



## Operation Manual

Bucyrus- Battery Charger  
Model: Bucyrus Super Service

Doc. No.: A6474X233



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## 2 Your safety





## Safety instructions

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### **maintenance, repair**

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

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

- the wiring and cables are not pinched or trapped.
- the conduits are not abnormally rigid or hard.
- the conduits are not damaged.
- the connectors are securely inserted into the sockets.
- the connections are tight.

Secure wiring and cables only with the proper clamps. Always fasten the clamps completely and with both sides. Never use nails, wire or similar materials for securing.

After finishing repair work, check all connectors and connections to ensure they are tight.



### Before transport

#### temperatures below freezing

During transport of this equipment with floor-mounted vehicles at such low temperatures, measures must also be taken to ensure that the parts and devices are not subjected to sudden impact loads. At very low temperatures and on poor roads, the transport vehicle speed must therefore be limited to a maximum of 15 mph (25 kph) for truck transport.

#### electronic components

Electrical and electronic components must be removed for overseas transport or prolonged storage outdoors unless these components or the complete equipment is protected against harmful environmental influences by a suitable packaging.

The electrical cables remain in the equipment. They must be carefully protected against transport damage and soiling of the connections.



## Location

- locate the charging station away from rain, snow, wet conditions or areas of high traffic when possible
- never place the unit directly above a battery. Gases from the battery will corrode and damage equipment
- Never allow the battery electrolyte to drop on the unit when reading specific gravity or filling the battery
- do not operate the unit in a closed area or restrict ventilation in any way
- Do not set a battery on top of the unit



## Battery charging procedure

After reading the previous descriptions and locating each control, the operator is ready to operate the battery charger. An experienced operator should monitor a new operator's indoctrination to the battery charging procedure.



### IMPORTANT!

**Before start-up, check that daily maintenance has been performed on the unit.**

### WARNING!

**Always wear safety glasses and protective clothing when servicing batteries. Neutralize any acid spills immediately. If acid contacts any part of the body, flush immediately with running water and seek medical attention.**

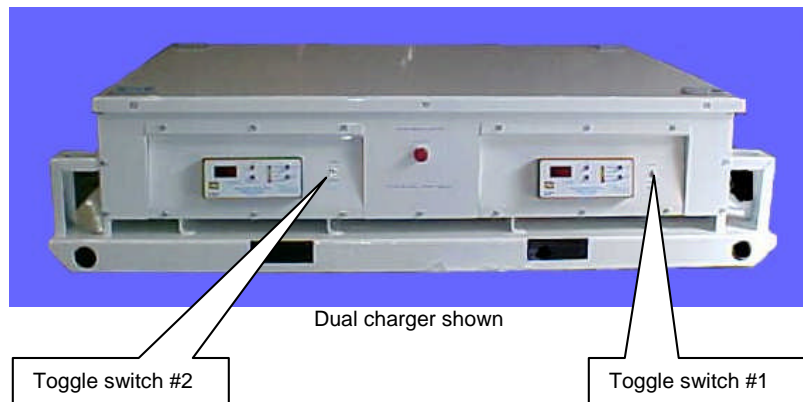
### WARNING!

**Care should be taken at all times to avoid electrical shock from the battery or charger. The charger must be turned off before connecting or disconnecting the lead (s) to the battery.**

## Charging

- ☞ Battery tray covers should be open during charge.
- ☞ Be sure the charger toggle switch is in the "OFF" position (Fig. 4).

**Fig. 4: Battery charger ON/OFF toggle switch**



- ☞ Check plugs and receptacles to be sure they are clean and in good condition.



## Input and output ratings

### D.C. voltage

The Bucyrus Super Service Battery Chargers are factory set to finish at 2.5 volts/per cell to 2.6 volts/per cell (160 vdc – 166 vdc) for lead acid batteries.

### A.C. voltage

Taps are provided for various three phase A.C. input voltages with an A.C. input voltage range of +/- 10% of nominal. (See charger schematic for details)

Table 2: Transformer tap settings

Input	TM	TC1	TC2
480VAC, 50HZ, 3PH	1 and 2	H1 and H3	480
575VAC, 50HZ, 3PH	1 and 3	H1 and H4	575

Table 3: Capacitor tap settings for finish rate adjustment

6 and 7	5 and 7	4 and 7	6 and 8	5 and 8	4 and 8
↑			↑		↑
Lowest			Nominal		Maximum



# Technical data

This chapter contains the most important technical data on the battery charger. Further data can be found in the spare parts lists. At the end of this chapter you will find information on the bolt tightening torques. Read this chapter through carefully and pay particular attention in particular to the safety instructions.

## Components of the battery charger

### Technical data sheet

<b>Part number:</b>	<b>LUP01984</b>
Model number:	Bucyrus -1500D
Output:	Dual
Voltage/hz:	480/575/60hz
Battery size:	1500
PA kit:	No
Overall length:	approx. 84"
Overall width:	approx. 53"
Overall height:	approx. 20.5"

<b>Part number:</b>	<b>LUP02066</b>
Model number:	Bucyrus -1375D
Output:	Dual
Voltage/hz:	480/575/60hz
Battery size:	1320 - 1375
PA kit:	No
Overall length:	approx. 84"
Overall width:	approx. 53"
Overall height:	approx. 20.5"

<b>Part number:</b>	<b>LUP02053</b>
Model number:	Bucyrus -1200D
Output:	Dual
Voltage/hz:	480/575/60hz
Battery size:	1200 - 1210
PA kit:	No
Overall length:	approx. 84"
Overall width:	approx. 53"
Overall height:	approx. 20.5"



## Components of the battery charger

**Part number:** LUP02102  
Model number: Bucyrus -850S  
Output: Single  
Voltage/hz: 480/575/60hz  
Battery size: 750 - 850  
PA kit: Yes  
Overall length: approx. 84"  
Overall width: approx. 35"  
Overall height: approx. 20.5"

