BI001975
A6474X230
October 2012

Operation Manual

Battery Charger with Digital Display
Models 5, 6, 8, 10, 12, 14 and 16

2 Your safety

Storage and transport

Maintain the prescribed storage periods and observe the instructions for storage.

Do not store materials or parts in the travel way or in your working area.

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

transport safety device

Ensure that the transport safety devices are correctly fitted.

Fix all moving parts with transport locks.

Never stand under unsupported parts or suspended loads.

means of attachment

Connect the lifting equipment only to the points of attachment provided for that purpose. Observe the different load limits of the attachment points. Also observe the instructions on the transport sheet.

Only use means of attachment which are in good condition and have been designed for the loads to be handled.

For round components use transport straps, only. Never use chains or steel cables for this purpose.

mobile handling equipment

When using mobile handling systems for transport, make sure that the center of gravity is as low as possible.

Pre-start inspection

operation

Read this entire guide before attempting to operate this unit.

inspection

Inspect the unit and have any malfunctioning, broken, or missing parts corrected or replaced before use.

maintenance

Verify that all maintenance has been performed.

instruction and safety tags

Verify that all instruction and safety tags are in place and are readable.

operating area

Clean any foreign material from the work area.

4 Installation

Electrical Connections and Field Wiring

AC input

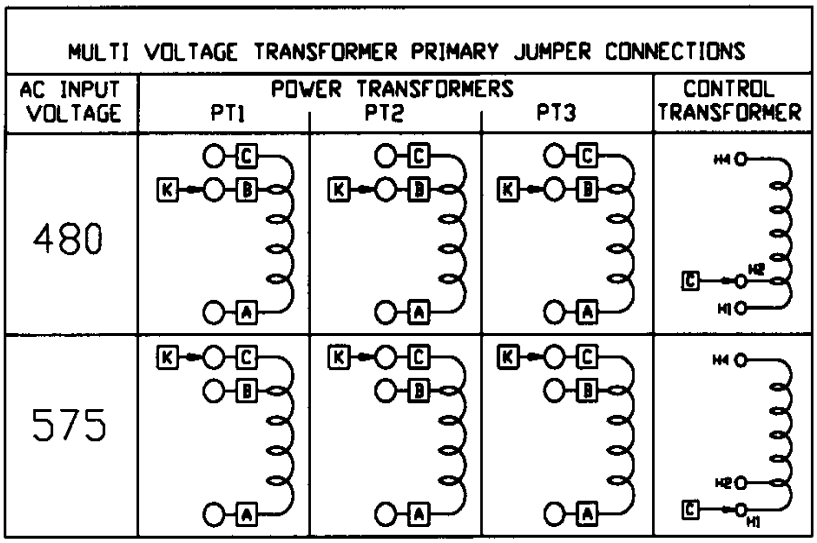
Make sure that the input source is the same voltage and frequency as that which is marked on the nameplate of the rectifier.

The AC input current, specified on the nameplate, is for (nominal) output. AC line fuses or breakers must be sized for the overload or current limit point of the charger, which is 130% of the nameplate value.

An adequate earth ground lead should be connected to the terminal marked "GROUND" or "GND" on the rectifier terminal board or case.

Be sure the transformer taps are set for the correct AC input (see Fig. 2 for standard chargers and Fig. 6 for PA models).

Fig. 2: Transformer tap connections (standard)



DC output

Make sure that the battery which is being connected to the rectifier matches the cell type and number of cells that is marked on the rectifier nameplate.

Polarity

The negative wire from the battery must be connected to the terminal marked “NEGATIVE” or “NEG” and the positive wire from the battery must be connected to the terminal marked “POSITIVE” or “POS” on the rectifier.

Adjustments

The charger is a completely automatic constant voltage charger. Each battery charger is designed to operate on a specific type of battery with a specified number of cells. **The unit is factory set at 2.5 volts per cell (V.p.c.).**

Circuit operation

The ferroresonant mine battery charger has three basic components; a ferroresonant step down transformer, silicon rectifiers (diodes) and electronic timer.

The regulating action of the unit is caused by the current developed in the resonant winding of the power transformer. The resonating capacitor along with the resonant winding of the transformer form a tuned circuit which establishes the correct core saturation point and in turn regulates the unit's output.

The transformer also steps down the AC input voltage to the proper voltage to charge the battery. It also provides isolation from the input to the output.

The silicon diodes convert the AC output from the secondary of the transformer to the DC voltage needed to charge the battery.

The automatic timer senses the connection of the battery and turns the unit on (green start button must be pushed in with the Ground Integrity option), the timer will allow the charger to charge the battery for a period of time (maximum 12 hours), then turns the charger off. It will also turn the charger off when the battery is disconnected.

Ground and short circuit test

A simple ohmmeter check can be performed to check the unit for a short to ground, primary to secondary breakdown, AC-DC short, or DC ground. Before installation of a new unit, the above checks should be made before installing. If a short of this type is suspected on a unit in service, check as follows:

- ☞ Disconnect AC input power to the unit. Disconnect the DC battery and loads from the rectifier.
- ☞ Set ohmmeter scale on ohms scale RX100.
- ☞ Measure from one terminal of the input to one terminal of the output. Meter should not indicate. If the meter reads full scale deflection, this indicates an AC-DC short. During shipping, an AC wire may rub against the DC lugs, terminals, etc. and cause a short. These problems may be eliminated by very carefully inspecting the wiring to make certain the AC wires are not touching the DC wiring. If no wires are touching, then it is possible that the primary and secondary of the transformer is shorted. Disconnect the secondary of the transformer from the diodes. Measure with ohmmeter from input terminal to one of the isolated secondary leads. If there is an ohmmeter indication, there is an insulation breakdown between primary and secondary windings. The transformer should be replaced.
- ☞ Check the input terminals to ground and check the output terminals ground. If the meter indicates full scale deflection, a wire is touching a metal part of the unit. Look for wires that are near any metal part and inspect for possible breakdown caused by shipping. The heat sink of the diodes and the control unit are insulated from ground through the mounting legs.

Troubleshooting and replacing power silicon diodes

If a portable multimeter is used, set the switches on "ohms", "DC", and " RX1 " scale.

