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August 2012

Operation and Maintenance Manual

SU488 L Scoop

128VAC Machines

2 Your safety

If hydraulic hose couplers are difficult to disconnect or cannot be disconnected, the hydraulic line may still be pressurized. Be sure to depressurize the line before disconnecting couplers.

Secure the connectors of the hydraulic elements only with the proper coupling 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 for leaks before pressurizing the system again.

permissible hoses

Use only hydraulic hoses approved for the prevailing pressures.

Do not use any hydraulic hoses with damaged connectors or worn o-rings.

Replace hydraulic hoses only with hoses of the same or a higher quality.

Observe the date of manufacture stamped on the hydraulic hoses. Never use hydraulic hoses which are more than 2 years old, even if they have no visible signs of damage.

Never try to hold a jumping hydraulic hose. Depressurize the line in question immediately.

Never try to repair damaged hydraulic hoses.

Replace hydraulic hoses at the first suspicion of damage.

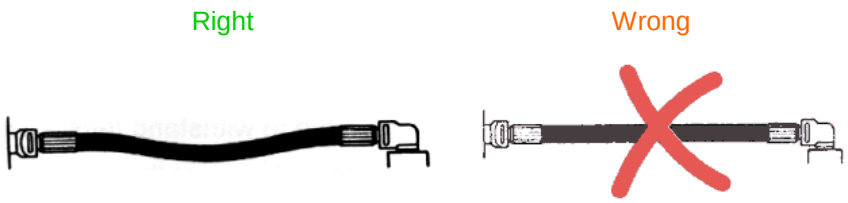
laying hydraulic hoses

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



4 Installation

Operation

This chapter contains important information on the operation and maintenance of the machine. Read this chapter carefully and thoroughly. In particular, observe the safety instructions in chapter 2 “Your safety”.

How to operate the SU488 L

DANGER!
Incorrect operation of the machine is often the cause of very serious accidents. Operate the unit only after being sufficiently trained on the machine and reading and understanding this operating manual. Should anything be unclear, please contact your immediate supervisor.

Who is allowed to operate the SU488 L?

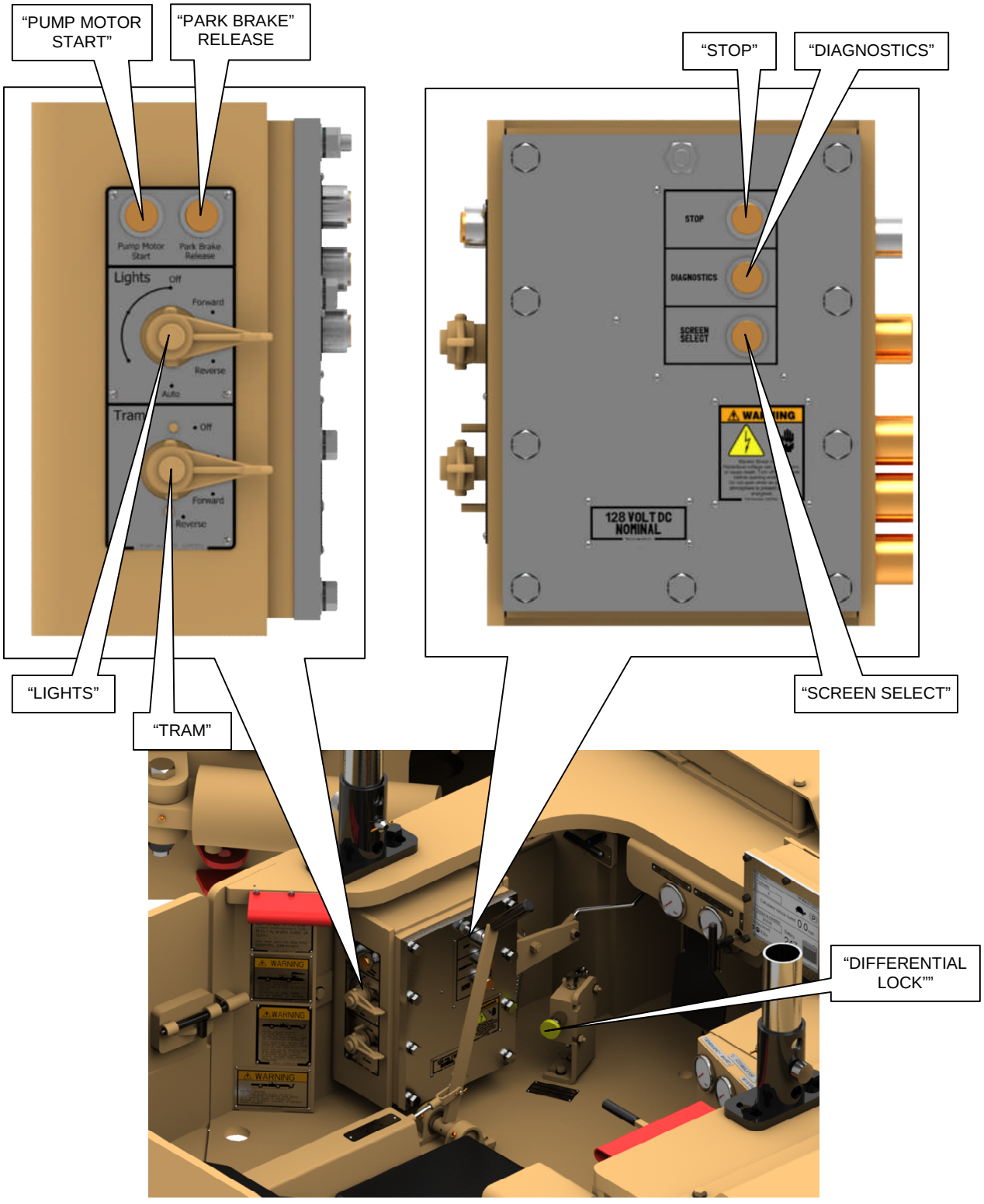
This machine is only allowed to be operated by persons with adequate knowledge of the complete machine. This includes:

- what safety devices are installed on the machine,
- where these safety devices are located, and
- how these safety devices are to be operated.

When can operation be started?

Operation must not be started until the safe condition and proper function of the complete machine has been checked and the daily maintenance operations have been carried out.

