# Operation Manual

## Bucyrus - UN-A-TRAC®
## Models - 488L and 488-6

## Doc. No.: A6474X235


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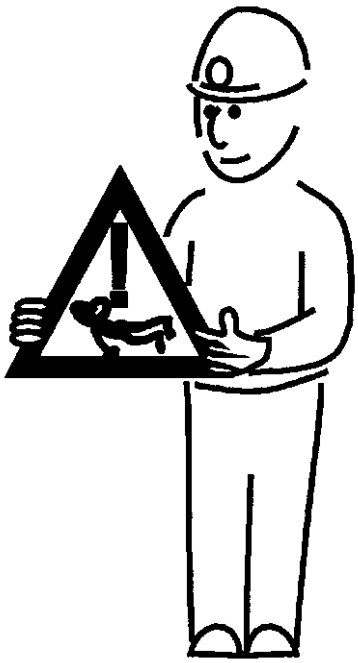
# 2 Your safety



**maintenance, repair**

Only persons who have and can demonstrate a special knowledge of hydraulics are allowed to work on the hydraulic system.

Avoid, whenever possible, servicing, cleaning or examining the machine in congested areas.

Avoid, whenever possible, servicing or providing maintenance to the unit unless the wheels are chocked and steering lockout device is connected to prevent accidental movement of the unit.

Do not alter the electrical or hydraulic settings from that indicated in this manual or as set at the factory.

Always replace damaged or lost decals and metal instruction plates.

Disconnect the battery when working with the electrical system, or when welding on the unit to prevent electrical shock.

Be sure the battery area is well ventilated (clear of fumes) when it is necessary to connect battery charger. Fumes from the battery could ignite from a spark and explode.

Always follow all safety procedures of each particular mine when performing maintenance.

It is important that any procedure not specifically recommended in this guide be thoroughly evaluated from the standpoint of safety before it is implemented.

Some illustrations in this manual show guards or cover panels removed for purposes of clarity. Never operate unit without guards or cover panels in place.

Carry out a visual inspection of all the hydraulic components at regular intervals. In particular check that:

- the hoses are not pinched or trapped,
- the hoses have no bubbles or blisters,
- the hose or outer sheathes of the hose are not abnormally rigid or hard,
- the outer sheath of the hoses is not damaged,
- the connectors are securely inserted into the sockets, and
- the connections are leak-tight.

Ensure that no dirt enters the hydraulic system during repair work. Dirt in the hydraulic system can cause serious damage in the whole system! Flush out the hydraulic lines thoroughly before connecting.

**WARNING!**
**Power must be removed by unplugging the battery plugs before servicing the motor.**

**WARNING!**
**Mixing parts of different designs or from a variety of sources for wheels with pneumatic tires could cause severe injury or death.**

## Chapter 6: Technical data

**IMPORTANT!**
**Due to the application of fasteners being subject to great stresses and heavy or extreme vibration, it is imperative that all bolts be applied with an adequate amount of torque. For this reason this list of recommended torque settings for different types and sizes of fasteners used has been compiled. The tightening torques stated in the spare parts lists have to be observed, as well, for installation and maintenance.**

**NOTICE!**
**Use only lubrication fluids and greases approved by Bucyrus America, Inc. ! These fluids and greases have been tested at Bucyrus America, Inc. and guarantee reliable operation of the mechanical and hydraulic functions of the machine.**

**IMPORTANT!**
**The lubrication fluids and greases listed in the same table can be mixed. Other products may only be used if the supplier can guarantee that they are equivalent. Differently composed fluids and greases must not be mixed as this may change the consistency, i.e. the mixture can become thinner so that the lubrication effect is not sufficient. It may also be dangerous to use lubricating greases and fluids having the same specification base but different origins. In case of doubt, the manufacturer of the lubrication to be used should be contacted as to the compatibility of the lubrication in question.**

**IMPORTANT!**
**Bucyrus America, Inc. expressly point out that the approval of the listed products relates only to the pure technical use in our mechanical and hydraulic systems. The responsibility for the constituents used in the hydraulic concentrates lies solely with the respective manufacturer.**

**NOTICE!**
**When performing maintenance on the machine, all used oil and lubricants should be disposed of per your local EPA standards.**

# Installation

## Points to observe prior to installation

### Who is allowed to carry out installation?

Installation is only allowed to be carried out by personnel having received adequate training to perform this task.

Work on:

the safety components (pressure relief valves, fire extinguishing equipment etc.),

the electrical equipment (control units, signaling devices, etc.), and

the hydraulic equipment (cylinders, directional control valves, hoses etc.)

should only be carried out by Bucyrus America, Inc. service engineers or by specially trained personnel.

### Which tools are required for installation?

**tool box**

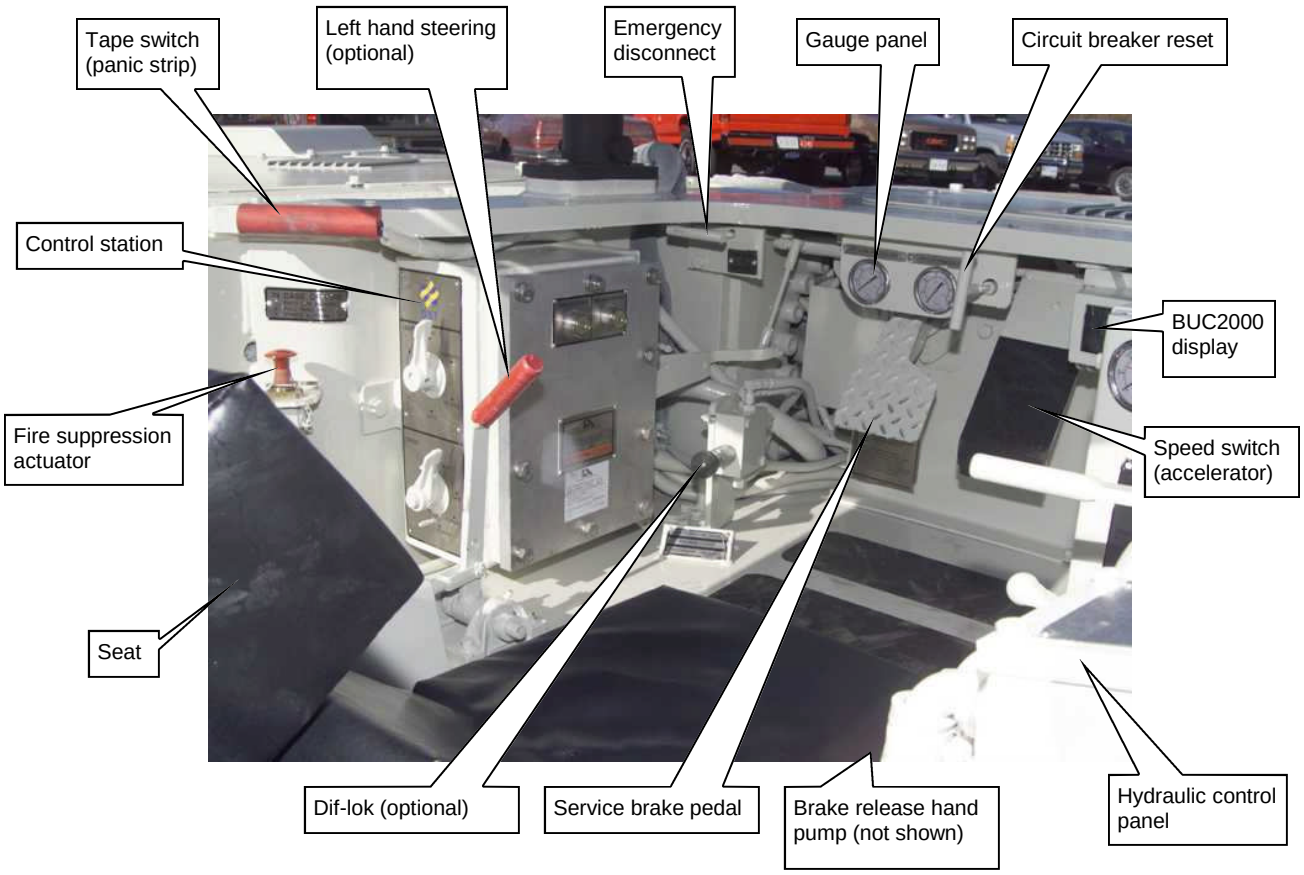
No special tools are required to put the UN-A-TRAC® into service.

The battery plugs and receptacles come with a special wrench for connecting and disconnecting battery plugs and receptacles.