**Part number:** LUP02103  
Model number: Bucyrus -650S  
Output: Single  
Voltage/hz: 480/575/60hz  
Battery size: 585 - 650  
PA kit: Yes  
Overall length: approx. 84"  
Overall width: approx. 35"  
Overall height: approx. 20.5"

**Part number:** LUP02104  
Model number: Bucyrus -550S  
Output: Single  
Voltage/hz: 480/575/60hz  
Battery size: 495 - 550  
PA kit: Yes  
Overall length: approx. 84"  
Overall width: approx. 35"  
Overall height: approx. 20.5"

**Part number:** LUP02105  
Model number: Bucyrus -1500D  
Output: Dual  
Voltage/hz: 480/575/60hz  
Battery size: 1500  
PA kit: Yes  
Overall length: approx. 84"  
Overall width: approx. 53"  
Overall height: approx. 20.5"  
Special: With ground check circuit and 125 VAC outlets



**Table 17 ; Electrically zinc plated (Coarse thread)**

Property class	Torque	Recommended torque setting			Nominal diameter			
		Ma	M33	M4	M5	M6	M7	M8
5.6	Nm	0.56	1.28	2.50	4.3	7.1	10.5	21
	Ft-lbs	0.41	0.94	1.84	3.1	5.2	7.7	15
8.8	Nm	1.28	2.90	5.75	9.9	16.5	24	48
	Ft-lbs	0.94	2.14	4.24	7.3	12.1	17.7	35
10.9	Nm	1.80	4.10	8.10	14	23	34	67
	Ft-lbs	1.33	3.02	5.97	10.3	16.9	25	49
12.9	Nm	2.15	4.95	9.70	16.5	27	40	81
	Ft-lbs	1.59	3.65	7.15	12.1	19.9	29	59

**Table 18 : Electrically zinc plated (Coarse thread, continued)**

Property class	Torque	Recommended torque setting			Nominal diameter			
		Ma	M12	M14	M16	M18	M20	M22
5.6	Nm	36	58	88	121	171	230	
	Ft-lbs	26	42	54	89	126	169	
8.8	Nm	83	132	200	275	390	530	
	Ft-lbs	61	97	147	202	287	390	
10.9	Nm	117	185	285	390	550	745	
	Ft-lbs	86.2	136	210	287	405	549	
12.9	Nm	140	220	340	470	660	890	
	Ft-lbs	103	162	250	346	486	656	

**Table 19 : Electrically zinc plated (Coarse thread, continued)**

Property class	Torque	Recommended torque setting			Nominal diameter			
		Ma	M24	M27	M30			
5.6	Nm	295	435	590	800	1030	1340	
	Ft-lbs	217	320	435	590	759	988	
8.8	Nm	675	995	1350	1830	2360	3050	
	Ft-lbs	497	733	995	1349	1740	2249	
10.9	Nm	960	1400	1900	2680	3310	4290	
	Ft-lbs	708	1032	1401	1902	2441	3163	
12.9	Nm	1140	1680	2280	3090	3980	5150	
	Ft-lbs	840	1239	1661	2278	2935	3798	

Bucyrus America, Inc.

BBC06 series with brakes mechanical disconnect  
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## 6. Technical data

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## Your safety

This chapter provides vital information for your safety. Pay special attention to this chapter. The safety instructions and rules of procedure will help you to avoid hazardous situations and to perform the necessary work as safely as possible.

### state of the art

The machine has been manufactured in accordance with the state of the art and generally recognized safety standards and regulations. You and others can nevertheless be exposed to dangerous situations e.g. as a result of environmental influences, machine damage or operator errors.

Do not make any alterations or modifications which could impair the safety of the machine. All modifications and changes must be approved by Bucyrus America, Inc.

Use only original spare parts from Bucyrus America, Inc. Note that the use of parts from other manufacturers will void the guarantee.

In addition to this operating manual be sure to also observe the respective legal provisions and regulations in your country.

Observe the safety and accident prevention regulations:

- of the mine.
- of the Mines Inspector and
- of the mining supervisory authorities

### further operating manuals

Please read also the operating manuals of the components required for operation, e.g. of gearboxes, electric motors, etc., carefully and thoroughly. Clarify any questions **before** starting work.



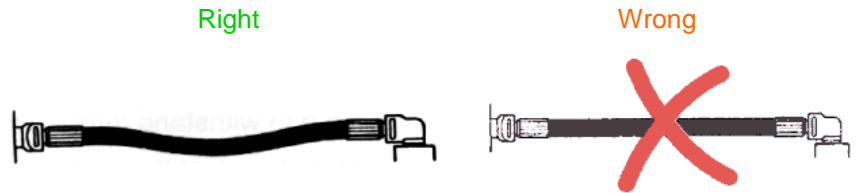
**laying hydraulic hoses**

Lay the hydraulic hoses properly behind the brackets and clamps provided for them.

Always lay hydraulic hoses so they:

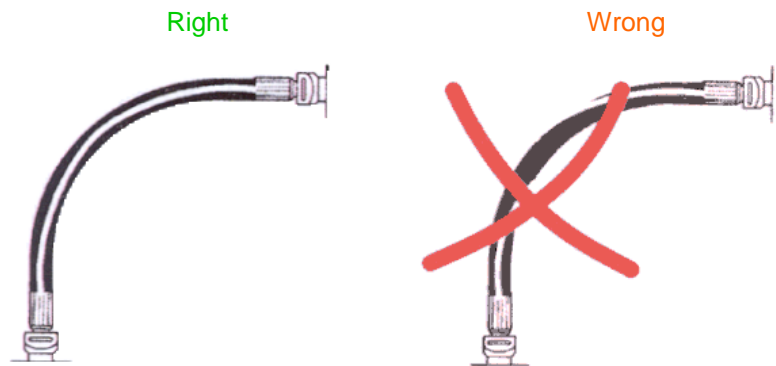
- always have a little slack.