Fig. 17: Control Station



Towing a disabled machine

WARNING!
It is not possible within the scope of this guide to anticipate all possible arrangements for towing a disabled vehicle. All possible precautions must be taken to protect the operators and all personnel around either vehicle from being injured by the towing vehicle, the towing device used (cables, bars, etc.), or the towing vehicle (scoop, tractor, etc.). The towing vehicle must be strong and heavy enough to maintain control of both vehicles through all bottom conditions that may be encountered. Safety chains or other safety devices must be used in case of failure of the primary towing device. Both operators must be alert at all times to prevent either unit from running away during towing. The vehicle to be towed must be securely coupled to the towing vehicle before the brakes are released on the disabled unit. The operator of the towing vehicle must be in place in the towing vehicle with the brakes applied before the brakes of the disabled vehicle are released.

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

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

3. Begin pumping the hand pump. The building pressure moves the shuttle valve and allows the park brake system to be pressurized.

4. The park brake should be released when the “EMERGENCY BRAKE” pressure gauge reads 138 bar (2,000 psi).

CAUTION!
For long distance towing, disconnect and remove front and rear drive lines.

WARNING!
At no time during towing should anyone ride in or on the vehicle being towed or stand in between the towing vehicle and the disabled vehicle.

5. Begin towing the vehicle.

6. Once the destination is reached, stop both vehicles and set the parking brake on the disabled vehicle before removing the towing devices. The disabled vehicle should be chocked in both directions at all four wheels for additional stability. The brake is set by turning the valve handle on the hand pump to “NORMAL RE-APPLY”.

WARNING!
Failure to set the parking brake on the disabled vehicle before removing the towing device could allow the disabled vehicle to roll away uncontrolled.

Critical torque values

Torque values are expressed in lubricated values.

Table 1: Critical torque values

Location	Bolt size	Grade	Lubricated
Steering cylinder pins	2” x 7.5”	8	460
Tire-Wheel mounting nuts	3/4-16 x 2 1/2”	8	300
Drive motor-to-gear case mounting bolts	3/4” NC X 2-3/4”	5	282 (382 m-n)

Lubricants, fluids and capacities

Table 2: Lubricants, fluids and capacities

Location	Specification	Approximate capacity	Notes
Hydraulic oil tank	Spec. 100-1	40 gal (151.5 l)	1
Gear box (reducer)	Spec. 100-6	As Required	
Lubrication points	Spec. 100-3	As Required	3
Axle housing	John Deere Hy-Gard Oil	As Required	2
Planetary differential	John Deere Hy-Gard Oil	As Required (each wheel end)	2
Wet disc brakes	Spec. 100-12	As Required	2

Notes:

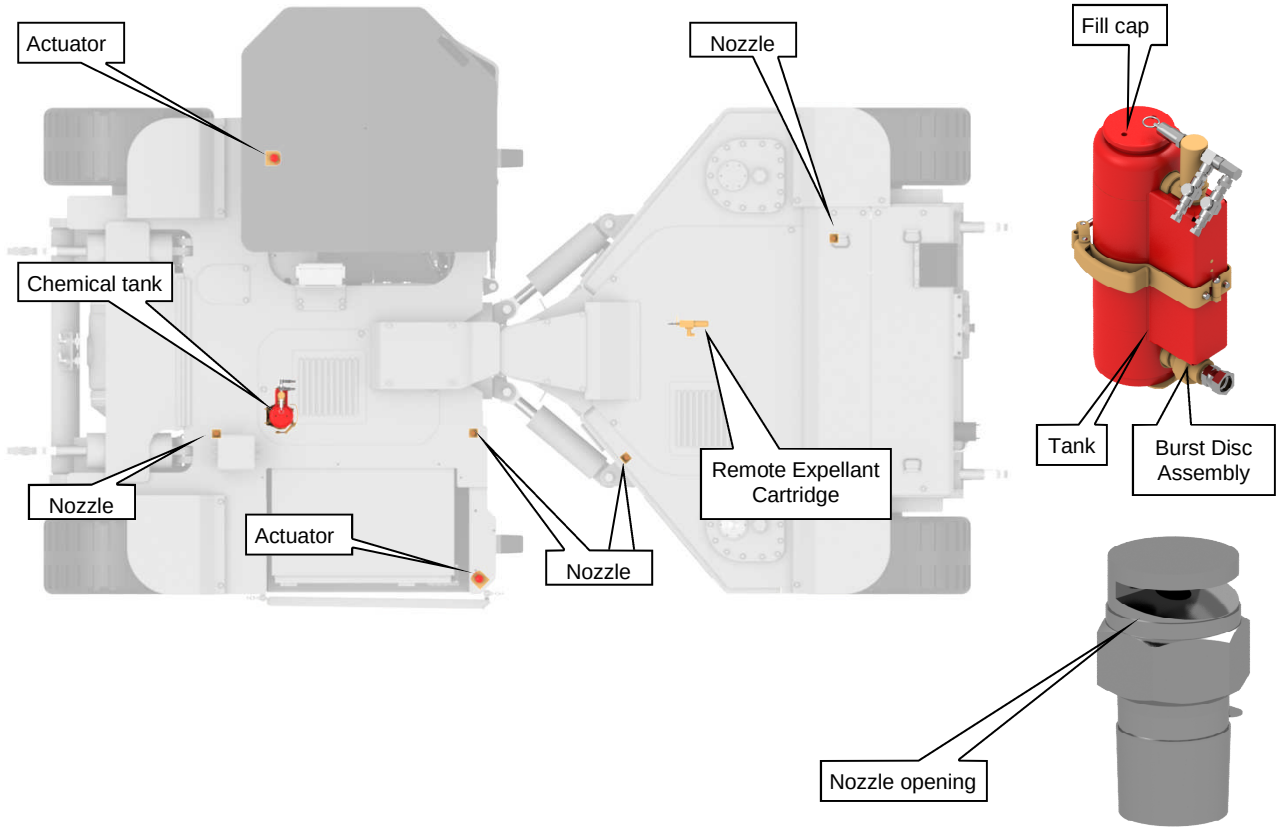
1. With ejector blade completely retracted.
2. The axle housing, brake cooling sumps, and planetary wheel end assemblies do not have a common oil source. Each assembly must be filled separately. Make sure the level and fill hole in the planetary wheel end cover is in the proper position. Rotate the wheel end as required to bring the fill hole to either the 3 o'clock or 9 o'clock position. When filling the axle housing and planetary wheel ends, allow enough time for the lubricant to fill the various cavities and around component parts in each assembly. Continue adding oil into each assembly until the required oil level is reached
3. Pump grease into fitting until old grease can be observed coming out of component.
4. When bleeding brakes, bleed both ports at the same time.

fire suppression system

Check the fire suppression system (Fig. 49).

