Power

Alpha Lomain Ni-Cd Pocket Plate Battery Technical Manual

Effective: July 2009

Alpha Technologies

Power

Alpha Technologies

Alpha Lomain Ni-Cd Pocket Plate Battery Technical Manual

745-680-B10-001, Rev. A

Effective Date: July, 2009

member of The alpha Group™

NOTE:

Photographs contained in this manual are for illustrative purposes only. These photographs may not match your installation.

NOTE:

Operator is cautioned to review the drawings and illustrations contained in this manual before proceeding. If there are questions regarding the safe operation of this powering system, please contact Alpha Technologies or your nearest Alpha representative.

NOTE:

Alpha shall not be held liable for any damage or injury involving its enclosures, power supplies, generators, batteries, or other hardware if used or operated in any manner or subject to any condition not consistent with its intended purpose, or is installed or operated in an unapproved manner, or improperly maintained.

Contacting Alpha Technologies: *www.alpha.com*
or
For general product information and customer service (7 AM to 5 PM, Pacific Time), call
1-800-863-3930,

For complete technical support, call
1-800-863-3364
7 AM to 5 PM, Pacific Time or 24/7 emergency support

Table of Contents

Table of Contents

Figures and Tables

Safety Notes

Review the drawings and illustrations contained in this manual before proceeding. If there are any questions regarding the safe installation or operation of this product, contact Alpha Technologies or the nearest Alpha representative. Save this document for future reference.

To reduce the risk of injury or death, and to ensure the continued safe operation of this product, the following symbols have been placed throughout this manual. Where these symbols appear, use extra care and attention.

ATTENTION:

The use of ATTENTION indicates specific regulatory/code requirements that may affect the placement of equipment and /or installation procedures.

NOTE:

A NOTE provide additional information to help complete a specific task or procedure.

CAUTION!

The use of CAUTION indicates safety information intended to PREVENT DAMAGE to material or equipment.

WARNING!

WARNING presents safety information to PREVENT INJURY OR DEATH to the technician or user.

Battery Safety Precautions

WARNING!

Service personnel must always wear protective clothing (e.g., rubber gloves, safety goggles with side guards, or a face shield) when working with electrolyte and on cells / batteries.

- The battery pack, which provides backup power, contains dangerous voltages. Only qualified personnel should inspect, service or replace batteries.
- If batteries are being stored prior to installation, charge at least once every six (6) months to ensure optimum performance and maximum battery service life.
- Reduce the chance of spark and wear on the connectors; always switch the inverter's battery circuit breaker off before connecting or disconnecting the battery pack
- Always use proper lifting techniques whenever handling batteries.
- In the event of a short-circuit, batteries present a risk of electrical shock and burns from high current. Observe proper safety precautions. Always carry a supply of water, such as a water jug, to wash the eyes or skin in the event of exposure to battery electrolyte.
- The battery must be kept clean using only water. Do not use a wire brush or solvents of any kind.

NOTE:

Once the battery has been filled with the correct electrolyte at the factory there is no need to periodically check the electrolyte density

- Check regularly (appr. every year) that all connectors, nuts and screws are tightly fastened. All metal parts of the battery should be corrosion-protected by coating with a thin layer of anti-corrosion grease. Do not coat any plastic part of the battery, for example, the cell cases.
- Check the charging voltage. If a battery is parallel connected it is important that the recommended charging voltage remains unchanged. The charging current in the strings should also be checked to ensure it is equal. These checks has to be carried out once a year. High water consumption of the battery is usually caused by improper voltage setting of the charger.

Battery Safety Precautions, continued

- Check the electrolyte temperature from time to time. The temperature of the electrolyte should never exceed 45 °C as higher temperatures have a detrimental effect on the function and duration of the cells. In the course of charging an electrolyte temperature of ≤ 35 °C should be aimed for. On exceeding 45 °C the charging should be temporarily interrupted until the electrolyte temperature falls down to 35 °C. The temperature measurements are to be made on one of the cells in the middle of the battery. Low ambient or electrolyte temperatures down to –25 °C do not have any detrimental effect on the battery they just cause a temporary reduction in capacity.
- NiCd batteries must not be stored in the same room as lead acid batteries. Also, the charging gases from lead acid batteries must be kept away from Ni-Cd batteries by suitable precautions such as ventilation or hermetic isolation of the rooms. Tools for lead acid batteries must not be used for NiCd batteries
- Do not place electrically conductive objects (e.g., tools) on the battery as this is a short circuit and fire hazard.
- Do not wear rings, metal bracelets, watches, or jewelry when working with the batteries and battery systems.
- Provide sufficient ventilation (e.g., open the doors of the battery cabinet) during charging so any accumulated gases can escape. The charging gases from batteries are explosive.
- Do not allow open fire or ember in the vicinity of the battery.
- Caustic potash solution is used as electrolyte, and is a highly corrosive liquid which can cause severe damage to health if it comes into contact with the eyes or the skin (risk of blinding). If even small quantities are swallowed there is a possibility of internal injuries.
- Contact with the eyes: Flush out immediately with copious amounts of water for 10 to 15 minutes, and seek immediate medical attention.
- Contact with the skin: Remove splashed clothing immediately and wash the affected skin areas with copious amounts of water, and seek immediate medical attention.
- Swallowing: Rinse out the mouth immediately with large amounts of water and keep drinking large amounts of water. Do not induce vomiting, and seek immediate medical attention.

