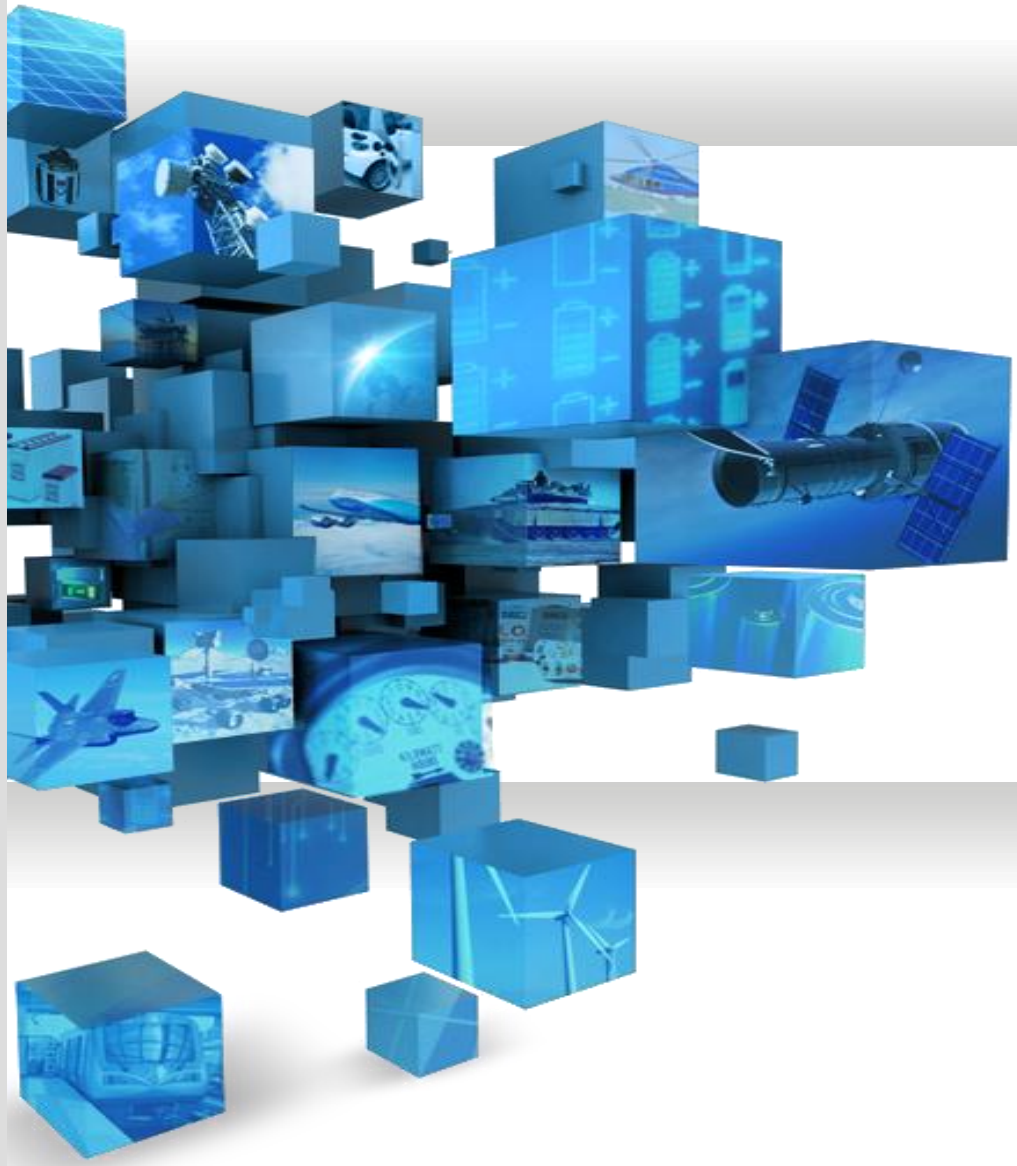
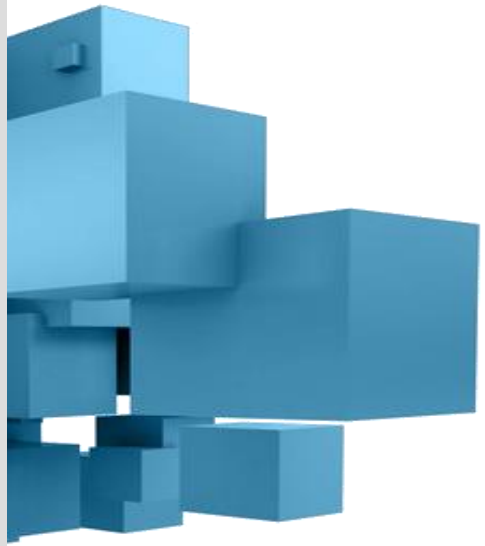


Ni cad Pocket plate Battery technology for Industrial Stand by application



1. Why Ni cad ?

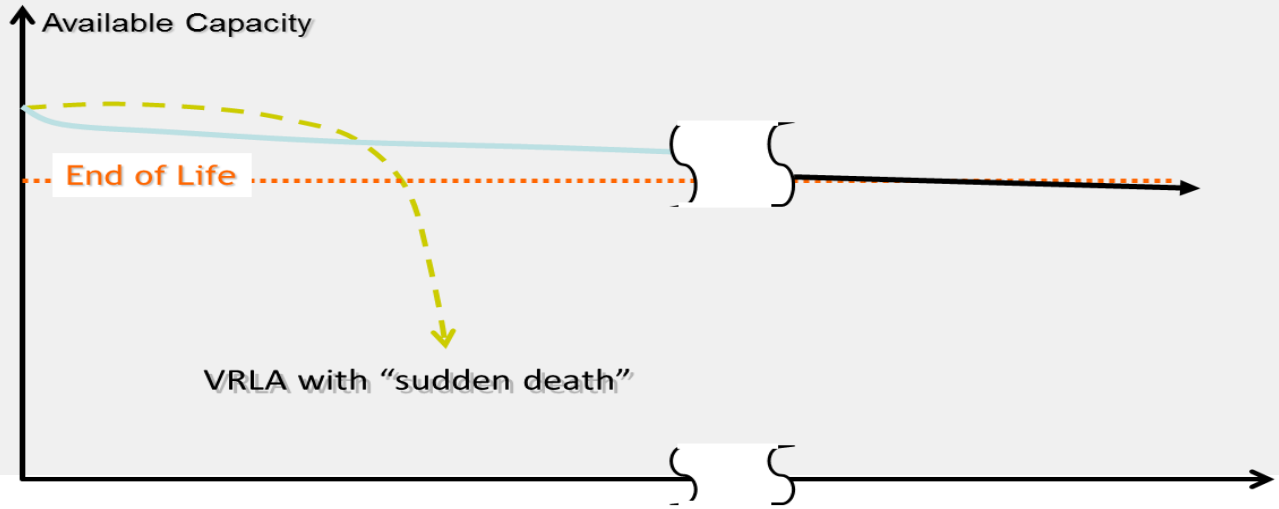
The benefits of Ni-Cd

- **Total reliability**
- **Long service life**
- **Tolerant of extreme temperatures**
- **Electrical and mechanical robustness**
- **Low Total Cost of Ownership (TCO)**