- ☞ Inspect the hoses, fittings, and nozzles and replace any found damaged.
- ☞ Check the extinguisher tank for signs of damage or corrosion. The extinguisher tank is located in the middle section of the machine.
- ☞ Check the nozzle openings. The slot should be packed with silicone grease. If the nozzles are open or need to be repacked, the lines should be checked for blockage and blown clear before repacking them with clean silicone grease.
- ☞ Remove the fill cap.
- ☞ Check that the extinguisher is filled with free flowing Ansul multipurpose A, B, C dry chemical to a level not more than 3 inches (75 mm) from the bottom of the fill opening.
- ☞ Replace the fill cap, hand tight.
- ☞ Disconnect discharge connection union of tank output and inspect burst disc assembly. Replace if damaged to insure proper operation of material discharge.

Fig. 49: Fire suppression system



The following procedure is for the initial start-up and pressure adjustments of the machine.

1. Insure that the suction port of the pump has been purged of any trapped air by loosening the suction port adapter until oil is present at that point then secure the adapter.

2. Insure that the pump case is full of oil by disconnecting the case drain hose and examining the case drain port for the presence of oil. If oil is not present at the case drain port, it should be filled manually. Once the case is full, secure the case drain connection to the pump.

3. Loosen the compensator adjustment on the pump (Fig. 59) and turn counterclockwise several turns prior to start up to insure that high pressure spikes are avoided during the initial pump operation.

4. The pump circuit control module (Fig. 60) is factory set at 3,500 psi (241 bar). With the pump compensator backed off, this setting will be satisfactory.

5. Install a pressure gauge in the gauge port of the pump circuit control module to monitor system pressure adjustments and to check for correct pump rotation.

6. Preset the brake cooling manifold as follows (as applicable; not required with the John Deere Axle option):

    a. Loosen the jam nut on the relief setting and turn the adjustment stem out (counterclockwise) all the way. Secure the jam nut.

    b. Loosen the jam nuts on the flow control valves and turn the adjustments all the way (clockwise) to close them off; then open each flow control 1½ turns (CCW) and secure the jam nuts.

8. Minimize all pressure reducing valve settings.

9. Insure that the jet fill or power fill tank system controls are closed.

10. Insure that the motor cutback switch cable is disconnected.

11. Bump (turn on then off) the pump two or three times to verify proper pump rotation (pressure should build at the gauge port of the pump circuit control module).

12. After the pump rotation is verified, the pump may be started and allowed to run continuously.

13. Read the system pressure on the gauge installed. Turn the pump compensator adjustment (Fig. 59) in (clockwise) until 2,400 psi (165 bar) is achieved and stable. Continue turning the compensator in (clockwise) to confirm the adjustment for the pump circuit control module (target is 3,500 psi (241 bar)).

Table 4 (continued): Hydraulic system (general) troubleshooting

Trouble, symptom or cause	Probable cause	Test, check and/or remedy
overheating of system (continued)	☞ Improper air circulation around reservoir.	☞ Check to see if the area around the reservoir is clear.
	☞ System relief valve set too high or too low.	☞ Reset the relief valve to specifications.
	☞ System controls open or bypassed	☞ Inspect auxiliary system controls
foreign matter sources in the circuit	☞ Sealing compound (pipe dope, Teflon tape).	☞ Clean or replace seals.
	☞ Burrs inside piping components.	☞ Disassemble piping components and remove any burrs.
	☞ Tag ends of packing coming loose.	☞ Remove old packing and replace with new.
	☞ Lines left unprotected and dirty, repaired components.	☞ Drain and replace oil.
	☞ Repair parts not properly protected while stored.	☞ Clean parts thoroughly before installation.
accumulator charging cycle repeats frequently when accumulator is not normally being discharged in service	☞ Leaking accumulator lines or fittings.	☞ Check lines and fittings for leaks and correct.
	☞ Accumulator gas charge too low.	☞ Check accumulator gas charge.
	☞ Accumulator gas charge too high.	☞ Check accumulator.
	☞ Line to accumulator plugged.	☞ Replace line.
accumulator starts to charge but doesn't reach high limit	☞ No oil or low oil in tank.	☞ Check oil level.
	☞ Defective or worn pump (pump doesn't deliver full flow or pressure).	☞ Check pump pressure and flow.
	☞ Defective system relief valve (valve leaking or has low setting so full flow and pressure are not available).	☞ Check relief valve.
	☞ Defective dump valve	☞ Inspect dump valve
	☞ Defective charging valve.	☞ Replace valve.

Technical data

This chapter contains the most important technical data on the CAT® SU488 L. 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, HFA fluids, greases, etc. Read this chapter through carefully and pay particular attention in particular to the safety instructions.

The technical data listed in this chapter is for stock machines only. Customer specials may not be listed.

CAT® SU488 L

Technical data sheet

general

Length
with bucket: ..... approx. 28’ 8”

Overall width
with bucket: ..... approx. 9’7”

Wheelbase: ..... approx. 12’ 2”

Weight
empty less battery: ..... approx. 28,000 lbs
with battery: ..... approx. 42,200 lbs

Battery height from ground:
with battery and 35X15-15 tires ..... approx. 36.5”

Ground clearance (no axle spacers):
with 35X15-15 tires ..... approx. 11”

Minimum adjustable cab height (from ground):
with 35X15-15 tires ..... approx. 3’ 6””

Main frame height (from ground):
with 35X15-15 tires ..... approx. 2’ 6.75”

Load per axle ..... 30% front axle
70% rear axle

Maximum grade 12%

performance

Inside turning radius ..... approx. 11’ 11”
Outside turning radius: ..... approx. 23’ 3”
Steering articulation: ..... 80 degrees total
Tram speed: ..... 4-5 mph
Lift capacity: ..... approx. 10 tons at 40” from bucket pivot pin

Table 18: Extreme pressure gear oils (Spec. 100-2)

	Supplier	Brand name
1	Amoco Oil Company	Amoco Permagear EP 460
2	Gulf Oil	EP Lubricant HD 460
3	Mobil Oil Corporation	Mobil Gear 634 Mobil Gear 636
4	Chevron U.S.A.	Chevron Gear Compound EP ISO 460
5	Sun Oil Company	Sunep 460
6	Unocal 76	Extra Duty NL Gear Lube 7 EP Extra Duty NL Gear Lube 8 EP
7	Shell Oil Company	Shell Omala 680
8	Century Lubricating Oils, Inc.	Hulbest EP-7 Powergear 460
9	Texaco Lubricants Company	Meropa 680
10	Exxon	Spartan EP 460
11	Pennzoil	Super Maxol EP 460 Gear Lube Super Maxol EP 460 Gear Lube
12	Lubricating Engineers	608 Almosal Vari-Purpose Gear Lubricant
13	Conoco Inc.	Gear oil 460
14	Hydrotex	933 Industrial Gear Lubricant
15	Phillips	All Purpose Gear Oil 85W-90 5EP
16	Miners Oil	Gear Oil EP460

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

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

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

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

Characters and symbols used

The following characters and symbols are used for safety instructions and important information in the operating manual.

