 90

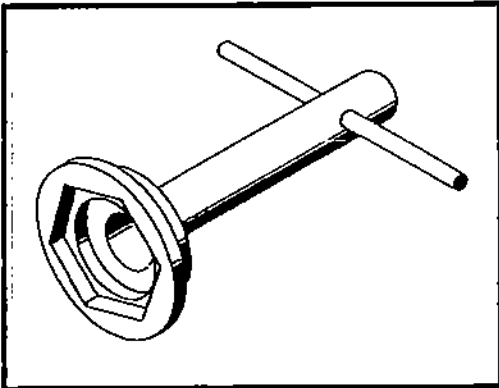
TEXACO - Multigear EP SAE 85 W / 90

AGIP - Rotra MP / Rotra MP DB

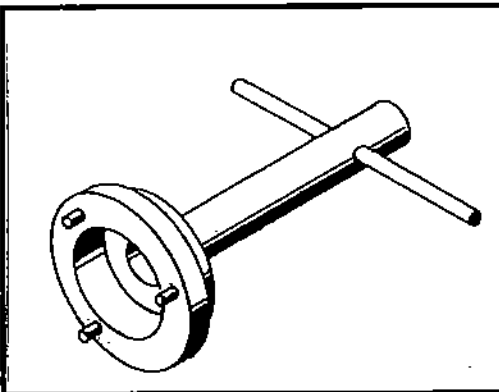
On no account use „ normal „ gear oils !

**Service tools**

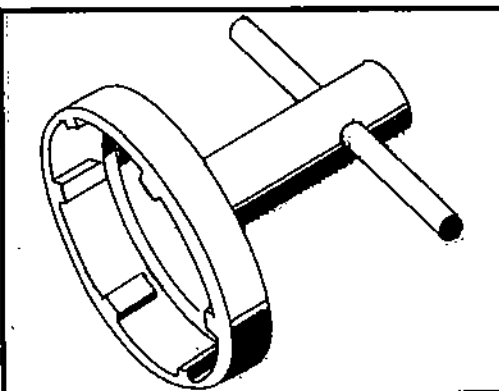
When ordering service tools please provide order number ( installation drawing no. ), resp. fabrication number → see identification plate . ( The illustrations are not binding for the design ) .

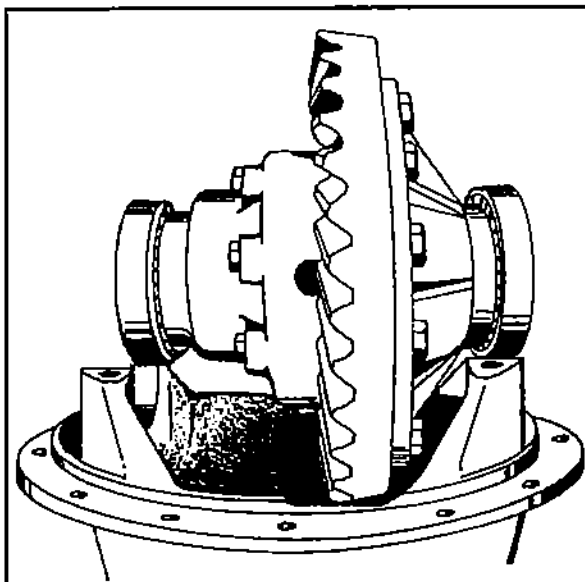


Spanner for wheel safety nut



Spanner for splined nut ( hub assembly )



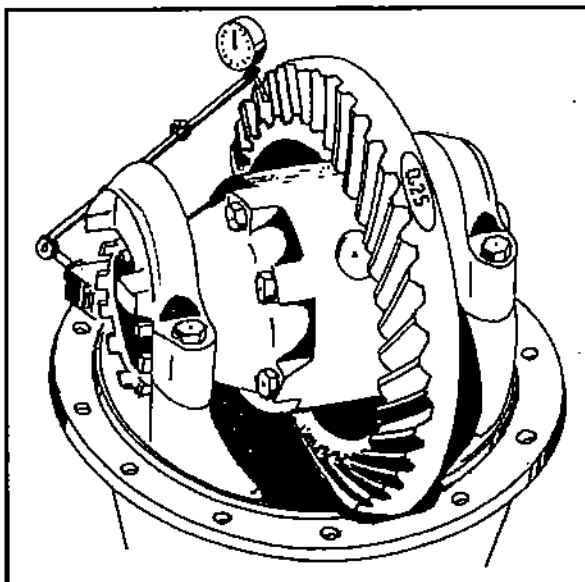


**Assembly of drive assembly**

Place the differential with the outer rings of the taper roller bearings on the differential carrier which is in a vertical position, with mounted drive pinion.