- ☞ Isolate one end of the diode by disconnecting the wires attached to the nipple (or pigtail) end of the diode (only one end of the diode must be disconnected).
- ☞ Clip one lead of the ohmmeter to the anode lead of the diode. Clip the other ohmmeter lead to the cathode.
- ☞ Note the ohmmeter reading, then reverse the leads to the diode. Again, note the ohmmeter reading. If the diode is good, the meter will indicate a high resistance in one direction, and a low resistance with the leads reversed. If the diode is shorted, the meter will read full scale, or zero ("0") resistance with the leads in either direction. If the diode is "open", the ohmmeter needle will not indicate or it will show infinite resistance in either direction, indicating an open circuit.

7 For your information

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 equipment or machine used.

machine type

This operating manual is intended for:

CAT® Model SU488 L

and is only permitted to be used for equipment of this type.

new operation manual

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

Storage and transport

Maintain the prescribed storage periods and observe the instructions for storage.

Do not store materials or parts in the travel way or in your working area.

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

transport safety device

Ensure that the transport safety devices are correctly fitted.

Fix all moving parts with transport locks.

Never stand under unsupported parts or suspended loads.

means of attachment

Connect the lifting equipment only to the points of attachment provided for that purpose. Observe the different load limits of the attachment points. Also observe the instructions on the transport sheet.

Only use means of attachment which are in good condition and have been designed for the loads to be handled.

For round components use transport straps, only. Never use chains or steel cables for this purpose.

Do not damage the treated or polished surfaces of shafts, sealing surfaces, etc.

mobile handling equipment

When using mobile handling systems for transport make sure that the center of gravity is as low as possible.

Pre-start inspection

operation

Read this entire guide before attempting to operate this machine.

inspection

Inspect the machine and have any malfunctioning, broken or missing parts corrected or replaced before use.

maintenance

Verify that all maintenance has been performed.

instruction and safety tags

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

operator’s compartment

Clean any foreign material from the operator’s compartment.

cab/canopy

This machine was shipped from the factory equipped with a protective cab/canopy. The cab/canopy must be securely in place before operating the unit.

Storage and transport

This chapter contains important information on the correct storage and transport of the SU488 L. Observance of the instructions and tips will increase the service life and availability of the machine. You will also be able to carry out the transport work quicker and more safely. Careful attention to the points in this chapter will help you to simplify your day-to-day work.

Storage

corrosion protection

Components coated with temporary corrosion inhibitor are protected for approximately six months.

Before delivery, the hydraulically operated equipment is operated and all axles, gear boxes, hydraulic oil tank, etc. are filled to their maximum fill point.

Storage of the machine and spare parts

no direct exposure to sunlight

Store the equipment indoors or cover with a tarpaulin to protect against direct exposure to sunlight. Store the electrical equipment, electronic components, spare parts of rubber or plastic – such as seals and hoses – and hydraulic fluids only in closed rooms at temperatures of (15° C to 25°C (60° F to 77° F).

dirt and moisture

Protect the equipment and all spare parts stored outdoors against moisture and dirt, e.g. using tarpaulins.

The mounting surfaces of hydraulic components must be protected against corrosion and sealed with blind plates. Protect the hydraulic plug connectors and the connectors of the electrical cables with the caps and plugs supplied.

short-term storage

During short-term storage (approximately 4 weeks) of equipment outdoors, but at temperatures above freezing, electrical components need not be removed. Such components must be particularly protected against excessive temperatures, dirt and moisture.

long-term storage

If the equipment is to be stored more than six months, the hydraulic components must be completely filled with a corrosion inhibiting/frost-proofing fluid.

Fill the hollow areas of hydraulic components (e.g. the piston chambers) in horizontal position (ports facing upwards) until they start to overflow.
Then seal the ports with plastic or steel plugs.

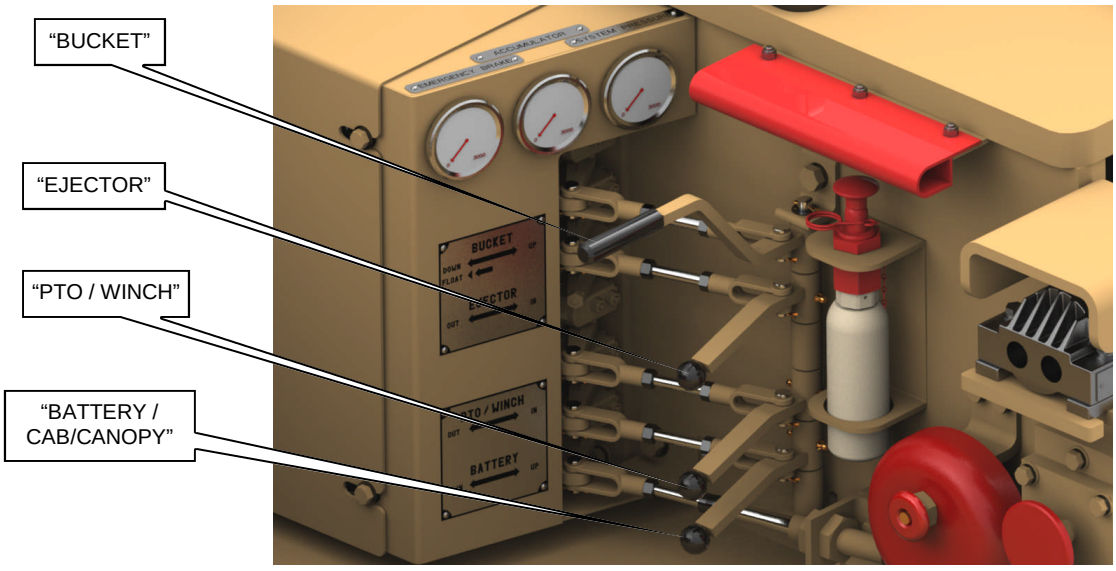
The equipment must be stored in a well ventilated, dry room. Do not store outdoors.

emergency stop buttons

There is one emergency stop buttons located in the operator's compartment. It is located on the operator's right.

Pushing the emergency stop button on the operator's right trips the machine circuit breaker. The circuit breaker must be reset and diagnostics run (see start up procedures) before the machine can be restarted.