Try to memorize the symbols and their meanings.

DANGER!
Points in the text marked with this symbol draw your attention to immediately impending danger. Possible consequences are: very serious injury or even death.

WARNING!
These points contain information on dangerous situations. Possible consequences are: very serious injury or even death.

CAUTION!
This symbol draws attention to dangerous situations. Possible consequences are: light to moderately serious injuries and machine damage.

NOTICE!
Points in the text marked with this symbol draw attention to harmful situations. Possible consequences are: damage to the machine or damage in the immediate vicinity.

IMPORTANT!
Points in the text marked with this symbol contain useful tips and information intended to facilitate work for you. They do not warn about harmful or dangerous situations.

3 Operation

Features

The HiPAC 10 incorporates a variety of independent protection systems. These improve reliability, shield the motors and VFDs from overload, protect the machine from inadvertent abuse, and help to protect workers from potential harm from malfunctioning equipment.

The system utilizes the main circuit breaker as a means of failsafe protection by mechanically disconnecting the motor from the battery supply in the event of drive failure. There are two parts to this, look-ahead and failsafe protection:

- The look-ahead feature is where the traction system monitors the vital parts of the controller and motor and, according to their conditions, will or will not allow the circuit breaker to be closed.

- The failsafe feature will engage when the system detects any part of the controller or motor to be non-operational and/or faulty. At this point, the system will open the main circuit breaker.

Additionally, due to the inherent advantage of an AC motor, if there is a failure in any of the motor phases or drive controller phases, the motor will come to a stop and can no longer be driven, even if a faulty drive controller were to continue to pulse the remaining two phases.

Motor overload is defined as running the motor beyond the manufacturer's continuous rated specification up to a specified maximum limit. Operating the machine in this way allows more power to be produced for shorter periods of time. This is acceptable use of the motor as long as consideration is given to the extra heating effect in the motor. The HiPAC 10 implements three parallel and independent temperature measurements in the motor:

- PTC temperature probe embedded in the motor: The voltage proportional to temperature formed across this device represents the internal winding temperature and is fed back in to the controller and converted to a real temperature.

- A thermal switch, which changes state above a certain temperature, is attached to the motor. This is fed to the controller and, when activated, cuts the available power to the motor to 30% of maximum (Fig. 10).

- A motor temperature estimate is implemented in software which predicts the motor temperature based upon the current in the motor, its thermal time-constant, and impedance.

In the event of motor over current, the software will attempt to resist the over current by applying voltage to oppose it. However, if the situation is unrecoverable (for example: in the case of a dead short), a hardware trip will disable the inverter, putting the outputs into a high impedance state.

Table 10: Pump VFD, connector “C” (Standard)

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

Table 11: Pump VFD, connector “D” (Standard)

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

Table 25: Rear Auxiliary (2) Traction VFD (Node 7), 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 26: Rear Auxiliary (2) Traction VFD (Node 7), 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

main screen The main screen (Fig. 17) is displayed after the main circuit breaker is closed (turned on).