Various items of auxiliary equipment and machines may be required at the point of installation. These include:

- hoists with adequate lifting capacity
- means of attachment with adequate lifting capacity
- unloading dock
- jacks with adequate lifting capacity

**Fig. 9: Operator's compartment with control station**




Note:
Typical operator's compartment shown, location of controls may vary.

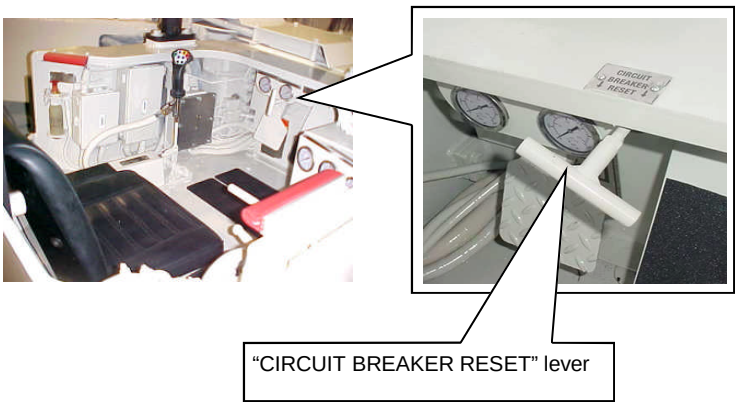
**WARNING!**
**Before operating any levers or pedals on the UN-A-TRAC® always make sure no one is in the hazard zone (see Hazard zone in this chapter). Do not operate any levers or pedals from outside the operator's compartment.**

## Operator's compartment - control handle model only

**"CIRCUIT BREAKER RESET" lever**

The "CIRCUIT BREAKER RESET" lever (Fig. 18), located in front of and to the right of the operator, is used to reset the connection box (batteries) breaker when it has tripped. This circuit breaker is located in the connection box in the rear section of the UN-A-TRAC®. If the breaker has tripped, the reset lever must be pulled all the way out to the "RESET" position first and then pushed in to the "ON" position.

**Fig. 18: "CIRCUIT BREAKER RESET" lever**




**WARNING!**
**The circuit breaker de-energizes the electrical controller and motors. However, electrical power is still present inside the connection box to the circuit breaker. If the circuit breaker inside the connection box requires service, the battery plugs must be disconnected from the batteries.**

The circuit breaker is not intended as an "ON-OFF" switch for normal operation. Except in an emergency, the UN-A-TRAC® should be SHUTDOWN by first moving the master switch to the "OFF" position and then moving the circuit breaker to the "OFF" position.

**WARNING!**
**The circuit breaker should be in the "OFF" position and the parking brake set before the operator leaves the operator's seat. In an emergency, the operator can stop the UN-A-TRAC® by striking the tape switch (panic bar), which trips the circuit breaker. The machine can also be stopped by moving the circuit breaker lever to the "OFF" position.**

## Control handle

**IMPORTANT!**
**For more detailed control handle operating instructions, see Starting procedures in this chapter.**

The control handle (Fig. 19) located to the left of the operator has a group of switches that control the following:

**"TRACTION ASSIST"**

Press down for Traction Assist.

## Shutdown procedure with control handle

Tram the UN-A-TRAC® to its designated parking place.

Stop the UN-A-TRAC® by releasing the speed-switch foot pedal and depressing the foot brake pedal. When the speed-switch foot pedal is released, the tram (traveling) motors will stop. Applying the foot brake will stop forward (or reverse) motion. The hydraulic pump's electric motor will still be running, making a whining sound.

☞ 1. If equipped with optional quick attach bucket, ensure that the bucket (or other attachment) is lowered to the surface and ejector blade is returned to the back of the bucket. There should be no obstructions between the back of the bucket and ejector blade.

**WARNING!**
**If equipped with optional quick attach bucket or other attachment, ensure that the bucket or attachment is lowered to the surface and ejector blade is returned to the back of the bucket. Always check before moving the ejector blade control lever to make sure no one has any part of their body between the ejector blade and the back of the bucket.**

Note: Refer to Fig. 24 for illustration of control handle.

☞ 2. Before leaving the operator's compartment, press J3" to turn "OFF" the machine.

☞ 3. Turn "OFF" the machine circuit breaker.

☞ 4. Turn "OFF" battery circuit breaker and/or disconnect switch (if equipped) before leaving the machine area.

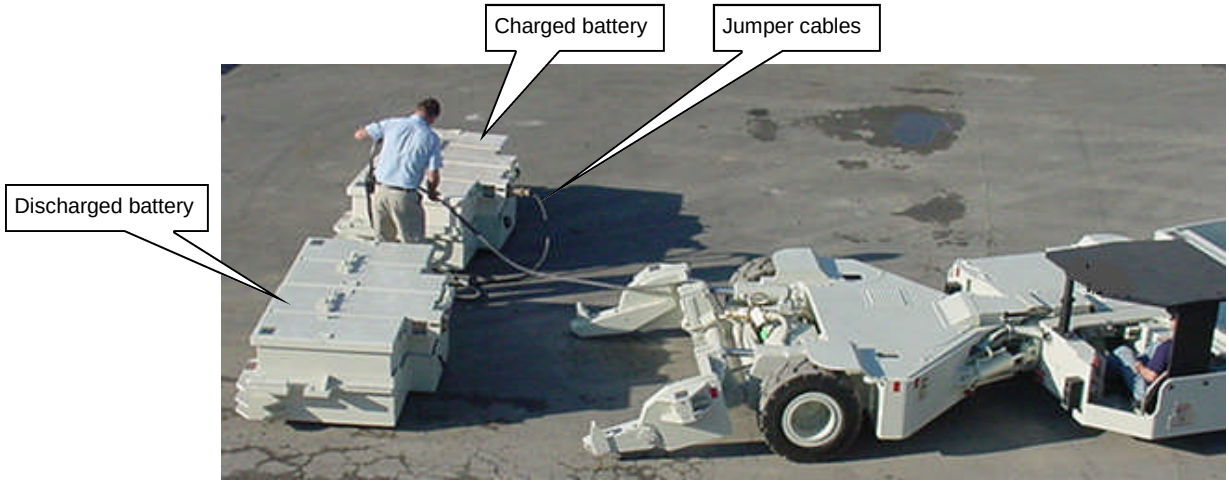
☞ 5. Connect the steering lockout device (Fig. 25):

- remove the steering lockout device from its storage lugs
- remove the hitch pin from the end farthest from the center section
- adjust turnbuckle until holes line up between the turnbuckle lug and the front section lug
- insert the hitch pin into the front section lug through the turnbuckle

**WARNING!**
**Never enter the articulation area while the machine is running. Completely shutdown the machine as outlined before connecting the steering lockout device. Failure to observe this precaution may result in injury or death.**

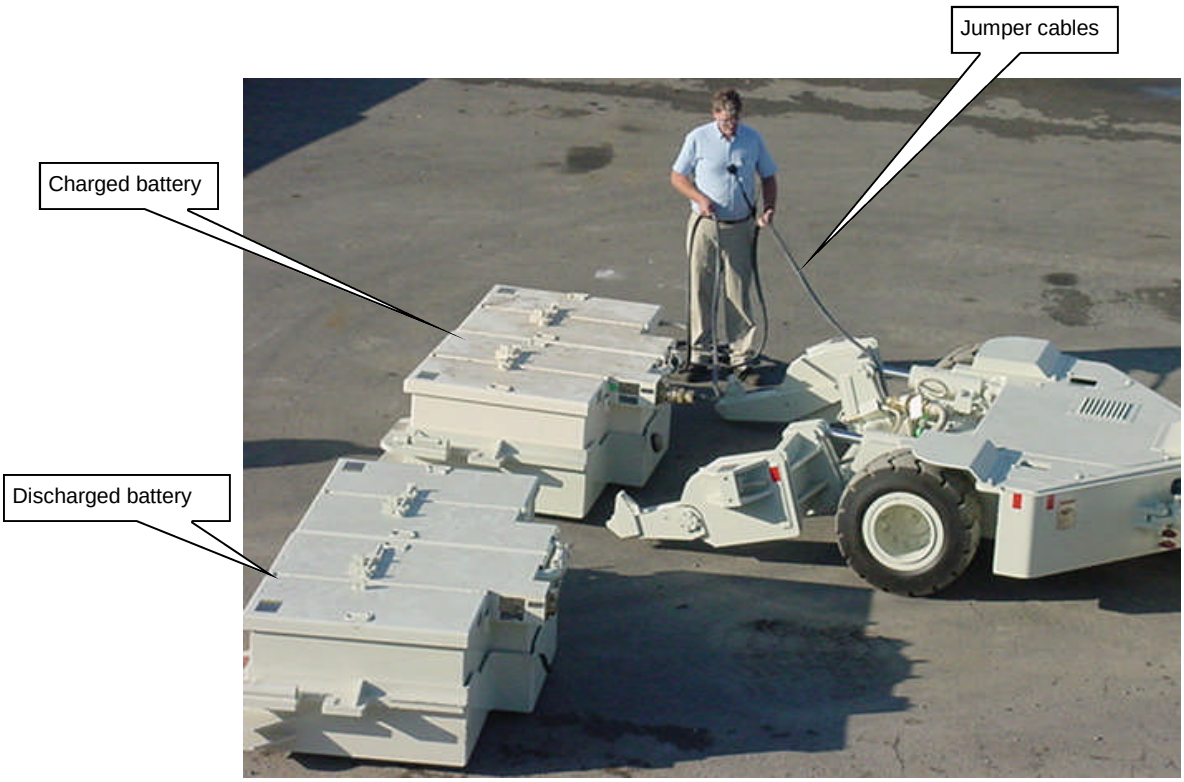
☞ Start the UN-A-TRAC® (see Starting Procedure in this manual). Gently pull away from the discharged battery while the second person holds the jumper cable away from possible damage (Fig. 30).