Fig. 12: Hydraulic control system



pressure gauge panels

The gauge panels (Fig. 14) consists of five pressure gauges, divided into 2 locations: "DIF-LOK" and "BRAKE PRESSURE" are located directly in front of the operator, "EMERGENCY BRAKE", "ACCUMULATOR", and 'SYSTEM PRESSURE" are located above the valve bank to the operator's right.

The "DIF-LOK PRESSURE" gauge should read 41 bar (600 psi) maximum when the differential lock (traction assist) function is engaged.

The "BRAKE PRESSURE" gauge should read a maximum of 45 bar (650 psi) when the brakes are applied.

The "EMERGENCY BRAKE" pressure gauge should read 138 to 152 bar (2,000 to 2,200 psi).

The "ACCUMULATOR" gauge should read 103 to 152 bar (1,500 to 2, 200 psi).

The hydraulic system pressure relief valve is set to relief at 207 bar (3,000 psi) and the "SYSTEM PRESSURE" is set at 155 bar (2,250 psi).

WARNING!
If any of the above gauges read above or below the pressures listed, shutdown the machine and call a maintenance person (see Shutdown procedure in this Chapter).

12. To set the park brake and leave the pump motor running, rotate the TRAM switch to the “PARK” position

13. To turn off the pump motor and set the park brake, press “STOP” or rotated the TRAM rotary switch to “OFF”

14. To activate a tramming direction (the pump motor must be running and the park brake must be released), rotate the TRAM switch to the desired direction until the dashboard display indicates direction of travel.

15. The accelerator pedal may now be depressed to control the machine.

WARNING!
The machine is equipped with a solid state speed controller. This means that the farther the speed switch foot pedal is depressed, the faster the machine will tram.

16. To change direction of travel, rotate the TRAM switch to the desired direction, the dashboard display will indicates direction of travel.

17. Each time the direction of travel is changed, the accelerator pedal will require recycling through the off position.

18. To disable tramming, rotate the TRAM switch to the “OFF” or “PARK” position.

19. To leave pump motor running, set park brake, and disable tramming, Rotate the TRAM rotary switch to “PARK”

20. To disable tramming, turn off the pump motor, and set the park brake, press the “STOP” button on the Control Station, or press either Emergency tape strip switches.

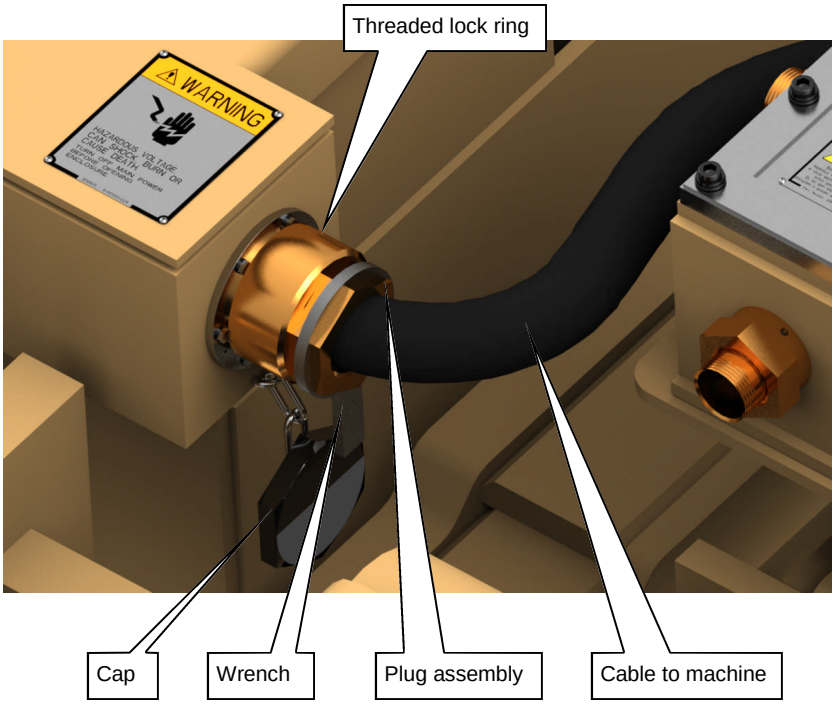
21. Rotate the LIGHTS switch on the Control Station to the desired light direction.

22. For auto position headlights, rotate the “LIGHTS” switch on the Control Station to the “AUTO” position where the headlights follow the tram direction.

12. Disconnect the jumper cable and connect the charged battery directly to the machine's cable (Fig. 33). Remember to be careful with the plugs. After the plug is in the receptacle, the lock ring should be rotated clockwise (CW) until hand tight. The padlock must be in the locking lug and locked for this connection to be permissible.

13. Start the machine (see Starting Procedure in this manual).

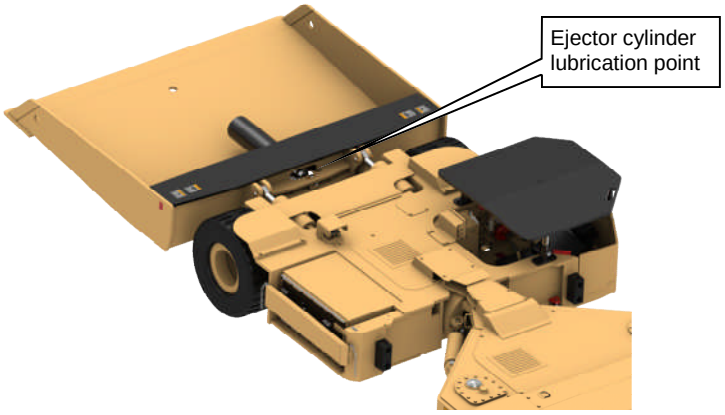
Fig. 33: Battery plug and receptacle assembly (typical)



ejector cylinder

Lubricate the ejector cylinder rod end (1 place) with Spec. 100-3 grease through the grease fitting located at the back of the bucket (Fig. 41). Pump grease into the fitting until new grease can be observed coming out of the pin.