**Fig. 1: Laying hydraulic hoses, slack**



- are not twisted.

**Fig. 2: Laying hydraulic hoses, twisting**



- are not bent directly behind the connections. (distance min. 1.5 x nominal diameter).

**Fig. 3: Laying hydraulic hoses, bending**





**WARNING!**

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

**WARNING!**

When torquing any wheel bolt pattern, always torque in a triangular pattern.



**IMPORTANT!**

Wheel bolts or nuts “seat in” during normal vehicle operation. Therefore, it is necessary to repeat torquing procedures as necessary to seat the wheel to the hub. Planned periodic checks will help maintain correct torque values. All bolts and nuts, regardless of type, should be regularly checked for tightness.

**WARNING!**

Do not install or remove tire/wheel assemblies from a machine without proper training.

**WARNING!**

Check wheel components periodically for cracks or broken parts. Replace all cracked, badly worn, damaged or severely rusted components. When in doubt replace.

**WARNING!**

Do not, under any circumstances, attempt to rework, weld, heat or braze any wheel components that are cracked, broken or damaged. Replace such components with new OEM parts of the correct size and type.

**WARNING!**

Mixing wheel parts of different design or from a variety of sources is potentially dangerous.

**WARNING!**

Replace broken studs and each unbroken stud next to the broken one.

**WARNING!**

Replace all damaged wheel studs or bolts.

**WARNING!**

Because you will be working close to the false bottom, you must completely shutdown the unit (see shutdown procedure) and disconnect the battery plug to prevent accidental movement of the false bottom.

**WARNING!**

Do not operate the machine with the canopy removed. You or other personnel could be seriously injured.



# 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-HAULER ® into service.

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

In addition, various items of auxiliary equipment and machines may be required at the point of installation.

These include i.e.:

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



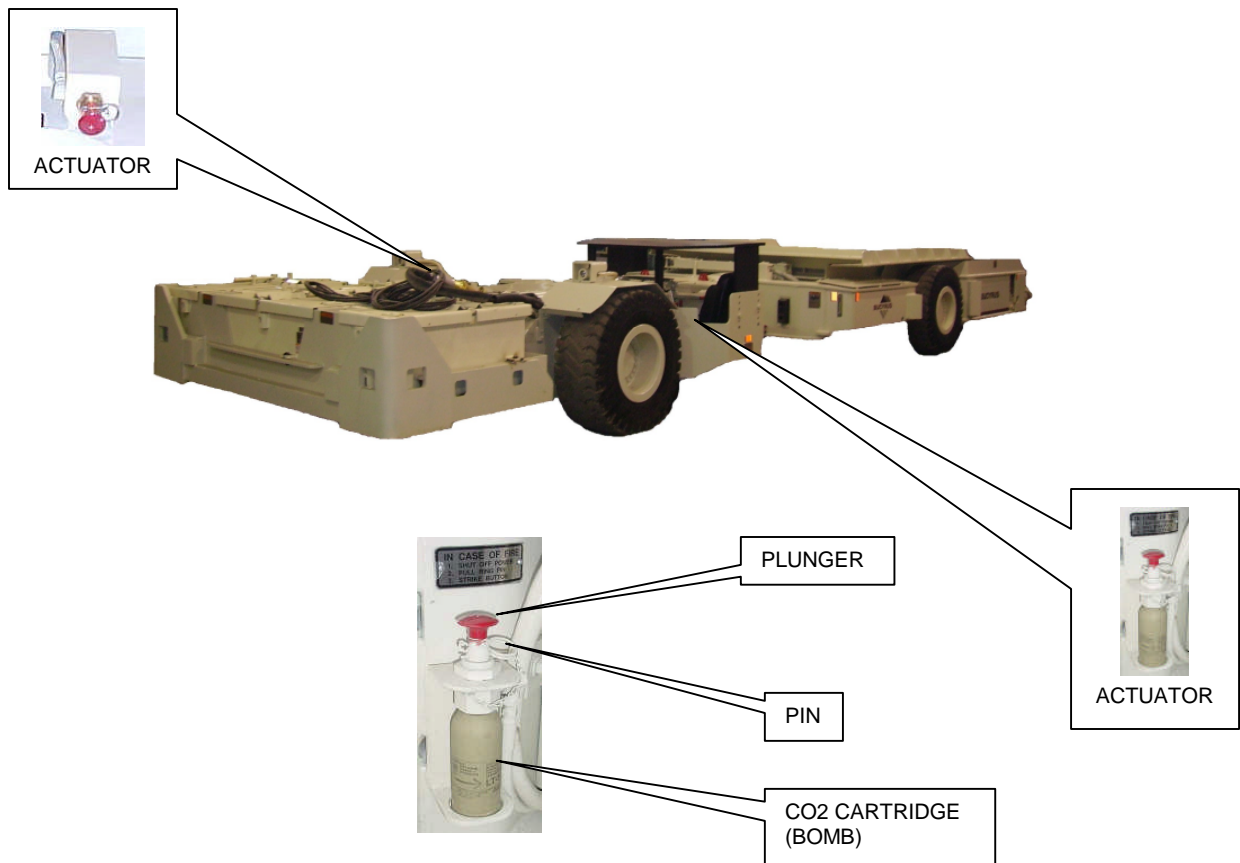
**WARNING!**

Before operating any levers or pedals on the UN-A-HAULER<sup>®</sup> always make sure no one is in the hazard zone (page 20). Do not operate any levers or pedals from outside the operator's compartment.

**fire suppression actuators**

The two fire suppression (remote) actuators (Fig. 9) are located to the operator's left in the operator's compartment and beside the battery on the side of the machine opposite the operator. This particular suppression system is pneumatically actuated and extinguishes with dry chemicals. To actuate the fire suppression system from either of the two actuators, pull the safety pin and strike downward on the plunger. Immediately after the plunger is struck, dry chemical will be dispensed throughout the tractor through six nozzles, located over each electric motor, behind the hydraulic control panel, and in the rear (payload) section.

