# Sunica.plus Ni-Cd batteries

## Extended capability for challenging photovoltaic conditions


May 2009

# Performance
## beyond conventional limits

**Situated in the most punishing environments, photovoltaic applications experience conditions for energy storage that only the toughest battery can survive.**

## For the particular needs of photovoltaic applications...

The correct choice of battery energy storage is crucial to enable photovoltaic system efficiency. To optimise performance, and to guarantee uninterrupted service, batteries must withstand –

- cycling at variable state of charge (SOC) and depth of discharge (DOD)
- operation with erratic charging conditions
- wide temperature fluctuations
- absolute reliability with minimal maintenance
- unpredictable demands in isolated locations
- physical and mechanical abuses
- complex patterns of shallow and deep discharges

## ...the specialised solution is Sunica.plus Ni-Cd batteries...

Saft nickel-cadmium batteries are proven in the field of photovoltaics and are specified for their very broad capability and total reliability in uncertain conditions.

- corrosion-free steel internal construction, unaffected by alkaline electrolyte
- low life cycle cost
- electrochemically stable during charge and discharge (no plate degradation)

## ...for performance beyond the lead acid limit

- resistant to over- and under-charging, and complete discharge
- no premature capacity loss – sulphation – when cycled at low state of charge
- operates at temperatures lower than -20°C (-4°F) with no risk of freezing electrolyte

# Reliability
# – energy storage redefined

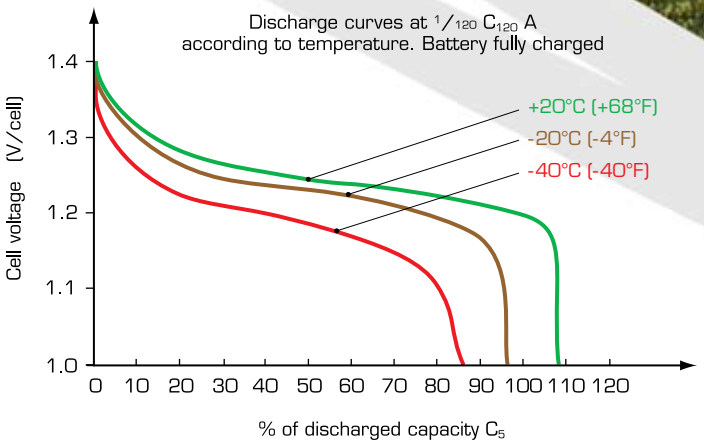
## Operates in extremes of temperature

Sunica.plus generally operates between temperatures of -20°C to +50°C (-4°F to +122°F) but can tolerate extremes of -50°C to +70°C (-58°F to +158°F).

For operation in temperatures below -20°C (-4°F), a special electrolyte with higher density is used.

Nickel-cadmium active materials remain stable when cycling during high states of charge and do not shed active mass during deep cycles. Sunica.plus operates with –

- no risk of sudden death
- no plate degradation or sulphation
- more than 80% of capacity for a typical 120 hour discharge at -40°C (-40°F)
- only 20% decrease in life at +30°C (+86°F), vs. 50% reduction for lead acid




## ...performs at any state of charge...

The stable alkaline electrolyte in Sunica.plus does not change during charge and discharge. It continues to operate irrespective of the charge level and is unaffected by accidental overcharge, deep discharges or inversion. During the critical winter months the charge efficiency is close to 100%.