Fig. 41: Ejector cylinder lubrication points



accelerator pedal

Lubricate the accelerator pedal (2 places) with Spec. 100-3 grease through the grease fittings located on each pillow block bearing. Pump grease into the fittings until new grease can be observed coming out of the bearings.

brake pedal

Lubricate the brake pedal with Spec. 100-3 grease through the grease fittings located on each pillow block bearing. Pump grease into the fitting until new grease can be observed coming out of the bearing.

left hand steering

Lubricate the left hand steering handle (2 places) with Spec. 100-3 grease through the grease fitting located on each pillow block bearing (Fig. 42). Pump grease into the fitting until new grease can be observed coming out of the bearing.

Fig. 42: Left hand steering lever lubrication points

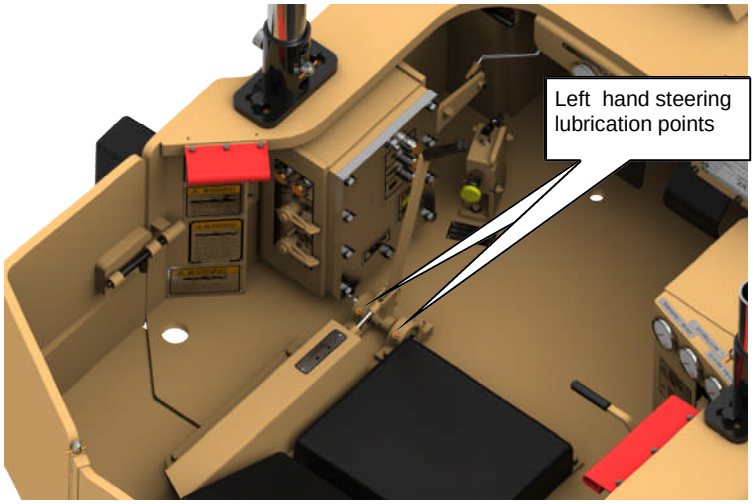
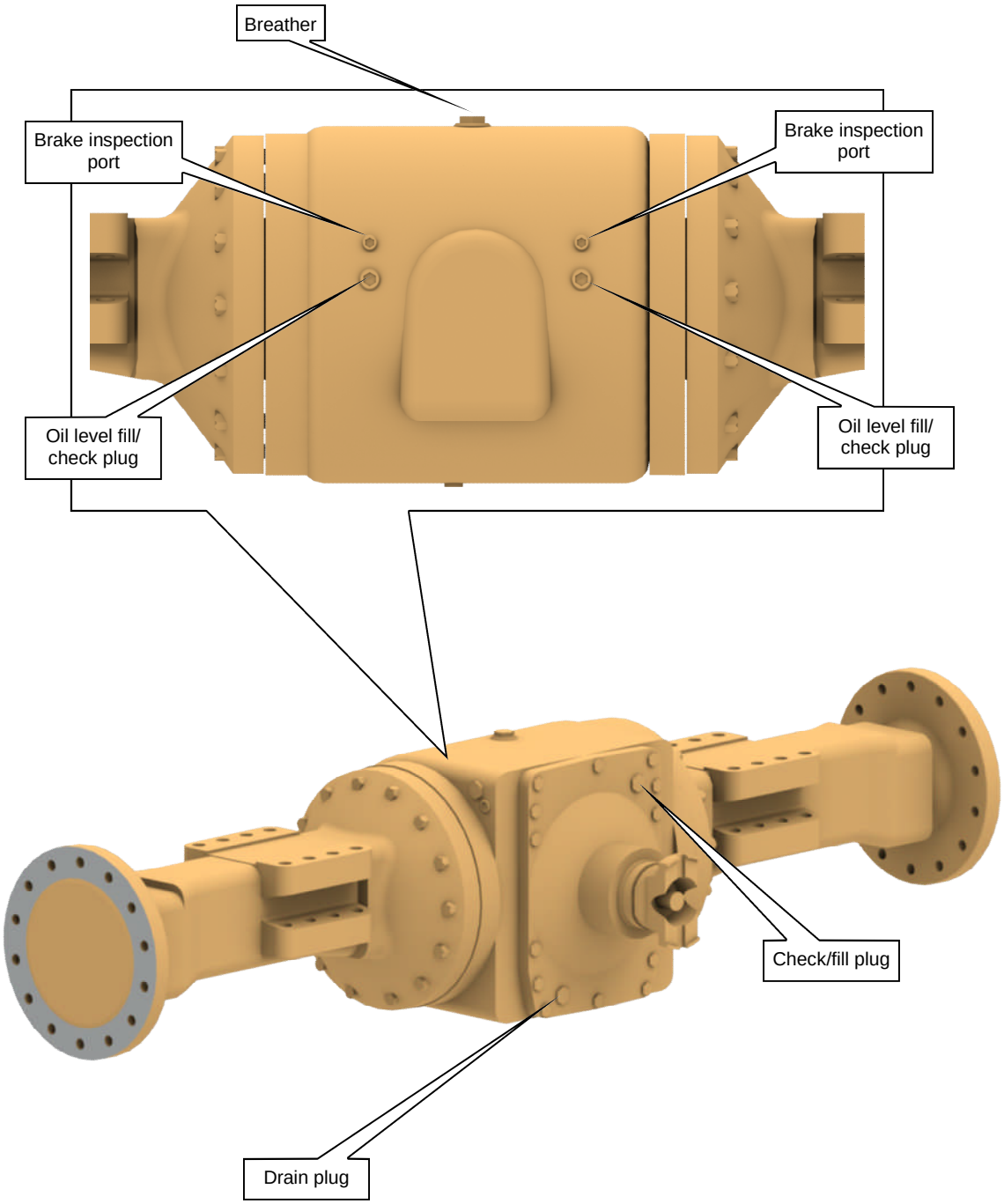


Fig. 54: Axle and wet disc brake oil level



recommended wheel mounting procedure

- ☞ All steel mating surfaces, including wheel/hub tapers and disc faces, must be free and clean of all dirt, corrosion, paint, etc. **NO PAINT** should be present under bolt heads or nuts.
- ☞ Fasteners should be in good condition. Any fastener with damage (corrosion, bent, worn threads, etc.) should be replaced. Replace all broken wheel studs.
- ☞ After positioning the wheel on the hub, tighten nuts down evenly. Triangulate the bolt pattern tightening sequence as shown in Fig. 62.
- ☞ After operating the machine for a short period of time, check the wheel-mounting bolts or nuts for proper torque.