**Fig. 9: Fire suppression locator (typical)**



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**Fig. 18: UN-A-HAULER ® shown in “UP” articulated position**



Note: Typical machine shown.

**“TAILGATE” (optional)**

The optional tailgate lowers automatically when the “EJECTOR” control lever is engaged and raises when the ejector blade and false bottom are retracted.

**disconnect switch (optional)**

An optional disconnect switch is available to disconnect power to the motors through a switch located in an enclosure near the controller. To disconnect power, push in the disconnect button. To reset the switch, pull the button back out.

**rear tractive assist (optional)**

An optional rear tractive assist package is available that provides on-demand, hydraulically-driven rear wheels to assist travel in areas of bad bottom conditions. To engage the rear wheels, press down the rear tractive assist button located on the control handle and release (Fig. 13). To disengage the rear wheels, press the button again and release.

**brake release hand pump**

The automatic emergency brakes are spring-applied (on), pressure-release (off) brakes located inside the gear reducers. The automatic (park) brake is normally released using the “PARK BRAKE” release button located on the control handle (see “AUTOMATIC EMERGENCY BRAKES”, in this chapter). Should hydraulic system failure occur, the automatic (park) brake can be released using the manual brake release hand pump. To release the brakes using the hand pump, turn the hand pump selector valve to the set position. Pump the hand pump until the brake release valve indicates the required minimum 1,500 psi.



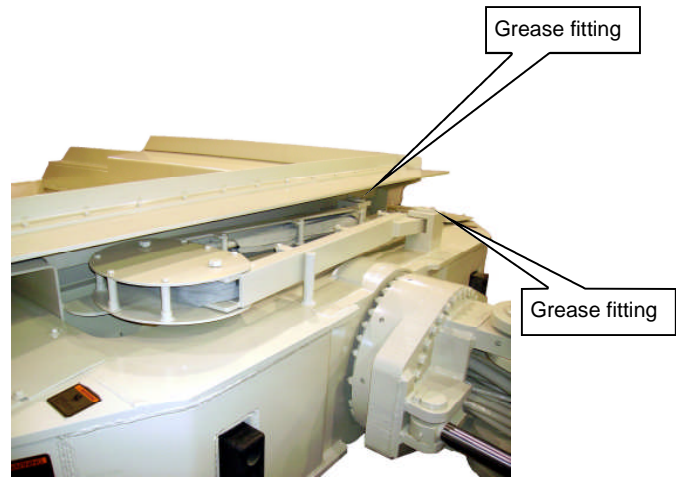
- ☞ After shutting down the Un-A-Hauler®, disconnect the discharged battery (Figure 29):
  - Unlock and remove the padlock at the battery connector.
  - Grasp the threaded lock ring and rotate it counterclockwise (CCW) until the threads are disengaged and it is free to slide away from the locking lug; the lock ring is designed to move freely but to not come off the plug.
  - Grasp the plug and pull it out until the plug is completely disconnected from the receptacle; the plug is made to fit very tightly inside the battery receptacle and should not be driven out of the receptacle, dropped, or handled roughly; if the plug (or receptacle) is damaged, it will not fit together properly.
  - Install the cap which is secured to the receptacle on the battery by a small chain; this cap is placed over the threaded receptacle and rotated in a clockwise (CW) direction until hand tight and until a padlock will fit into the locking lug; the padlocks all use the same key.
- ☞ Connect the jumper cable:
  - Connect the receptacle end of the jumper cable to the plug coming out of the connection box on the UN-A-HAULER ® (Fig. 26).
  - Connect the plug end of the jumper cable to the fully charged battery.
  - Secure the jumper cable connections by using the threaded lock rings. These lock rings must be hand tight but do not have to be padlocked.
  - One person should hold the jumper cable so it will not be damaged or be run over when the UN-A-HAULER ® is moved.



**ejector hose carrier**

Lubricate the ejector hose carrier (2 places) with Spec. 100-3 through the grease fittings located at the two (2) pivot points (Fig. 32). Pump grease into the fittings until new grease can be observed coming out of the pins.

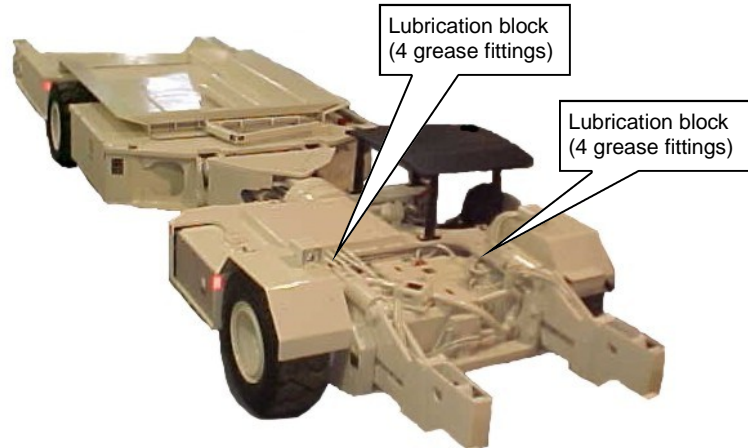
**Fig. 32: Ejector hose carrier lubrication points**



**battery change assembly**

Lubricate the battery change assembly (8 places) with Spec. 100-3 through the grease fittings located on the two (2) lubrication blocks (Fig. 33). Pump grease into the fittings until new grease can be observed coming out of the pins.

**Fig. 33: Battery change assembly lubrication points**





## Monthly

### drive and pump motor (s)

Inspect the drive and pump motors (Fig. 50).