Fig. 17: Main screens

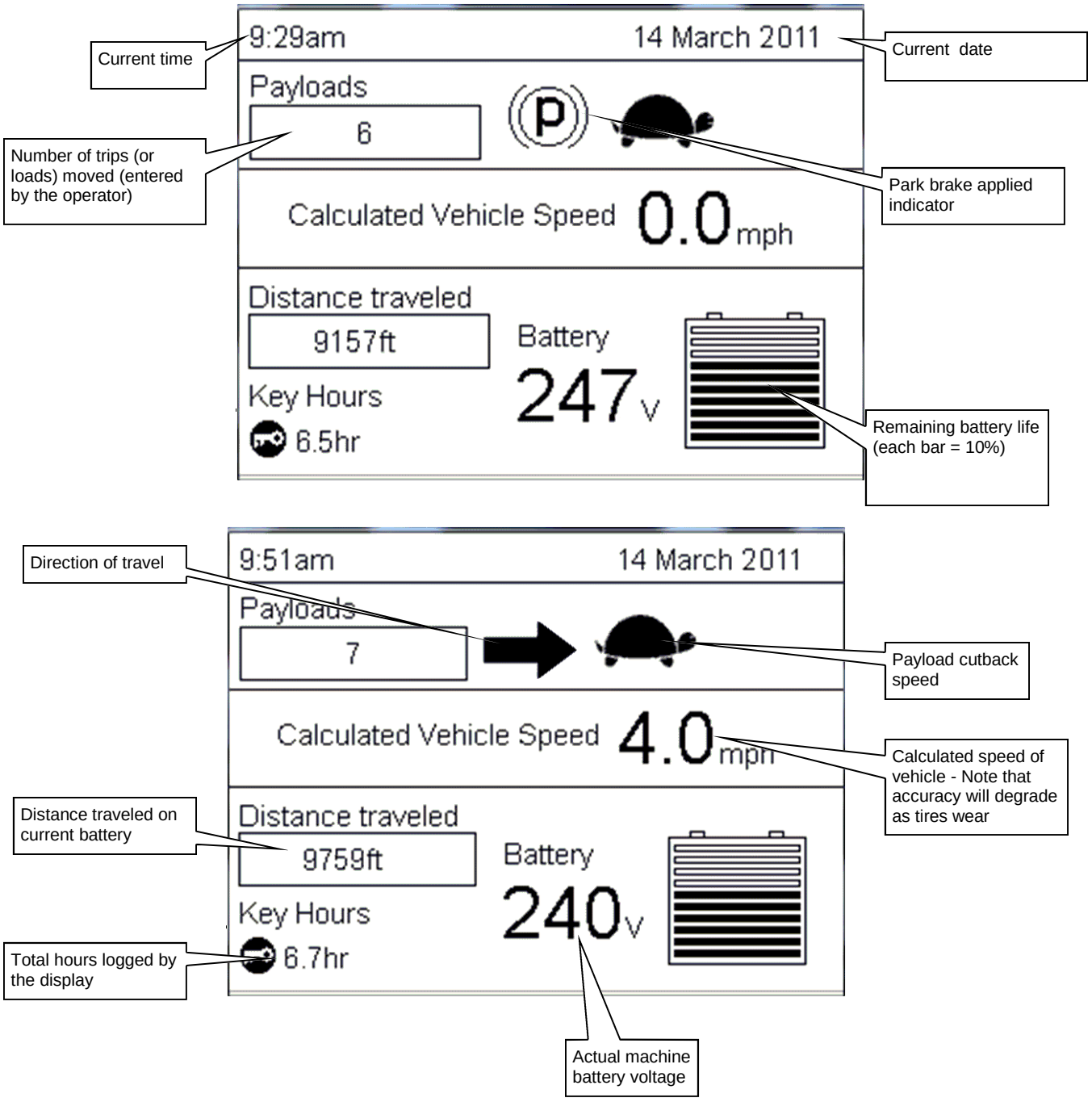


Table 27: Fault information codes, continued

Fault ID	Severity	Fault Description	Fault Help
45c6	1	Precharge Input Voltage Low	Precharge input is below 150V. Check all battery and CB connections. Recharge battery. Check “D” connector wiring and fuse.
45c7	1	Precharge Input Voltage High	Precharge input is above 300V. Check all battery and CB connections. Possible controller fault. Battery may be overcharged.
45c8	1	Vcap above rated maximum	DC link above rated maximum. Check all battery and CB connections. Possible drive fault. Battery may be overcharged.
45c9	1	Caps not discharged	Controller is attempting to discharge the capacitor bank, but lethal voltages may still be present. Exercise extreme caution when servicing.
45ca	1	Motor in low-voltage cutback	Motor performance has been cut back due to low voltage.
45cb	1	Motor in high-voltage cutback	Motor performance has been cut back due to over voltage.
45cc	1	Motor temperature sensor fault	Motor temperature measurement is invalid. Check motor temperature sensor. Check sensor connections and fuses. Make sure it is not shorted to motor windings.
4601	1	Heat sink too cold	Controller is below -30°C. Verify temperature reading. Replace controller if not accurate.
4602	1	Heat sink too hot	Controller is above 85°C. Limit operation or shut down. Check unit temperature is accurate. Make sure there is thermal grease between controller baseplate and vehicle frame. Check for any debris between them.
4603	1	Motor in thermal cutback	This motor is too hot. Limited operation or shutdown. Check motor temp switch and sensor. Also check related wiring and fuses.
4604	1	Power switch silicon too hot (IGBT)	An estimate of the silicon temperature switch (IGBT) is within 10°C of max allowed temp. Ensure adequate cooling of control enclosure. Ensure there is thermal grease between controller baseplate and vehicle frame. Also check for debris between the two.
4681	1	Supervisor not operational	Check other drives are connected to the CANbus and are powered up. Use DVT or Drive Wizard to set into operational mode. Otherwise, replace the drive.
4682	1	Units still initializing	Not all expected CAN messages were received. Cycle power. If fault persists, contact device manufacturer.
46c1	1	Motor Encoder Warning	Encoder signal is corrupted. Check encoder wiring for shorts or breaks. Replace encoder. Vehicle may still be able to drive with reduced power.
4782	1	24V supply low	Check supply input to drives. Cycle power. If fault does not clear, replace controller.

Table 28: LED flash fault codes, continued

# of Flashes	Fault	Checks/Remedies
5	Operator warning faults (will not shut down the vehicle). Most commonly, these are the Vehicle Isolation Fault or the No Speed Fault.	
	A Vehicle Isolation Fault indicates that current has been detected between the 24V supply and battery positive or negative. Persistent faults of this type can eventually damage the vehicle electronics.	Clean around the terminals on the drives.
	A No Speed Fault occurs when a controller draws 25% or more of current limit but no vehicle motion has been detected.	Normally occurs when the vehicle is stuck or pushed into a wall. May be caused by a failing speed sensor.
	Hydraulic pump or cooling fan issues.	See troubleshooting for the hydraulic pump and cooling fan.
	Vehicle wiring faults.	Recycle power, replace drive is fault doesn't clear.
6	Analog input fault to VFD.	Check wiring and inputs, recycle power, replace drive if fault doesn't clear.
	Bad accelerator.	Check the accelerator and the wires leading to it.
	Faulty footswitch.	Check the footswitch.
7	Battery voltage faults.	Recharge the battery. If the display was recently replaced, check that the BDI levels are set correctly. If the fault occurs during driving or braking, check the battery and motor connections. Recycle power. Replace drive if fault doesn't clear.
	Capacitor pre-charge circuit failure (rare).	The driver circuit has overheated. Remove power for ten minutes, then retry. If fault does not clear, the driver has suffered an internal failure. Replace drive.
8	Thermal cutback faults (drive or motor has overheated).	Allow vehicle to cool for 20 minutes. Check for contamination between drive heat sink and vehicle frame. Make sure there is enough thermal compound. Check thermistors, temperature switch, and related wiring. Make sure sensor is not shorted to motor windings. Recycle power. Replace drive if fault doesn't clear.
9	Drive has failed.	Replace drive.
10	Drive is stuck in Pre-operational mode.	Only occurs during programming. Drive was not returned to Operational mode after firmware or settings update. Use DriveWizard or DVT to do this.
11	Motor control faults.	Check encoder, wiring, and drive inputs. Recycle power. Replace drive if fault doesn't clear.

Control System Inputs

Inputs to the PLC may be monitored on the PLC (Fig. 28). Inputs to the HiPAC 10 may be monitored on the vehicle inputs monitor screen (Fig. 27).

Control System Outputs

The PLC outputs may be monitored on either the HiPAC 10 display Vehicle Inputs Monitor Screen (Fig. 27) or on the Programmable Controller (PLC) LED indication card (not used on control station models) (Fig. 28).

Fig. 27: Vehicle inputs monitor screen

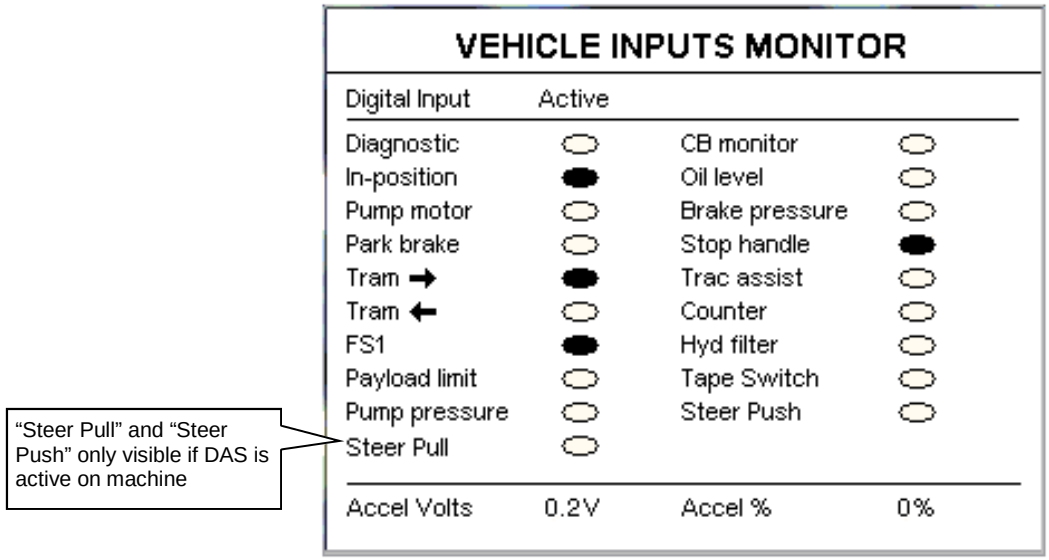


Fig. 28: Programmable controller (PLC) LED indication chart (not used on control station models)