**Fig 30: Battery changing procedure (ground level)**




☞ Line the UN-A-TRAC® up with the fully charged battery. Move the machine back until the lift arms are aligned with the sides of the battery (Fig. 30 and 31).

**Fig. 31: Battery changing procedure (ground level)**



## Specific lubrication and maintenance procedures

### Every shift

**electrical cables and conduits**
**hydraulic hoses and fittings**
**tires and headlights**

Inspect all electrical cables, conduits, hydraulic hoses, fittings, tires, and headlights for signs of wear or damage. Repair or replace any damaged item.

**warning tags and reflectors**

Visually inspect the condition and readability of all warning tags, labels, and reflectors. Replace all that are found missing or damaged.

**tape switches (panic bars)**

Check the tape switches (panic bars) located inside the operator's compartment (Fig. 36). Start the machine but do not tram. Strike the tape switch: the machine circuit breaker should trip and the UN-A-TRAC® should shut down. Repeat with the other tape switch.

**Fig. 36: Tape switch (panic strip) location**


**hydraulic oil level**

Check the hydraulic oil level by looking at the sight glass located on the oil tank (Fig. 37). If the oil level is low, add oil:
(Spec. 100-1, if equipped with John Deere or Axle Tech axles)
(Spec. 100-12, if equipped with Kessler axles)

**Fig. 37: Hydraulic oil level**

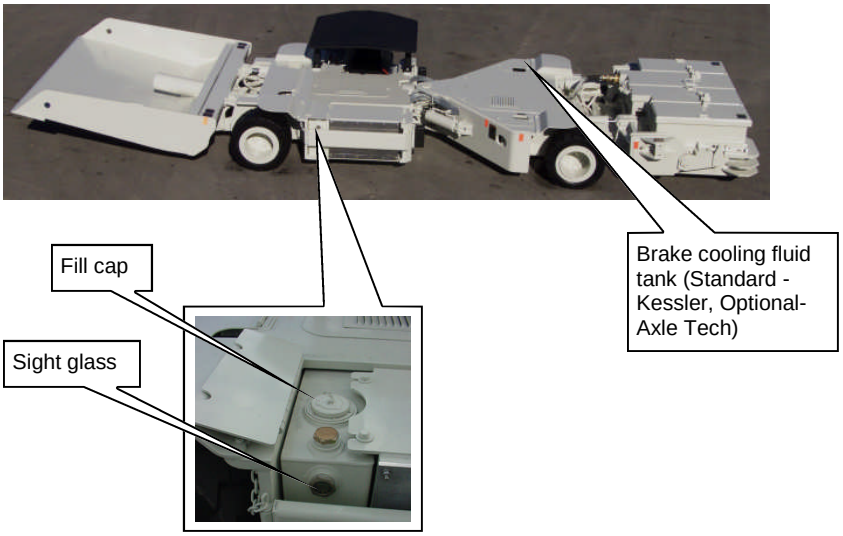
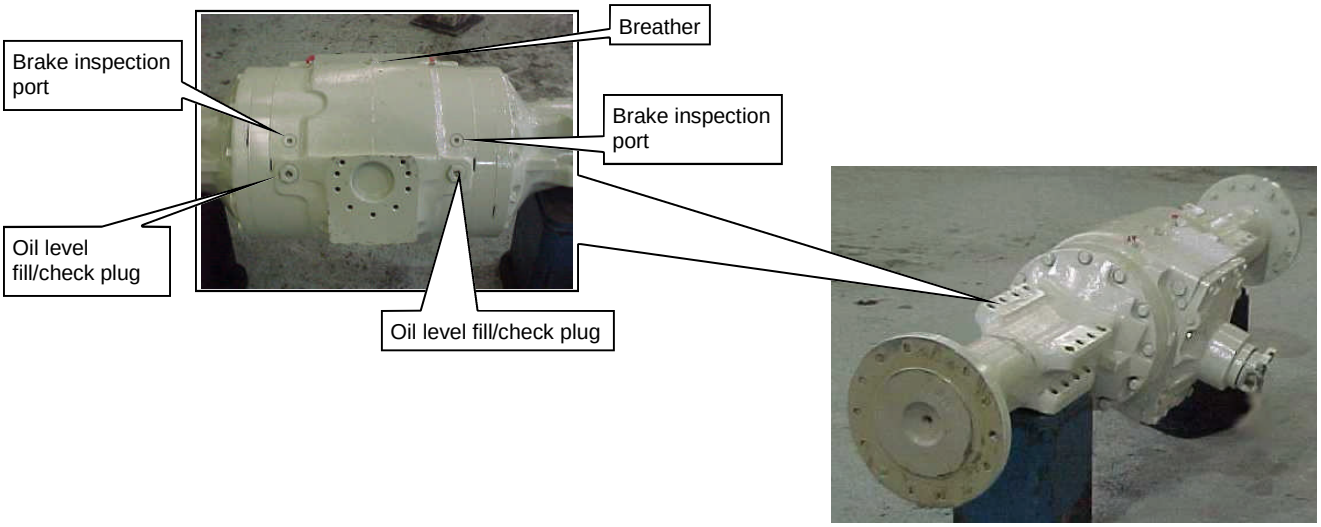


**Fig. 54: Axle oil level (John Deere)**

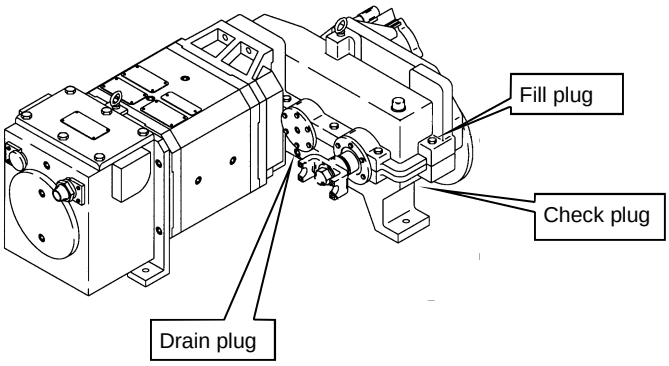



**speed reducer (gear case) oil**

Check the oil in both speed reducers (Fig. 55).

- ☞ Park the UN-A-TRAC® on solid level ground.
- ☞ Remove the check plug from the speed reducer (gearbox). The oil level should be kept at the level of the check plug.
- ☞ Should it be necessary to add oil, add the oil (Spec. 100-6) through the fill plug hole slowly until oil flows from the check plug hole. Do not overfill speed reducer.
- ☞ Replaced the check and fill plugs.

