ALCAD

STANDBY BATTERIES

Installation and Operation Manual for Nickel Cadmium Batteries

Contents

1 Safety Precautions

Warning – read before installation

The use of alkaline batteries is not hazardous provided strict precautions are taken.

The British Standards Institution publish a code of practice for the safe operation of alkaline secondary batteries BS6132:1983 which should be implemented in conjunction with the following recommended precautions.

DO

- ☐ Keep the batteries upright.
- ☐ Wear goggles when removing transit stoppers.
- ☐ Use tools with insulated handles.
- ☐ Wear protective clothing when handling electrolyte.
- ☐ Remember that the battery electrolyte is corrosive and toxic.

DON'T

- ☐ Smoke or permit naked flames near the battery.
- ☐ Spill electrolyte on skin or clothing.
- ☐ Allow metal objects to rest on battery or fall across terminals.
- ☐ Wear nylon coats or overalls as they can create static electricity.

In the event of an accident

Wash skin burns with copious amounts of clean water then cover immediately with dry gauze.

For the eyes wash out with copious amounts of clean water followed by a wash of saline solution (prepared from two level tablespoons of salt dissolved in one pint of purified water). This should be available wherever electrolyte is handled.

In all cases obtain immediate medical attention.

2 Batteries on Arrival

2.1 Unpacking and Inspection

Open the cases and check for any indication of damage in transit.

Remove the cells and any accessories from the packaging.

Check that contents are correct to order and inspect for any damage in transit.

Damage must be reported immediately to the Carrier, and the Company or its Agent.

2.2 Storage

If batteries are not put into service immediately they should be stored in a clean, dry, cool and well ventilated store on open shelves. Plastic cells should not be exposed to direct sunlight.

Before storage ensure that:

(a) Cells are kept clean with adequate protective finish such as Komoline on glands and connectors and on steel cell tops.

(b) Electrolyte in cells is 10 mm below the specified maximum level.

(c) Vents are correctly seated and vent plugs firmly in position. KEEP TRANSIT PLUGS INSERTED.

NOTE: IF EXCESSIVE LOSS OF ELECTROLYTE IN TRANSIT IS FOUND IN CELLS SUPPLIED DISCHARGED AND FILLED, THE CELLS MUST BE CORRECTLY FILLED BEFORE STORAGE BY FOLLOWING PROCEDURE IN SECTION 2.3.

If storage in the delivery cases is necessary, then the tops of the cases must be removed. If storage in stacked delivery cases is necessary, then strong battens should be placed across the open top of each case in the stack. The battens should run transverse to the feet on the cases, but locate on the solid feet at the corners to give adequate ventilation.

Cells 'filled and discharged' or 'filled and partially charged' can be stored for up to a maximum of one year. The cells should be sealed with the firmly fitting transit vent plugs supplied with the cells. Check the plugs upon receipt. If for unavoidable reasons cells have to be stored for more than one year they must be given a maintenance cycle as follows. Remove plugs from cells, charge to 200% of capacity at an available rate (C/5 for 10 hours or C/10 for 20 hours) and then discharge at the same rate to 1.1 Volts per cell. Replace plugs firmly and return the cells/batteries to store. Repeat every 12 months. For batteries stored for more than 12 months, at least two charge/discharge cycles as above are recommended before putting into service.

Cells discharged and empty can be stored for an indefinite period. It is important that they are sealed with the firmly fitting transit vent plugs supplied with the cells and these should be checked periodically during storage.

All cells after storage must be prepared for service and fully commissioned (see Section 4).

2.3 Preparation for Service

Before starting preparation, read and implement the Safety Instructions.

Cells Delivered or Stored

(a) **Filled and Discharged**
or
Filled and Partially Charged
Cells delivered 'Filled and Discharged' are fitted with a black plastic transit plug or black rubber stopper. Cells which are 'Filled and Partially Charged' are either fitted with a white plastic transit plug or black rubber stopper.

Check cells are externally clean with adequate protective finish on glands, poles and connectors and on steel cell tops.

Carefully loosen the plastic transit plugs in the flip top vent or the rubber stopper in the screw-in vent to release any gas pressure or partial vacuum in the cells and then remove them completely. Retain them against possible later re-use such as further transit or return to storage. Leave the flip-top vent caps open. Remove and retain screw-in vents.

For plastic cells, visually check that electrolyte levels in the opened cells are 10 mm below the MAX level on the container.

For steel cells check electrolyte levels in the opened cells using the plastic level testing tube. The correct electrolyte level above plates is 10 mm less than the value given in Section 7.

Adjust by careful addition of approved distilled or demineralised water if necessary.

If there has been excessive loss of electrolyte, e.g. electrolyte levels more than 20 mm below the MAX level, prepare sufficient new electrolyte and carefully fill the cells to 10 mm below to the displayed or required MAX level by following procedure in Section 2.3 for preparation for service of discharged and empty cells.

Wipe up any small spillage on cells using a clean cloth and re-check electrolyte levels. Close the flip-top vent caps or re-fit the screw-in plastic vents to complete preparation for service.

(b) **Discharged and Empty**
Cells delivered discharged and empty are fitted with a red plastic transit plug or a black rubber stopper.

Assemble cells to be prepared for service. Check they are externally clean with adequate protective finish (Komoline) on glands, poles and connectors and on steel cell tops.

Identify and calculate the electrolyte type and quantity required to fill the assembled cells from the Cell Data tables. Do not remove cell vent plugs or vents at this stage.

Prepare new electrolyte to requirement from solid electrolyte or liquid electrolyte as supplied. Full mixing instructions are supplied on containers. Ensure that only demineralised or pure distilled water is used.

Carefully loosen the plastic transit plugs in the flip-top vent or the rubber stopper in the screw-in vent of the assembled cells to release any gas pressure or partial vacuum and then remove them completely. Retain against possible later re-use, such as further transit of cells or their return to storage.

Leave the flip-top vent caps open or remove and retain the screw-in vents.

Carefully first fill the assembled cells using plastic jug and funnel to a level 15-20 mm below the displayed or required MAX level. Check the level in steel cells using the plastic level testing tube. Allow the cells to stand for 24 hours. For large installations the Acfil pump is recommended.

After the 24 hour stand, carefully complete filling the cell with electrolyte to 10 mm below the displayed or required MAX level, (check the level in steel cells using the plastic level testing tube).

Wipe up any small spillage on cells using a clean cloth. Close the flip-top vent caps or re-fit the screw-in plastic vent to complete preparation for service.

3 Installation

3.1 Battery Room

Normal building materials are suitable for the walls of rooms housing ALCAD batteries since the gasses given off are not corrosive. The room should be provided with good lighting and kept in a clean and dry condition at all times. Electrical fittings may have to be of flame proof design. Temperature level is to be as stable as possible and while ALCAD batteries are tolerant of extremes of temperature it is preferable to operate within the range of 15°C to 25°C to optimise efficiency. Avoid direct sunlight and heat on cells.

Display WARNING NOTICES and SAFETY PRECAUTIONS.