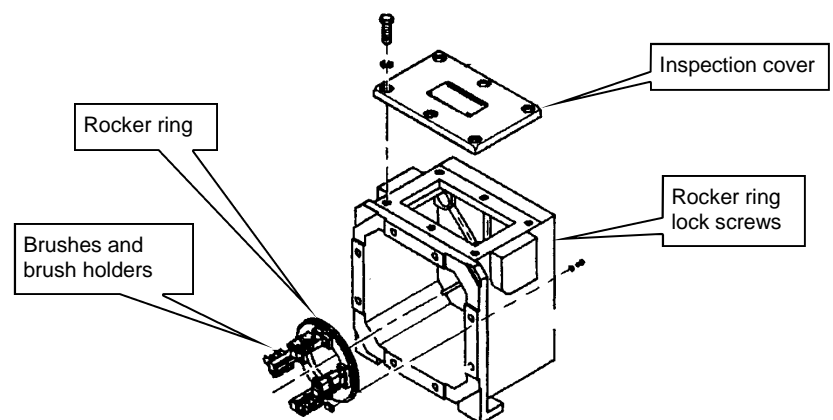
- ☞ Be sure that the machine circuit breaker lever is in the "OFF" position.
- ☞ Remove the inspection cover.
- ☞ Inspect the windings, commutators, brushes, armature, and terminal leads.
  - Windings should be dry and free of dust, grease, oil, and dirt.
  - The commutator should be clean and smooth with a medium polish and a light brown color.
  - 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 in this chapter)
  - The armature and field leads should be undamaged.
  - Terminal leads should be tight.
- ☞ Replace the inspection plate being sure it is securely tightened.



### IMPORTANT!

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 gear case oil.

Fig. 50: Rocker ring and brushes





Another mounting arrangement is based on holding a very close pilot fit where the tolerance between the wheel and hub is very tight, requiring a clamp-load force to hold the wheel securely in place. If the wheel studs or bolts are allowed to loosen, the load will be transmitted to them, resulting in sheared studs or bolts.

#### problem areas

Periodic wheel inspection is critical to the life cycle of a tire/wheel assembly. A fractured wheel, broken bolt pattern and missing or broken wheel studs are all contributors to tire/wheel failures. Problems in these areas occur as the result of repeated cyclical loading as the tire/wheel unit rotates during machine travel. Haulage vehicles loaded unevenly, downhill hauls with high speed turns, or operating a vehicle with one tire of a dual assembly damaged or flat are some examples of conditions that produce damaging high stresses in wheel assemblies. Also, the effects of corroding or poorly fitted mating parts can produce surface irregularities that result in cracks and ultimate failure of a wheel.

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.

An other 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.

#### **WARNING!**

**When torquing any wheel bolt pattern, always torque in a triangular pattern.**



### Refer to false bottom sequence cartridge (5 – 2).

- ☞ Adjust the false bottom sequence cartridge (5 – 2). This is labeled ejector cylinder sequence cartridge, but it needs to plumb to the false bottom cylinder. First obtain a multi-gauge or simply install a 3,000 psi pressure gauge on port (G2). Operate the extend sequence of the circuit until the false bottom is fully extended. Stop and turn the cartridge counterclockwise until a pressure reading is seen on the gauge (low pressure, 100 - 200 psi). Once this pressure is seen, turn the stem one complete turn clockwise. Operate the extend sequence until the false bottom is extended fully. Operate the retract sequence. If you witness pressure on the gauge during this sequence, stop and increase the pressure setting of the cartridge by turning the stem clockwise. Extend the false bottom blade fully and then operate the retract sequence. If you continue to see pressure, stop and adjust the pressure again. Continue this process until no pressure is seen on the gauge. Once this is complete, operate the extend sequence until the false bottom is fully extended. Operate the retract mode and monitor the gauge during this process. You **should not** see pressure on the gauge until the rod of the cylinder retracts back to the pilot port of the jack which is located 18" (26.62" on Model 818"s) from the rod end, or roughly 1" past the tailgate. If you witness pressure prior to this, adjust the cartridge as described above.

### Refer to ejector cylinder sequence cartridge (5 – 3).

- ☞ Move gauge to port (G1). This gauge port will measure the pressure coming out of the ejector sequence cartridge. First obtain a multi-gauge or simply install a 3,000 psi pressure gauge on port (G2). Operate the extend sequence of the circuit until the ejector blade is fully extended. Stop and turn the cartridge counterclockwise until a pressure reading is seen on the gauge (low pressure, 100 - 200 psi). Once this pressure is seen, turn the stem one complete turn clockwise. Operate the extend sequence until the ejector blade is extended fully. Operate the retract sequence. If you witness pressure on the gauge during this sequence, stop and increase the pressure setting of the cartridge by turning the stem clockwise. Extend the ejector blade fully and then operate the retract sequence. If you continue to see pressure, stop and adjust the pressure again. Continue this process until no pressure is seen on the gauge. Once this is complete, operate the extend sequence until the ejector blade is fully extended. Operate the retract mode and monitor the gauge during this process. You **should not** see pressure on the gauge until the rod of the cylinder retracts back to the pilot port of the jack which is located 70" from the rod end of the cylinder. If you witness pressure prior to this, adjust the cartridge as described above.

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### Gear case and planetary wheel end shim procedure number 1

The purpose of the shim procedure is to set the axial end play between the gear case spacer (bronze) and the planet carrier/wheel end to from 0.005" to 0.030" (loose).

**NOTICE!**

The following procedure is only for installing a new drive, wheel end or gear case only where stamped measurements are visible. If the drive or wheel end have had parts replaced, refer to Gear case and planetary wheel end shim procedure number 2 in this chapter.

**DANGER!**

You could be seriously injured or even killed by falling loads. Observe the safe working load of the lifting and blocking devices and keep a safe distance away from suspended loads.

To calculate the required amount of shims for the gear case and planetary wheel end proceed as follows (Fig. 71).