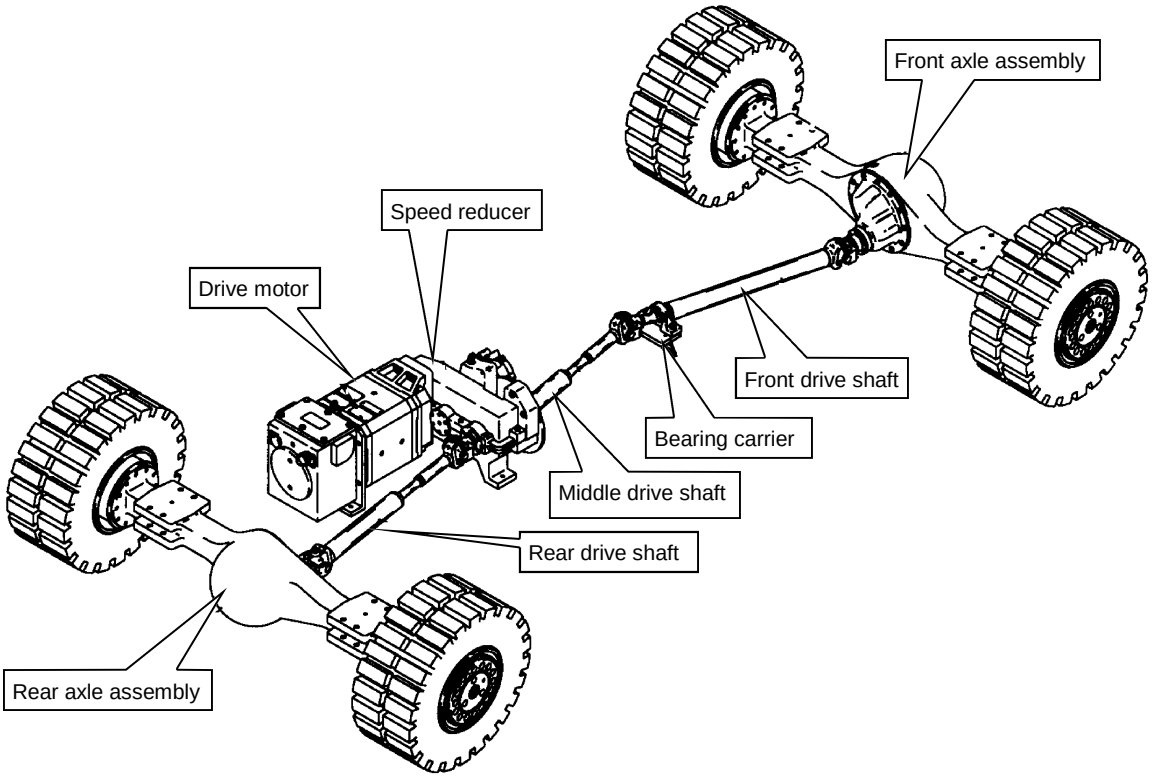
**Fig. 55: Speed reducer (gear case) oil**



## Drive motor/gearbox (speed reducer) removal and replacement

**WARNING!**
**Power must be removed by unplugging the battery plugs before servicing the motor.**

**Fig. 67: Drive train components**






The following procedures reference Fig. 67.

**Drive motor**

- ☞ Remove the motor inspection cover and disconnect the power cables to the motor. Unpack the motor gland and completely remove the wiring and conduit from the motor.
- ☞ Attach a crane or hoist, capable of lifting the motor, to the eyebolt on top of the motor and take up any slack in hoist chain.
- ☞ Remove the four (4) bolts that attach the motor to the gearbox.
- ☞ Lift the motor out of the unit.
- ☞ Cover the reducer opening to prevent foreign matter from entering the gearbox.

## Brakes

**Table 6: Brakes troubleshooting**

| Trouble, symptom or cause | Probable cause | Test, check and/or remedy |
|---|---|---|
| **brakes slow to apply** | ☞ No gas charge in accumulator. | ☞ Check gas charge. |
| | ☞ Defective brakes. | ☞ Check brakes. |
| | ☞ Hydraulic lines or fittings leaking. | ☞ Check for leaks and repair. |
| | ☞ Pedal linkage out of adjustment. | ☞ Adjust linkage. |
| | ☞ Damaged hydraulic brake lines. | ☞ Check lines for dents that restrict flow of oil. |
| **brakes won't release** | ☞ Pedal linkage out of adjustment or binding. | ☞ Check for proper adjustment and binding. |
| | ☞ Defective brakes. | ☞ Check brakes . |
| | ☞ Defective brake valve. | ☞ Replace brake valve. |
| **insufficient brakes** | ☞ No oil or low level in tank. | ☞ Check oil level in tank. |
| | ☞ Pedal linkage out of adjustment. | ☞ Adjust linkage. |
| | ☞ Brake line mashed. | ☞ Check lines and replace. |
| | ☞ No gas charge in accumulator. | ☞ Check gas charge. |
| | ☞ Defective brakes. | ☞ Check brakes. |
| | ☞ Brake valve defective. | ☞ Replace valve. |
| **brakes will not release completely** | ☞ Defective brakes. | ☞ Check brakes. |
| | ☞ Pedal linkage out of adjustment. | ☞ Adjust pedal linkage. |
| | ☞ Air in brakes. | ☞ Bleed brakes. |
| | ☞ Defective brake valve. | ☞ Replace brake valve. |
| | ☞ Back pressure on return line too high. | ☞ Remove restriction. |
| **excessive braking** | ☞ Defective brakes. | ☞ Check brakes. |
| | ☞ Defective brake valve. | ☞ Replace brake valve. |

# Tightening torques

**IMPORTANT!**
**Due to the application of fasteners being subject to great stresses and heavy or extreme vibration, it is imperative that all bolts be applied with an adequate amount of torque. For this reason this list of recommended torque settings for different types and sizes of fasteners used has been compiled.**
**The tightening torques stated in the spare parts lists have to be observed, as well, for installation and maintenance.**

## Set screws

**Table 10: Set screws (Socket long-lok)**

| Nominal diameter | Recommended torque setting |
|---|---|
| #6 | 6 in-lbs |
| #8 | 9 in-lbs |
| #10 | 13 in-lbs |
| ¼” | 30 in-lbs |
| 5/16” | 5 ft-lbs |
| 3/8” | 8 ft-lbs |
| 7/16” | 11 ft-lbs |
| ½” | 16.7 ft-lbs |

**Table 11: Set screws (Socket standard steel)**

| Nominal diameter | Recommended torque setting |
|---|---|
| #6 | 9 in-lbs |
| #8 | 16 in-lbs |
| #10 | 30 in-lbs |
| ¼” | 6 ft-lbs |
| 5/16” | 12 ft-lbs |
| 3/8” | 18 ft-lbs |
| 7/16” | 29 ft-lbs |
| ½” | 43 ft-lbs |
| 5/8” | 100 ft-lbs |
| ¾” | 146 ft-lbs |
| 7/8” | 199 ft-lbs |
| 1” | 262 ft-lbs |

**Table 22: Invert emulsion hydraulic fluid (Spec. 100-5)**

| | Supplier | Brand name |
|---|---|---|
| 1 | Unocal 76 | FR Fluid |
| 2 | Conoco Inc. | FR Hydraulic Fluid |
| 3 | Atlantic Richfield Company | Duro FR-HD |
| 4 | Brooks Oil Company | Brooks Fire Resistant Hydraulic Fluid B |
| 5 | Cincinnati – Vulcon Company | Vulcon FR Fluid #1 |
| 6 | Cities Service Oil Company | Citgo Pacemaker Invert FR Fluid |
| 7 | Century Oils Limited | Aquacent Light |
| 8 | Fiske Bros. Refining Company | Lubriplate HO-Retard |
| 9 | Getty Oil Company (Veedol, Tidewater) | Veedol Auburn FRH |
| 10 | Gulf Oil Company | FR Fluid |
| 11 | E.F. Houghton | Houghto-Safe 5046<br>Houghto-Safe 5046W |
| 12 | Century Lubricating Oils | Hulsafe 600 |
| 13 | Imperial Oil and Grease | Astrol 587 |
| 14 | Mobil Oil Corporation | Pyrogard D |
| 15 | National Oil and Chemical Co. | Erifon 1, 2, and 3 |
| 16 | Pennzoil | Maxmul FRP/G |
| 17 | Quaker Chemical Company | Quintolubric 958 Series<br>Quintolubric 958 Series |
| 18 | Henery E. Sanson and Sons MFGE Company | Hydra-Mul Premium Emulsion Fluid |
| 19 | Southwest Grease and Oil Company, Inc. | Invert Emulsion Fire Resistant Hydraulic Fluid |
| 20 | Southwest Petroleum Corp. | Swepco Fire Resistant Hydraulic oil #718 |
| 21 | Standard Oil Company of Ohio (Boron Sohio) | Staysol FR |
| 22 | Sun Oil Company | Sunsafe F |
| 23 | Tower Oil Company | Safoil Anti-Wear Hydraulic Fluid |
| 24 | Wynn Oil Company | Hydra-Safe Heavy Medium |
| 25 | Lubrication Engineers | 6455 Monolec Fire Resistant Hydraulic Fluid |
| 26 | Hydrotex | HY-Guard |