1.0 Introduction

The Alpha Lomain Ni-Cd pocket plate battery is one of the most reliable batteries available and is well-suited for operation under extreme environmental conditions. Features of the Alpha Lomain Ni-Cd pocket plate battery include the following:

- Very good high power rating.
- Low internal resistance.
- Reduced loss of capacity at deep temperature.
- No ice formation at temperatures below 0 °C.
- Long lifetime at high temperatures.
- Resistant to the affects of repeated deep discharges.
- Long shelf life.
- No electrolyte stratification.
- Robust construction makes the battery well-suited for use in extreme conditions.

1.0 Introduction, continued

1	Low-pressure, flame-arresting vent; prevents carbonate formation.
2	Safety terminal; Redundant leak protection minimizes carbonate formation.
3	Electrode Edge; connected to pole bolt via hardware for high mechanical stability
4	Horizontal pockets; formed by perforated steel strips containing the active material.
5	Electrode frame; Comprised of electrode edge and side bars. Seals the plates and serves as a current collector
6	Fiber mat separator; special separator insulates the plates and improves the internal recombination.

Fig. 1, Design of a Alpha Lomain Ni-Cd pocket plate cell

1.1 Theory of Operation

A standard Ni-Cd flooded battery type needs to be topped up with distilled water after a certain period of time depending on charging regime and operating temperature. The loss of water during overcharge is caused by the following chemical reaction:

At the positive plate $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$ -Oxygen Evolution

At the negative plate $4H_2O + 4e^- \rightarrow 2H_2 + 4OH^-$ -Hydrogen Evolution

In theory, the quantity of water used according to Faraday's equation is that each ampere hour of overcharge breaks down 0.336 cm^3 of water. While charging a Ni-Cd battery oxygen evolution occurs just before the positive plate reaches its fully state of charge and reaches its peak if it becomes fully charged. Since the negative plate provides a much better charge acceptance than the positive plate hydrogen is not evolved until it has reached its fully-charged state.

In order to reduce the water consumption Alpha Lomain-concept has been developed based on four distinctive key features:

- Plate design
- Seperation system
- Venting system
- Cell design

Special plate design

Alpha Lomain batteries have been designed with an excess of negative material (cadmium) to ensure that oxygen evolution occurs prior to hydrogen evolution to enhance the above mentioned effect.

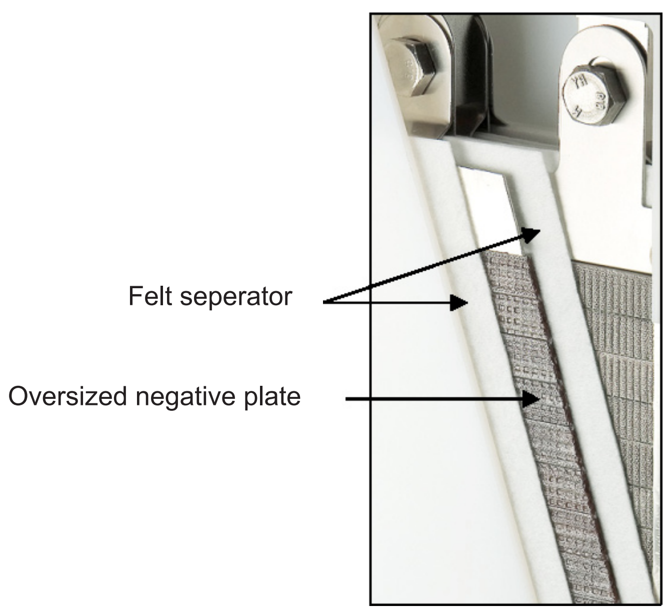


Fig. 2, Detail of plate design

1.1 Theory of Operation, continued

Special seperation system

The oxygen created at the positive plate is absorbed by a special felt seperator and prevented to escape from the distance between the plates. Displacement of electrolyte by oxygen boubles occur within the seperator and reach the surface of the negative plate causing the following reaction:

Chemically:

$2Cd + O_2 + 2H_2O \rightarrow 2Cd(OH)_2$

This reaction chemically discharges a certain amount of cadmium to cadmium hydroxide. The current going through the battery recharges this material.

Electrochemically:

$O_2 + 2H_2O + 4e \rightarrow 4OH$

This reaction consumes the current directly; that is, hydrogen evolution at the negative plate is prevented since the preferred reaction is oxygen recombination.

Special venting system

The battery cells are equipped with a low pressure flame arresting vent which operates as a one way valve and allows to escape hydrogen and non-recombined oxygen and fixes the internal pressure at 0.2 bar.