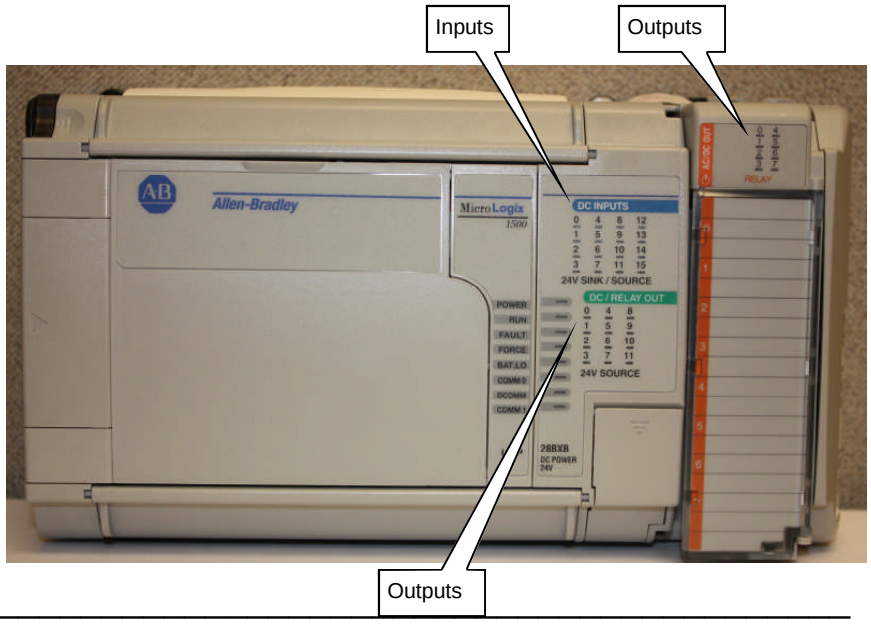


Table 35: Adjustable parameters, continued

Menu1	Menu2	Menu3	Menu 4	Description	Node	Pass-word Level	Min	Max	SU Series Scoops (240V) Default	SU Series Scoops (128V) Default	SH Series Roof Support Carriers (240V) Default	SH Series Roof Support Carriers (128V) Default	SH680 Roof Support Carriers (240V) Default	FH Series Face Haulage (240V) Default	FH Series Face Haulage (128) Default	Units	Description
Data Logging																	
		Display logs															
				Clear data log	Display	1	No change, reset										clears temperature log
				Set data log interval	Display	1	1	600	300	300	300	300	300	300	300		Seconds
				Clear fault log	Display	1	No change, reset										clears fault log on display only
Display Parameters																	
		Configuration settings															
				Units Format	Display	1	Metric, Imperial		Imperial	Imperial	Imperial	Imperial	Imperial	Imperial	Imperial		
				Clock format	Display	1	12Hour, 24Hour		12Hour	12Hour	12Hour	12Hour	12Hour	12Hour	12Hour		
				Date format	Display	1	DDMMYY, MMDDYY		MMDDYY	MMDDYY	MMDDYY	MMDDYY	MMDDYY	MMDDYY	MMDDYY		
				Display Contrast	Display	1	1	255	133	133	133	133	133	133	133		
				Distance Units	Display	1	feet, meters, miles, kilometers		Feet	Feet	Feet	Feet	Feet	Feet	Feet		
				Flash backlight if BDI low			Yes/No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes/ No	Yes=Active or No=disable feature (starts flashing when BDI warning is active
		Clock settings															
				hours	Display	1	0	23								Hours	Hours
				mins	Display	1	0	59								Min.	Minutes
				day of month	Display	1	1	31								Day	Day
				month	Display	1	January through December									Month	Month
				year	Display	1	2000	2050								Year	Year
		Vehicle Description															
				Auto-Manual selection	Trac 1	2	Auto or User selections		Auto	Auto	Auto	Auto	Auto	Auto	Auto		These Items Are Set By The Machine Configuration Wiring
				Vehicle Type	Display	2	FH Series, SU Series, SH Series										
				Traction Motor Type	Display	2	2x75HP, 2x100HP, 1x75HP, 1x100HP, 4x100HP										
				Pump Motor Type	Display	2	48HP, 100HP										
				Vehicle Gear Ratio	Display	2	See Wiring Diagram										
				Vehicle Tire Diameter	Display	2	See Wiring Diagram										
				Vehicle orientation	Display	1	Positive or Negative		Neg.	Neg.	Pos.	Pos.	Pos.	Pos.	Pos.		Direction Arrow as seen on the Display
				Battery Supply Voltage	Display	1	128VDC or 240 VDC										Battery Voltage setting
				Tow mode	Trac 1	1	Yes or No		No	No	No	No	No	No	NO		When Yes, all driving and braking torque is set to zero.

4 Technical data

TABLE OF CONTENTS

REMOVE personal metal items such as rings, bracelets, necklaces, and watches when working with a battery. A battery can produce a short circuit current high enough to weld a ring or the like to metal, causing a severe burn.

NEVER charge a frozen battery.

If it is necessary to remove the battery connections, always remove the grounded terminal from the battery first. Make sure all loads are disconnected and unit is off, so as not to cause an arc.

Be sure the area around the battery is well ventilated while the battery is being charged.
When cleaning battery terminals, be careful to keep corrosion from coming in contact with the eyes.

Study all the battery manufacturer's specific precautions such as do not remove cell caps while charging, recommended rates of charge, and maintenance procedures.

INSTALLATION INFORMATION

Minimum Wire Sizes

Table 2 lists the a.c. input and the d.c. output minimum wire size requirements. At distances exceeding 10 ft., the d.c. wire size should be chosen to keep the voltage difference between the units d.c. output terminals and the battery at less than 1/2 volt when the unit is fully loaded.