NOTE: 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.

Precautions

- ■ Do not install or remove tire/wheel assemblies from a machine without proper training.
- ■ Check wheel components periodically for cracks or broken parts. Replace all cracked, badly worn, damaged, or severely rusted components. When in doubt, replace.
- ■ Do not, under any circumstances, attempt to rework, weld, heat, or braze any wheel component that is cracked, broken or damaged. Replace such components with new OEM parts of the correct size and type.
- ■ Mixing wheel parts of different designs or from a variety of sources is potentially dangerous.
- ■ Replace broken studs **AND** each unbroken stud next to the broken one.

Table 7 (continued): Hydraulic pump troubleshooting

Trouble, symptom or cause	Probable cause	Test, check and/or remedy
seal leak (continued)	☞ Oil viscosity too high or operating temperature too low.	☞ Replace with recommended oil.
	☞ Air leak in suction line or fittings.	☞ Replace lines or fittings if badly worn.
	☞ Loose or worn pump parts.	☞ Replace worn pump parts.
	☞ Air leak at pump shaft seal.	☞ Replace pump shaft seals.
	☞ Oil level too low and drawing air in through inlet pipe opening.	☞ Check oil level.
	☞ Air bubbles in intake oil.	☞ Check oil level and tighten any loose fittings.
	☞ Pump housing bolts loose or not properly torqued.	☞ Tighten the housing bolts and re-torque bolts.
pump failure to deliver oil	☞ Low oil level in reservoir.	☞ Fill to proper level.
	☞ Oil intake hose suction strainer plugged.	☞ Clean or replace strainer.
	☞ Air leak in suction line and preventing priming.	☞ Tighten or replace suction lines.
	☞ Pump shaft turning too slowly.	☞ Gears are worn and need replacing.
	☞ Oil viscosity too high.	☞ Replace with recommended oil.
	☞ Wrong shaft rotation.	☞ Check pump motor wiring.
	☞ Pump shaft or parts broken.	☞ Replace shaft or broken parts.
	☞ Dirt in pump.	☞ Clean pump .
oil leakage around pump	☞ Shaft seal worn.	☞ Replace seals.
	☞ Head of oil on suction hose connection leaking.	☞ Tighten bolts. Tighten or replace connections.
	☞ Pump housing bolts loose or improperly torqued.	☞ Tighten bolts.

Table 15: Electrically zinc plated (Coarse thread)

Property class	Torque	Recommended torque setting		Nominal diameter				
	Ma	M33	M4	M5	M6	M7	M8	M10
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 15: 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 15: 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

Table 26: Light gear oil, SAE 40 motor oil (Spec. 100-10)

	Supplier	Brand name
1	Amoco Oil Company	Amoco 300 SAE 40
2	Gulf Oil	Super Duty 40
3	Mobil Oil Corporation	Delvac 1340
4	Chevron U.S.A.	Chevron RPM Heavy Duty Motor Oil 15W-40
5	Sun Oil Company	Sunoco Super C 40
6	Unocal 76	Guardol Motor Oil SAE 40
7	Shell Oil Vompany	Rotella Oil 40 (Automotive) Turbo Oil 150 (Industrial) Rimula CT40 (Foreign) Rotela SX40 (Foreign)
8	Century	Flexe SAE 40
9	Texaco Lubricants Company	Ursa Super Plus SAE 40
10	Exxon	XD-3 Extra SAE 40 or XD-3 SAE 40
11	Pennzoil	Long Life SAE 40 Motor Oil
12	Lubricating Engineers	8440 Monolex GFS Engine Oil
13	Conoco Inc.	Fleet Heavy Duty Motor Oil SAE 40
14	Hydrotex	Hyfilm SAE 40
15	Phillips	Super HD II Motor Oil SAE 15W-40

Table 27: Synthetic EP gear lubricants (Spec. 100-11)

	Supplier	Brand name
1	Century Lubricants Company	Synthetic EP Gear Lubricants

Table 27: Multi-purpose tractor hydraulic fluid (Spec. 100-12)

	Supplier	Brand name
1	Exxon / Mobil	Mobilfluid 424
2	Century / Fuchs	Multitran
3	Shell	Donax TD
4	Chevron	Tractor Hydraulic Fluid
5	BP Lubricants	Tractran UTH
6	Quaker State	Quaker State FCI HD
7	Conoco	Powertran Fluid

1 About this manual

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

Start the machine only when it is in a good and safe operating condition and all protective devices, e.g. EMERGENCY STOP devices, cover plates, etc. are correctly installed.

Observe the acoustic and optical start-up warnings of the machine.

symbol plates

Observe the symbol plates on the machine.

emergency stop

Press the machine's EMERGENCY STOP switch immediately in the event of fault or irregularities in operation. Report any peculiarity to your superior so that necessary measures can be taken immediately.

disconnect battery

Disconnect the battery while performing:

- maintenance work
- inspection work
- repair work

welding

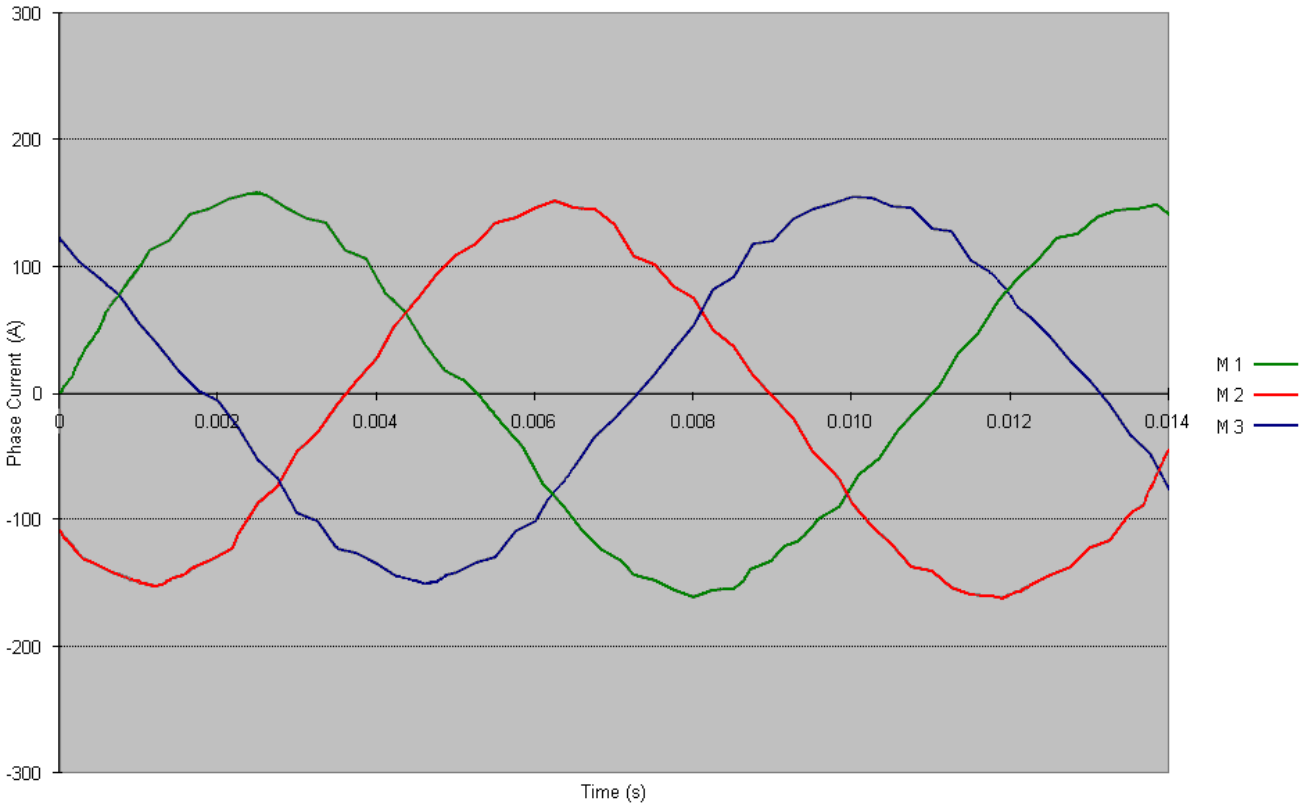
Batteries should be well vented before servicing, particularly if welding or burning on the battery.

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

While welding, the battery must be disconnected to be sure that you do not damage the electrical system and/or any of the electrical components.

WARNING!
Study all warning/caution labels and notes related to working with batteries and electric motors. These labels may be on the battery, the motor, and/or on the machine, as well as in this Operator's manual. Failure to comply with the safety instructions regarding working with batteries and electric motors can result in death or serious injury by electrocution.

Fig. 7: Three phase current waveform



In summary, the power inverter allows a DC voltage to be applied as an AC voltage; this is achieved by pulsing the switching devices at high frequency. Because the AC voltage is created from a series of pulses of DC link voltage, this AC voltage can be varied in both magnitude and frequency. An AC voltage of variable magnitude and frequency is necessary in order to control the speed of an induction machine.

Table 4: Supervisor traction VFD, connector “C” (Standard)

Input Description	Connector/Pin
+24VDC Supply input	C1
(Reserved for service brake)	C2
UVR Driver (24VDC Common)	C3
Park Brake Solenoid Driver (24VDC Common)	C4
Breaker “ON” for headlight relay driver (24VDC common)	C5
Not Used	C6
Not Used	C7
Not Used	C8

Table 5: Supervisor traction VFD, connector “D” (Standard)

Not Used	D1
Pre-Charge Feed from B+	D2
Not Used	D3
Not Used	D4
Not Used	D5
Not Used	D6
Not Used	D7
Not Used	D8

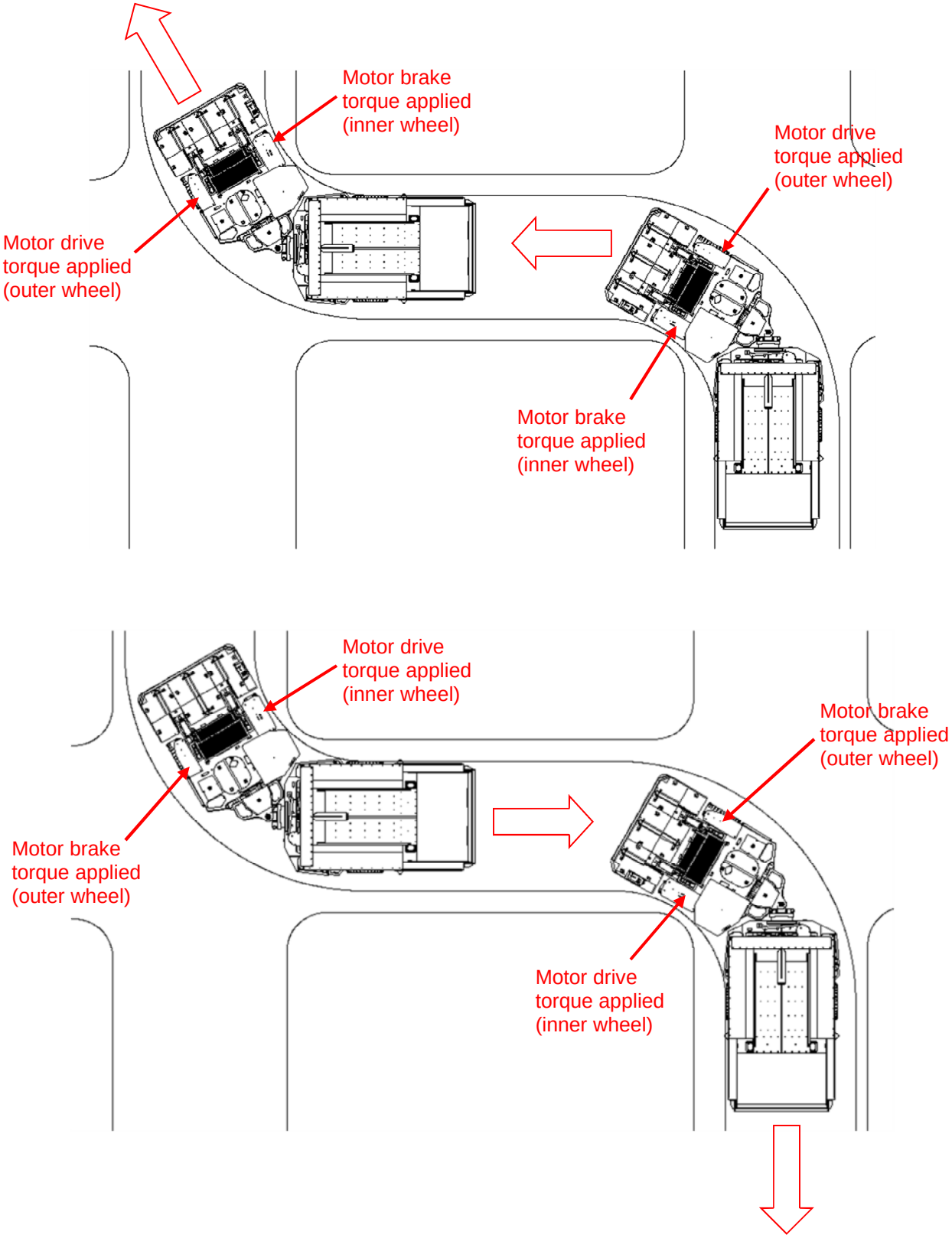
Table 19: Front Auxiliary Traction VFD (Node 6), connector "C" (VT680)