Mount the differential straps and align them with the thread rings.

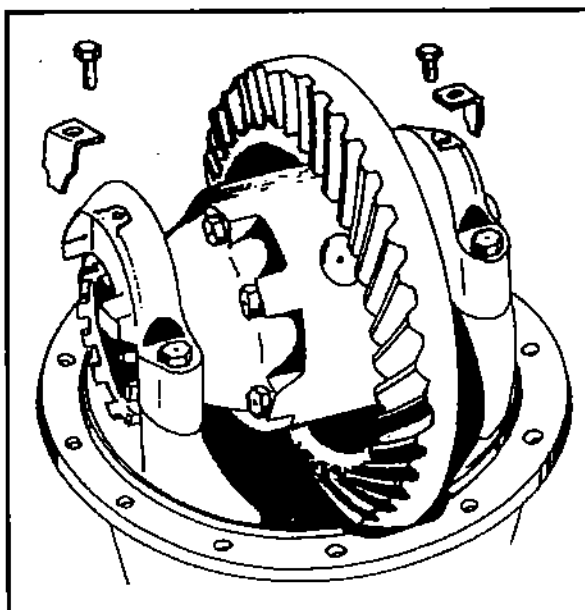
During this operation be careful of the alignment marks on the differential straps with respect to the differential carrier. (Do not interchange the differential straps.)



Hand tighten the differential strap bolts. By a counter rotation of the two thread rings, move the differential until the backlash is correct. (The smallest admissible value at the closest place is marked on the ring gear).

Therefore hold the drive pinion at the drive flange. Check the backlash by careful forwards and rearwards rotating the ring gear. Use a dial indicator.

Measure the backlash during a few times turns of the ring gear and if need correct the backlash, because of the smallest admissible value at the closest place must not be fall short of.



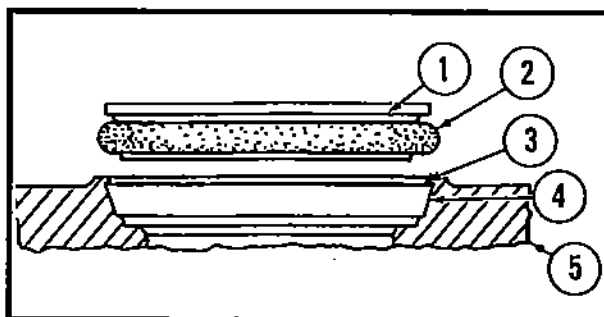
Adjust gear meshing according to sheet „Adjustment of gear meshing of Gleason gears“.

Tighten screws of the differential straps and lock them with Loctite 262.

Adjust the bearing roll resistance trough tightening of the thread rings. Set value : 2,0 to 3,0 Nm. Check the value with a torque wrench. If measuring at the drive pinion / drive flange, take the ratio of the bevel wheel set into account.

Screw the lock plates for the thread rings and secure with Loctite 270, if need bend the lock plates.

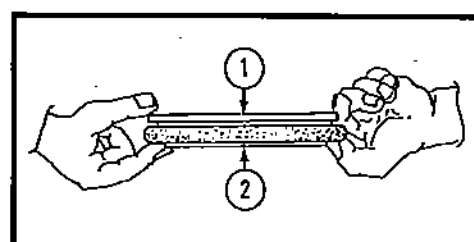
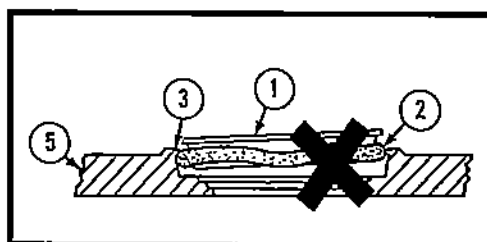
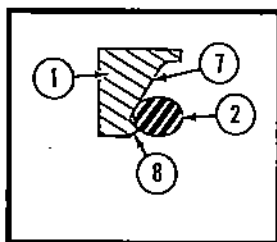
## Assembly of the face seal



- 1 . Seal ring
- 2 . Rubber toric ring
- 3 . Housing retaining lip
- 4 . Housing ramp
- 5 . Seal ring housing

Seal rings , torics , and housings must be clean and free of any oil film , dust , or other foreign matter . Use a solvent that evaporates quickly , leaves no residue , and is compatible with the rubber toric rings . The recommended solvent is Isopropanol . Ring and housings should be wiped with a solvent - soaked lint free cloth or paper towel .