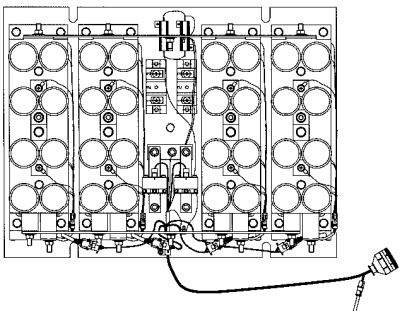
# Operation and Troubleshooting Manual

## BUCYRUS - Dual and Single Motor Controller

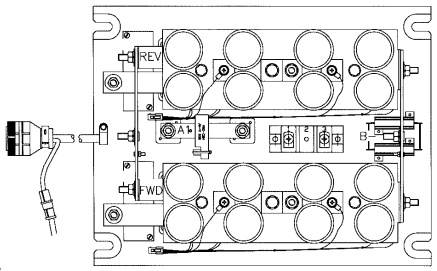
## Model - BUC2000

## Doc. No.: A6474X226

Dual Motor



Single Motor

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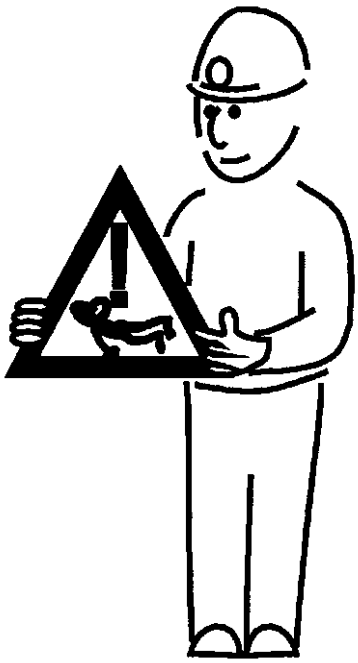
# 2 Your safety



# Operation

This chapter contains important information on the operation and troubleshooting of the model BUC2000 Dual and Single Motor Controller.

Read this chapter carefully and thoroughly. In particular, observe the safety instructions in Chapter 2 “Your safety”.

## History

In the early 1970's, S&S Corporation lead the way in mining innovation with the introduction of solid state speed controls for battery-powered underground mining equipment. Solid state controls increased the range and reliability of the battery powered vehicles along with providing smooth, stepless acceleration. Even with solid state speed control, direction change was achieved with the use of electromechanical contactors. These contactors provided an endless source of maintenance problems and consumed excessive amounts of valuable controller-box space. Also, most solid state controllers of the past utilized an electromechanical "bypass" contactor to connect the motor directly to the batteries which caused more contactor problems.

In the 1980’s Bucyrus America, Inc., in conjunction with Sevcon, developed a contactorless motor controller (X90) to be used exclusively on Bucyrus equipment. The X90 system used a dual-field motor in combination with SCRs (Silicone Controlled Rectifier) to achieve solid state direction change.

Now Bucyrus America, Inc., in conjunction with Sevcon, has developed the BUC2000 motor controller. The BUC2000 system uses IGBTs (Insulated Gate Bipolar Transistors) to achieve motor control and direction change. Unlike an SCR, an IGBT is turned ON and OFF via a gating electronic signal. This eliminated commutating capacitor banks and coils. The microprocessor based BUC2000 Logic Card provides complete motor control and drives both a Diagnostic Dashboard Display along with a hand held Calibrator/Diagnostic Unit.

The IGBT switch operates so fast that it can connect and disconnect the motor in less than 1/1700 second. This is such a short time period that the dual-field motor does not have time to move. Each time the IGBT switch closes and reopens, the full battery voltage is applied to the motor terminals for about 1/1700 second. This is commonly referred to as a "pulse." (Fig. 1)

The IGBT speed control works by feeding to the motor a rapid series of pulses. The number of pulses per second determines the average voltage at the motor terminals. (Fig. 2)

There is an LED on the logic card which serves as an indicator of the status of the controller. The following diagnostics shall apply:

| | |
|---|---|
| **LED on** | Controller operational |
| **LED off** | Power-up fault – check display or calibrator. If all is blank, then replace logic. |
| **1 Flash** | **Personality CRC EEPROM Error.** Using the hand-held calibrator, change a password to any number then recycle power – should clear, otherwise replace logic. |
| **2 Flash** | **Procedure FAULT** FS1 closed before power on or 2 Directional Fault. Recycle FS1 through neutral to clear. |
| **3 Flash** | **IGBT permanently low (IGBT Short Circuit FAULT).** This includes IGBT short circuit or IGBT open circuit. This fault shuts down all modes. Recycle FS1 through neutral to clear. |
| **4 Flash** | **Motor neither low nor high (Breaker Open FAULT).** This includes breaker open circuit or IGBT open circuit. This fault shuts down all modes. Recycle FS1 through neutral to clear. |
| **5 Flash** | **Motor permanently high. (Breaker welded FAULT)** This includes breaker welded. This fault shuts down all modes. Recycle "KEY" to clear. |
| **6 Flash** | **Faulty TRACTION accelerator.** This includes the accelerator greater than 15% at power on and wire-off. If wire-off occurs during active function then the motor speed will set to zero. This fault auto-clears. |
| **7 Flash** | **Battery voltage FAULT.** This includes battery below a predetermined value. Recycle FS1 through neutral to clear. |
| **8 Flash** | **Thermal cut-back (Over-Temperature FAULT).** This includes Heatsink temperature above 95° centigrade. |

**NOTICE!**
**As temperature rises above 95° centigrade, the controller will limit the current to 300 amps regardless of demand.**

| | |
|---|---|
| **9 Flash** | **UVR coil over-current FAULT (Coil short circuit FAULT).** Cleared with "KEY" recycled. |
| **10 Flash** | **Brake on FAULT** Fault will occur when directional and FS1 are energized without releasing brake. Recycle FS1 through neutral to clear. |
| **15 Flash** | **Current Transducer FAULT.** Occurs when current output is read during power-up or if no current is read during drive above 50% demand. "KEY" recycle to clear. |

### Table 5: Traction test display

| Display name | Range/Notes | Security levels displayed | Security levels adjustable |
|---|---|---|---|
| “ACCELERATOR VOLTAGE” | 0.0 V-5.0 V | ALL | N / A |
| “ACCELERATOR PERCENT DEMAND” | 0-100% | ALL | N / A |
| “FORWARD SWITCH” | OPEN / CLOSED | ALL | N / A |
| “REVERSE SWITCH” | OPEN / CLOSED | ALL | N / A |
| “FS1 SWITCH” | OPEN / CLOSED | ALL | N / A |
| “CONFIGURATION JUMPER 1” | OPEN / CLOSED | ALL | N / A |
| “CONFIGURATION JUMPER 2” | OPEN / CLOSED | ALL | N / A |
| “BRAKE INPUT” | OPEN / CLOSED | ALL | N / A |
| “CIRCUIT BREAKER INPUT” | OPEN / CLOSED | ALL | N / A |
| “OIL TEMPERATURE” | OK / HOT | ALL | N / A |
| “OIL LEVEL” | OK / LOW | ALL | N / A |
| “SOFTWARE VERSION” | VX.XXX | ALL | N / A |

### Table 6: Traction BDI display

| Display name | Range/Notes | Security levels displayed | Security levels adjustable |
|---|---|---|---|
| “% CHANGE LEFT” | 0 -100% | ENGINEERING | ENGINEERING |
| “BDI CELLS” | 35-80<br>(64) | ENGINEERING | ENGINEERING |
| “RESET CELL LEVEL” | 1.85V-2.50V<br><br>(2.04V) | SERVICE<br>ADVANCED<br>ENGINEERING | SERVICE<br>ADVANCED<br>ENGINEERING |
| “EMPTY CELL LEVEL” | 1.00V-1.99V<br><br>(1.70V) | SERVICE<br>ADVANCED<br>ENGINEERING | SERVICE<br>ADVANCED<br>ENGINEERING |
| “WARNING LEVEL” | 0%-90%<br><br>(20%) | SERVICE<br>ADVANCED<br>ENGINEERING | SERVICE<br>ADVANCED<br>ENGINEERING |
| “CUTOUT LEVEL” | 0%-90%<br><br>(0%) | ENGINEERING | ENGINEERING |
| “BATTERY CALLIBRATION VOLTAGE” | 1.00V–10.0V<br>(5-VOLTS) | ENGINEERING | ENGINEERING |
| “BDI SAMPLE TIMER” | 1.0-255 SECONDS<br>(20 SECONDS) | ENGINEERING | ENGINEERING |
| “DISPLAY WORKING” | OK | ADVANCED<br>ENGINEERING | ADVANCED<br>ENGINEERING |
| “DISPLAY STATUS” | LOCK / ROTATE<br>(ROTATE) | ALL | ALL |
| “SELECT DASHBOARD DISPLAY STATUS” | 0-4<br>(BATTERY VOLTAGE, PUMP CURRENT AND MOTOR CURRENT)<br>BATTERY VOLTAGE<br>(1) | ALL | ALL |
| “DISPLAY CONTRAST” | 0-127<br>(33) | ALL | ALL |