Total reliability

– No risk of sudden death

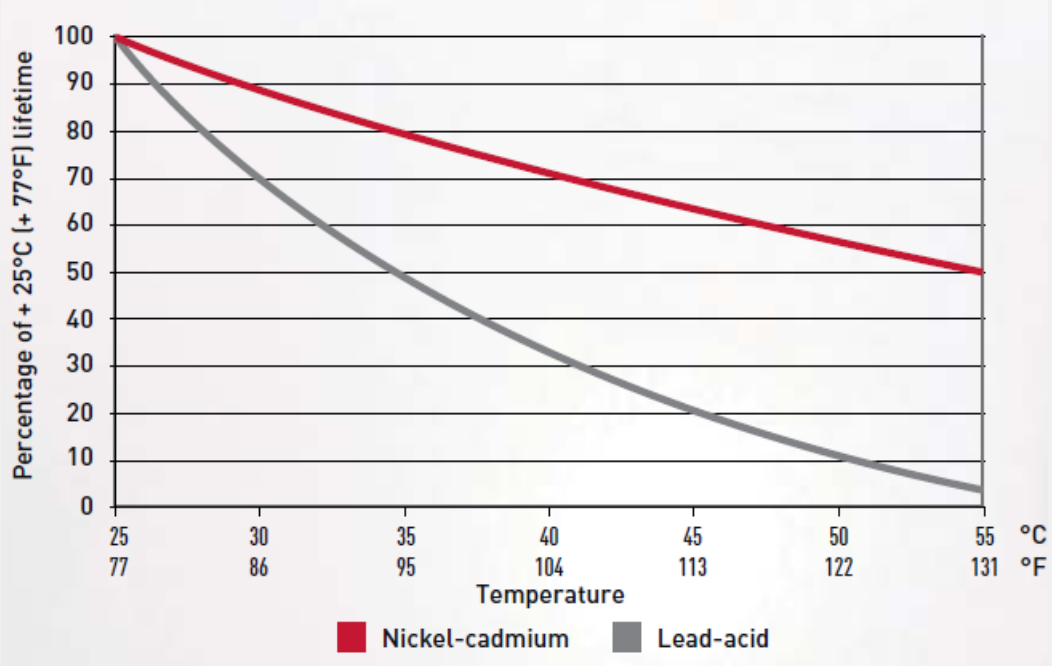
- No internal corrosion of steel structure
- Mechanical construction does not age and is not part of the electrochemical corrosion process
- Slow predictable aging of active materials
- No problems due to shedding of active materials
- The electrolyte is simply an ion carrier



Long service life

- Long lifetime 20-25 years in floating applications
- Excellent cycling capabilities

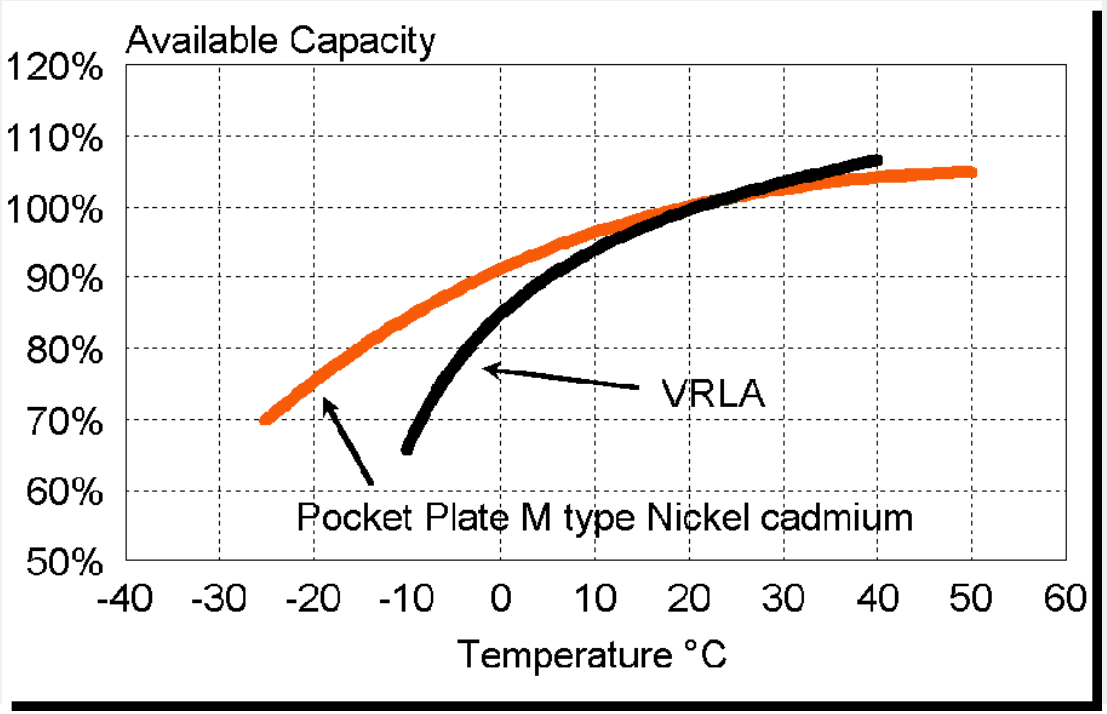
- Long service life even when operating at ambient temperatures of +40°C (+104°F) or more