- ☞ 1. Measure machined plate thickness of wheel well plate. Record figure on line "A".
- ☞ 2. Locate the value stamped on machined mount face of drive unit (gear case). Record this value on line "B".
- ☞ 3. Subtract line "B" from line "A" to get line "C".
- ☞ 4. Locate the value stamped on machined mount face of wheel end. Record this value on line "D".
- ☞ 5. If "C" is larger then "D", proceed to step 6. If "D" is larger than "C", proceed to step 7.
- ☞ 6. Subtract "D" from "C" to get "E". Then divide "E" by .025 and round answer up to nearest whole number. This is the number of shims that must be added at location "X".
- ☞ 7. Subtract "C" from "D" to get "F". Then divide "F" by .025 and round answer up to nearest whole number. This is the number of shims that must be removed from location "X".

A. _____	If "C" is greater:	IF "D" is greater:
B. - _____	C. _____	D. _____
C. _____	D. - _____	C. - _____
D. _____	E. _____	F. _____

E / .025 = Number of shims to be added

F / .025 = number of shims to be added



## Gear case and brake module disassembly and assembly

### WARNING!

Failure to observe the following procedures may result in bodily injury.

### NOTICE!

Replace the brake spring assembly each time the disc pack is replaced.

### WARNING!

Failure of a re-used brake spring shall reduce the brake effectiveness.

### WARNING!

The retainer plate is under spring force. Remove hydraulic pressure before disassembly. Set the parking brake.

### brake spring removal

Disassembly procedure for removal of brake springs:

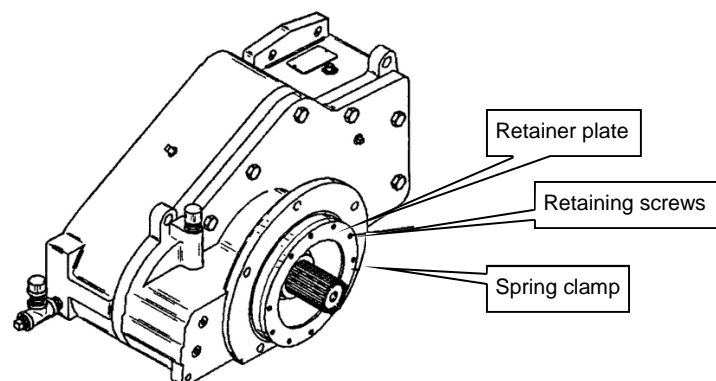
- ☞ Loosen the retaining screws (Fig. 75) by consecutively rotating the screws two turns counterclockwise. Continue this procedure until the brake spring pressure has been released.
- ☞ When the retaining screws have been rotated sufficiently to release spring pressure, the screws can be completely backed out by hand.
- ☞ Remove the bolts from the spring clamp.

### WARNING!

The retainer plate is under spring force. Remove hydraulic pressure before disassembly. Set the parking brake.

- ☞ Remove the spring clamp.
- ☞ Remove the brake spring.

Fig. 75: Brake pack removal





## Accumulator operation and precharging procedure

### operation

The accumulator used in the Un-A-Hauler's braking system is a hydro-pneumatic bladder accumulator working essentially as a fluid pressure storage chamber. Incompressible fluid (hydraulic oil) is stored against a compressible force of gas (nitrogen) to act as a secondary source of pressure.

The flexible rubber bladder in the accumulator shell is precharged to 40 bar with nitrogen gas. If the fluid pressure in the accumulator is less than 40 bar, the accumulator charging valve opens, allowing the hydraulic pump to force hydraulic oil into the fluid chamber of the accumulator. As fluid is forced into the chamber, the nitrogen gas in the bladder compresses until the gas pressure becomes equal to the system pressure. At 130 bar the accumulator charging valve closes until the fluid pressure has dropped back to below 100 bar.

### WARNING!

**Do not disconnect any hoses in the brake system until all pressure has been relieved and the "accumulator" gauge indicates "0" bar.**

### precharging bladder

- ☞ Mount hose assembly gland nut on pressure regulator. Use "oil pumped or dry nitrogen" which is commercially available (Reference Fig. 81).

### WARNING!

**Do not use oxygen or any gas other than nitrogen.**

- ☞ Attach swivel connector of hose assembly to gas valve. Hand tighten sufficiently to compress gasket swivel connector in order to prevent gas leakage.
- ☞ Pre-charge bladder slowly to about 0.68 bar before completely tightening the valve stem nut. Use a second wrench on the valve stem flats to react the torque applied to the stem nut.
- ☞ Proceed to inflate accumulator to predetermined pressure (40 bar) by slowly opening the pressure regulator valve on nitrogen cylinder, closing it occasionally to allow needle on pressure gauge to stabilize (thus giving accurate reading of pre-charge pressure). When correct pre-charge has been reached, close pressure regulator valve on nitrogen cylinder securely.

### WARNING!

**Do not exceed 55 bar precharge pressure.**

- ☞ Bleeder valve can be used to let out any gas pressure in excess of desired pre-charge.
- ☞ Replace dynaseal and valve guard.



## Tailgate assembly removal procedure

### WARNING!

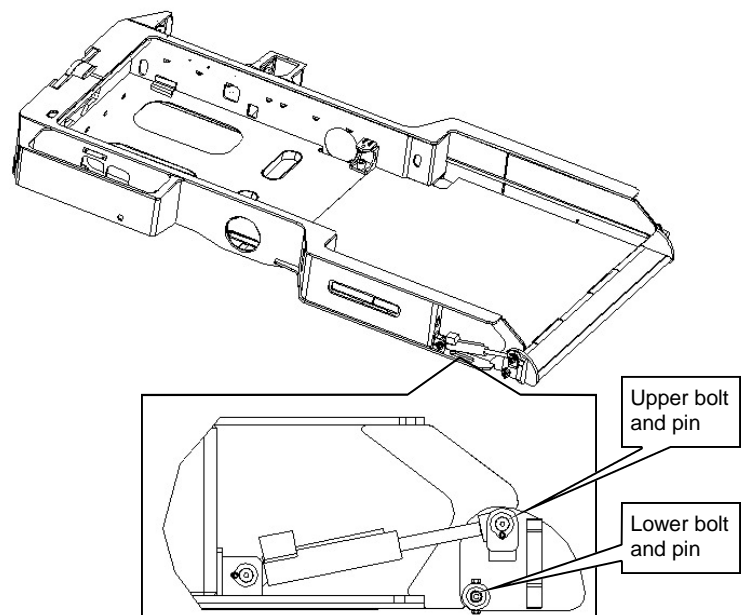
Because you will be working close to the false bottom, you must completely shutdown the unit (see shutdown procedure) and disconnect the battery plug to prevent accidental movement of the false bottom.