Fig. 24: Calibrator unit

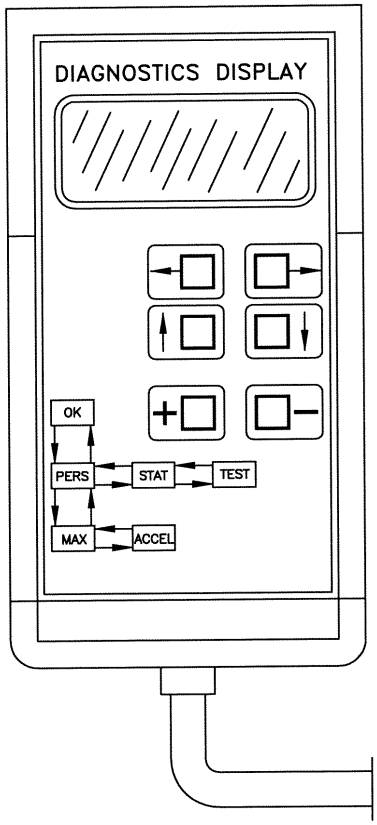
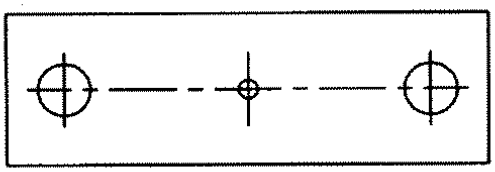
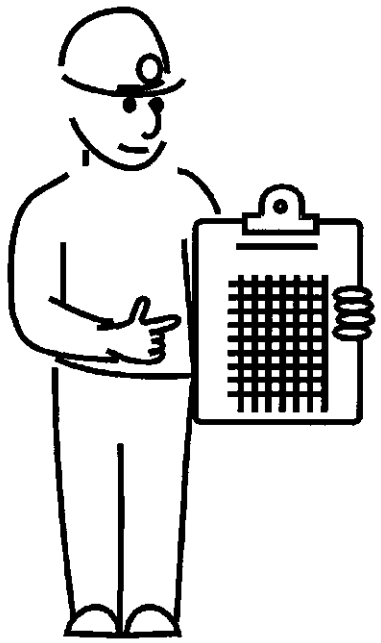



Fig. 25: BUC2000 pump motor shunt



# 4 Tightening torques



# Important remarks

## General maintenance instructions

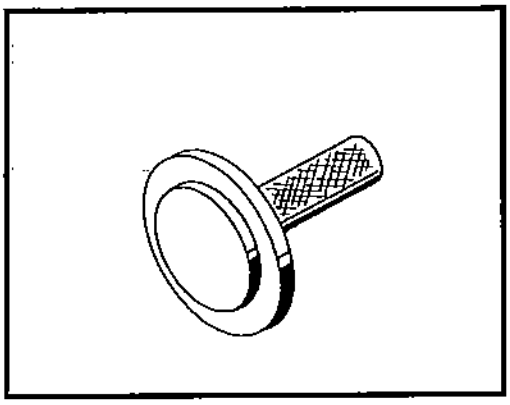
| Check - and maintenance points | Remarks | Maintenance intervals 1.) | | | | |
|---|---|---|---|---|---|---|
| | | after 50Bh 500Km | after 100Bh 1000Km | every 500Bh 5000Km | every 1000Bh 10000Km | min. 1x Year |
| Wheel bearing | Inspect , if necessary readjust wheel bearing | | ⊕ | | | ⊕ |
| Wheel nuts | Check and tighten with a torque wrench ( after tire change after 50km and 200km ) | ⊕ | ⊕ | ⊕ | | |
| Castle nuts/track rod Screws/drive flange Nuts/axle mounting bolts | Check and retighten ( Verify the adjustment ) | ⊕ | ⊕ | ⊕ | | ⊕ |
| Brakes ( see also chapter 7 ) | Check lining wear , if necessary readjust , control the proper operation of the brake shafts | ⊕ | monthly | | | |
| NLB | Check lining wear | | | | | ⊕ |
| NLB - spring load design | Check lining wear | | | | ⊕ | |
| Steering - and trackrod lever | Check and retighten mounting bolts *) | | ⊕ | | | ⊕ |
| Bolted connections ( f. e. drive assembly ) | Check from time to time | | | ⊕ | | |
| Ring gear support bolt on drive assembly | Readjust ( if necessary ) | | | | | ⊕ |
| Seals | Check from time to time | monthly | | | | |
| Differential lock | Check function and the automatic return in original position | monthly | | | | |

( Bh = Hours of operation )

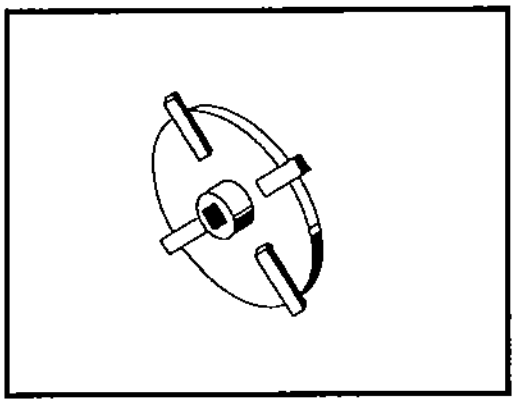
*) If the bolts are moving ( Loctite brakes loose ) , the lever has to be mounted once more .

1.) Whichever occurs first .

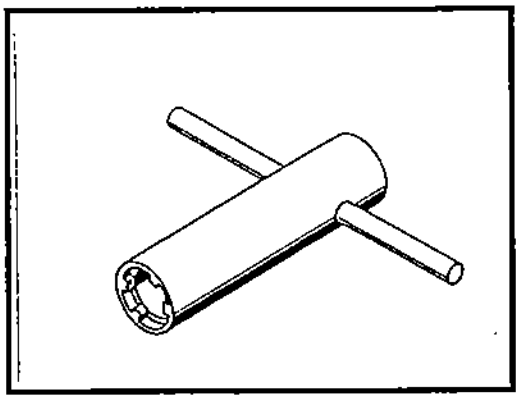
## Service tools



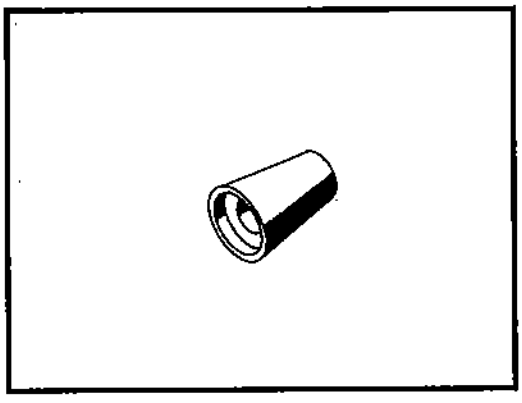
Seal ring sleeve driver



Spanner for thread rings
( differential bearing )

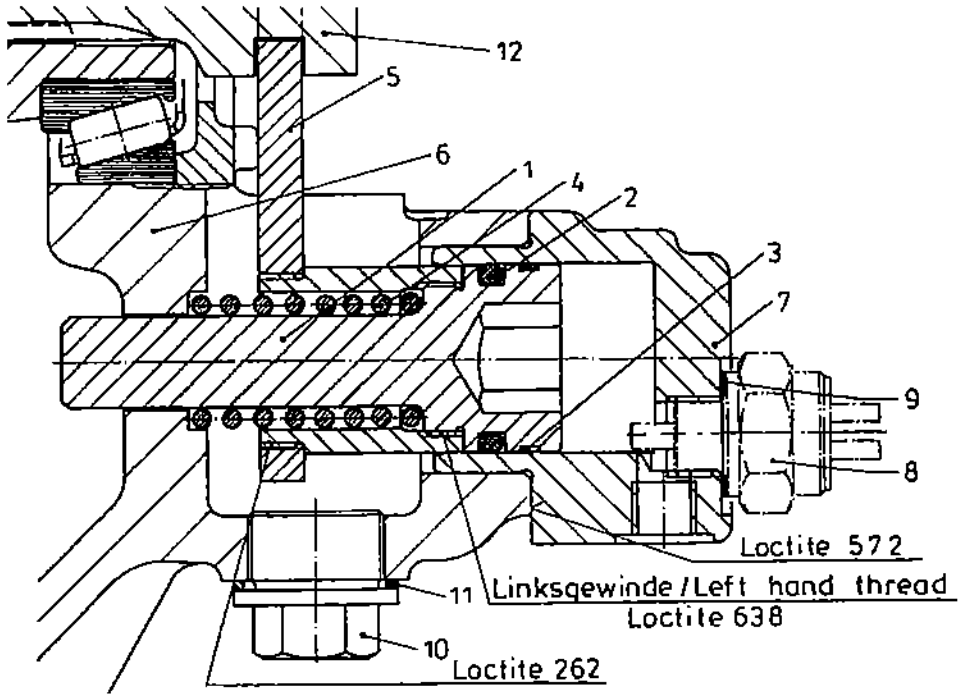


Spanner for counter nut
( planetary gear drive )