Tolerant of extreme temperatures

- Normal temperature range -20°C (-4°F) to + 50°C (+122°F)
- Short term operation up to +70°C
- Usable capacity at temperatures as low as -50°C

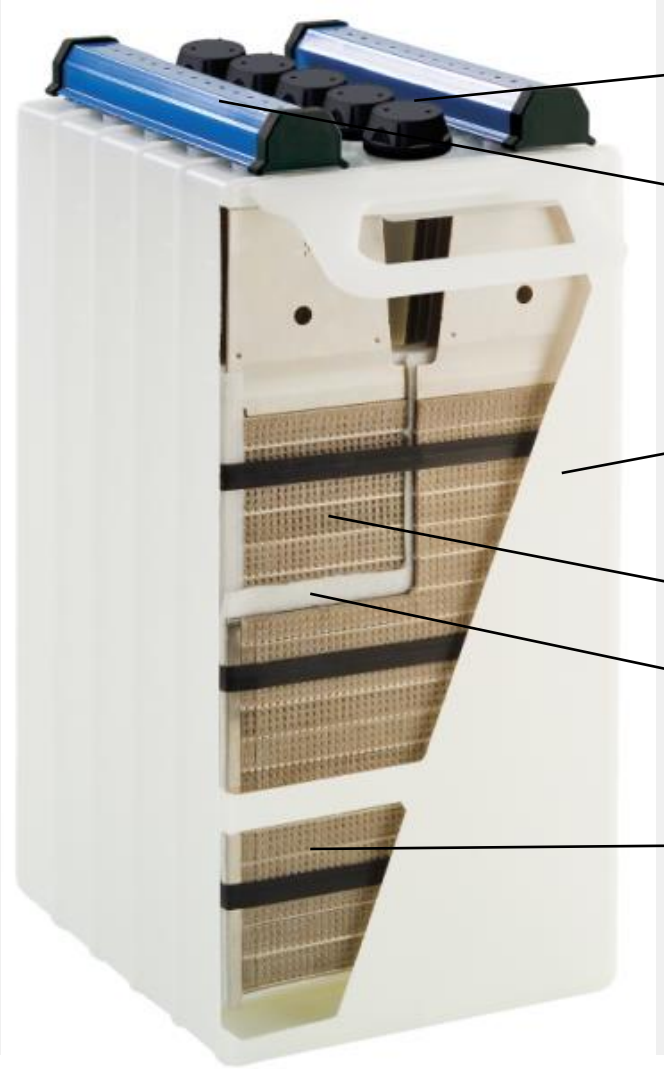
- Good performance even at low temperatures



Electrical and mechanical robustness

- Ni-Cd batteries can withstand:
  - Deep discharge
  - Reversal
  - Overcharge
  - Short circuits
  - Ripple
  - Long time storage
- All internal hardware is steel
- Withstand heavy shocks and vibrations (during transport and service)

Ni-Cd Pocket Plate Battery



Low pressure flame arresting vent

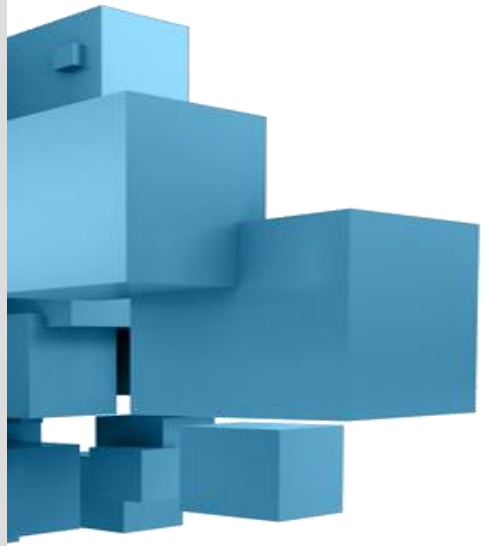
Terminals beneath terminal covers

Polypropylene container

Ni positive electrode

Polypropylene fibrous separator

Cd negative electrode



2. Ni cad Vs Lead Acid

VRLA failure modes
Thermal runaway

- VRLA batteries:
  - starved electrolyte
  - stack compression
  - often placed in very confined location
  - increasing impedance
  - associated with dry-out

    - Ni-Cd battery design involves a large quantity of free electrolyte, that means a large thermal inertia

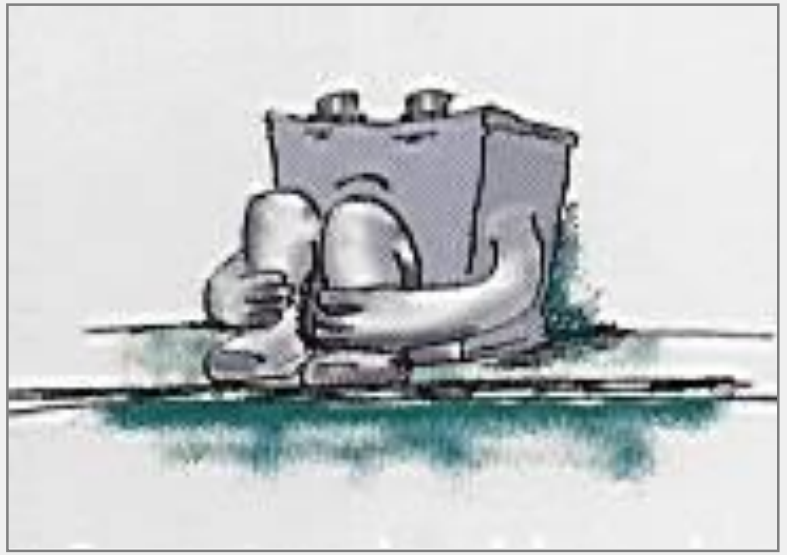
VRLA failure modes
Ripple current

- VRLA batteries:
  - excessive ripple will increase battery temperature, shorten life and accelerates degradation of the positive plate

- The lifetime of Ni-Cd batteries is unaffected by ripple currents

VRLA failure modes
Storage

- VRLA batteries should not be stored for more then 6 month



- Filled and charged Ni-Cd batteries can be stored up to 1 year
  Routine freshening charges are not necessary during storage
- Empty and discharged Ni-Cd batteries can be stored for many years