Ventilation

During recharge the hydrogen and oxygen evolved from a battery can form an explosive mixture and for this reason ventilation must be provided to keep the hydrogen content to a very low value. Air bricks or grilles to take away any gas mixture should be placed as high as possible in the room since hydrogen is less dense than air. Sometimes batteries mounted in very confined spaces may need to be force ventilated. Where forced ventilation is necessary to obtain the required air changes, the air should be drawn in from a high location in the room. If it is necessary to draw air out, then a flameproof fan must be used.

A typical figure for natural room ventilation is about 2.5 air changes per hour and it is satisfactory under such conditions to install 20 watt hours of battery capacity per cubic foot if the final charge current is C/10. When batteries are housed in cubicles they should have adequate ventilation. The cubicle must be installed in a room which is ventilated to give the requisite air changes. Batteries which are floated or low rate charged will have a low rate of gas emission.

The following formula should be used for calculations:

$$\text{Air changes required per hour} = \frac{1.47 \times \text{Final Charge (amps)} \times \text{No. of Cells}}{\text{Room air volume in cubic feet.}}$$

The above is for a mean hydrogen concentration of 1%.

All data is based on maximum gas evolution, although this only occurs at end of charge or on overcharge. When calculating air changes in confined spaces it will be necessary to deduct the battery volume and that of other apparatus.

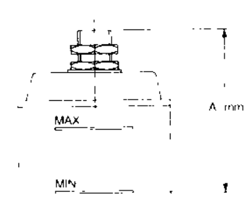
3.2 Cubicles

When the battery is housed in a cubicle or enclosed compartment it is essential to provide adequate ventilation at the top and bottom to disperse gasses given off during charge and also to minimise condensation. Display prominently a battery installation warning label.
Allow at least 200 mm space over tops of cells to ensure easy access during topping up.

When mounting plastic cased cells on step stands or shelves ensure electrolyte level markings are visible. Table below gives dimensions.

HEIGHT FROM TOP OF TERMINALS TO MINIMUM ELECTROLYTE LEVEL.

Cell type	"A"	Cell type	"A"
LP11-LP65	82	HP10-HP50	94
LP80-LP430	157	HP55-HP235	140
LP475-LP675	166	HPB260-HPB865	135
LPB465-LPB1515	135	UHP10-UHP50	94
MP12-MP55	94	UHP55-UHP235	140
MP80-MP320	157	UHPB260-UHPB790	135
MPB335-MPB1155	135	VP60-VP380	157



Procedure

(i) Open lid or doors.

(ii) Place crates or taped blocks of cells in correct position for connecting in series, i.e., red positive terminal to black negative terminal. When cells are fitted with hinged vent caps place the crates or blocks so that when the vent caps are open they will not be in the way of topping up. Plastic flip top vents may be removed from the cells and turned through 180° if required in order to achieve the most convenient positioning.

(iii) Fit the inter-crate or inter-block connectors and the inter-tier connector on tiered arrangements.

(iv) Connect positive and negative terminals of each battery to the main battery leads making sure that these are well secured and of ample length to avoid chaffing as well as strain on the terminal sockets.

(v) Tighten all nuts firmly with a box spanner. Do not use excessive force. Fit shrouding as supplied.
The torques to be used for upper terminal nuts are as follows:

Terminal	Plastic cased cells		Steel cased cells	
	lbf.in	N.m	lbf.in	N.m
3/8 inch	105-135	12-15	105-135	12-15
5/8 inch	225-255	25-29	225-255	25-29
7/8 inch	275-305	31-34	275-305	31-34
10 mm	105-135	12-15	105-135	12-15
20 mm	275-305	31-34	275-305	31-34
10 mm Female	480	54		

3.3 Stands

For a stand mounted battery it is important to have easy access to all cells and they should be situated in a readily available position. Stands should be placed 75-100 mm from battery room walls to permit general circulation of air and arranged to provide suitable access for servicing the battery. Gangways should have a minimum width of 1 metre. When double or three tiered stands are arranged end to end, it is desirable to provide 50 mm space between stands. Where narrow or special three tier stands are installed these should be anchored to prevent tipping. The overall weight of the battery must be considered and the load bearing on the flooring taken into account in the selection of the battery accommodation.

(a) Place stand or stands in position allocated or in accordance with any Layout Drawings.

(b) When insulators are supplied, fit these below the legs of the stands with the projecting pegs engaged with the recesses in the base of the stand legs.

(c) Place taped blocks in position to suit shelf lengths and their polarities positioned for correct connecting.

(d) Cells fitted with hinged vent caps should be placed so that when vent caps are open they do not prevent topping up.

(e) Fit inter block or inter crate connectors and the inter-tier connectors of tiered stands. Tighten all nuts as detailed in 3.2. Fit shrouding as supplied.

Floor Standing

If the battery has to be placed on the floor, it is necessary to use battens, preferably on insulators. This will raise crate or cells clear of any damp or dust conditions.

3.4 Electrical Connections

The overall layout should be as simple as possible with minimum cable lengths to reduce voltage drop between battery and operating equipment.

High voltages between adjacent sections should be avoided and connections and mounting arranged as far apart as practical to minimise electrical leakage paths. When a steel cubicle or battery compartment is used care should be taken to avoid possible shorting of the live battery connections to the steelwork.

The main positive and main negative take-off points should always be arranged well apart. They must be well secured and of ample length to avoid chaffing and strain on the terminal sockets.

A light protective coating of Komoline or similar mineral jelly should be applied.

3.5 Mobile Applications

Where batteries may be liable to movement in service, they must be fixed firmly in position. Flexible inter block or inter crate connections must be used. Adequate ventilation must be provided, and also access for servicing.

The company will give advice on the correct installation of batteries for mobile duties.

4 Charging

The amount of electrical energy which can be stored in a cell (or battery) is measured by its capacity (**C**) stated in ampere hours, i.e., the arithmetical product of the current in amperes which the cell can provide and the time in hours, for which that current can be sustained.

To fully charge a cell requires an input from the charger to the battery of 160% of the capacity.

Example:–
A 100 ampere hour cell requires 160 ampere hours to fully charge it from a fully discharged state. If for example the charger can supply 20 amperes then the time to leave the battery on charge would be 160/20 i.e. 8 hours.

This assumes that the charger has sufficient voltage to maintain the current for the full 8 hours. Frequently the voltage is not high enough and therefore the current falls away towards the end of the charging period. In such instances the charging period should be extended to compensate for the decline in input rate into the battery.

IF IN DOUBT – OVERCHARGE.

4.1 Commissioning

ALCAD batteries are generally supplied electrically discharged and require an initial or commissioning charge prior to putting the battery into regular service. This is a once only operation and is essential to prepare the battery for its long service life.

This charge requires an input to the battery of around 300/350% of its capacity and therefore needs a charge period not less than twice as long as the normal boost charge.

If the recommended voltages (Table 1) cannot be achieved then charging periods will be extended up to 72 hours.

To obtain a higher charging voltage per cell, some cells can be omitted from the circuit. Cells removed from this first charge should then be returned to the circuit and an identical number of cells removed from the charged section and a second commissioning charge carried out. Overcharging is not harmful to nickel cadmium cells.