Assembly cone for o - ring
( differential lock )

## Assembly of the cross differential lock D 51 / D 108 / D 71 through drive

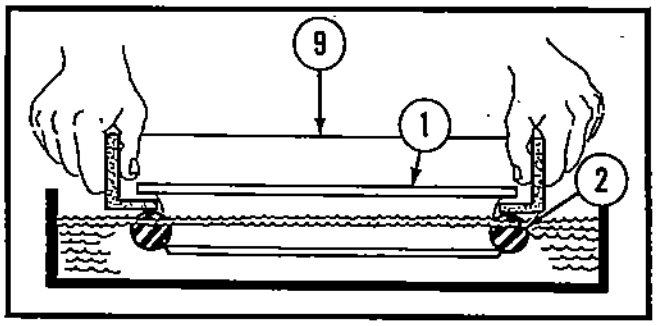



1. Install the sliding sleeve (12) and the shifter fork (5) into the differential carrier (6).
2. Coat the ring grooves of the piston (1) for the O - ring (2) resp. piston guide band (3) with Klüber special grease Microlube GL 261. Mount the O - ring (2) with the aid of the service tool (see 3.6), put the piston guide band (3) into the slot of the piston (1). Coat the thread of the piston (1) with Loctite 262.
3. Thread the spring (4) onto the piston (1). Guide the piston (1) through the shifter fork (5) and screw the piston into the shifter fork by using the service tool (see 3.6).
   Tightening torque = 150 Nm.
4. Coat the piston tread in the shifter cylinder (7) with Klüber special grease Microlube GL 261, coat the contact surface of the shifter cylinder (7) with Loctite 572. Mount the shifter cylinder (7) (**Attention** : Do not damage the piston tread), tighten the screws with 49 Nm. Mount the switch (8) with the seal ring (9).
5. Check the differential lock for function and tightness.
6. Screw in the screw plug (10) with the seal ring (11) (not inapplicable at carrier D 71 through drive).

**Changing of the O - ring (2) and the piston guide band (3) :**

- Remove the shifter cylinder (7).
- Change the O - ring (2) and the piston guide band (3).
- Coat the contact surface of the shifter cylinder (7) with Loctite 572 and mount shifter cylinder .
- Check the differential lock for function and tightness.

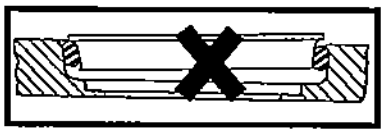
Place the installation tool around the seal ring and dip the seal ring into a pan of Isopropanol solvent to lubricate the toric ring . It is essential to lubricate the toric with Isopropanol so that the toric will slip past the housing retaining lip and seal uniformly in the housing nose radius . Insufficient lubrication can cause poor seal performance due to nonuniform loading ( twisted torics or cocked seals ) . Use of solvents other than Isopropanol can leave a residue on the toric or ramps and allow the toric to slide rather than roll in seat . This can also result in poor seal performance due to nonuniform loading .




Put the installation tool (9) onto the seal ring (1) with toric ring (2) . Lower the rings into a container with Isopropanol until all surfaces of the toric (2) are wet .

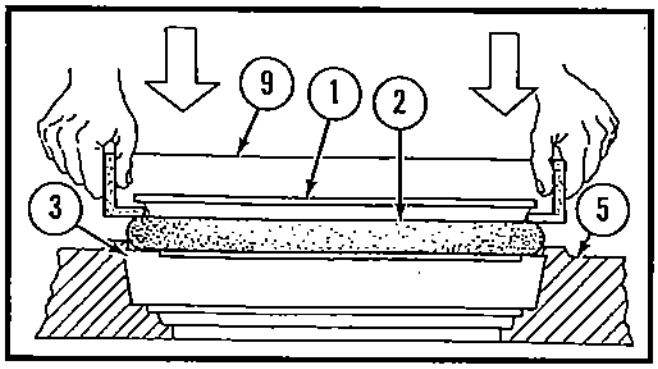
Toric sliding on retainer ramp .

Toric caught on housing retainer lip .



Toric sliding on seal ramp .

After dipping the seal assembly in the solvent , shake the excess solvent from the seal assembly and immediately „ pop „ the seal into the housing with a firm push of the installation tool . Remove the installation tool and check the seal stantout height at several places around the circumference of the ring to verify an accurate installation . If the seal does not meet the height specification , inspect the toric for twists or obvious bulges .




With all surfaces of the toric ring (2) wet with Isopropanol , use the installation tool (9) to position the seal ring (1) and the toric ring (2) squarely against the housing (5) as shown . Use sudden and even pressure to pop ( push ) the toric ring (2) under the retaining lip (3) of the housing (5) .

# Assembly service brake

## Remarks to the Wet Disk Brake

**Permissible oil for brake without external cooling ( oil sump = cooling fluid )**

**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 o. D

2 ) ATF C - 3 or Dexron ®

3 ) Hydraulicoil HLP DIN 51524 Teil 2

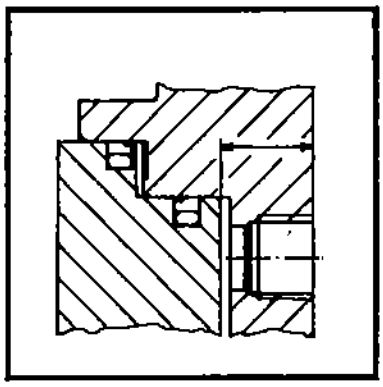
**Viscosity :**

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

**Cooling fluid :**

Hypoid gear oil like specification on installation drawing :
SAE 90 per MIL - L - 2105 B , API GL 5 .
**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 6178

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

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

# About this manual

This chapter provides important information making it easier for you to use this manual. You will also be given information on the structure of the manual and the symbols and characters used.

## Before starting to work

**applicable operating manual**

Take care to ensure that the operating manual available to you is applicable for the type of battery used.

**machine type**

This operating manual is intended for:

Bucyrus - Mine power storage batteries
Serial No. - N/A

and is only permitted to be used for these batteries.

**new operation manual**

The operating manual must be accessible at all times to all persons working on or with the batteries.

It should, if possible, always be available at the place of operation.

Send for a new operation manual immediately if the present manual is no longer complete or has become illegible.

## Who is this operating manual intended for?

This operating manual is intended for those persons who work with or on the battery.
.
Every person working on the face or in the intersection between face and entry or in the entry must read this operating manual.

**This includes persons who:**

- are in charge of transport
- perform assembly / disassembly work
- operate the machine
- eliminate faults
- perform daily routine work on the face or in the entry
- perform maintenance work
- perform repair work

**supervisory personnel who:**

- initiate and/or
- supervise the activities just indicated.

# Safety instructions

## General rules

**general**

Always work with full concentration.

Familiarize yourself with your working environment.

**noise emissions**

Always wear your personal protective equipment. This also includes ear protectors as the noise emitted by other equipment in the area may at times exceed 85 db(A).

Inform your colleagues of:

- your exact location,
- the work you are performing, and
- the time that you will probably require.

**safety equipment**

Put the battery into service only when it is in a good and safe operating condition and all protective devices, e.g. cover plates, are correctly installed.

**symbol plates**

Observe the symbol plates on the battery and the machine being used.

**disconnect battery**

Disconnect the battery while performing:

- maintenance work
- inspection work
- repair work

**welding**

Batteries should be well vented before servicing, particularly if welding or burning on the battery.

Disconnect the battery when working with the electrical system or when welding on the battery to prevent electrical shock.

While welding, the battery must be disconnected to ensure that the electrical system and/or electrical system components are not damaged.

## Storage and transport

Maintain the prescribed storage periods and observe the instructions for storage outlined in Chapter 3 of this manual.