### remove tailgate assembly

The tailgate assembly (Fig. 89) is operated by two hydraulic cylinders.

- ☞ Fully extend the tailgate by pressing the ejector extend button on the right control handle until the tailgate lowers fully.
- ☞ Shutdown the machine.
- ☞ Fully support the tailgate assembly.
- ☞ Remove upper bolts and pin from tailgate cylinder clevis (2) located in outer end of tailgate.
- ☞ Start-up machine and fully retract the tailgate cylinders. (Note: Be sure all persons are off of and away from the machine before start-up). The cylinders will pull out the clevises out from the tailgate assembly.
- ☞ Shutdown the machine.
- ☞ Remove lower pins and bolt from the tailgate assembly.
- ☞ Remove tailgate.

Fig. 89: Tailgate assembly





## 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 4: Set screws (Socket long-lok)

Nominal diameter	Recommended torque setting
#6	6 in-lbs
#8	9 in-lbs
#10	13 in-lbs
1/4"	30 in-lbs
5/16"	5 ft-lbs
3/8"	8 ft-lbs
7/16"	11 ft-lbs
1/2"	16.7 ft-lbs

Table 5: Set screws (Socket standard steel)

Nominal diameter	Recommended torque setting
#6	9 in-lbs
#8	16 in-lbs
#10	30 in-lbs
1/4"	6 ft-lbs
5/16"	12 ft-lbs
3/8"	18 ft-lbs
7/16"	29 ft-lbs
1/2"	43 ft-lbs
5/8"	100 ft-lbs
3/4"	146 ft-lbs
7/8"	199 ft-lbs
1"	262 ft-lbs



**Table 16: Invert emulsion hydraulic fluid (Spec. 100-5)**

	<b>Supplier</b>	<b>Brand name</b>
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 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 Quintolubric 958 Series
18	Henry 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.	Swepeco 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

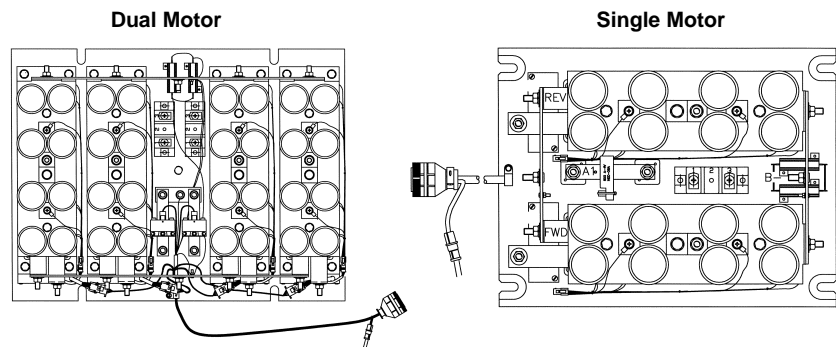


# Operation and Troubleshooting Manual

**BUCYRUS - Dual and Single  
Motor Controller**

**Model - BUC2000**

**Doc. No.: A6474X226**



**Bucyrus America, Inc.**

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Pulaski, VA

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Internet: [www.bucyrus.com](http://www.bucyrus.com)

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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 electro-mechanical "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. Check control wiring. possible shorted driver board, UVR, or “W” relay.
- 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.**  
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 heat sink temperature above 95° C.

**NOTICE!**  
As temperature rises above 95° C, the controller will limit the current to 300 amps (maximum), 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.
- 12 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.
- 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	Calibrator display	Range/Notes
"ACCELERATOR PERCENT DEMAND"	"ACCELERATOR x%"	0-100%
"ACCELERATOR VOLTAGE"	"ACCELERATOR xV"	0.0 V-5.0 V
"FORWARD SWITCH"	"FORWARD OPEN"	OPEN/CLOSED
"REVERSE SWITCH"	"REVERSE OPEN"	OPEN/CLOSED
"FS1 SWITCH"	"FS1 OPEN"	OPEN/CLOSED
"CONFIGURATION JUMPER 1"	"CONFIG 1"	OPEN/CLOSED
"CONFIGURATION JUMPER 2"	"CONFIG 2"	OPEN/CLOSED
"BRAKE INPUT"	"BRAKE ON"	OPEN/CLOSED
	"PTA LEVEL"	HIGH/LOW
"CIRCUIT BREAKER INPUT"	"CB AUX SW"	OPEN/CLOSED
	"I MAX SW"	
"SOFTWARE VERSION"	"SOFTWARE X.XXX"	VX.XXX
"DISPLAY STATUS"	"STATUS LOCK (or ROTATE)"	LOCK / ROTATE (ROTATE)
"SELECT DASHBOARD DISPLAY STATUS"	"STATUS #"	0-4 (Battery voltage, pump current, motor current, battery voltage) (0)
"DISPLAY CONTRAST"		0-127 (33)