FUSE SIZE	WIRE SIZE REQUIREMENT CUSTOMER CONNECTION	EQUIPMENT GROUNDING CONDUCTOR MINIMUM	FUSE SIZE	WIRE SIZE REQUIREMENT CUSTOMER CONNECTION	EQUIPMENT GROUNDING CONDUCTOR MINIMUM
1	#14	#14	150	#1	#6
3	#14	#14	175	#1/0	#6
4	#14	#14	200	#2/0	#6
5	#14	#14	225	#2/0	#4
6	#14	#14	250	#4/0	#4
10	#14	#14	300	250-MCM	#4
15	#12	#12	350	350-MCM	#2
20	#12	#12	400	400-MCM	#2
25	#10	#12	450	500-MCM	#2
30	#10	#10	500	600-MCM	#2
35	#8	#10	600	900-MCM	#1
40	#8	#10	700	1500-MCM	1/0
45	#8	#10	800	2/500-MCM	1/0
50	#8	#10	1000	2/800-MCM	4/0
60	#6	#10	1200	2/1000-MCM	4/0
70	#6	#8	1600	2/2000-MCM	4/0
80	#4	#8	2000		250-MCM
90	#4	#8	2500		350-MCM
100	#4	#8	3000		400-MCM
110	#2	#6	4000		500-MCM
125	#2	#6	5000		700-MCM
130	#2	#6	6000		800-MCM

TABLE 2

Electrical Connections & Field Wiring

Terminal blocks are provided for connecting the a.c. input and d.c. output. A ground wire must be connected to the unit's case ground.

A.C. 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 a.c. input current, specified on the nameplate, is for (nominal) output. A.C. 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 a.c. input.

(see Figure 1, page 20).

Table of contents

1. About this manual

2. Your safety

3. Storage and transport

2 Your safety

Safety procedures

federal standards

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

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

while handling batteries

- Lift batteries with mechanical equipment, such as an overhead hoist, crane or lift truck. A properly insulated lifting beam, of adequate capacity, should always be used with overhead lifting equipment. Do not use chains attached to a hoist at a single central point forming a triangle. This procedure is unsafe and could damage the steel tray.
- Always wear safety shoes and safety glasses.
- Tools, chains, and other metallic objects should be kept away from the top of uncovered batteries to prevent possible short circuits.
- Battery operated equipment should be properly positioned with switch off, brake set, and battery unplugged when changing batteries or charging them while in the equipment.
- Personnel who work around batteries should not wear jewelry made from a conductive material. Metal items can short circuit a battery and could cause severe burns.
- Only trained and authorized personnel should be permitted to change or charge batteries.
- Reinstalled batteries should be properly positioned and secured in the unit. Before installing a new or different battery, check both the unit nameplate and battery service weight to make sure that the proper weight battery is being used. A battery of the wrong weight could change the center of gravity and cause equipment to upset.

Storage and transport

This chapter contains important information on the correct storage and transport of the mine power storage battery.
.
Observance of the instructions and tips will increase the service life and availability of the battery. 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

Storage methods

charged and wet batteries

Lead acid batteries may be stored in a charged and wet (filled with electrolyte) condition when necessary for periods of up to several months. During such periods they should be stored in a clean, cool, dry, and well ventilated location away from radiators, hot air ducts, or other sources of heat, and protected from exposure to direct sunlight.

Before being stored, the battery should be fully charged and the electrolyte brought to the proper level. Any leads should be disconnected or insulated to prevent accidental discharge. The top of the battery should be protected from dust, foreign matter, and moisture. **Do not attempt to dismantle the battery.**

If the average storage temperature is 80° F or higher, the specific gravity of the electrolyte should be checked at least monthly. If the temperature is below 80° F, check the specific gravity at least every two months. Whenever the specific gravity, corrected to 80° F, falls to 1.240 or below, the battery should be given a freshening charge as described in Chapter 5 of this manual. A freshening charge is also recommended just before returning a battery to service.

charged and dry batteries

New batteries are often supplied charged and dry (without electrolyte). Batteries in this condition can remain in storage, unattended, for a period of at least two years. They should be stored in a cool, dry place with vent caps tightly closed. Average temperatures should not exceed 80° F.

Batteries should not be stored near radiators, hot air ducts, or other sources of heat, and should be protected from exposure to direct sunlight. The top of the battery should be protected from dust, foreign matter, and moisture.

When removed from storage, charged and dry batteries should be activated as described in Chapter 5 of this manual.

Operation

This chapter contains important information on the operation and maintenance of the battery. Read this chapter carefully and thoroughly. In particular, observe the safety instructions in chapter 2, “Your safety”.

Definitions

The definitions referenced throughout this manual generally agree with accepted industry standards. For a more complete listing of "Definitions for Lead-Acid Industrial Storage Batteries", see NEMA Standards publication No. 1B 1-1971.

Copies of NEMA standards may be obtained at nominal cost by writing to: National Electrical Manufacturers Association, Department of Engineering and Safety Regulations, 2101 L Street, N.W. Washington, D.C. 20037.

Description and construction

Battery

Mine power lead-acid batteries for electric vehicles typically consist of a steel tray into which the cells are assembled, a battery terminal connector, and various other components necessary to secure and protect the cells and provide the necessary electrical interconnections.

battery identification and data

The essential information necessary for proper care of an industrial motive power battery appears on the battery, either stamped into one of the intercell connectors or on a name plate affixed to the tray. This information usually includes the manufacturer's name and model, number of plates per cell, battery capacity, battery voltage, serial number, suggested charging rate, and fully charged specific gravity of electrolyte.

If vital information is missing or is no longer legible, the information can be obtained by contacting your nearest representative.

Some manufacturers list, as a part of the model or type designation, the rated ampere-hour capacity of a single positive plate, such as "SS75". As an alternate means of determining rated battery capacity, this number should be multiplied by the total number of positive plates in one cell. To find the number of positive plates in a cell, subtract one from the total number of plates and divide by two. To find the capacity of a battery designated "SS75-19," therefore: 19 - 1 = 18; 18 divided by 2 = 9; 9 x 75 = 675 Ah battery capacity.

Sulfation

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

Operating cycle

An operating cycle of a storage battery consists of the discharge, subsequent charge cycle to restore its initial condition, and an eight hour cooling, or rest, period following the charge.