## ...achieves 8000 cycles at 15% depth of discharge

At +20°C (+68°F), Sunica.plus nickel-cadmium batteries can achieve –

- up to 8000 cycles at 15% depth of discharge during its 20 years life
- good cycling ability in unstable photovoltaic conditions, even at partial state of charge

# Sunica.plus is new

**With a heritage of long life, reliable, low maintenance and low life cycle cost solutions, Saft Sunica.plus is an innovation in battery technology for photovoltaics.**

## Designed specifically for this application

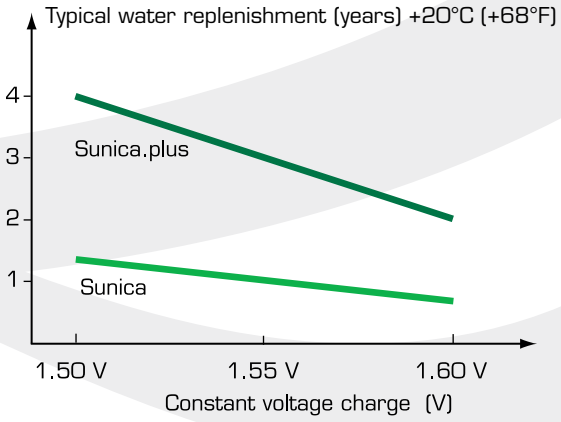
Sunica.plus has been developed in line with the safety requirements of EN 50272-2, and components used (such as insulated cable connectors and end lug covers) are defined to ensure high protection against electric shocks (IP2 level).

Sunica.plus features Saft's highly efficient internal gas recombination pocket plate technology – meets IEC 62259 – and electrode design, optimised for photovoltaic applications. These features, plus inherently safe Ni-Cd, provide the low maintenance service vital in isolated locations.

- more than 4 years maintenance-free intervals without topping-up, depending upon application requirements
- compatible with all current photovoltaic charge regulators
- improved cycling ability

### Optimised for practical reliability

- robust construction withstands heavy treatment
- unaffected by fluctuating climatic conditions
- resistant to electrical abuses
- integrated handles mean easy handling
- easy to install, simple block construction




# Robustness
## guaranteed by design

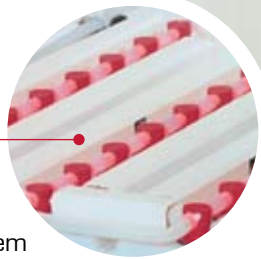
**Protective cover**
- to prevent external short-circuits
- in line with EN 50272-2 (safety) with IP2 level

**Flame arresting vent plug**
with transport seal protection

**Handles**


**Block concept**
up to 10 cells

**Cell container**
made of tough polypropylene



**Automated integral water filling system**

Saft's automated integral water filling system is available as an option for Sunica.plus cell types 185 Ah to 1110 Ah.

The main benefits of the system are:
- centrally monitors levels
- tops up accurately and efficiently when necessary
- enables gases generated to be evacuated outside the battery room

## 20 years low life cycle cost product

A combination of factors add up to give a predictably low life cycle cost.
- low maintenance
- fail-safe technology
- long life time
- easy to install
- 24 months storage filled and charged, ready for immediate commissioning

Over 20 years operation, typically cycling at an average 15% DOD, Saft Sunica.plus will rapidly repay initial battery investment and overall photovoltaic system costs through autonomous operation and total reliability.

## Where customers rely on Sunica

Around the coast of Scotland and the Isle of Man, 95 solar-powered land-based lighthouses have been equipped with Sunica batteries. Solar panels combined with a suitably sized and highly efficient 24 V battery can accumulate sufficient energy to ensure reliable signalling, even in the less sunny winter months.

An installation for Spencer Gulf Telecasters in Australia comprised a 3 kW solar array supported by two 18 cell parallel strings of SUN 84-1 Sunica cells, each with a nominal capacity of 860 Ah. In 2001 a further 3 kW solar array was installed together with another string of 18 SUN 84-1 Sunica cells.