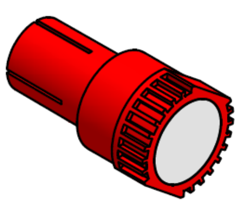


Fig. 3, Battery Vent

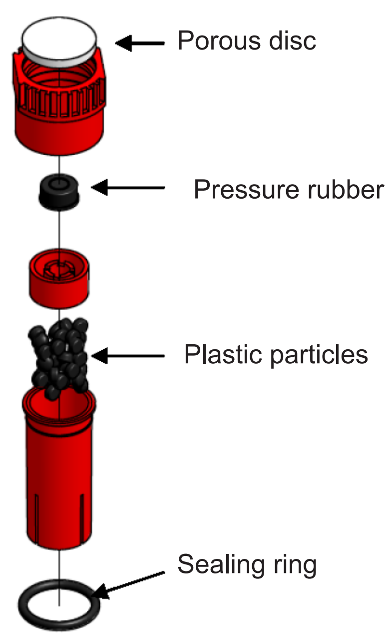


Fig. 4, Exploded view, Battery vent

1.1 Theory of Operation, continued

Single cell design

Due to the pressure inside of the battery cell, which is needed to reach a high recombination level, a sturdy cell design is necessary to prevent leakage. The cells of the Lomain battery are injection-molded from a single piece of plastic to prevent leakage of the cell casing and the seams (welded or glued) of the cell cases and the lids are above the electrolyte level. The single cell design completely eliminates the risk of faulty welded seams on the sides and on the bottom of the cell cases. This design enhances system economy as it enables the service personnel to replace only the defective cell(s).

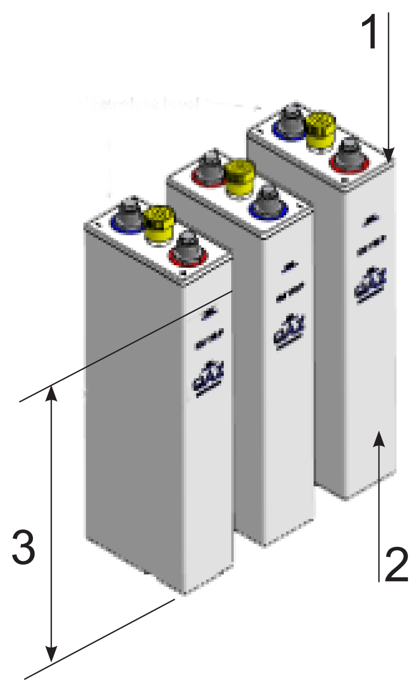


Fig. 5, Smaller Capacity Batteries

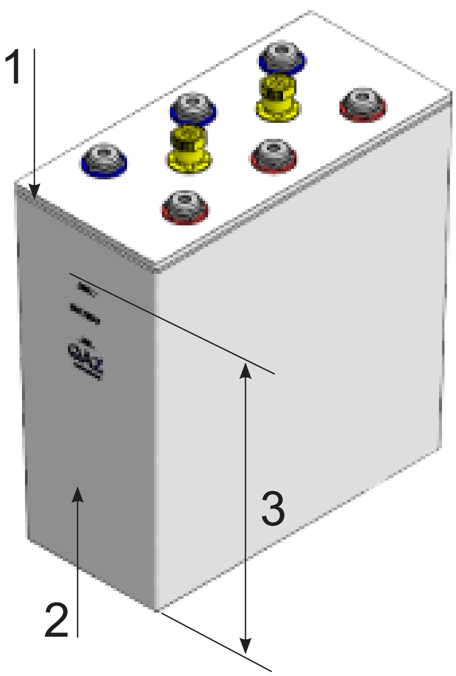


Fig. 6, Larger Capacity Batteries

1 Sealed seams (glued or welded above Electrolyte level)

2 One piece case

3 Electrolyte level

1.2 Safety terminal

Tha Alpha Lomain battery features a specially developed terminal design with a redundant leak protection to prevent electrolyte leakage. The battery terminals may be either male of female threaded, depending upon the type and range of the battery. In either case, the polarity of the terminals will be clearly indicated (color-coded).

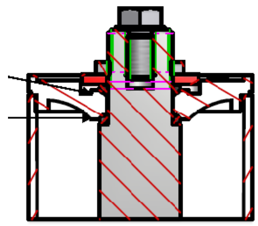


Fig. 7, Terminal cross section

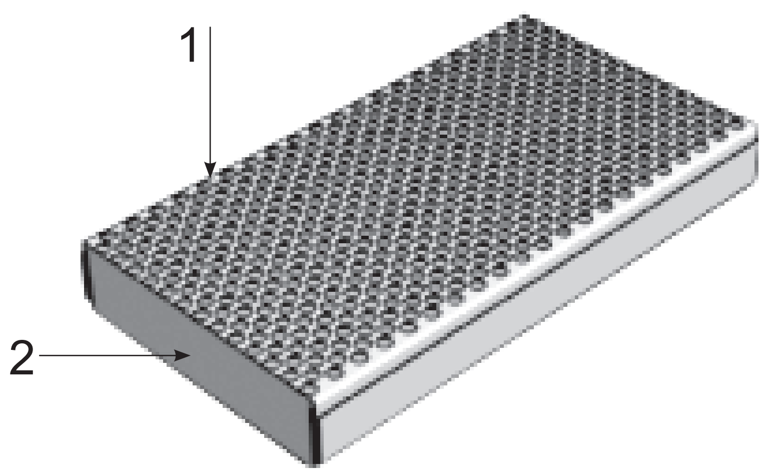
1.3 Electrode Frame

The electrode frame consists of a right and a left side bar as well as the electrode edge which are connected by welding, giving shape to the electrode frame. The electrode frame operates as a current collector and also seals the electrode plates. This procedure leads to an electrode design with high mechanical robustness but also ensures a reliable service for the complete lifetime of the battery.