After each commission charge the electrolyte temperature must be allowed to cool to 25°C or ambient, whichever is the lower. During charging do not permit the electrolyte temperature to exceed 45°C.

4.2 Charging in Service

The most common form of charging for stationary batteries is modified constant voltage, usually with current limitation to C/5 or C/10. The battery is permanently connected to the charger which applies a constant voltage across the battery terminals. This system is self compensating and the value of the current delivered to the battery automatically reduces as the state of charge of the battery increases.

Such chargers have a 'Normal' or 'float charge' setting which is set between 1.40 and 1.48 Volts per cell. At the correct setting the batteries can be left permanently on charge and will automatically restore the battery to a high state of charge following a discharge and thereafter maintain the battery in a high state of charge. (Table 1 shows settings).

It is usual to have a 'Boost' or 'Commissioning' charge setting on the charger and this position should be selected as detailed by the manufacturer. However any battery will benefit from a boost charge at six monthly intervals or following a battery discharge and this will restore the battery to a fully charged condition. **Batteries should not be left on boost charge for extended periods** as water consumption is greatly increased.

Operating voltage window for ALCAD cell

Cell Voltages	
1.80 – 1.60	Boost Voltages
1.60 – 1.50	Auto boost
1.50 – 1.40	Float Voltage range
1.28	Open Circuit
1.20	Nominal Voltage
1.10 – 1.00	Normal termination of discharge

4.3 Charge Acceptance

TABLE 1 **20°C ±5°C**

BATTERY BEHAVIOUR	UHP/UHPB/ UHS and HP/HPB/HS Cells	MP/MPB/MS Cells	VP and RV Cells	LP/LPB Cells
	Volts per Cell	Volts per Cell	Volts per Cell	Volts per Cell
Minimum float voltage for normal applications. Negligible water loss but will require boost charging at 6 monthly intervals and after discharge.	1.40	1.41	1.41	1.41
Recommended float voltage for fully automatic operation. Supplementary charging is not normally necessary and 80% capacity can be restored within 5 hours (LP range - 12 hours) after an emergency discharge.	1.45	1.47	1.47	1.47
Will restore full capacity within one week. Water consumption will be high if battery is charged continuously at this rate.	1.53	1.55	1.57	1.63
Will restore full capacity within 24 hours. Water consumption very high.	1.58	1.60	1.62	1.68
Will restore full capacity within 8 hours when C/5 current available.	1.68	1.69	1.70	1.72
Will commission in 24 hours when C/5 current available.	1.67	1.70	1.70	1.72

There are two variants of constant voltage (float) charging:–

(1) Float charging at 1.46/1.47 Vpc. This allows automatic recharge and restores the battery to around 80% charged in a short time and does not need routine boost charging *unless* a fully charged battery condition is required.

(2) Float charging at 1.40/1.45 Vpc. This system again gives automatic recharge in a short period. However due to the lower voltage levels and the corresponding lower charging current flowing, the voltages and state of charge of the cells will gradually get out of balance. It is therefore essential to apply a higher, equalising voltage, or boost voltage every 6 months, in order to restore the situation. This would preferably be at boost voltage levels (1.60/1.75 Vpc) and hence bring the battery up to a fully charged condition, or at say 1.50/1.55 Vpc in which case the battery could be restored to 85/90% charged.

Other Methods of Charging

All methods of charging can be used with ALCAD nickel cadmium batteries including constant current, tapering current, solar cell, alternator and pulse charging. In all these instances it should be ensured that there is sufficient voltage, and ampere hours input to the battery. The company can be contacted to discuss a particular system.

5 Routine Maintenance

5.1 Cleanliness

Cells must be kept clean and dry at all times as dust and damp cause current leakage. Terminals and connectors should be kept clean and any electrolyte spillage during maintenance should be wiped with a clean cloth. Deposits should be removed with careful use of a stiff non-metallic brush and warm water. Vent caps and flame retardant vent plugs must be tightly fitted. Do not use solvents to clean plastic cells.

Terminals, connectors and tops of cells should always be kept lightly greased with Komoline.

5.2 Topping Up

Cells must be topped up as often as necessary to prevent the electrolyte falling below the tops of the plates. The frequency of topping up is governed by the duty cycle and can only be determined by experience.

Excessive consumption of water indicates operation at too high a voltage level or at too high a temperature. Negligible consumption of water, with batteries on continuous low current or float charge, indicates under-charging. A reasonable consumption of water is the best indication that a battery is being operated under healthy conditions. Any marked change in the rate of water consumption should be investigated immediately.

Batteries on automatic float charge should initially have cell electrolyte levels checked at monthly intervals to determine the frequency of topping-up required.

Only approved water (Section 6.2) must be used for topping up and the electrolyte level must *never* be allowed to fall below the MINIMUM mark. Do not fill above the correct level as this may cause loss of electrolyte, necessitating too frequent renewal and damage to the battery through external damp and leakage currents.

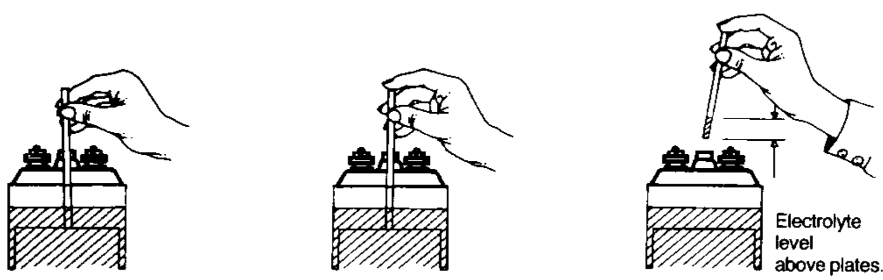
Always top up before charging so that subsequent gassing mixes the solution; never check levels or add water during or immediately after boost charging because the gas in suspension at this stage gives false readings.

Checking Electrolyte Levels

To measure the electrolyte level in a steel cased cell use the ALCAD graduated plastic level testing test tube. Insert end through the filler opening until the tube touches the top of the plates. Close the other end of the tube with a finger and remove from the cell. The height of the liquid maintained in the tube indicates the level of electrolyte above the plates.

Electrolyte levels in plastic cased cells are normally visible but the level testing tube may be necessary in poorly lit installations.

Correct levels for cells are given in Section 7.

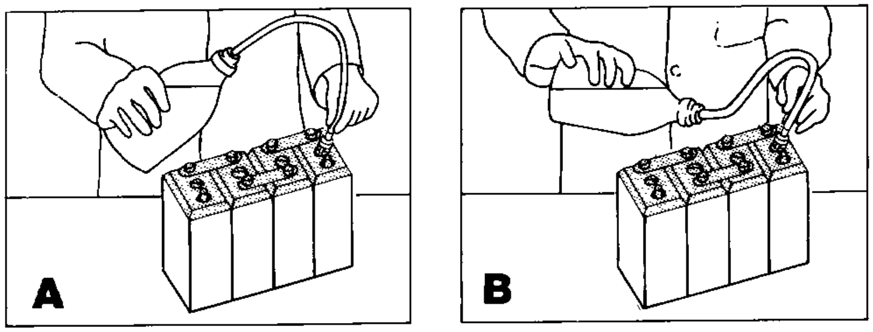


(i) Insert level testing tube into cell vent until it touches the top of the plate group.