Saft's product benefits for Backup

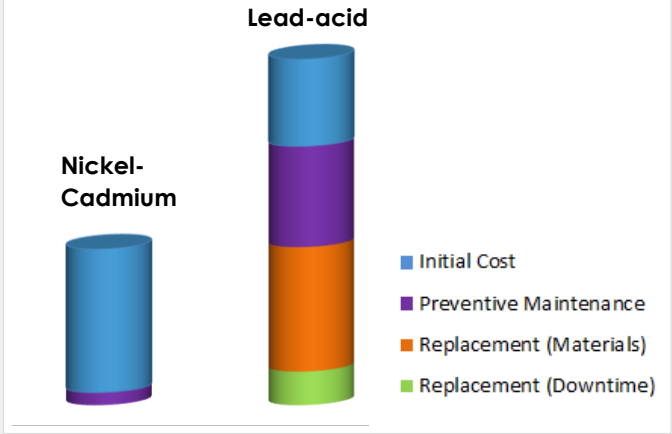
Saft Ni-Cd benefits versus Lead-acid

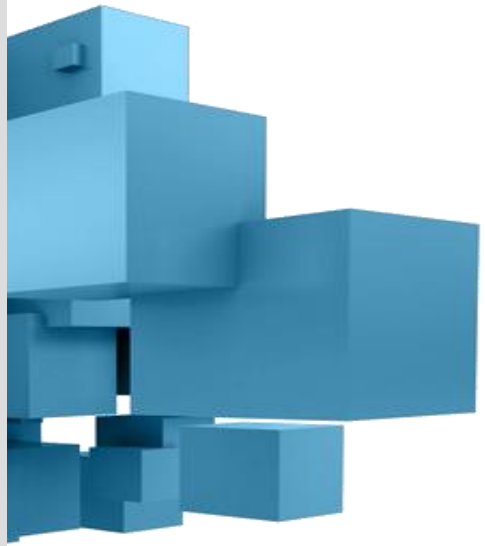
Lower TCO of Saft Nickel-Cadmium batteries

- No downtime cost
- No replacement cost
- Low maintenance cost
- Optimized performance

Lower cycle cost of Saft Nickel-Cadmium batteries versus lead-acid

Life-cycle cost comparison after 12 years





3. Amco Saft product range

Pocket plate Ni-Cd Product range & its applications

AMCO Saft offers **KPL**, **KPM**, **KPH & VRNM** offer different performance characteristics and cover a wide capacity range, enabling selection of an AMCO Saft Ni-Cd battery for any application:

(1) KPL : Low rate applications where requires low current for longer discharge periods

(2) KPM : "Mixed" loads which involve high and low discharge rates

(3) KPH : High rate applications where requires high current for shorter discharge periods

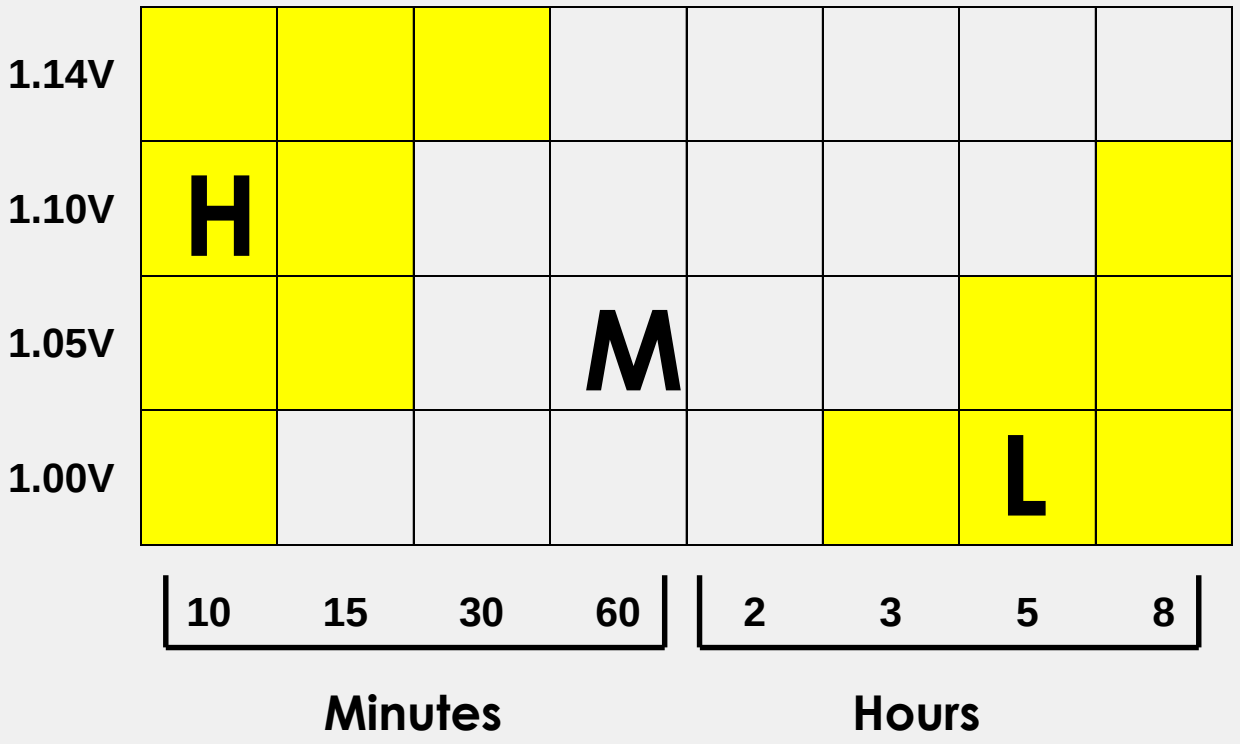
(4) VRNM : For medium rate applications with ultra low maintenance feature

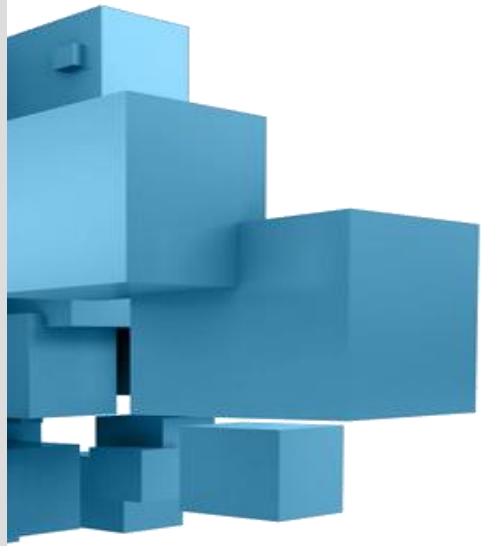
Pocket plate Ni-Cd Product range

Product range & capacity steps:

Sl.No.	Type	Min (Ah)	Max (Ah)	Capacity steps(No's)
1	KPH	8	1012	72
2	KPM	10	1365	52
3	KPL	11	1550	64
4	VRNM	9	750	42

Most cost effective product





4. Ni cad Battery sizing

Battery Sizing: Parameters

Voltage Window → **Maximum DC Voltage**
Minimum DC Voltage

Discharge Profile → **Current & Time**
or
Power & Time

Temperature

State of Charge

Ageing

Battery Sizing: DC Voltage Window

Voltage Window → **125 Volts Maximum**
99 Volts Minimum

No Choice!