1.4 Positive and negative electrode plate

The nickel-cadmium cell is composed of the positive plates containing nickel hydroxide and the negative plates containing cadmium hydroxide.

Individual pockets are formed from a nickel plated and perforated steel tape (pocket tape) and house strips of the active material.



1 Pocket tape

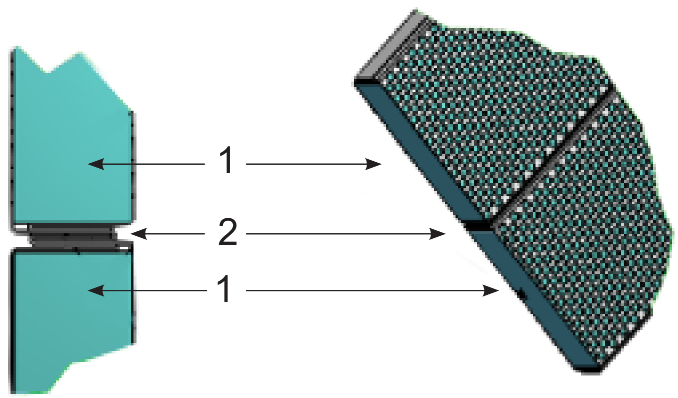
2 Active material

Fig. 8, Electrode Strip

1.4 Positive and negative electrode plate, continued

The electrode strips are mechanically linked together to form the electrode plate and are consecutively cut to the appropriate width based on the cell type and range. The plates then are welded or mechanically linked to the plate frame (see Fig. 8) to form the electrodes, then assembled to the plate block.

The extemely long useful lifetime and the very good cycle life features of the Ni-Cd pocket plate batteries are a direct result of the special plate designs whose structural components are made of steel.



1 Electrode Strips

2 Mechanical Linkage

Fig. 9, Strips connected

This prevents the gradual deterioration by corrosion. Because the alkaline electrolyte does not react with steel, the substructure of the battery remains intact for the total lifetime of the battery. The integrity of the substructure is maintained by surrounding the electrochemical active mass in perforated nickel-steel pockets, reducing the risk of shedding or penetration of material as well as the risk of structural damage. Also, this design allows for the control of soft short circuits.

1.5 Electrolyte

The electrolyte used in the Ni-Cd batteries is a solution of potassium hydroxide and lithium hydroxide that is optimized to give the best combination of performance, energy efficiency and a wide temperature range of use.

It is an important property of the battery, and indeed all nickel-cadmium batteries, that the electrolyte does not change during charge and discharge. It retains its ability to transfer ions between the cell plates, irrespective of the charge level.

In most applications the electrolyte will retain its effectiveness for the life of the battery and will never need replacing. However, under certain conditions, such as extended use in high temperature situations, the electrolyte can become carbonated. If this occurs the battery performance can be improved by replacing the electrolyte (see ·Maintenance and Handling Instructions“).

2.0 Battery range and applications

LOMAIN KGL...P	The Alpha Lomain cell type is used for low rates of discharge over long periods where the current is relatively low in comparison with the total stored energy. The discharges can generally be infrequent and the recommend discharge time for the KGL...P range is 1 hour to 100 hours.

LOMAIN KGM...P	The KGM...P type battery is designed for "mixed loads" that include a mixture of high and low rates of discharge. It is used for frequent and infrequent discharges and the recommended discharge time is 30 to 120 minutes.

3.0 Electrochemistry of Ni-Cd batteries

Oxidation of cadmium at the negative electrode

$$Cd \longrightarrow Cd^{2+} + 2e^{-}$$

Reduction of trivalent nickel ions to bivalent at the positive electrode

$$Ni^{3+} + e^{-} \longrightarrow Ni^{2+}$$

During charging the both reactions are reversed.

The complete reaction is: indicated below:

Negative electrode:

$$Cd + 2\,OH^{-} \longleftrightarrow Cd(OH)_2 + 2e^{-}$$

Positive electrode

$$2NiOOH + 2\,H_2O + 2e^{-} \longleftrightarrow Cd(OH)_2 + 2e^{-}$$

Cell reaction

$$2NiOOH + Cd + 2\,H_2O \longleftrightarrow 2Ni(OH)_2 + Cd(OH)_2$$

4.0 Operating Features

4.1 Capacity

The capacity of Nickel-Cadmium batteries is rated in ampere-hours (Ah) and is the quantity of electricity at +20 °C (± 5 °C) available for a 5 hour discharge after being fully charged for 15 hours at 0.2C5. These figures and procedures are based on the IEC 62259 standard.

According to IEC 62259, 0.2C5A is also expressed as 0.2 ItA. The reference test current It is expressed as:

ItA= Cn Ah 1h

Cn is the rated capacity declared by the manufacturer in ampere-hours (Ah) n is the time based in hours (h) for which the rated capacity is declared

4.2 Cell voltage

The cell voltage of a Ni-Cd cell is the result of the electrochemical potentials of the Nickel and the Cadmium active materials in the Potassium hydroxide electrolyte. Therefore, the nominal voltage for this electrochemical couple is 1.2 V. From the electrochemistry of the reaction given above, the free voltage of 1.3 V is given for the Ni-Cd cell. This voltage is also observed directly after charging of the cell.