(ii) Place finger over top of tube.

Small Installations

Where only one or two small batteries are involved, topping up can be done with a jug and funnel or a syphon hydrometer and the level checked with a plastic level testing tube. Where a number of batteries are involved, the plastic bottle Type PB4 should be used. This bottle is specially designed to work in conjunction with our patented plastic screw-in vent, the combination enabling topping up to be done without removing the vents. The system is clean and speedy and automatically tops up to the correct level.



Type PB4 Plastic Bottle Filler

Ensure that the appropriate nozzle is fitted to the bottle (see table) and fill to about 50 mm below the mouth of the bottle with pure distilled water. Hold the bottle as in position **A**, compress it gently and then insert the nozzle to the full extent through the hole in the plastic vent. Now release the pressure and if liquid is withdrawn into the plastic tube, it indicates that no topping up is required. Return the extracted liquid to the cell by gently compressing the bottle. If, however, no liquid is withdrawn the cell requires topping up as follows:

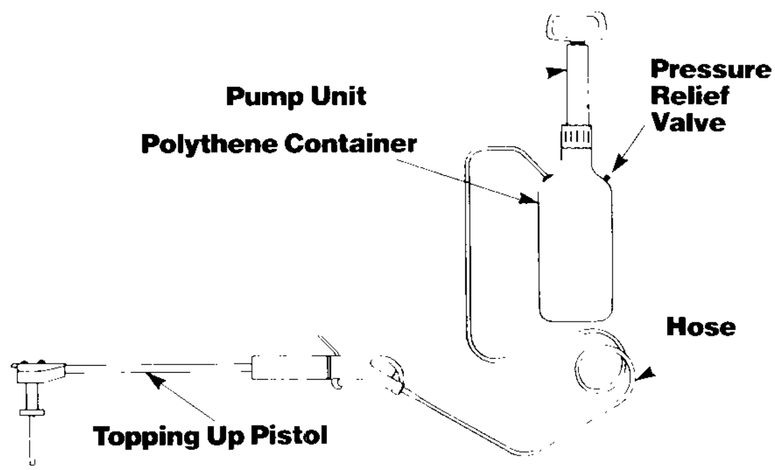
Hold the bottle in position **B**, as close to the level of the cell-tops as possible, and compress gently to inject a little water into the cell. Release pressure to allow withdrawal of air. Continue to compress and release gently until a solid column of liquid appears in the tube permeated with a continuous stream of small air bubbles. The cell is now topped up to the correct level.

Return the bottle to position **A** and compress to empty tube and avoid dripping water between cells.

Designed for use with the plastic vent fitted to small cells, the bottle may equally well be used on larger cells fitted with plastic vents, provided, of course, that such cells are not so large or so numerous as to require too frequent replenishment of the bottle. Appropriate nozzles (see table) are provided for use with the various ranges of cells and the method of use is exactly as described above.

Cell Types	Nozzle No.	Part No.	Cell Types	Nozzle No.	Part No.
RV, RVHW 6 to 10	2	83252	MP 80 to 115 HP 55 to 125 UHP 55 to 125 LP 80 to 135 VP60 to 100 MS 80 to 115 HS 65 to 125 UHS 65 to 125	11	01096
RV, RVHW 12 to 52 LP 11 to 65	7	83257			
MP 12 to 55 HP 10 to 50 UHP 10 to 50 MS 30 to 55 HS 20 to 40 UHS 20 to 40	10	01089	MP 140 to 320 HP 135 to 235 UHP 135 to 235 LP 165 to 430 VP125 to 380 MS 140 to 1070 HS 150 to 785 UHS 150 to 785	12	01097

Large Installations



Celltopper Topping Up Apparatus

General Description
The equipment has been designed to aid the topping up of large sizes or numbers of Alcad cells, especially where the level of electrolyte cannot be readily seen.

The equipment consists of two basic units, a filling pistol and a water container. The filling pistol is composed of a hand operated control valve with extended delivery tube to which is fitted a sensing probe. The electronic sensing circuitry and audible/visual warning device, together with a small primary cell battery are integrated into a single housing mounted adjacent to the control valve. The water container has a seven litre capacity and is used to feed demineralised or pure distilled water by pressurising it with a hand pump. A safety valve is fitted to provide pressure relief.

Operation
To top up a cell the operator commences by pressurising the water container and inserting the probe into the cell. For most cells the adjustable collar on the probe is located on the top of the vent assembly but with cells fitted with large steel vents, the collar sits inside the vent. Open the lever on the control valve to allow water to flow. When the electrolyte reaches the upper tip of the probe an electrical circuit is completed and a buzzer/light will give a signal. This is a warning to the operator to immediately release the lever and stop water flow. The pressure relief valve may be used to release the pressure in the container prior to pump unit removal and refilling with water.

Electrolyte Level
It is important to maintain the electrolyte level at the correct height which may differ for different cell types. The correct topping up height with this equipment is determined by the length of a spacer tube above the adjustable collar.

Check that the correct spacer tube is fitted for the appropriate cell type as given in Spacer Tube List.

WARNING: After filling the cells, wash probe to remove surplus electrolyte. Observe Safety Precautions for ALCAD Batteries.

Do not fill the container beyond the maximum level indicated.

Battery
The battery pack consists of mercury button cells (Duracell TR115N) and should last for several thousand operations before replacement is necessary. In the event of the equipment being out of service for some time and as routine check before usage a reasonable estimation of the battery condition may be obtained by applying an electrical short across the probe tip. The buzzer should sound clearly for 10 seconds. To replace the battery remove the large screw from the housing and pull out the battery.

Probe Replacement
A faulty probe may be changed by unscrewing the threaded sealing collar on the underside of the probe head and then carefully removing the electrical connections. On replacement ensure that the electrical connections and the 'O' ring seal are effective.