Input Description	Connector/Pin
+24VDC Supply input	C1
Not Used	C2
Not Used	C3
Not Used	C4
Not Used	C5
Not Used	C6
Not Used	C7
Not Used	C8

Table 20: Front Auxiliary Traction VFD (Node 6), connector "D" (VT680)

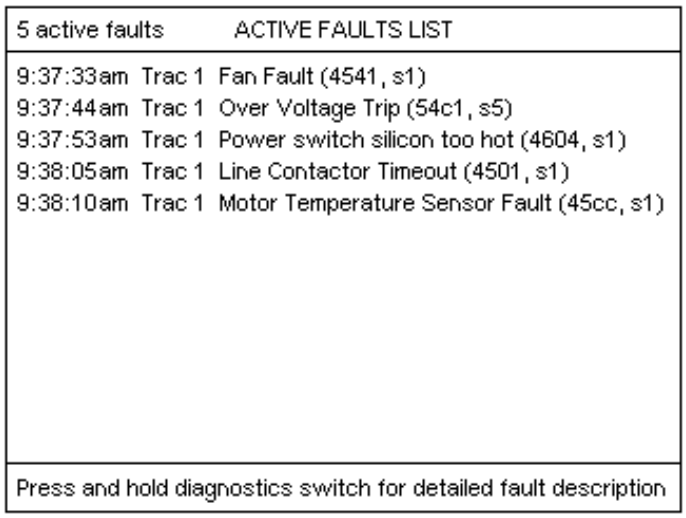
Input Description	Connector/Pin
Not Used	D1
Pre-Charge Feed from B+	D2
Not Used	D3
Not Used	D4
Not Used	D5
Not Used	D6
Not Used	D7
Not Used	D8

Fig. 13: Steering control system



Level 3, 4, and 5 faults will normally drop the breaker. All Traction and Pump drives will shut down, as well. The display will fall into the Active Fault List screen (Fig. 25). Fault events are listed chronologically, oldest first. This can be a valuable troubleshooting aid. When there are multiple faults, it is helpful to know which one occurred first.

Fig. 25: Active Faults List screen



To enter the extended active fault system help screen (Fig. 26), press and hold the diagnostics button for five (5) seconds. After the extended screen comes up, quickly pressing the diagnostics button will toggle to each of the faults logged. To exit the extended active fault system help screen, press and hold the diagnostics button for another five (5) seconds.