Service life

The service life of a storage battery is the period during which it provides useful power while being discharged. It is usually expressed as the time period, or number of cycles, which elapses before the ampere-hour capacity falls below 80% of its rated value. To obtain maximum service life, it is recommended that a battery be restricted to one full cycle per 24 hour day or fewer than 300 cycles per year. Other factors which most often adversely influence service life are:

- Abnormally high or low electrolyte temperatures.
- Frequent over discharging.
- Failure to add water regularly.
- Frequent overcharging.
- Poor, or high, resistance, connections or contacts.
- Overfilling with water, which causes electrolyte loss.

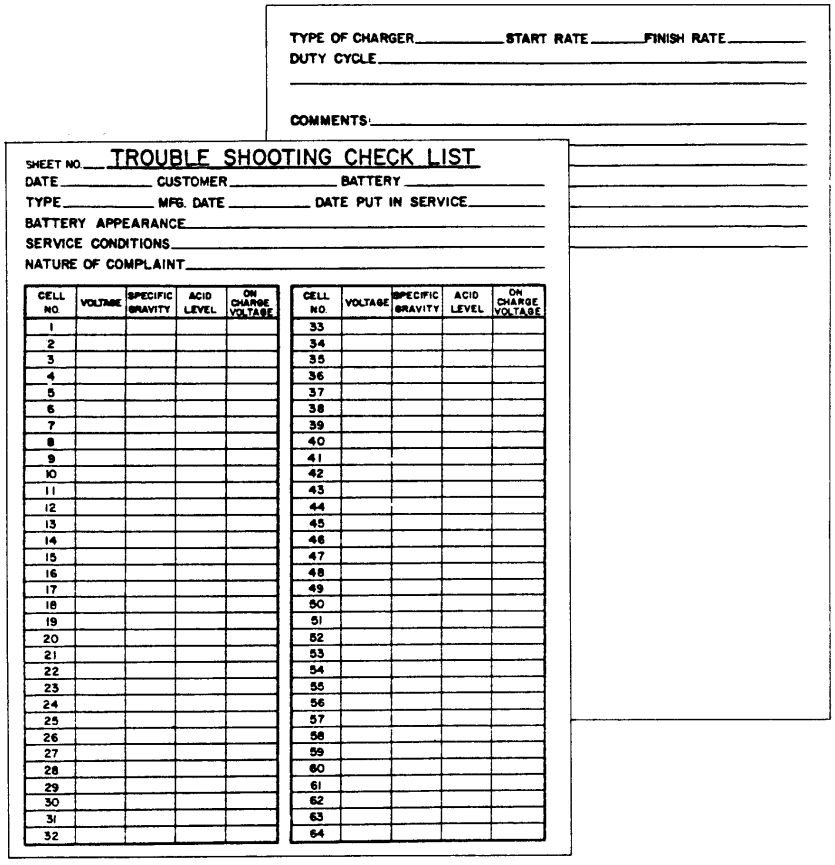
Temperature

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

low temperature

Available battery power is reduced by low temperature because electrolyte viscosity and resistance is increased and diffusion throughout the pores of the active material is retarded. For example, a fully charged battery (1.280 to 1.295 specific gravity at 77° F.), when its electrolyte temperature is about 32° F, will deliver only 75% of the capacity which would be available at normal room temperature (see Table 1). This drops to 40% at 0° F. The electrolyte could freeze if a discharged battery were exposed to very cold temperatures for several hours. (See Table 2 for freezing points of various electrolyte concentrations.)

Fig. 3: Monthly storage battery record



TYPE OF CHARGER _____ START RATE _____ FINISH RATE _____
DUTY CYCLE _____

COMMENTS: _____

SHEET NO. ___ TROUBLE SHOOTING CHECK LIST
DATE _____ CUSTOMER _____ BATTERY _____
TYPE _____ MFG. DATE _____ DATE PUT IN SERVICE _____
BATTERY APPEARANCE _____
SERVICE CONDITIONS _____
NATURE OF COMPLAINT _____

CELL NO.	VOLTAGE	SPECIFIC GRAVITY	ACID LEVEL	ON CHARGE VOLTAGE
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				

CELL NO.	VOLTAGE	SPECIFIC GRAVITY	ACID LEVEL	ON CHARGE VOLTAGE
33				
34				
35				
36				
37				
38				
39				
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Repairing batteries

Storage batteries which have been damaged or which contain defective cells may, if the rebuilding cost and time are justified, be restored to a serviceable condition.

It is important to check a battery thoroughly if it has been involved in an accident or if it is believed to be defective. A neglected battery will continue to deteriorate even when not in use. **Usually, rebuilding is justified if the majority of the cells are in good condition.**

This section explains how to remove cells from a battery and how to repair them if they are to be salvaged. Some special tools and parts will be required, depending upon the work to be done. Reference will be made to the use of such special devices but they will not be further identified in this manual. Each manufacturer identifies all tools, accessories, and replacement parts by an appropriate part number. Use this number when making reference to them.

Purging gas

☞ Before starting any repairs, remove all vent caps from cells to be repaired as well as from all surrounding cells.

☞ The space above the electrolyte must be cleared of hydrogen gas before proceeding with repairs. Introduce a low volume air stream (volume and force equal to that produced by fanning each cell with a stiff piece of cardboard or other suitable nonconducting material) into each cell for at least 30 seconds. Be very careful when using air so that the electrolyte is not splashed out of the cell.

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

☞ After cells have been purged, cover all vent openings with several layers of water-dampened cloth before starting repairs.

Removing intercell connectors

Special intercell connector drills, available in different sizes, are designed to cut the bond between the cell post and the connector while permitting the post to remain for later rebuilding.

☞ Make certain vent plugs are in place.

☞ Cut the bond between the cell post and the connector. Be careful to cut only as deep as necessary, usually 1/4" to 3/8". During drilling, try to center on the cover bushing and make sure any lead curl produced does not short across other connectors.

☞ Lift the intercell connectors off with a pair of pliers.

Table 11: FSR hex bolts (SAE 5 and 325 steel)

Nominal diameter	Recommended torque setting
¼”	9 ft-lbs
5/16”	18 ft-lbs
3/8”	31 ft-lbs
7/16”	50 ft-lbs
½”	75 ft-lbs
9/16”	110 ft-lbs
5/8”	150 ft-lbs
¾”	250 ft-lbs
7/8”	378 ft-lbs
1”	583 ft-lbs
1 1/8”	782 ft-lbs
1 ¼”	1,097 ft-lbs
1 3/8”	1,461 ft-lbs
1 ½”	1,748 ft-lbs
1 ¾”	3,114 ft-lbs
2”	4,504 ft-lbs
2 ¼”	6,497 ft-lbs
2 ½”	7,144 ft-lbs
2 ¾”	12,092 ft-lbs
3”	15,744 ft-lbs