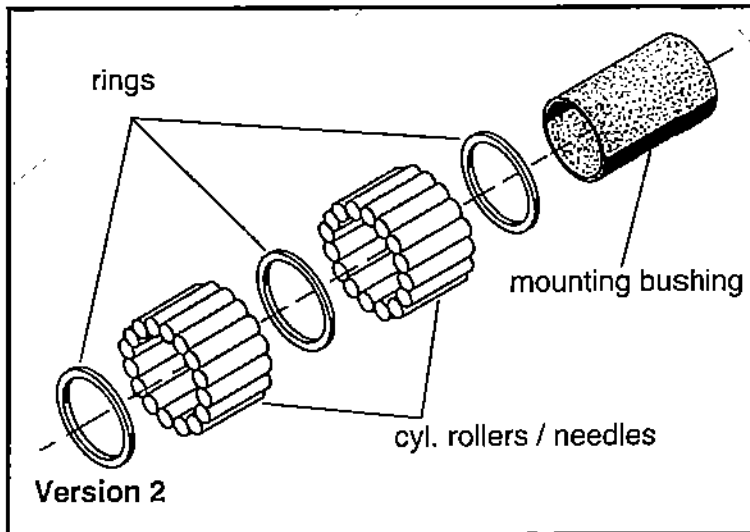
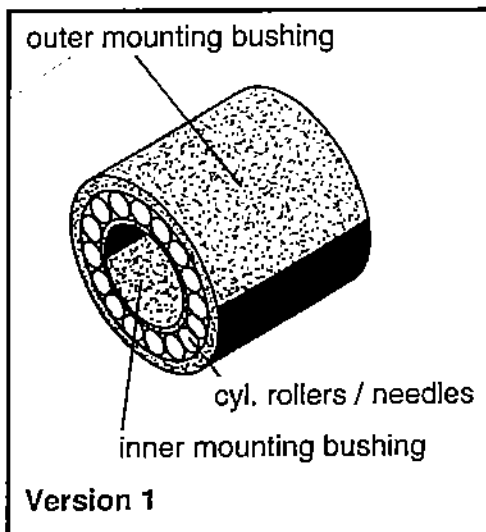
After all components have been wiped clean, the torics should be installed on the metal seal rings so that they rest in the radius on the tail of the metal ring . Insure that the torics are not twisted by inspecting the mold flash line on the outside diameter of the toric for true circumferential tracking around the seal . Twisted torics will cause nonuniform face load that can result in leakage of lubricant and pumping of debris past the toric . If a twist is apparent , it can be eliminated by gently pulling a section of the toric radially away from the metal seal ring and letting it „ snap „ back . Repeating this in several places around the ring will eliminate any twist in the toric ring .



Put the toric ring (2) on seal ring (1) , at the bottom of the seal ring ramp (7) and against the retaining lip (8) . The toric ring (2) can twist if it is not wet all around during installation or if there are burrs or fins on the retaining lip (3) of the housing (5) .

Eliminate toric twist by gently pulling a section of the toric (2) rapidly away from the seal ring (1) and letting it „ snap „ back .

**Assembly / disassembly cageless needle bearing**  
**(planetary gear bearing)**



**Assembly:**

**Version 1:** Install the needle bearing with mounting bushings into the planetary gear, thereby the outer mounting bushing will be stripping.  
 Insert the planetary gear with thrust disks into the planetary housing.  
 Press in the planetary pin, thereby the inner mounting bushing will remove.

**Version 2:** Place one thrust disk on the work bench, place on the planetary gear and insert the mounting bushing.  
 Insert the cylindrical rollers / needles alternately with the rings (according to the design).  
 Insert the planetary gear with thrust disks into the planetary housing.  
 Press in the planetary pin, thereby the mounting bushing will remove.

**Hint:** Note the passage "Assembly of the planetary gear"!

**Disassembly:**

At the disassembly of the planetary pin the cageless needle bearing will fall asunder, if not a mounting bushing will be pushing inwards at planetary pin removing.

**Hint:** Note the passage "Disassembly of the planetary gear"!

**Remarks to the Wet Disk Brake**

**Permissible oil for brake with external cooling**

**Actuation fluid :**

**Do not use brake fluid any time !**

**Use a mineral oil base hydraulic oil type fluid only !**

- 1 ) Motoroil      API SE / CD  
   MIL - L - 46152C / MIL - L - 2104 C p. D
- 2 ) ATF C - 3 or Dexron ®
- 3 ) Hydraulicoil HLP DIN 51524 Teil 2

**Viscosity :**

- for moderate climate              ISO VG 22 - 32
- for extremly cold climate        ISO VG 15
- for extremly warm climate        ISO VG 46

**Cooling fluid :**

like actuation fluid .