Fig. 26: Extended active fault on system help screen

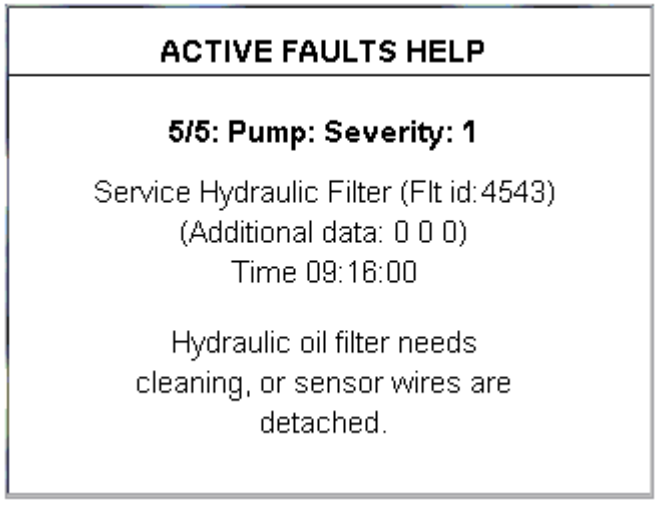


Table 27: Fault information codes, continued

Fault ID	Severity	Fault Description	Fault Help
5317	4	Unable to request data via CAN	Node has difficulty communicating via CAN. Confirm all drives have unique node ID. Check that other drives are connected to the CAN bus and powered up. Check configuration wiring.
5318	4	Unable to request data via CAN	Node has difficulty communicating via CAN. Confirm all drives have unique node ID. Check that other drives are connected to the CAN bus and powered up. Check configuration wiring.
5319	4	Drive not responding	One or more drives have stopped responding to the Supervisor. Check for faults on other drive(s) and additional fault messages.
5341	5	Internal software fault	Potential configuration error on drive. Recycle power. If fault does not clear, check firmware and configuration.
5342	3	Internal hardware fault	Check for shorts to vehicle chassis. Check motor isolation. Cycle power. If fault persists, replace affected drive.
5343	5	Internal software fault	Potential configuration error on drive. Recycle power. If fault does not clear, check firmware and configuration.
5344	5	Internal software fault	Potential configuration error on drive. Recycle power. If fault does not clear, check firmware and configuration.
5381	3	CANbus configuration fault	Node has difficulty communicating via CAN. Confirm all drives have unique node ID. Check that all other drives are connected and powered up. Check configuration wiring.
54c1	5	Over Voltage Trip	Capacitor voltage over 280 Volts. Check all battery and circuit breaker connections. Possible drive fault.
54c2	5	DSP PF Fault	Severe over-current or over-voltage occurred. Recycle power. Check encoder, motor, battery cables, and motor cables.
54c3	5	IGBT S/C M1 Top	M1 Terminal shorted to B+. Look for controller, motor, or motor cable short to B+ terminal of controller. Disconnect motor; if fault persists, replace drive.
54c4	5	IGBT S/C M1 Bottom	M1 Terminal shorted to B-. Look for controller, motor, or motor cable short to B- terminal of controller. Disconnect motor; if fault persists, replace drive.
54c5	5	IGBT S/C M2 Top	M2 Terminal shorted to B+. Look for controller, motor, or motor cable short to B+ terminal of controller. Disconnect motor; if fault persists, replace drive.
0xc6	5	IGBT S/C M2 Bottom	M2 Terminal shorted to B-. Look for controller, motor, or motor cable short to B- terminal of controller. If this fault is reported with the motor disconnected, replace the drive.
54c7	5	IGBT S/C M3 Top	M3 Terminal shorted to B+. Look for controller, motor, or motor cable short to B+ terminal of controller. Disconnect motor; if fault persists, replace drive.

Motors

The HiPAC 10 system utilizes highly efficient, higher power density, AC three-phase induction motors resulting in:

- No brush or brush holders.
- Total system approach to insure motor and VFD are matched together for optimum performance.
- Larger rotor design and increased torque and horsepower.
- High power density and smaller frame size.
- High quality Class “H” VPI epoxy resin insulation system for longer life expectancy. It is high temperature, inverter grade, corona eliminating and fully compatible with variable frequency drives.
- Increased RPM capabilities resulting in higher machine speeds.
- Improved efficiency and performance.
- Totally enclosed, MSHA certified, non-vented enclosure prevents ingress of dust, grit, or moisture.

Bearings

The pump motor has a maintenance free sealed bearing. The traction motor(s) have a maintenance free sealed bearing on the non-driven end. The driven end bearing is lubricated by the gear box.

Motor Megger testing

CAUTION!
Disconnect all motor leads including the temperature switch and sensors before Megger testing. Electrical system and/or VFD damage may occur if leads remain connected.

☞ Connect the Megger between a winding and the motor frame.

☞ Per the IEEE 43 version 2000, meg each winding for 60 seconds before taking a reading. If the value is 5 meg Ohms or greater at 40°C, it is okay.

- A value below 5 meg Ohms indicates possible insulation breakdown, shorted winding, contamination in the motor, and/or moisture. The motor is questionable.
- A very low or zero reading means that a motor winding has shorted to ground. Otherwise, the internal temperature sensor may have shorted to one of the windings. Check for broken insulation on the motor terminals and sensor wires. If they are OK, the motor may need to be rewound.

To exit the adjustable parameters menu, press and hold the control handle Stop and Traction Assist buttons simultaneously. The display will return to its normal operating mode.

In a system this complex, simply printing all of the parameter change screens would be impractical. All of the adjustable parameters are instead organized and listed in the Adjustable Parameters table (Table 35).

IMPORTANT!
Currently, the State of Pennsylvania does not allow regenerative braking. This law is under consideration. However, currently regenerative braking must be disabled in the State of Pennsylvania only, via setting all braking torques to zero. See adjustable parameters chart (Table 25): all braking torques to be disabled (set to zero) are shown in red. All indicated braking torques (shown in red) must be set to zero when used in the State of Pennsylvania.

CAUTION!
Caution should be used when adjusting any parameter. Operators should be made aware of changes to such parameters as machine speeds and torques, braking torques and speeds, acceleration rates, roll-off speeds, and accelerator settings (increased machine speed, sudden acceleration or deceleration) may occur.

CAUTION!
The service brake and park brake are the primary means for stopping the vehicle.

Wiring diagrams

See your machine parts manual for the complete machine wiring diagram applicable to your particular machine.

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
351 Ragland Road
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
Oak Hill, WV 25901

843 Lochgelly Road
Oak Hill, WV 25901
Phone: (304) 469-3302
Fax: (304) 465-0450

Paonia, CO
P.O. Box 566
Paonia, CO 81428

719 Second Street
Paonia, CO 81428
Phone: (970) 527-3151
Fax: (970) 527-6846

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

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:

Mine power lead acid 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. High concentrations of hydrogen gas are produced by the battery and can potentially be explosive.

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 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.

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. This method is not recommended for repeated daily charging and should only be used occasionally. Battery service life may be seriously shortened, especially on high specific gravity batteries, if this method is used as the primary means of charging.

Specific maintenance procedures

Every shift

charger functionality

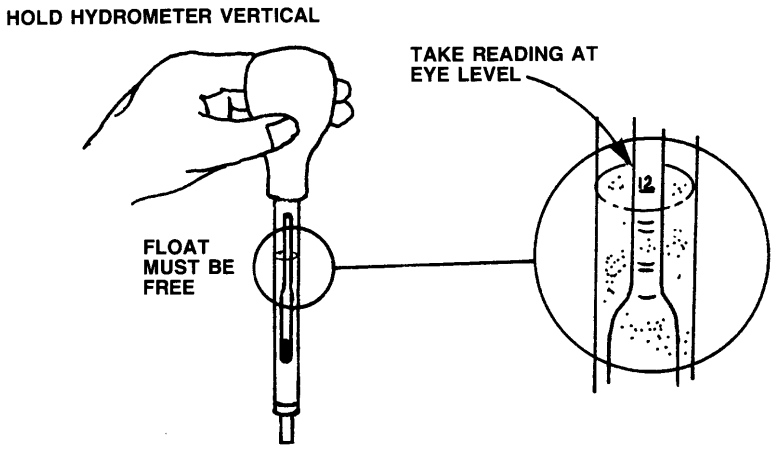
Make sure that the charger adjustment, used for control of charging rates and cut-off, is correct. This will ensure that the batteries are properly charged with no excessive overcharge. Batteries that are overcharged regularly will need water more often, and cell temperatures usually will be higher than 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.

6 Technical data