Topping Up Equipment – Parts List

Item	Part Number
Complete equipment – pressure feed	37971
Standard Pistol	33893
Plastic bottle (7 litre) – pressure feed	83491
Flexible hose	38080

Spacer Tube List

Topping Up Equipment Standard Filling Pistol (Part No. 33893)

Cell	Type of Vent	Spacer Number	Part Number
M80 – MP115 HP55 – HP125 UHP55 – UHP125 LP80 – LP135	Plastic	No. 52	34582
MP140 – MP320 HP135 – HP235 UHP135 – UHP235 LP165 – LP430	Plastic	No. 53	34583
MS64 – MS115 HS65 – HS125 UHS65 – UHS785	Plastic	No. 54	34584
MS140 – MS1070 HS150 – HS785 UHS150 – UHS785	Plastic	No. 52	34582
RV6 – RV10	Plastic	No. 54	34584
RV12 – RV104	Plastic	No. 52	34582
RV22 – RV52	Steel	No. 54	34584
RV12 – RV20 RV64 – RV104	Steel	No. 51	34581
VP60 – VP100	Plastic	No. 52	34582
VP125 – VP380	Plastic	No. 53	34583
LP475 – LP675	Plastic	No. 51	34581
LPB465 – LBP1515 MPB335 – MPB1155 HPB260 – HPB865 UHPB260 – UHPB790	Plastic	No. 54	34584
LPB465 – LPB1515 MPB335 – MPB1155 HPB260 – HPB865 UHPB260 – UHPB790	Plastic Flip/Top Flame Retardant	No. 54	34584

5.3 Specific Gravity Checks

The specific gravity (S.G.) of cell electrolyte falls very gradually in service, due mainly to the addition of water during maintenance over a long period and it should be checked every 12 months. Acceptable limits for electrolyte S.G. are given in Section 6.3 and are for an electrolyte temperature of 20°C. **It does not vary significantly with the state of charge.**

S.G. measurements should be made after the electrolyte level has been adjusted to the specified maximum level by the addition of distilled or demineralised water and the cells charged for a few hours to ensure thorough mixing, and then standing to allow gas bubbles to disperse. The S.G. is normally measured by withdrawing a sample of electrolyte from 10-20mm above the top of the plate group using a hydrometer unit until the hydrometer is floating freely in the electrolyte. The S.G. is then read from the scale on the hydrometer stem. After measurement the electrolyte sample is carefully returned to the cell. The electrolyte temperature is measured in the same zone sampled for the S.G. determination. The S.G. is corrected to 20°C by using the formula given in Section 6.3.

5.4 Connections

All terminals and electrical connections should be checked for tightness as part of regular maintenance. Flexible cables should be examined to ensure insulation is in good condition.

6 Electrolyte

The correct control of the electrolyte directly relates to specified performance and life of Alcad cells.

Before handling liquid or solid electrolytes, read the Safety Instructions in this booklet. Solid and liquid electrolyte are hazardous materials and must be handled by personnel wearing protective equipment.

6.1 Electrolyte Material

Three standard electrolytes are supplied by the Company:

Type R Type 8 Type 3

Electrolytes are either supplied (a) as liquids ready for use or (b) as solids to produce electrolyte when dissolved in approved distilled or de-mineralised water.

Electrolyte types and quantities per cell are listed in Section 7.

Electrolyte is supplied in plastic bottles or drums that comply with international transportation regulations. Containers are labelled to show electrolyte type and regulatory hazard information. Full instructions for first filling or changing the electrolyte are supplied with each consignment but the essentials are detailed below.

6.2 Preparation of New Electrolyte

Solid form electrolyte is supplied to produce liquid electrolyte to specified requirements when dissolved in approved water.

Liquid electrolyte is made from solid form as follows:

Equipment

(i) Clean mixing vessel (part no. 65743)
(ii) Mixing paddle (part no. 65747)
(iii) Thermometer (part no. 67518)
(iv) Hydrometer (part no. 65014)
(v) Jug (part no. 65743)

NOTE: Use a plain iron, porcelain or plastic vessel. Do not use vessels of copper, aluminium or galvanised steel or vessels with soldered joints. Do not use lead acid battery equipment.

Procedure

Dissolve solid form electrolyte in approved water (see below) in the clean mixing vessel to the instructions supplied on the labels, i.e. in the proportions of 2 kg of solid form to 5 litres of water for electrolytes type R and 3, or 2 kg of solid form to 7 litres of water for electrolyte type 8. Always add solid electrolyte to the water gradually to prevent overheating. **NEVER** add water to dry electrolyte. Dissolve the complete contents of one tin at a time. Stir the solution well until dissolution of solids is complete. Cover the top of the mixing vessel with a lid or a clean cloth and allow to cool thoroughly. Check the specific gravity (S.G.) which will be above specification. Add small quantities of approved water with thorough mixing until the temperature corrected specific gravity (determined as in 6.3) is in the following specified range:

	Types R and 3	**Type 8**
S.G. at 20°C	1.195-1.205	1.155-1.165

These liquid electrolytes can now be used for first fill of new cells or electrolyte change.

Solid and liquid electrolytes are supplied in standard non-returnable drums. Type R is available in solid or liquid form and other types in solid form only.

Solid (kg)	Liquid (Litre)
0.05	
0.25	0.5
0.5	1.0
1.0	2.5
2.5	5.0
12.5	25.0
25.0	

The volumes of liquid electrolytes that can be prepared from the standard range of solid mixes are:–

Solid (kg)	Will make up liquid electrolyte Types R and 3 (Litre)	Type 8 (Litre)
0.25	0.7	0.9
0.5	1.4	1.8
1.0	2.9	3.7
2.5	7.3	9.3
12.5	36.5	46.6
25	73	93

Use only the liquid or solid form electrolytes supplied by the Company or its agents.

Approved Water

Water used for electrolyte preparation must be purified by distillation or ion exchange (demineralised) and have a conductivity not greater than 1 micro Siemen per metre. The total dissolved solids should not be greater than 20 mg/dm^3.

Water sold as 'Distilled water for automotive batteries' must not be used as this can contain dilute sulphuric acid that will destroy the nickel cadmium cell.

6.3 Specific Gravity (S.G.) Limits

Specific gravity is specified at the temperature of 20°C.

Measurement requires a reading of the electrolyte S.G. and electrolyte temperature. To obtain the S.G. corrected to 20°C for measurements taken in the temperature range +10 to +40°C proceed as follows:–

(1) For every 2°C above 20°C, add 0.001 to the measured S.G.
(2) For every 2°C below 20°C, subtract 0.001 from the measured S.G.

Example
Measured cell electrolyte S.G. 1.180 at temperature 30°C.
Temperature corrected S.G. at 20°C is

$$1.180 + \left[\frac{(30-20)}{2} \times 0.001\right] = 1.185$$

New Electrolyte

New electrolyte supplied as liquid or produced from approved solid form has the following Specific Gravity:–

	Specified S.G. at 20°C
Type R	1.195-1.205
Type 3	1.195-1.205
Type 8	1.155-1.165

New Cell Deliveries

New cells contain electrolyte with S.G. in the ranges:–
Standard cells (Types R and 3) – 1.190-1.200
High electrolyte reserve cells (Type 8) – 1.150-1.160

Cells in Service

The electrolyte S.G. in cells the first few months of service should be in the following ranges for the appropriate electrolyte type at 20°C.

Type R and 3	1.170-1.190
Type 8	1.145-1.155

During routine maintenance of batteries on float charge topping up is the first operation followed by boost charging. Electrolyte specific gravity measurement is always the final operation, after the cells have been topped up and charged.

As indicated in Section 5.3 the electrolyte S.G. falls very gradually in service and it is recommended that cells are not operated with gravities below the levels given in the following table. If a scheduled maintenance visit shows that S.G. is about 0.002 above the lower limit an electrolyte change is recommended during the next maintenance visit.

Type R and 3	1.145
Type 8	1.115

6.4 Changing the Electrolyte

Electrolyte renewal is normally not required during the service life of a battery.