87 Cells
- **Charging Voltage** → **1.44 Volts/Cell**
- **End of Discharge** → **1.14 Volts/Cell**

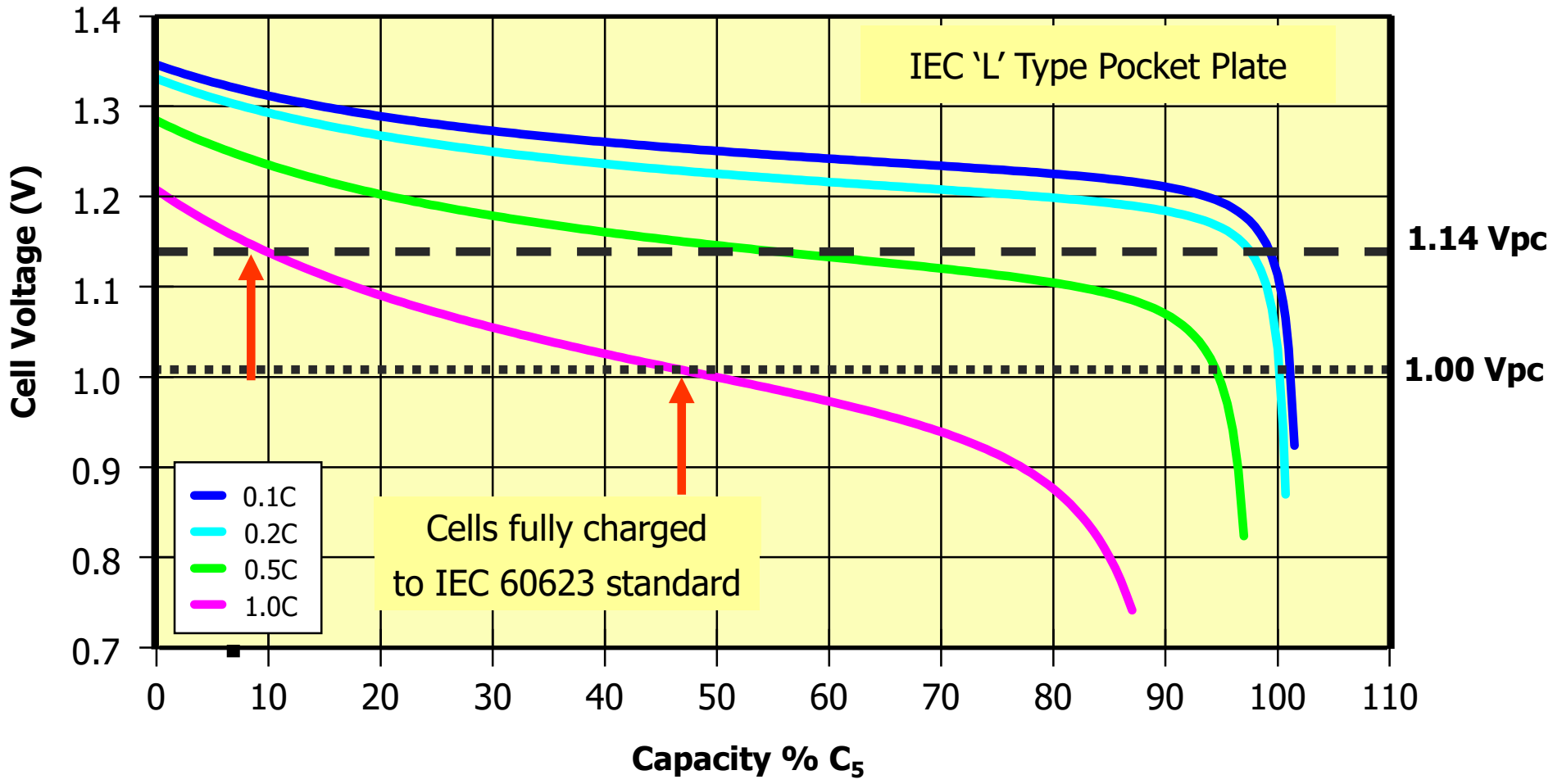
Battery Sizing: DC Voltage Window

Voltage Window → **130 Volts Maximum**
90 Volts Minimum

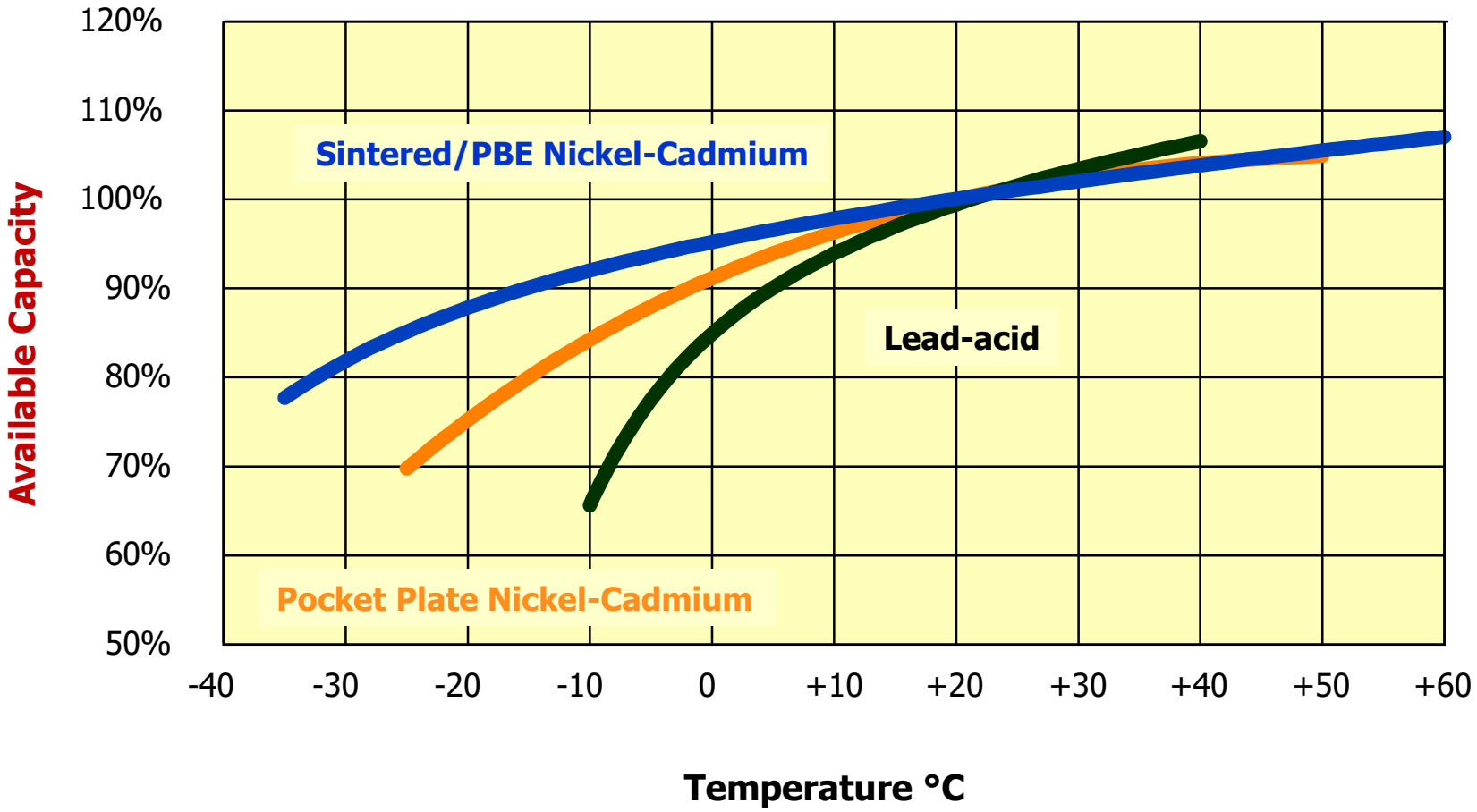
There is a Choice to be Made!

Number of Cells	**79**	**82**	**86**	**90**
Charge Voltage	**1.65 Vpc**	**1.59 Vpc**	**1.51 Vpc**	**1.44 Vpc**
End of Discharge	**1.14 Vpc**	**1.10 Vpc**	**1.05 Vpc**	**1.00 Vpc**

Battery Sizing: DC Voltage Window