4.3 Internal resistance

The internal resistance of a Ni-Cd cell is dependant upon several factors, e.g., battery temperature, state of discharge (whether high or low), cell type and size. The internal resistance also depends on the cell type and size as well; it increases for lower state of charge. Apart from this the internal resistance of a fully discharged cell no carries weight. Reducing the temperature also increases the internal resistance. Contact your local representative for specific information regarding conditions that may affect the battery.

4.4 Impact of temperature on cell performance and available capacity

When sizing and choosing a battery the variations in ambient temperature and their influence on the cell performance have to be taken into consideration. Low ambient temperature conditions reduce the cell performance. However, operations with higher temperatures are similar to those at normal temperatures. Lomain next generation batteries offer improved values especially at high temperature applications. The effects of low-temperature operation increase with higher rates of discharge.

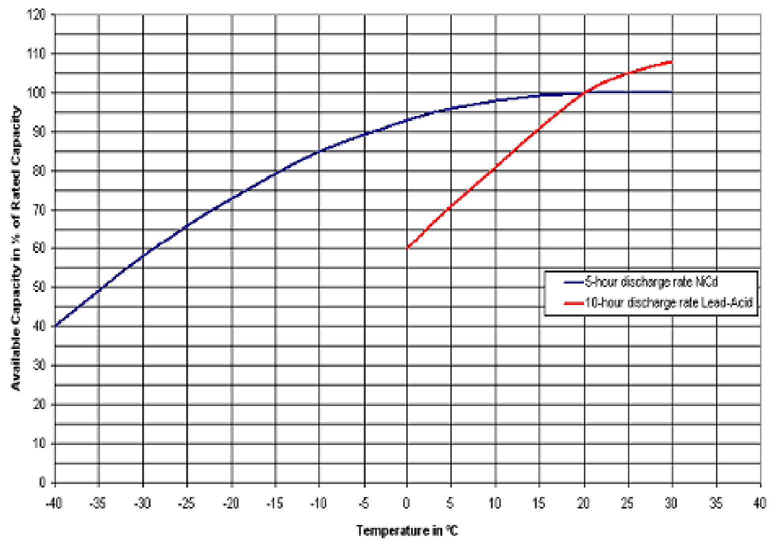


Fig. 10, NiCd vs. Lead-Acid performance as a function of temperature

The values, which have to be taken into account, can be found in the following graph.

Lomain next generation batteries passed a long term temperature test at constant +50°C surrounding temperature followed by a discharge test out of the float mode as indicated on the chart below.

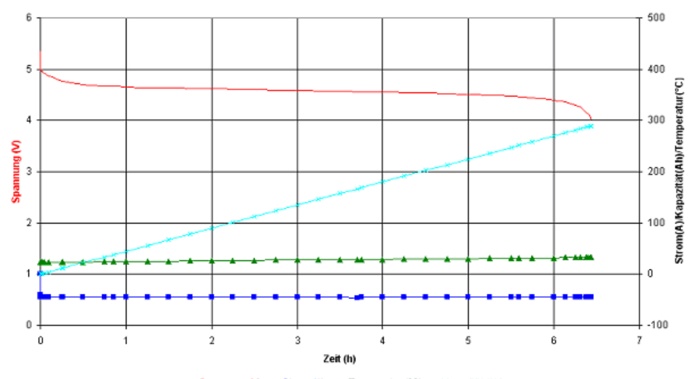


Fig. 11, Discharge curve of 45A x 4 KGL225P post-2224h Float Charge @ +50°C

4.5 Impact of temperature on lifetime

Operating battery systems at higher temperatures reduces the service life. The Alpha Lomain Ni-Cd battery is designed to be less susceptible to the affects of higher temperatures than lead-acid batteries as shown by the following graph.

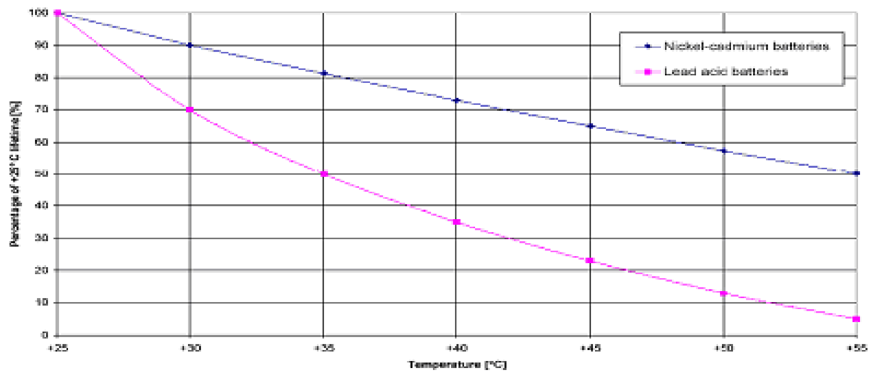


Fig. 12, Battery life at higher temperatures as percentage of +25°C lifetime

For standard Ni-Cd batteries the normal operating temperature is based at + 20 °C (± 5 °C) and, therefore, special considerations have to be taken into account when specifying a Ni-Cd battery for high temperature applications.

