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Installation, Use Maintenance and Repair Manual

Mine Power Storage Batteries

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 battery 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.

- Items in lists are marked with bullets.
  - Points in sub-lists are marked with a long dash at the start of the line.

☞ Points in text marked in this way describe individual operations. Follow these instructions step by step. They will help you carry out your work faster and more importantly, safer.

Maintenance and repair

Be sure to observe the prescribed maintenance and inspection intervals.

Inform the supervisory personnel and the face crew of any maintenance and repair operations. Give them information on the intended operations and the anticipated duration.

securing

Secure your working area over a wide range, in order to avoid endangering other persons.

Disconnect the battery from the machine to prevent unauthorized and unintentional restarting.

Protect your work area against falling rocks.

replacing components

Disconnect the battery from machine to prevent from restarting before replacing any defective components.

Pass defective components removed on for servicing without delay in order to prevent these parts from being reinstalled elsewhere.

original parts

Use only spare parts which satisfy the specified technical requirements. This is only ensured with original spare parts.
Please refer to the spare parts lists for the order numbers.

lifting

For raising the battery use only:

- crib blocks with adequate load-holding capacity.
- hoists, jacks or cranes with adequate load-carrying capacity.

maintenance, repair

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

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

Always replace damaged or lost decals and metal instruction plates.

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

Be sure the battery charging area is well ventilated (clear of fumes). Hydrogen gas from the battery could ignite from a spark and explode.

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

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

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

3 Storage and transport

5 Operation

Principles of operation

Fundamentals of cycling

A cycle is a discharge followed by a charge followed by an eight hour cooling, or rest, period. During the charge, the electrical energy supplied by the charger causes an electromechanical reaction within the battery. This restores the active materials to a fully charged condition.

fully charged cell or battery

The positive and negative plates (electrodes) are separated from each other and immersed in electrolyte. In the fully charged condition, the active material of the positive plate is lead dioxide and that of the negative plate is sponge lead. The electrolyte is a solution of sulfuric acid and water that normally varies in a specific gravity from 1.280 to 1.295 for a conventional lead acid battery and 1.320 - 1.330 for high gravity lead acid battery products.. The combination produces a voltage of approximately 2 volts on open circuit. This voltage potential results from the fundamental characteristic of a storage battery which dictates that when two electrodes of dissimilar metals are immersed in suitable electrolyte, and a circuit is closed between the two, electrons begin to flow. A fully charged cell should normally have an on-charge voltage of from 2.45 to 2.70 volts when charging at the finish rate.

discharging cell or battery

While a battery is being discharged or used, lead dioxide and sponge lead combine with sulfuric acid to form lead sulfate within both plates. This action causes the specific gravity of the electrolyte to decrease. As the discharge progresses, individual cell and battery voltages decline, generally in direct proportion to the rate of discharge.

discharged cell or battery

As the depth of discharge increases, more sulfuric acid is removed from the electrolyte, causing the specific gravity to decrease, possibly below 1.100 as it approaches the specific gravity of water. Almost all of the active material of both positive and negative plates is converted to lead sulfate, and an effective electromechanical reaction is no longer possible. At this point, the battery has reached its discharge limit.

charging cell or battery

The charging action begins when the terminals of the battery are connected to an external source of direct current. The electromechanical reaction is reversed and the positive plates, negative plates, and electrolyte start returning to their original charged condition. Charging causes the battery voltage to rise as active materials are restored. A cell being charged may have a voltage of from 2.12 to 2.70 volts depending upon charging rate and time.

general

Storage batteries do not actually store electrical energy; instead, they accept the electrical energy delivered to them during charging and convert it into chemical energy. During discharging, this chemical energy is reconverted into electrical energy to be used as needed. To obtain the best performance and life from a mine power storage battery, the battery should immediately be charged after each shift of use or whenever the specific gravity of the electrolyte falls below 1.240. It is very important that proper ventilation be provided during charging to make certain that the hydrogen gas, given off toward the end of the charging process, is dissipated and that individual cell electrolyte temperatures, during normal operations, do not exceed 110° F.