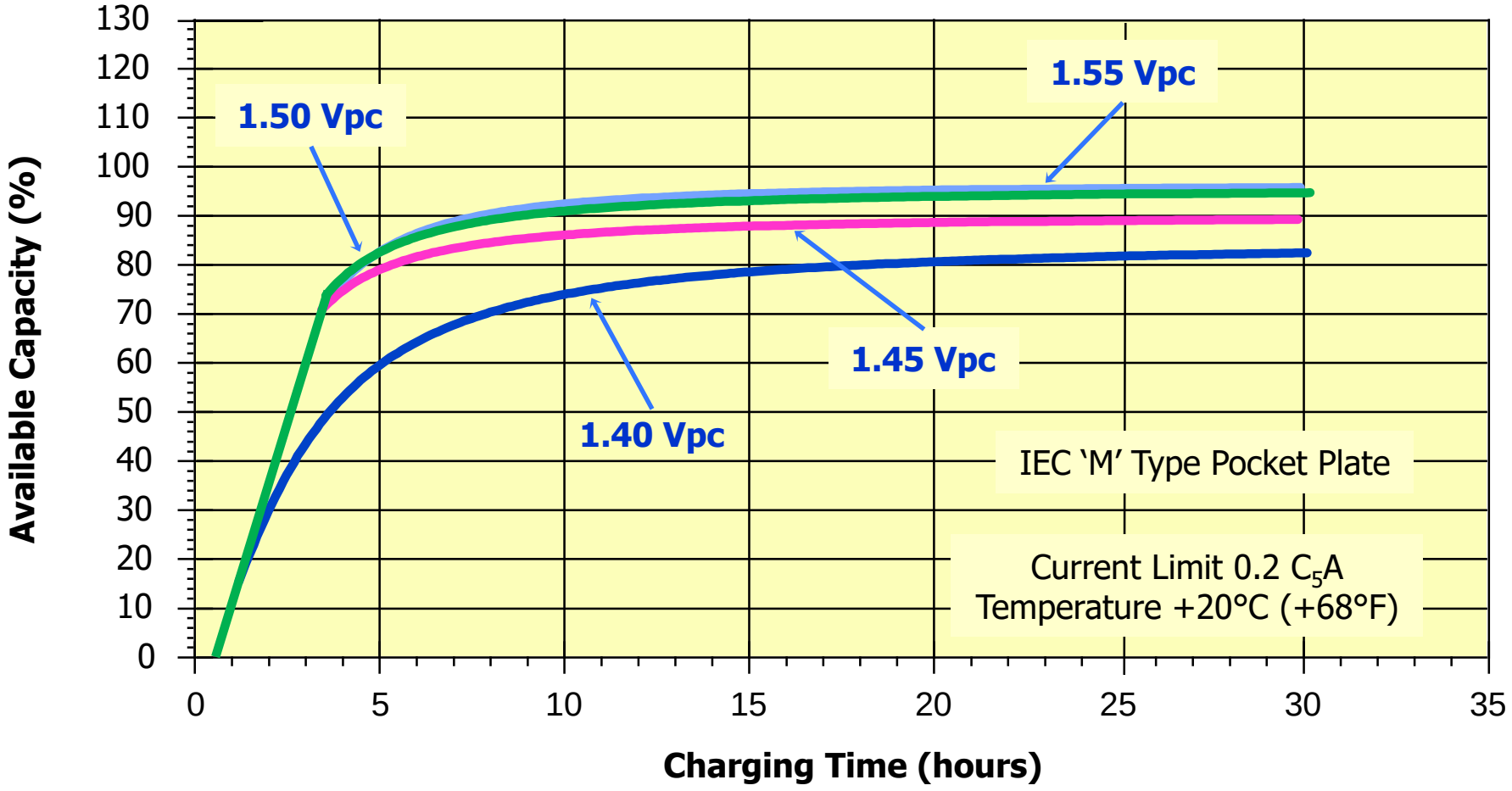
Battery Sizing: Temperature De-rating



Battery Sizing: Temperature De-rating

- Performance decreases with decreasing temperature
- Sizing at low temperature increases the battery size
- Before de-rating for low temperature operation, ensure that the specification requires the battery to give full discharge performance at that temperature
- Performance increases at temperatures above 20°C (68°F), but the battery is more difficult to charge