4.6 Short-circuit values

The short-circuit values of a Alpha Lomain Ni-Cd pocket plate battery are unique to each cell range. Contact your dealer for specific information.

4.7 Open circuit loss

The state of charge of a cell on open circuit slowly decreases due to its self-discharge.

This decrease is quite rapid during the first two weeks and then stabilizes at about 2% per month at +20°C.

In general the self-discharge of a Ni-Cd battery is affected by various temperatures. The open circuit loss is reduced at low temperatures; that is, the self-discharge is significantly increased at higher temperatures.

4.8 Cycling

The Alpha Lomain Ni-Cd battery is designed to perform a significant number of charge-discharge cycles in stationary standby operations.

The determining factor for the number of charge-discharge cycles the battery is able to provide is the depth of discharge.

A battery that is less deeply discharged will provide more charge-discharge cycles until it reaches the point at which it can no longer provide the minimum design limit.

Conversely, a battery that has been more deeply discharged will have a shorter charge-discharge cycle life.

The graph below illustrates typical values for the effect of depth of discharge on the available charge-discharge cycle life.

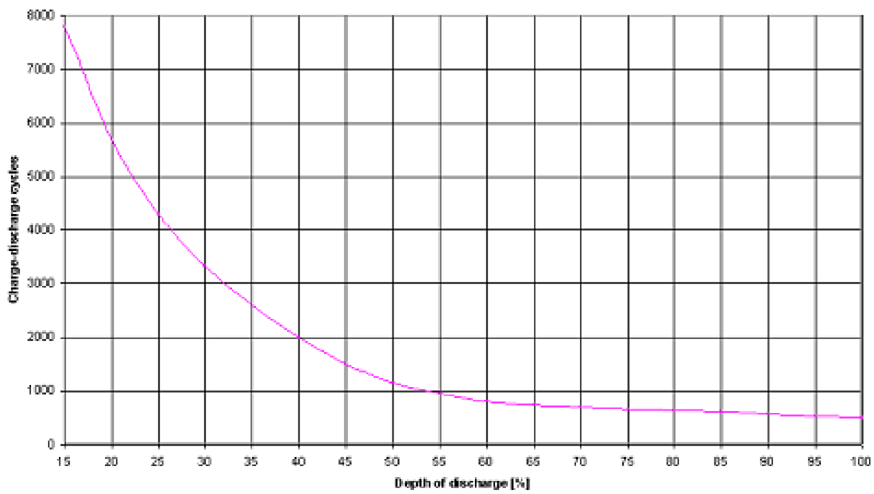


Fig. 13, Cycle life vs. depth of discharge as a percentage of rated capacity (20°C)

4.9 Topping up interval

At the final stage of the charging procedure of a Ni-Cd battery the provided electrical energy cannot be fully absorbed but is absolutely necessary to reach the fully charged state of the cells. The difference between absorbed and provided energy leads to a break down of the electrolyte's water content into oxygen and hydrogen (electrolysis). This loss has to be compensated by topping up the cells with pure distilled water.

The water loss depends on the current used for overcharging. A battery on standby operation will consume less water than a battery that is cycled constantly, (e.g., a battery which is discharged and recharged on a regular basis).

In theory, the quantity of water used can be found by Faraday's equation that each ampere hour of overcharge breaks down 0.336 cm^3 of water. Depending upon the operating temperature of the battery and the charging conditions, the Alpha Lomain battery has a recombination rate of 90%.

Calculation of topping up interval for KGL 1390:

A cell (KGL 1390P) is floated at 1.41 V/cell

The electrolyte reserve for this cell is approx. 8730 cm^3

A standard cell at 1.41 V/cell will use approx. 0.025 cm^3/month for 1Ah of capacity

When the KGL 1390P reaches a 90% recombination rate which means the use will only be 0.025 cm^3/month for 1 Ah of capacity

Therefore, a KGL 1390P battery will use 0.025 x 1390 = 34.75 cm^3 per month and the electrolyte reserve will be used in 8730/34.75 (approx. 251 months)

Or, approximately 21 years at 20°C

5.0 Sizing method for standby applications

The Lomain Ni-Cd pocket-plate batteries used for standby floating applications are sized according to the international sizing method IEEE 1115. A special battery sizing calculation program (available at www.url here.com) that allows sizing calculations to be made allowing for multiple discharges, and factors such as temperature de-rating and aging.

A significant feature and advantage of the Ni-Cd battery in comparison to the lead acid battery is that it can be fully discharged without any reduction in the lifetime or recharge of the battery. This feature enables the battery to operate for longer periods between charges.

The most important sizing parameters are:

5.1 Voltage window

This is the minimum and maximum voltage acceptable for the system. The maximum voltage provides the voltage that is available to charge the battery, whereas, the minimum voltage gives the lowest voltage acceptable to the system to that the battery can be discharged.

5.2 Load profile

The load profile is the electrical performance required by the system from the battery for the particular application. It can be expressed in terms of amperes for certain duration or in watts for certain duration. The requirements might vary for example from just one discharge to multiple discharge of a complex nature. In order to calculate the appropriated battery size please take into consideration point 5.1 voltage window.

5.3 Ambient temperature

The ambient temperature will have in any case an influence on the sizing of the battery (see Section 4.4, "*Impact of temperature on cell performance available Capacity"* and Section 4.5 "*Impact of temperature on lifetime"*).