Weekly

adding water

A certain amount of water loss in cells is normal and it should be replaced with "pure" tap water or distilled water. In some geographical areas, tap water may contain chemicals or other impurities harmful to batteries. The recommendation for battery replacement water quality, Table 5, lists the maximum allowable impurities..

Table 5: Recommendations for battery replacement water quality

Impurity	Maximum Concentration (ppm)
Total Solids	350
Fixed Solids	200
Chlorides as CI	25
Nitrates as NO_2	10
Nitrates as NO_3	10
Iron as Fe	4
Organic and Volatiles	150 ppm
Ammonia (NH_4)	5
Manganese	0.07
Calcium and Magnesium	

NOTICE!
A minimum of one quart of water is required. Consult your sales representative if water analysis is required.

Check the height of the electrolyte at least weekly and if water is needed, add just enough to bring the electrolyte to proper level. Do not overfill. Water should only be added to batteries while the batteries are on charge and gassing, or as soon after recharge as possible.

Add water often enough to prevent the electrolyte level from dropping below the perforated separator protector. Ideally, a watering schedule should be established. This schedule should assure adequate watering while taking into consideration those factors which control water consumption, such as (1) frequency of charging, (2) water storage capacity of the specific cell type, (3) age and condition of the battery, and (4) changes in work demand.

battery top

Remove dirt or electrolyte accumulation from the tops of the cells. Wash weekly with clean water. Using a solution of baking soda and water (one pound of baking soda to one gallon of water), neutralize any acid which may be collected at cell or battery terminals to keep them free from corrosion.

Use the solution until all fizzing stops. Work the solution under the connectors. To remove all traces of soda solution and loose dirt, rinse the battery down with clear water from a low pressure hose. Whenever the battery top is being cleaned or rinsed, vent caps must be tightly in place.

CAUTION!
Vent caps must be tightly in place when the battery top is being cleaned or rinsed. Loose or open vent caps will allow contamination into the battery cell.

Excessive self-discharge correction

While a storage battery is in a charged state, a local electrochemical reaction takes place within the cells, which causes very gradual discharging. This reaction is known as self-discharge. A small amount is quite normal in mine power batteries where grids are made from antimonial lead. The rate of self-discharge is temperature-related and increases significantly as temperatures rise. Table 7 shows the relationship between temperature and loss of specific gravity. The normal rate at 77° F to 80° F is a loss in specific gravity of about one point (.001) per day. This becomes of concern only when a wet battery is to be stored for weeks at a time. It can be ignored as a factor in normal battery operation.

It is possible, however, particularly during the latter stages of a battery's life, for the rate of discharge to become much greater and even limit the battery's duty cycle. Excessive self-discharge may be caused by defective separators or plates which have become shorted at the edges. Edge shorting is usually caused by loss of positive active material which can fill the sediment well or build up on the top or sides of the plates and eventually bridge the space between the positives and negatives. If a shorted condition seems likely, the element should be pulled for examination and the defective separator replaced, shorts cleared, or cells replaced. Usually, if the sediment well is full, salvage is impractical.

Table 7: Temperature effect on battery self-discharge

Temperature (°F)	Loss of Specific Gravity per Day
120	0.004
100	0.003
80	0.001
50	0.0005

Test discharge

A capacity test is sometimes desirable to determine a battery's actual discharge capability as compared to its 6-hour rated capacity.

This can be a significant diagnostic tool when equipment does not operate as expected and it can help determine when the battery should be replaced. When a battery consistently delivers less than 80% of its rated ampere-hour capacity, either some cells are substandard or the battery has reached the end of its useful life and should be replaced.

A test discharge is performed by discharging a fully charged battery at a fixed rate under carefully controlled test conditions.

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 7: Set screws (Socket long-lok)

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

Table 8: Set screws (Socket standard steel)

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