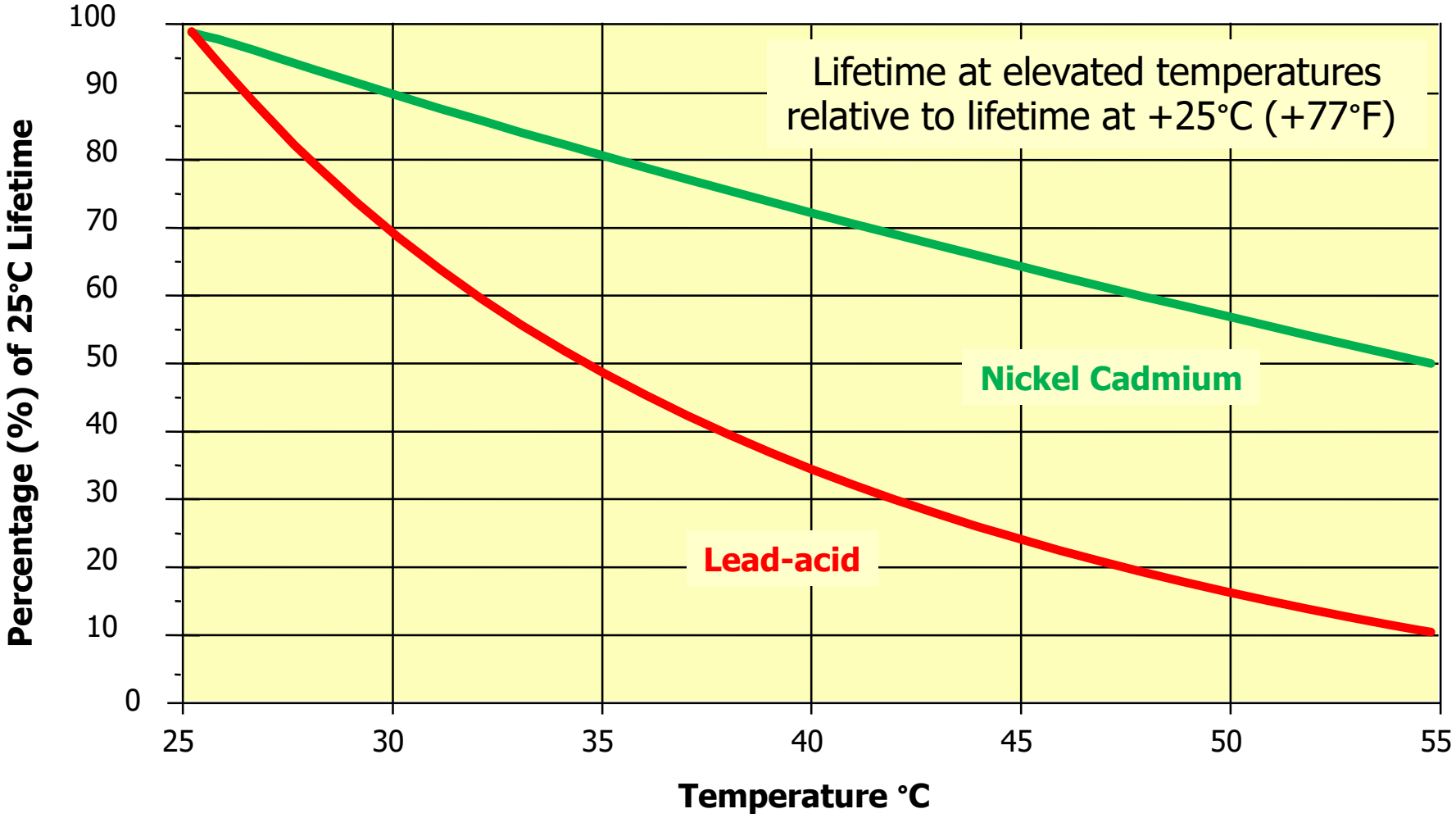
Battery Sizing: State of Charge



Battery Sizing: State of Charge

- When a battery is charged at constant voltage it requires time to reach full capacity
- The level of charge of a battery is not necessarily a measure of the ability of the battery to provide the service
- It is not necessary to add a factor for the state of charge unless it is requested and then, it should be related to the capacity required and not the capacity of the battery
- A requirement for a high state of charge does not necessarily mean a high charge voltage

Battery Sizing: Life Considerations



Battery Sizing: Life Considerations

- The lifetime of a nickel cadmium cell in stationary applications is in excess of +20 years
- The general factor for ageing is 1% per year in terms of loss of battery capacity
  - Note: IEC 60623 capacity is rated at five hours to 1.0 Volt with a current limit of 0.2 C_5
- The lifetime of a battery reduces with increasing temperature
- Sizing to the lowest end of discharge voltage possible helps the ageing

Battery Sizing: DC Voltage Window

Voltage Window → **130 Volts Max, 90 Volts Min**

Number of Cells	79	82	86	90
Charge Voltage	1.65 Vpc	1.59 Vpc	1.51 Vpc	1.44 Vpc
End of Discharge	1.14 Vpc	1.10 Vpc	1.05 Vpc	1.00 Vpc