5.4 Recharge time and state of charge

Some application might require a full discharge cycle of the battery after a certain time after the previous discharge. The factors to be taken into account depend on the depth of discharge, the rate of discharge as well as the charging conditions.

5.5 Aging

It might be required that a value has to be added to ensure the correct service of the battery during the lifetime. The value to be used depends on the discharge rate of the battery and on the conditions under which is carried out. Our experts or partners are able to help you chosing the right battery for your special requirements.

5.6 Floating effect -Voltage depression

When a Ni-Cd battery operates at a fixed floating voltage over a certain period of time, a decrease of the voltage level of the discharge curve occurs. It begins after one week and reaches its peak in approximately 3 months. Since this effect reduces the voltage level of the battery it can be considered as reducing the performance and autonomy of the battery. Therefore, it is necessary to take this effect into consideration when sizing a Lomain Ni-Cd battery. The calculation program allows this factor to be included into the customers´calculation. The floating effect is a reversible effect and can only be eliminated by a full discharge/charge cycle. Please note that it cannot be prevented by just a boost charge. The battery sizing program provides the option to calculate with and without this floating effect so that the customer is able to see the added values. Our recommendation is always to include this factor when sizing a battery.

6.0 Charging

The Lomain Ni-Cd battery can generally be charged by all normal methods. Usually, batteries in parallel operation with charger and load are charged with constant voltage. For operations where the battery is charged separately from the load, charging with constant current is possible. Overcharging will not damage the battery but will lead to an increase of water consumption.

6.1 Constant voltage charge

The common method to charge a battery in stationary applications is carried out by a constant voltage system and the recommended solution is to use a two-rate type that is able to provide a constant voltage charge and a lower floating voltage or single rate floating voltage. The two level charger has an high voltage stage to charge the battery properly after a discharge followed by a lower voltage float level charge. This results in a quick charge of the battery and in relatively low water consumption due to the low level float charge.

Two level charge

Boost charge: 1.45 Floating 1.40 – 1.42 V/cell

A high voltage will increase the speed and efficiency of recharging the battery.

In reality often single level charger can be found. This is surely a compromise between a voltage high enough to charge the battery and low enough to have adequate water consumption.

Single level charge

1.43 – 1.45 V/cell

For commisioning the batteries, please see Section 7.0, *“Commissioning”.*

6.2 Charge acceptance

Lomain next generation batteries offer improved charging acceptance even in high temperature applications.

Available 5-hour-capacity of 5 x KGL 665P after 15 room hours charging at 1.43 V/pc at 30°C room temperature temperature.

Fig. 14, Available 5-hour-capacity of 5 x KGM 140P after 15 hours charging at 1.43 V/pc at 30°C

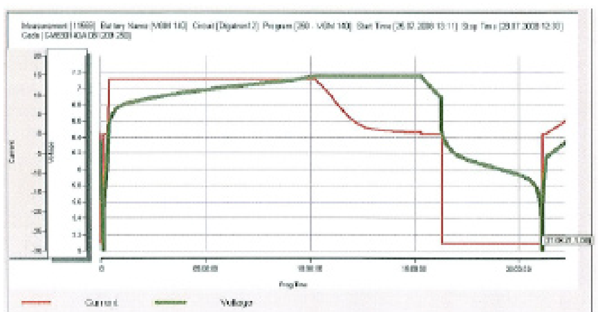


Fig. 15, Total Discharge time 4:43h = 94% of nominal capacity

Fig. 16, Available 5-hour-capacity of 5 x KGL 665P after 15 hours charging at 1.43 V/pc at 30°C

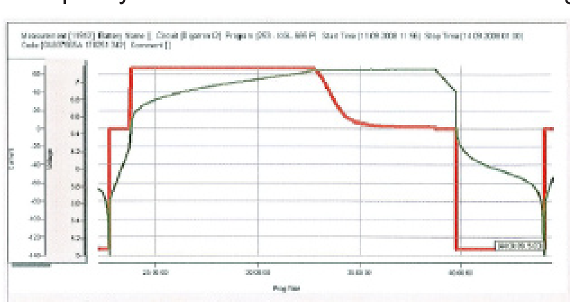


Fig. 17, Total Discharge time 4:15h = 85% of nominal capacity

6.3 Charge efficiency

The charge efficiency depends mostly on the state of charge of the battery and the ambient temperature as well as the charging current. For much of its charge profile the Ni-Cd battery is charged at a high level of efficiency. As the battery approaches a fully charged condition, the charging efficiency decreases.

6.4 Temperature influence

The electrochemical behavior of the battery becomes more active if temperature increases, i.e. for the same floating voltage the current increases. If the temperature decreases the reverse occurs. Increasing the current increases the consumption of water and reducing the current could lead to an insufficient charging.

For standby application it is normally not necessary to compensate the charging voltage with the temperature. In order to reduce the water consumption it is recommended to compensate it at elevated temperature as for example from + 35 °C on by use of the negative temperature coefficient of −3mV/K and cell.

For operation at low temperatures, i.e. below 0 °C, there is a risk of poor charging and it is recommended to adjust the charging voltage or to compensate the charging with the temperature (-3 mV/K, starting from an ambient temperature of + 20 °C).