Calculate from the data tables the type and quantity of new electrolyte required for the electrolyte change on the battery.

Prepare the new electrolyte as detailed in 6.2.

Procedure

a. Discharge the battery at a normal (5 hour or 10 hour) rate to 0.8 volts per cell average. Disconnect main system connections and inter crate or block connectors to break the battery down into units that can be handled. Remove the cell vents.

b. Empty the cells into a suitable collector system by carefully tipping the cells. Only empty as many cells as can be refilled in one hour. Do not shake cell during emptying and **do not wash out with water**. Allow to drain for 30 minutes, stand upright and immediately fill the cells using plastic jug (part no. 65746) and funnel (part no. 65745) to a level 15- 20 mm below the displayed or required MAX level. Check the level in steel cells using the plastic level testing tube (part no. 65475). Allow the cells to stand for 24 hours.

c. After the 24 hour stand, carefully complete the cell filling to 10 mm below the displayed or required MAX level, again checking the level in the steel cells using the plastic level test tube to the procedure detailed in Section 5.

d. Carry out the routine maintenance procedure for cleanliness and for connections during re-assembly part of the battery.

e. Re-commission the prepared battery as detailed in Section 4.

Battery electrolyte must not be disposed of in public drainage systems. Contact local authorities for advice.

7 Cell Data

Plastic Container Cells

LP RANGE

	Capacity at 5 hour rate	Optimum Charge Rate	Measurable level of electrolyte above tops of plates	Quantity of liquid electrolyte per cell
	Ampere-hours	Amp. for 8 hours	mm	Type R Litres
LP 11	11	2.5	25	0.4
LP 17	17	3.5	25	0.8
LP 28	27	6.0	25	0.7
LP 37	37	7.5	25	0.8
LP 46	46	9.5	25	0.9
LP 56	56	11.5	25	0.9
LP 65	65	13.0	25	0.8
LP 80	80	16	72	1.5
LP 95	95	19	72	1.4
LP 105	105	21	72	1.2
LP 135	135	27	72	1.8
LP 165	165	34	72	3.6
LP 200	200	40	72	3.3
LP 230	230	46	72	3.1
LP 265	265	53	72	2.8
LP 300	300	60	72	3.8
LP 330	330	66	72	3.6
LP 365	365	73	72	4.8
LP 400	400	80	72	4.6
LP 430	430	86	72	4.3

LPB RANGE

	Capacity at 5 hour rate	Optimum Charge Rate	Measurable level of electrolyte above tops of plates	Quantity of liquid electrolyte per cell
	Ampere-hours	Amp. for 8 hours	mm	Type R Litres
LPB 465	465	93	45	5.5
LPB 505	505	101	45	5.0
LPB 540	540	108	45	7.5
LPB 620	620	124	45	7.0
LPB 700	700	140	45	7.5
LPB 775	775	155	45	9.5
LPB 855	855	171	45	9.0
LPB 930	930	186	45	10.5
LPB 1005	1005	201	45	10.0
LPB 1165	1165	233	45	14.0
LPB 1280	1280	256	45	13.0
LPB 1400	1400	280	45	16.0
LPB 1515	1515	303	45	15.0

MP RANGE

	Capacity at 5 hour rate at	Optimum Charge Rate	Measurable level of electrolyte above tops of plates	Quantity of liquid electrolyte per cell
	Ampere-hours	Amp. for 8 hours	mm	Type R Litres
MP 12	11	2	30	0.6
MP 18	18	4	30	0.5
MP 25	25	5	30	0.4
MP 30	31	6	30	1.0
MP 37	37	7.5	30	1.0
MP 50	50	10	30	0.8
MP 55	56	11	30	0.8
MP 80	80	16	62	1.3
MP 95	96	20	62	1.9
MP 115	115	23	62	1.7
MP 140	140	28	62	3.5
MP 160	160	32	62	3.3
MP 180	180	36	62	3.1
MP 200	200	40	62	2.9
MP 220	220	44	62	4.0
MP 240	240	48	62	3.8
MP 260	260	52	62	3.6
MP 280	280	56	62	4.8
MP 300	300	60	62	4.6
MP 320	320	64	62	4.4

MPB RANGE

	Capacity at 5 hour rate	Optimum Charge Rate	Measurable level of electrolyte above tops of plates	Quantity of liquid electrolyte per cell
	Ampere-hours	Amp. for 8 hours	mm	Type R Litres
MPB 335	335	67	45	4.5
MPB 360	360	72	45	5.5
MPB 385	385	77	45	5.5
MPB 430	430	86	45	7.5
MPB 480	480	96	45	7.0
MPB 530	530	106	45	8.0
MPB 575	575	115	45	7.5
MPB 625	625	125	45	9.5
MPB 675	675	135	45	9.0
MPB 720	720	144	45	11.0
MPB 770	770	154	45	10.5
MPB 795	795	159	45	12.0
MPB 865	865	173	45	11.5
MPB 940	940	188	45	14.0
MPB 1010	1010	202	45	13.5
MPB 1085	1085	217	45	16.5
MPB 1155	1155	231	45	16.0

VP RANGE

	Capacity at 5 hour rate	Optimum Charge Rate	Measurable level of electrolyte above tops of plates	Quantity of liquid electrolyte per cell
	Ampere-hours	Amp. for 8 hours	mm	Type R Litres
VP 60	62	12.5	72	1.7
VP 80	83	17.0	72	2.3
VP 100	105	21.0	72	2.1
VP 125	130	26.0	72	4.1
VP 150	155	31.0	72	3.9
VP 175	180	36.0	72	3.6
VP 200	205	41.0	72	3.4
VP 230	230	46.0	72	3.1
VP 255	260	52.0	72	2.9
VP 280	285	57.0	72	4.0
VP 305	310	62.0	72	3.8
VP 330	335	67.0	72	5.1
VP 355	360	72.0	72	4.8
VP 380	390	78.0	72	4.6

HP & UHP RANGE

	Capacity at 5 hour rate	Optimum Charge Rate	Measurable level of electrolyte above tops of plates	Quantity of liquid electrolyte per cell
	Ampere-hours	Amp. for 8 hours	mm	Type R Litres
U/HP 10	10	2	30	0.4
U/HP 14	14	3	30	0.5
U/HP 17	17	3.5	30	0.5
U/HP 20	20	4	30	0.4
U/HP 25	25	5	30	1.0
U/HP 30	30	6	30	0.9
U/HP 35	35	7	30	0.9
U/HP 40	40	8	30	0.7
U/HP 50	45	9	30	0.7
U/HP 55	55	11	45	1.2
U/HP 65	62	13	45	1.0
U/HP 75	78	16	45	1.5
U/HP 80	85	17	45	1.2
U/HP 90	90	18	45	2.5
U/HP 100	100	20	45	2.1
U/HP 115	115	23	45	2.1
U/HP 125	122	25	45	1.8
U/HP 135	135	27	45	3.7
U/HP 150	150	30	45	3.2
U/HP 170	170	34	45	3.2
U/HP 185	190	38	45	2.6
U/HP 215	220	44	45	3.4
U/HP 230	230	46	45	3.7
U/HP 235	240	48	45	3.1