**Table 6: Traction BDI display**

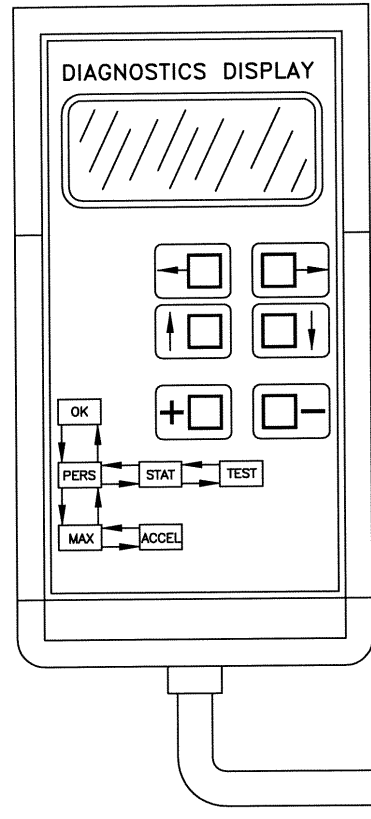
Display name	Calibrator display	Range/Notes	Adjustable with password
"RESET CELL LEVEL"	"RESET xV CELL"	1.85V-2.50V (2.04V)	X
"EMPTY CELL LEVEL"	"EMPTY xV CELL"	1.00V-1.99V (1.70V)	X
"WARNING LEVEL"	"WARNING X%"	0%-90% (20%)	X

Note 1: Values in parentheses are default values.

Note 2: When the last status (Traction test or Traction BDI) is displayed, the display will go back to the first status and scroll through again.

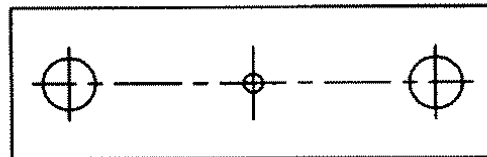


Fig. 24: Calibrator unit



© BUCYRUS AMERICA, INC.

Fig. 25: BUC2000 pump motor shunt





## Panel measurements

Before taking readings, the meter should be in DC volts (and appropriate range) and the following system conditions must be met:

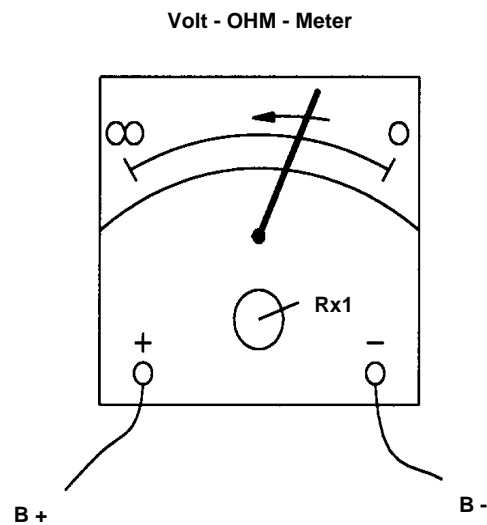
- ☞ All connections attached, and power applied.
- ☞ Main circuit breaker on.
- ☞ Master switch or control handle in the “PARK” or “PARK BRAKE APPLIED” position.
- ☞ Accelerator NOT depressed (FS1 open).

B+ to B-: Battery Voltage

B- to AA: »50V

B- to S1L, S4L, S1R, & S4R: »50V

**Fig. 32: Panel measurements**





## For your information

### Our service

If you need to order spare parts or if technical problems occur, please contact our after-sales service personnel or contact us direct.

### Service address

#### Beckley, WV

200 George Street, Suite 4  
Beckley, WV 25801  
Phone: (304) 256-5927  
Fax: (304) 256-5928

#### Craig, CO

400 Mack Lane  
Craig, CO 81625  
Phone: (970) 824-3249  
Fax: (970) 824-8851

#### Duffield, VA

P.O. Box 847  
6808 Fraley Avenue  
Duffield, VA 24244  
Phone: (276) 431-7000  
Fax: (276) 431-2464

#### Houston, PA

2045 West Pike Street  
Houston, PA 15342  
Phone: (724) 743-1200  
Fax: (724) 743-1201

#### Carrier Mills, IL

9580 State Route 13 West  
Carrier Mills, IL 62917  
Phone: (618) 982-9000  
Fax: (618) 982-9912

#### Oak Hill, WV

P.O. Box 60  
843 Lochgelly Road  
Oak Hill, WV 25901  
Phone: (304) 469-3302  
Fax: (304) 465-0450

#### Pulaski, VA

4041 Wurno Road  
Pulaski, VA 24301  
Phone: 540-980-4530  
Fax: 540-980-6211

#### Washington, PA

255 Berry Road  
Washington, PA 15301  
Phone: (724) 743-1200  
Fax: (724) 228-2177

#### Paonia, CO

P.O. Box 566  
719 Second Street  
Paonia, CO 81428  
Phone: (970) 527-3151  
Fax: (970) 527-6846



## 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.



## Overview of safety instructions

---

### **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.

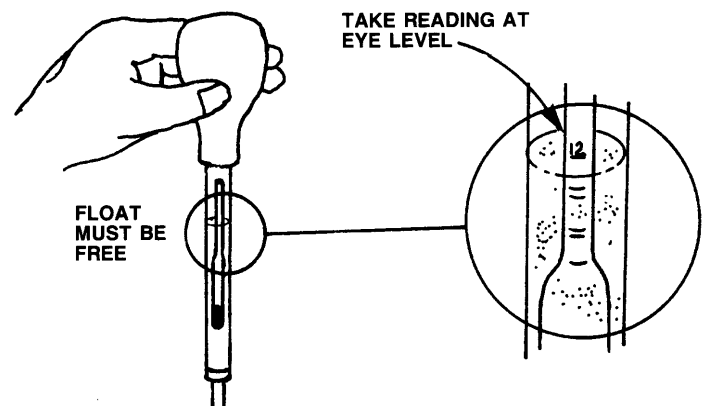
#### hydrometer reading

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**

HOLD HYDROMETER VERTICAL





## 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.**



## Replacement of parts

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