Example:

A 110 V battery consisting of 90 cells is charged at + 20°C with a 1.41 V/cell float modus making a total float voltage of 127 V/battery. The same battery will be charged with just 121.6 V/battery at + 40°C and with 132.4V/battery at 0°C.

7.0 Commissioning

The following instructions are valid for commissioning while 20 °C till 30 °C. For different conditions please contact manufacturer. Charge at constant current is preferable. If a site test is requested it has to be carried out in accordance with to IEC 62259.

According to IEC 62259, 0.1C5A is also expressed as 0.1 ItA. The reference test current It is expressed as: ItA= Cn Ah 1h

Example:

ItA means:

10 A for a 100 Ah battery

50 A for a 500 Ah battery

7.1 Commissioning with constant current

Lomain cells stored up to 6 months:

A commissioning charge is normally not required and the cells are ready for service. If full performance is necessary immediately, a commissioning charge of 10 hours at 0.1 It A is recommended.

During the charge the temperature should be observed see Section 5.3, *“Ambient temperature”.*

Lomain cells stored more than 6 months and up to 1 year:

A commissioning charge of 15 hours at 0.1 It A is necessary.

During the charge the temperature should be observed see Section 5.3, *“Ambient temperature”.*

7.2 Commissioning with constant voltage

If the charger´s maximum voltage setting is to low to supply constant current charging divide the battery into two parts to be charged individually.

Lomain cells stored up to 6 months:

A commissioning charge is normally not required and the cells are ready for service. If full performance is necessary immediately, a commissioning charge of 20 hours at 1,65 V/ cell with current limited to 0.1 It A is recommended.

During the charge the temperature should be observed see Section 5.3, *“Ambient temperature”.*

Lomain cells stored more than 6 months and up to 1 year:

A commissioning charge of 30 hours at 1.65 V/cell with current limited to 0.1 ItA is necessary.

During the charge the temperature should be observed see Section 5.3, *“Ambient temperature”.*

8.0 Charging in operation

Do not open or remove the low pressure vent caps during operation. The current limit should be 0.1 It A maximum in general. Recommended charging voltages for ambient temperatures + 20°C to + 25°C are:

8.1. Two level charge

Float level: 1.40 – 1.42 V/cell

High level: 1.45 V/cell

8.2. Single level charge

1.40 – 1,42 V/cell

For temperatures higher than +25 °C, the correcting factor for charge voltage is –3 mV/K.

9.0 Periodic Maintenance

Alpha Lomain are extreme low maintenance batteries and requrire a minimum of maintenance. The following is recommended:

The battery must be kept clean using only water. Do not use a wire brush or solvents of any kind.

Check regularly (appr. every year) that all connectors, nuts and screws are tightly fastened. All metal parts of the battery should be corrosion-protected by coating with a thin layer of anti-corrosion grease. ***Do not coat any plastic part of the battery, (e.g., the cell cases).***

Check the charging voltage. If a battery is parallel connected it is important that the recommended charging voltage remains unchanged. The charging current in the strings should also be checked to ensure it is equal. These checks has to be carried out once a year. High water consumption of the battery is usually caused by improper voltage setting of the charger.

Check the electrolyte temperature from time to time. The temperature of the electrolyte should never exceed 45 °C as higher temperatures have a detrimental effect on the function and duration of the cells. In the course of charging an electrolyte temperature of ≤ 35 °C should be aimed for. On exceeding 45 °C the charging should be temporarily interrupted until the electrolyte temperature falls down to 35 °C. The temperature measurements are to be made on one of the cells in the middle of the battery. Low ambient or electrolyte temperatures down to –25 °C do not have any detrimental effect on the battery they just cause a temporary reduction in capacity.

Power

Alpha Technologies

Alpha Technologies
3767 Alpha Way
Bellingham, WA 98226
USA
Tel: +1 360 647 2360
Fax: +1 360 671 4936
Web: www.alpha.com

Alpha Technologies Ltd.
4084 McConnell Court
Burnaby, BC, V5A 3N7
CANADA
Tel: +1 604 430 1476
Fax: +1 604 430 8908

Alpha Technologies
Europe Ltd.
Twyford House Thorley
Bishop's Stortford
Hertfordshire CM22 7PA
UNITED KINGDOM
Tel: +44 0 1279 501110
Fax: +44 1 279 659870

Alpha Technologies GmbH
Hansastrasse 8
D 91126 Schwabach
GERMANY
Tel: +49 9122 79889 0
Fax: +49 9122 79889 21

Alphatec, Ltd
339 St. Andrews Street
Suite 101 Andrea Chambers
3307 Limassol
CYPRUS
Tel: +357 25 375675
Fax: +357 25 359595

AlphaTEK ooo
Khokhlovskiy Pereulok 16
Stroenie 1 Office 403
109028 Moscow
RUSSIA
Tel: +7 495 916 1854
Fax: +7 495 916 1349

Alphatec Baltic
S. Konarskio Street G.49-201
Vilnius LT-03123
LITHUANIA
Tel: +370 5 210 5291
Fax: +370 5 210 5292

Alpha Technologies
34, Grande Rue
Bétheny, F-51450
France
Phone: +33 32 64990 54
Fax: +33 67 54289 44