HPB RANGE

	Capacity at 5 hour rate	Optimum Charge Rate	Measurable level of electrolyte above tops of plates	Quantity of liquid electrolyte per cell
	Ampere-hours	Amp. for 8 hours	mm	Type R Litres
HPB 260	260	52	45	6.0
HPB 285	285	57	45	5.7
HPB 325	325	65	45	8.0
HPB 375	375	75	45	7.5
HPB 425	425	85	45	8.0
HPB 475	475	95	45	10.0
HPB 525	525	105	45	12.0
HPB 575	575	115	45	11.5
HPB 640	640	128	45	12.0
HPB 715	715	143	45	15.0
HPB 790	790	158	45	18.0
HPB 865	865	173	45	17.0

UHPB RANGE

	Capacity at 5 hour rate	Optimum Charge Rate	Measurable level of electrolyte above tops of plates	Quantity of liquid electrolyte per cell
	Ampere-hours	Amp. for 8 hours	mm	Type R Litres
UHPB 260	260	52	45	6.0
UHPB 295	295	59	45	7.5
UHPB 340	340	68	45	8.0
UHPB 390	390	78	45	8.5
UHPB 435	435	87	45	10.5
UHPB 480	480	96	45	13.0
UHPB 525	525	105	45	12.0
UHPB 585	585	117	45	13.0
UHPB 650	650	130	45	15.5
UHPB 720	720	144	45	19.0
UHPB 790	790	158	45	18.0

Stainless Steel Container Cells

MS RANGE

	Capacity at 5 hour rate	Optimum Charge Rate	Measurable level of electrolyte above tops of plates	Quantity of liquid electrolyte per cell
	Ampere-hours	Amp. for 8 hours	mm	Type R Litres
MS 30	31	6	30	1.0
MS 50	50	10	30	0.8
MS 55	56	12	30	0.7
MS 80	80	16	62	1.3
MS 95	96	20	62	1.1
MS 115	115	23	62	1.3
MS 140	140	28	62	1.5
MS 160	160	32	62	1.8
MS 180	180	36	62	2.0
MS 200	200	40	62	2.2
MS 220	220	44	62	2.4
MS 240	240	48	62	2.7
MS 260	260	52	62	2.9
MS 280	280	56	62	3.1
MS 300	300	60	62	3.3
MS 320	320	64	62	3.5
MS 360	360	72	62	4.0
MS 380	380	76	62	4.2
MS 420	420	84	62	4.6
MS 460	460	92	62	5.0
MS 520	520	104	62	5.8
MS 595	600	120	62	7.3
MS 710	720	144	62	8.5
MS 830	840	170	62	10.0
MS 950	960	192	62	11.4
MS 1070	1080	216	62	12.9

HS & UHS RANGE

Type of Cell	Capacity at 5 hour rate	Optimum Charge Rate	Measurable level of electrolyte above tops of plates	Quantity of liquid electrolyte per cell
	Ampere-hours	Amp. for 8 hours	mm	Type R Litres
U/HS 20	20	4	30	0.5
U/HS 40	40	8	30	0.7
U/HS 65	62	13	45	0.8
U/HS 80	85	17	45	1.1
U/HS 100	100	20	45	1.3
U/HS 125	122	25	45	1.5
U/HS 150	150	30	45	1.8
U/HS 180	180	36	45	2.2
U/HS 215	220	44	45	2.6
U/HS 265	265	54	45	3.3
U/HS 315	320	64	45	4.0
U/HS 350	360	72	45	4.3
U/HS 400	410	82	45	4.9
U/HS 450	455	92	45	5.5
U/HS 535	540	108	45	7.6
U/HS 645	655	131	45	8.9
U/HS 785	800	160	45	10.9

RV RANGE

	Capacity at 5 hour rate	Optimum Charge Rate	Measurable level of electrolyte above tops of plates	Quantity of liquid electrolyte per cell (Litres)
	Ampere-hours	Amp. for 8 hours	mm	Type 3
RV 6	65	13	50	0.6
RV 8	80	16	50	0.7
RV 10	95	19	50	0.8
RV 12	115	23	50	1.0
RV 14	135	27	50	1.2
RV 16	155	31	50	1.4
RV 18	175	35	50	1.4
RV 20	200	40	50	1.6
RV 22	220	44	50	1.7
RV 25	245	49	50	1.9
RV 27	270	54	50	2.1
RV 30	295	59	50	2.2
RV 32	320	64	50	2.5
RV 35	345	69	50	2.7
RV 40	395	79	50	3.0
RV 45	445	89	50	3.5
RV 47	465	93	50	3.5
RV 50	500	100	50	3.7
RV 52	520	104	50	3.8
RV 64	640	128	50	5.8
RV 80	790	158	50	7.1
RV 94	930	186	50	8.1
RV 104	1040	208	50	8.5

For electrolyte renewal instructions, contact the company.

RV-HW RANGE

Type of Cell	Capacity at 5 hour rate	Optimum Charge Rate	Measurable level of electrolyte above tops of plates	Quantity of liquid electrolyte per cell (Litres)
	Ampere-hours	Amp. for 8 hours	mm	Type 8
RV 6HW	65	13	100	1.4
RV 8HW	80	16	100	2.3
RV 10HW	95	19	100	2.5
RV 12HW	115	23	100	2.6
RV 14HW	135	27	100	2.9
RV 16HW	155	31	100	3.2
RV 18HW	175	35	100	3.3
RV 20HW	200	40	100	3.6
RV 22HW	220	44	100	3.3
RV 25HW	245	49	100	3.6
RV 27HW	270	54	100	3.9
RV 30HW	295	59	100	4.1
RV 32HW	320	64	100	5.0
RV 35HW	345	69	100	5.8
RV 40HW	395	79	100	6.2
RV 45HW	445	89	100	6.8
RV 47HW	465	93	100	6.9
RV 50HW	500	100	100	7.2
RV 52HW	520	104	100	7.3

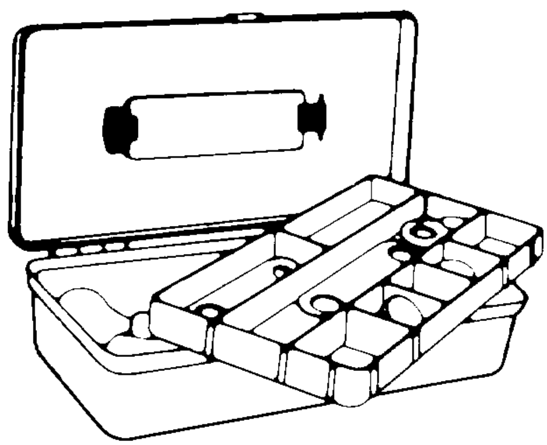
For electrolyte renewal instructions, contact the company.