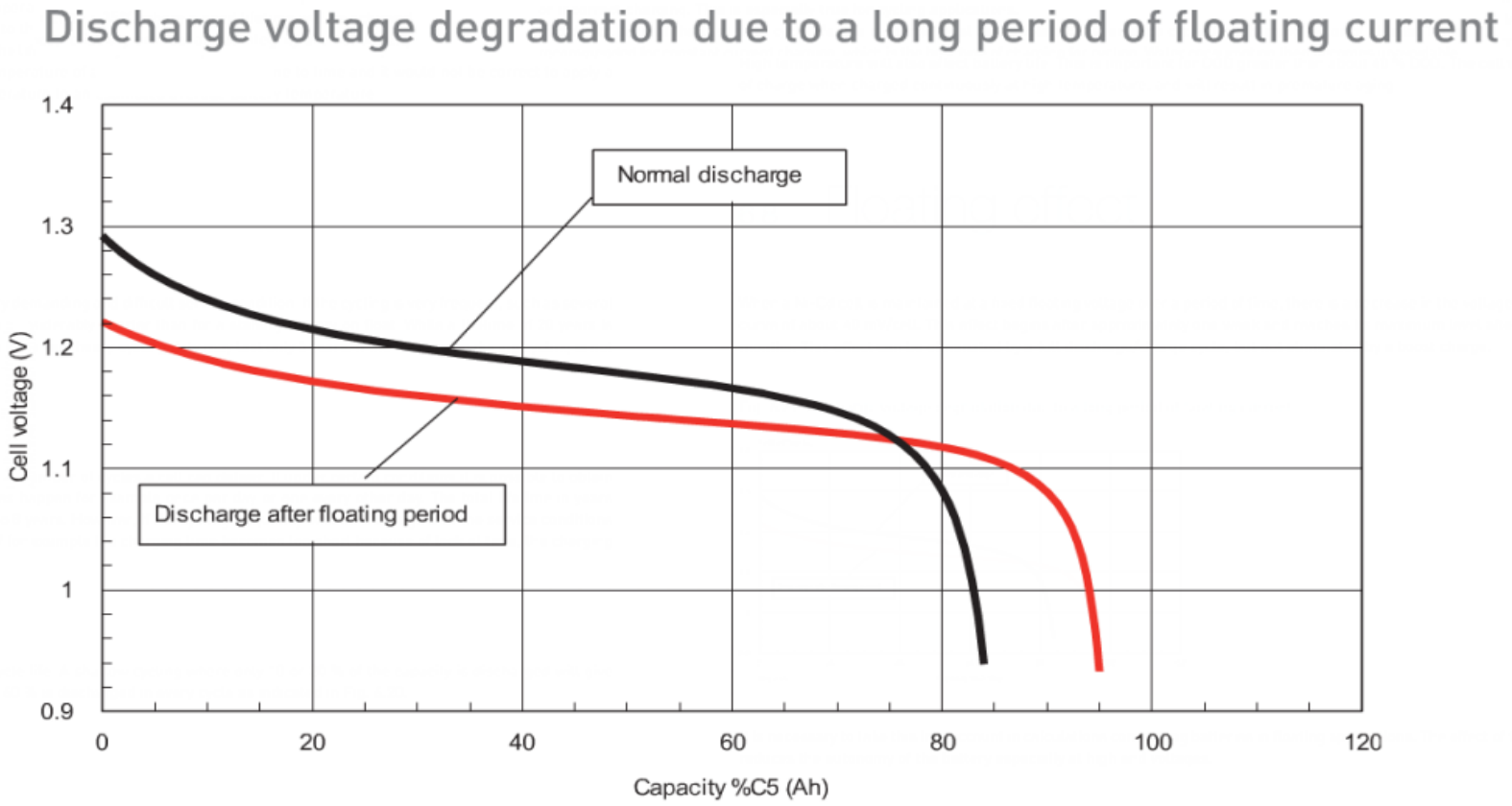
Sizing: 200 amps for 1 hour using IEC 'M' type performance,
fully charged data i.e. no allowance for floating effect

Capacity necessary	317 Ah	273 Ah	244 Ah	232 Ah
Total capacity (Ah)	25043	22386	20984	20880

Oversizing	**20%**	**7.0%**	**0.5%**	**0.0%**

Battery Sizing: Float Effect

- When Ni-Cd batteries are maintained at a fixed floating voltage over a period of time, there is a fall in the voltage level of the discharge curve



Battery Sizing: Float Effect

- The floating effect begins after one week
- After three months it is near its maximum
- It can be eliminated by a full discharge followed by a full recharge
- It cannot be eliminated by a boost/high-rate charge

Battery Sizing: Float Effect

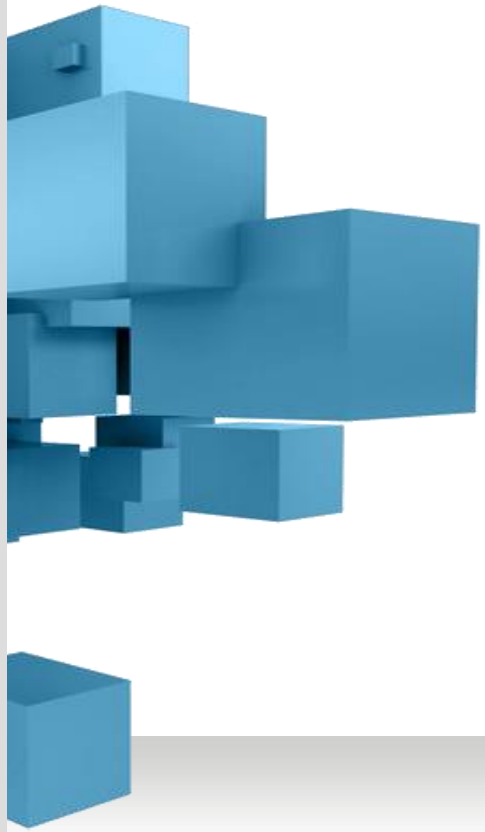
200 Amps for 1 hour – IEC 'M' Type → **130 Volts Max, 90 Volts Min**

Number of Cells	79	82	86	90
Charge Voltage	1.65 Vpc	1.59 Vpc	1.51 Vpc	1.44 Vpc
End of Discharge	1.14 Vpc	1.10 Vpc	1.05 Vpc	1.00 Vpc

Calculation with floating effect allowance

Floating Correction	0.72	0.77	0.82	0.87
Required Capacity	438 Ah	352 Ah	295 Ah	267 Ah
Total Capacity (Ah)	34602	28864	25370	24030

Oversizing **44%** **20%** **6%** **0%**



THANKS