Do not store in the way of travel or in the work area.

Inform the persons involved about the intended transport route and the anticipated duration of transport.

**CAUTION!**
**Never add acid with a specific gravity higher than 1.400. Stronger acid may permanently damage the cell. When mixing or cutting acid, always add the acid to the water. Never pour water into the acid; a violent reaction may result which may result in injury to personnel. When working with acid, always use a face shield or goggles, rubber gloves, and an acid resistant apron.**

**CAUTION!**
**Do not blow breath into cells. Wear protective face shield or goggles, rubber gloves, and apron.**

**WARNING!**
**You could be seriously injured or even killed by falling loads. Observe the safe working load limits of lifting devices.**

**NOTICE!**
**When pulling an element from a cell which has been removed from a battery, use jar hold-down clamps.**

**NOTICE!**
**Cells from which the elements were pulled, or which had damaged jars replaced, should be given an equalizing charge and acid should be adjusted immediately following repair, before they are returned to service.**

**NOTICE!**
**Cells must be connected in series with the positive side of one cell connected to the negative side of the adjacent cell.**

**WARNING!**
**Always be sure the cells are purged of gas before using an open flame or burning arc on top of the battery.**

# Installation

## Points to observe prior to installation

### Who is allowed to carry out installation?

Installation is only allowed to be carried out by personnel having received adequate training to perform this task.

Work on the battery should only be carried out by Bucyrus America, Inc. service engineers or by specially trained personnel.

### Which tools are required for installation?

No special tools are required to put the battery into service.

**tool box**

Various items of auxiliary equipment and machines may be required at the point of installation.

These include:

- hoists with adequate lifting capacity
- means of attachment with adequate lifting capacity
- unloading dock
- jacks with adequate lifting capacity
- battery plug and receptacle wrench

### Notes on installation

**CAUTION!**
**Serious damage can be caused to the battery as a result of incorrect installation. The battery should therefore only be installed under the instruction of specialists from Bucyrus America, Inc.**

Lead-acid batteries should be charged for a sufficient length of time and at a rate which will put back into the battery the same number of ampere-hours removed on discharge, plus approximately 10% additional which is an acceptable, and in fact desirable, overcharge. The specific amount of overcharge depends upon the temperature, age, and history of the battery. In general, it is more harmful to excessively overcharge an older battery, or one which is operating at high temperature, than a new battery or one operating consistently at room temperature. Any charge rate is permissible which does not produce excessive gassing or cell temperatures greater than 110° F.

**Control of gassing**

Gassing is the evolution of gases from one or more of the electrodes during electrolysis. It is a natural phenomenon which takes place when a battery on charge can no longer accept all of the current being applied to it. Gassing is evidenced by bubbling of the electrolyte. The gases liberated are oxygen (evolved at the positive plates) and hydrogen (evolved at the negative plates).

The point at which significant gassing begins is determined by voltage, but the amount of gas depends upon the portion of the charging current that is not being absorbed by the battery. Normally, noticeable gassing will begin when the voltage exceeds 2.30 volts per cell. At 2.40 volts per cell, gassing will be normal; at 2.50, it will be rapid. The amperage at which gassing becomes excessive depends primarily upon the state of charge and electrolyte temperatures. As the battery approaches full charge, it is necessary to reduce the charging rate to a point at which excessive gassing is prevented. This safe rate is the finishing rate or below. When proper charging equipment is used, the tapering of the charging current to the finishing rate is achieved automatically.

**Methods and equipment**

The modern storage battery, used with a properly designed, modern, automatic charger, needs only normal water additions, occasional cleaning, and regular checking of both charger adjustment and battery condition to provide long, dependable service.

There are two recommended methods for the normal charging of motive power batteries:

**modified constant voltage (potential) method**

The modified constant voltage method, in which the tapering of the charging rate is accomplished gradually, requires a source of direct current with a constant bus voltage of approximately 2.63 volts for each cell. This is for an 8-hour charge. Proper series resistance in the output circuit inherently provides the correct starting rate and assures that the rate will automatically be reduced, as the charge progresses, to the recommended finish rate. The constant voltage source may be either a motor-driven generator or rectifier.

## Specific maintenance procedures

### Every shift

**charger adjustment**

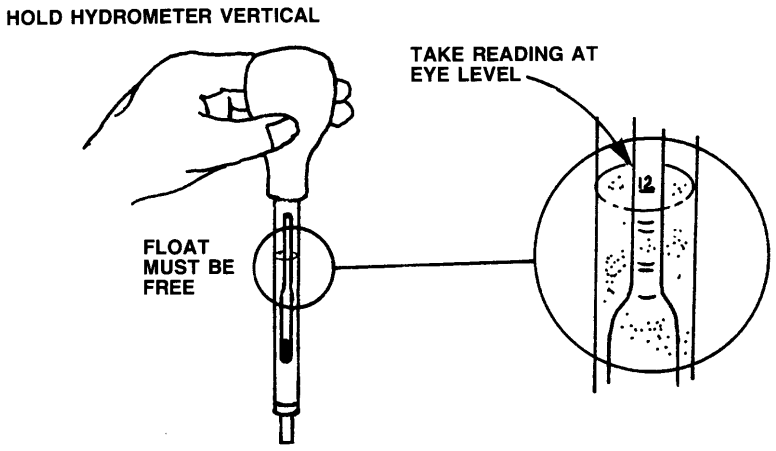
Make sure that the charger adjustment, used for control of charging rates and cut-off, is correct. This will ensure that the batteries are properly charged with no excessive overcharge. Batteries that are overcharged regularly will need water more often, and cell temperatures usually will be higher than normal. If either condition is evident, adjust the charge rate downward, in those chargers which have provision for adjustment, so it is between a normal finish rate and one-half normal finish rate.

**hydrometer reading**

Measure and record the specific gravity:

- ☞ With the tip of the hydrometer immersed in the electrolyte, squeeze the syringe bulb and then slowly release it, drawing into the cylinder or barrel just enough electrolyte to permit the hydrometer float to ride free. The float stem must not touch the side of the cylinder nor the top of the syringe. If the float stem touches the upper area of the syringe, too much electrolyte has been drawn up; if the float still rests on the bottom, too little electrolyte has been drawn up. (See Fig. 2.)
- ☞ Read the hydrometer float scale with your eye at the same level as the electrolyte. The reading should be taken at the surface of the liquid, disregarding any slight curvature. This reading will be the specific gravity uncorrected for temperature. (See Table 4 for correction factors.)
- ☞ Return all electrolyte to cell.

**Fig. 2: Hydrometer reading**



# Adjustment procedures

**Electrolyte specific gravity**

Fully charged cells usually operate at a specific gravity between 1.280 and 1.295. Normally, it should never be necessary to adjust the specific gravity, but upsets, jar breakage, additions of too much water, and careless use of the hydrometer can result in electrolyte loss and possible reductions of battery capacity. Lost electrolyte must be replaced but only after it has been determined that charging will not restore the specific gravity to normal when at the recommended level.

Therefore, a cell or battery should first be given an equalizing charge.

**IMPORTANT!**
**Never make a specific gravity adjustment on a cell which does not gas vigorously while on charge.**

If, after the equalizing charge, the specific gravity of any cell, corrected for temperature, is lower than normal, it should be adjusted in the following manner:

- ☞ Put battery back on charge at the finish rate until cells are actively gassing to provide proper mixing.
- ☞ Remove electrolyte from the low reading cells until level reaches separator protector.
- ☞ Slowly add 1.400 specific gravity sulfuric acid to the cell while it is still gassing.
- ☞ Wait 15 to 20 minutes for the added acid to become thoroughly mixed, then read the specific gravity. If it is still low, repeat the process until gravity is normal. As a guide, every 1/4" of electrolyte that has been removed and replaced by 1.400 acid will cause the specific gravity to rise 4 to 5 points (.004 to .005).

If the corrected specific gravity of any cell is higher than normal, proceed as follows:

- ☞ While the battery is gassing on charge, withdraw from the cell a small amount of electrolyte and replace with approved water.
- ☞ Repeat, if necessary, at 20 to 30 minute intervals until the desired reading is obtained. Every 1/4" of electrolyte which is replaced with water will cause the specific gravity of the cell electrolyte to drop 4 to 5 points (.004 to .005).

**CAUTION!**
**Never add acid with a specific gravity higher than 1.400. Stronger acid may permanently damage the cell. When mixing or cutting acid, always add the acid to the water. Never pour water into the acid; a violent reaction may result which may result in injury to personnel. When working with acid, always use a face shield or goggles, rubber gloves, and an acid resistant apron.**