Conversion	1 inch = 25.4 mm	1 gallon = 4.54 litres

8 Accessories and Spare Parts

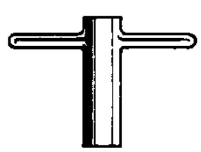
8.1 Maintenance Equipment

Description	Part Number	Description	Part Number
Celltopper Topping-Up Equipment	37971	PVC Aprons	65741
PB4 Topping-Up Bottle	83170	Goggles	65742
Accessory Box – complete	31618	Plastic Mixing Bin	65743
Hydrometer – Small	65002	Electrolyte Syphon	65744
Hydrometer Float	65007	Small Funnel (up to 65Ah)	65745
Level Testing Tube	25025	Large Funnel	65749
Thermometer	67518	PVC 2 litre Jug	65746
Voltmeter	47660	Mixing/Stirring Rod	65747
Tap for 25 litre Drum	73760	Eye Wash Bottle	65748
PVC Gloves	65740	Acfil Pump	34290

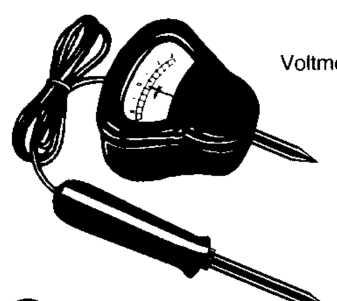


Accessory Box

CONTENTS:
Hydrometer
Box Spanner
End Lug
Terminal Nuts (4 off)
Level Test Tube (2 off)
Vent Cap Complete
Intercell Connectors (2 off)
Boss Insulators

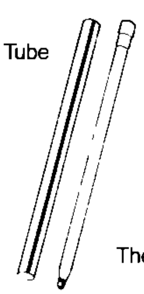


Box Spanner

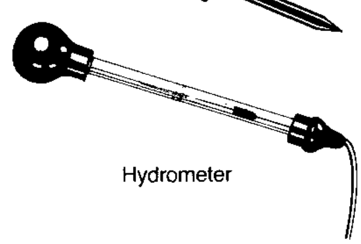


Voltmeter

Level Testing Tube



Thermometer



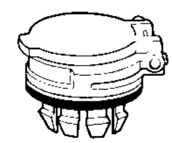
Hydrometer

8.2 Spares for Plastic Container Cells

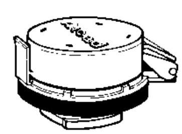
Cell Type	LP 11-65	LP 80-430	VP 60-380	MP 12-55	MP 80-320	UHP/HP 10-50	UHP/HP 55-235	LPB 465-1515		MPB 335-1155		U/HPB 260-865	
	Part No.		Part No.	Part No.		Part No.		Part No.		Part No.		Part No.	
Terminals													
Nuts	69835	88607	88607	01019	88607	01019	88607						
Bolts								07124		07124		07124	
Polarity Discs													
Red	89188	01225	01225	01023	01225	01023	01225	04330		04330		04330	
Black	89189	01226	01226	01024	01226	01024	01226	04331		04331		04331	
Steel Pole Washers	30405	01224	01224	01022	01224	01022	01224	05713		05713		05713	
End Lugs								**70 mm²**	**50 mm²**	**70 mm²**	**50 mm²**	**70 mm²**	**50 mm²**
Crimped	73268	73264	73264	73268	73264	73268	73264	20033	73247	20033	73247	20033	73247
Soldered	30638	25001	25001	89852	25001	89852	25001						
Vents	**Screw-in**			**Small Collett**				**Flip Top (Flame Retardant)**					
	68189			00006		00006		05060		05060		05060	
Medium Collet		**80-135** 00014	**60-100** 00014		**64-115** 00014		**55-125** 00014						
Large Collet		**165-430** 00024	**125-380** 00024		**140-320** 00024		**135-235** 00024						
Box Spanners	30522	25021	25021	25020	25021	25020	25021	25020		25020		25020	
Connector Shrouds (1 metre)	A4485	A4487	A4487	A4485	A4487	A4485	A4487	A4484		A4484		A4484	

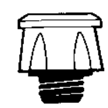

Terminal Nut

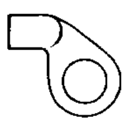

Screw-in Plastic Vent


Flip-Top Plastic Vent

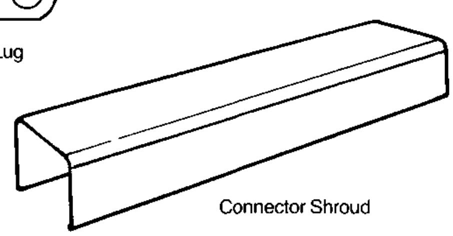

Gland Cap


Flip-Top Flame Retardant Vent


Screw-in Flame Retardant Vent


End Lug


End Lug


Connector Shroud

8.3 Spares for Steel Container Cells

	MS		HS/UHS		RV/RVHW	
	30-55 (M10)	64-1070 (M20)	20-40 (M10)	65-785 (M20)	6-10 (5/8")	12-104 (7/8")
Terminal Nuts	01019	88607	01019	88607	87899	87665
Gland Caps Red	67716	40677	67716	40677	40335	40735
Gland Caps Black	67717	40678	67717	40678	40336	40736
Steel Dished Washer	67718	88194	67718	88194	40337	40737
Plastic Vent	00006	**64-115** 00014 / **140-1070** 00024	00006	**65-125** 00014 / **150-785** 00024	00014	00024
Box Spanner	25020	25021	25020	25021	40390	42022
End Lugs						
Crimped	73268	73264	73268	73264	73273	73265
Soldered	89852	25001	89852	25001	40544	41244
Connector Shrouds	A4485	A4487	A4485	A4487	A4486	A4487

8.4 Electrolyte – Liquid and Solid Material

Type and quantity of electrolyte	Part Number
Type 'R' (Liquid)	
0.5 litre	47611
1.0 litre	47612
2.5 litres	47613
5.0 litres	47614
25.0 litres	47615
Type 'R' (Solid)	
0.05 kg	47601
0.25 kg	47602
0.5 kg	47603
1.0 kg	47604
2.5 kg	47606
12.5 kg	47692
25.0 kg	47693
Type '8' (Solid)	
1.0 kg	47665
12.5 kg	47667
25.0 kg	47668
Type '3' (Solid)	
1.0 kg	47624
2.5 kg	47626
12.5 kg	47627
25.0 kg	47628

8.5 Cell Dressings and Paints

Description	Part Number
Komoline (Mineral Jelly for Dressing Cell Tops)	
0.25 kg	34920
0.5 kg	34921
1.0 kg	34922
2.5 kg	34923
Cuprinol (Wood Preservative for Crates and Stands)	
1 litre	66815
Creocel (Repainting Crates and Stands)	
2.5 litres	34945
5 litres	34929

Notes

Your ALCAD battery will repay simple maintenance with long and reliable service.

ITS LIFE IS NOW IN YOUR HANDS!

- Ensure that charging is adequate in relation to the duty.
- Avoid over-discharging.
- Keep the electrolyte at the proper level by adding demineralised or pure distilled water only and do not overfill.
- Keep the cells and crates clean and dry.
- Keep vent caps closed except when topping up.
- *Never* put lead battery acid in an Alkaline battery and *never* use utensils which have been used for lead acid batteries.

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