**Important :** It is necessary to use oils with LS - additives ( Limited Slip ) , according to the recommendation of the oil supplier .

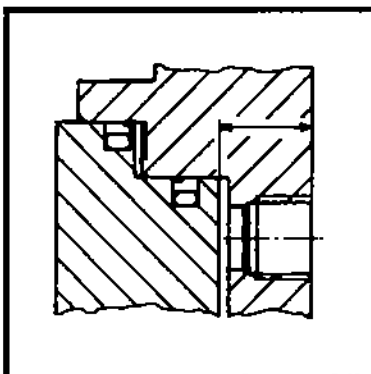
For example : 3 to 6% Lubrizol LZ 6117 / LZ 9990 A or LZ 6279

**Check measure :**

It is measured through the check hole , while actuating the brake .

The check measure , new , is marked in the housing below the hole .

Is the measured dimension bigger than the marked dimension and max. wear dimension , unconditional consult Kessler & Co .



After working at the brake , bleed the brake hydraulic system and check for tightness !



## **DANGER**

**ONLY TRAINED AUTHORIZED PERSONNEL SHOULD OPERATE OR PERFORM MAINTENANCE ON THE BATTERY.**

**FAILURE TO ADHERE TO DANGERS, WARNINGS AND CAUTIONS, NOTED IN THIS MANUAL, COULD RESULT IN SERIOUS INJURY OR DEATH.**

**FAILURE TO OPERATE OR MAINTAIN THIS BATTERY IN STRICT ADHERENCE TO THESE INSTRUCTIONS AND WARNINGS IN THIS MANUAL COULD VOID THE WARRANTY.**

the element. Due to the variety of job requirements, batteries are produced with many different sizes of cells.

### **1-8. Voltage**

With reference specifically to storage batteries, many "voltage" conditions have been recognized. The most important of these are:

- a. Open Circuit Voltage** - This is the voltage of a cell or battery at the terminals, when no current is flowing. The nominal open circuit voltage of an individual fully charged cell is 2 volts. This is true regardless of cell size. The voltage of a 64 cell lead-acid battery is stated, therefore, as 128 volts.
- b. Initial Voltage** - The initial voltage of a cell or battery is the closed circuit voltage at the beginning of a discharge. It is usually taken after current has been flowing for a sufficient period of time for the rate of change of the voltage to become practically constant, usually a matter of minutes.
- c. Average Voltage** - The average voltage of the cell or battery is the average value of the voltage during the period of charge or discharge.
- d. Final Voltage** - The final or cut-off voltage of a cell or battery is the prescribed voltage at which the discharge is considered complete. It is usually chosen so that the useful capacity of the battery is realized without subjecting it to harmful overdischarging. Final voltage will vary with the rate of discharge, cell temperature, and the type of service, but for mine power applications it is considered to be 1.70 volts per cell.

Initial voltage, average voltage, and final voltage are monitored when conducting test discharges.

### **1-9. Rated Capacity**

The rated capacity of a storage battery is the number of ampere-hours or watt-hours which it is capable of delivering when fully charged and under specified conditions of temperature, rate of discharge, final voltage, and specific gravity. United States industry standards for mine power batteries always specify this to be at the 6 hour rate of discharge. The total capacity available from a battery is greatest at low rates of discharge over a long period of time. Discharging at high current rates reduces the total ampere-hours available.

### **1-10. Sulfation**

Sulfation occurs when conditions within the cell cause sufficient accumulation of abnormal lead sulfate at both the positive and negative plates, permanently affecting the normal chemical reactions. Habitual overdischarging below final voltage, prolonged operation in an undercharged condition, and extended stand periods while in a discharged state are major causes of sulfation. A servicing schedule should be followed to provide frequent monitoring and adequate charging. See Chapter 3, Section 1, for methods of restoring a sulfated battery.

### **1-11. Operating Cycle**

An operating cycle of a storage battery is the discharge during use and subsequent charge to restore its initial condition.

### **1-12. Service Life**

The service life of a storage battery is the period during which it provides useful power while being discharged. It is usually expressed as the time period, or number of cycles, which elapses before the ampere-hour capacity falls below 80% of its rated value. To obtain maximum service life, it is





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