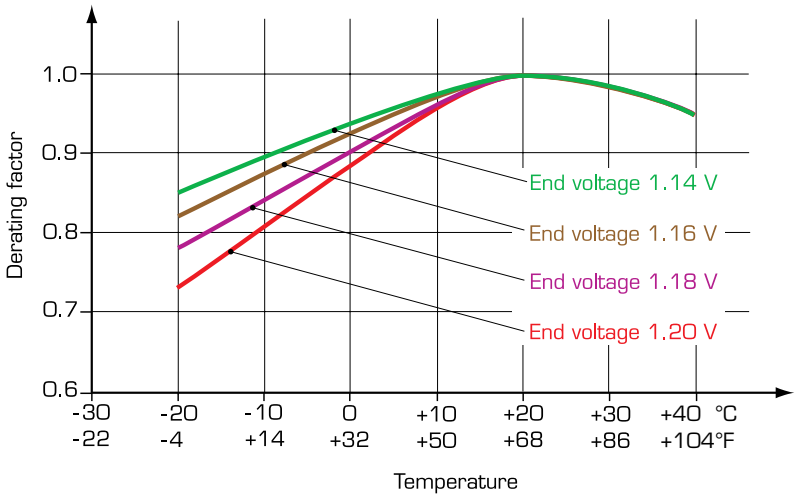
# A full range of solutions
## for a world of photovoltaic needs

| Sunica.plus type | Capacity $C_{120}$ 120 h 1.0 V Ah | Capacity $C_5$ 5 h 1.0 V Ah | Height mm | Height in | Width mm | Width in | Length per block 1 cell mm | 1 cell in | 2 cells mm | 2 cells in | 3 cells mm | 3 cells in | 4 cells mm | 4 cells in | 5 cells mm | 5 cells in | 6 cells mm | 6 cells in | 8 cells mm | 8 cells in | 9 cells mm | 9 cells in | 10 cells mm | 10 cells in | Approx. weight per cell kg | Approx. weight per cell lb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SUN⊕ 45 | 45 | 43 | 405 | 15.95 | 195 | 7.68 | | | | | 88 | 3.46 | 113 | 4.49 | 137 | 5.39 | 162 | 6.38 | 212 | 8.35 | 237 | 9.33 | 261 | 10.28 | 3.2 | 7.1 |
| SUN⊕ 90 | 90 | 85 | 405 | 15.95 | 195 | 7.68 | | | | | 121 | 4.76 | 157 | 6.18 | 192 | 7.56 | 228 | 8.98 | 300 | 11.81 | 336 | 13.23 | 371 | 14.61 | 4.9 | 10.8 |
| SUN⊕ 105 | 105 | 100 | 405 | 15.95 | 195 | 7.68 | | | | | 157 | 6.18 | 205 | 8.07 | 252 | 9.92 | 300 | 11.81 | 396 | 15.59 | 444 | 17.48 | | | 6.2 | 13.7 |
| SUN⊕ 140 | 140 | 128 | 405 | 15.95 | 195 | 7.68 | | | | | 157 | 6.18 | 205 | 8.07 | 252 | 9.92 | 300 | 11.81 | 396 | 15.59 | | | | | 6.7 | 14.8 |
| SUN⊕ 185 | 185 | 171 | 405 | 15.95 | 195 | 7.68 | | | | | 193 | 7.60 | 253 | 9.96 | 312 | 12.28 | 372 | 14.65 | | | | | | | 8.4 | 18.5 |
| SUN⊕ 230 | 230 | 213 | 405 | 15.95 | 195 | 7.68 | | | 159 | 6.26 | 232 | 9.13 | 305 | 12.01 | 377 | 14.84 | | | | | | | | | 9.9 | 21.8 |
| SUN⊕ 275 | 275 | 256 | 405 | 15.95 | 195 | 7.68 | | | 183 | 7.21 | 268 | 10.55 | 353 | 13.90 | 437 | 17.21 | | | | | | | | | 11.5 | 25.4 |
| SUN⊕ 320 | 320 | 300 | 405 | 15.95 | 195 | 7.68 | | | 228 | 8.98 | 336 | 13.23 | | | | | | | | | | | | | 15.1 | 33.3 |
| SUN⊕ 370 | 370 | 341 | 405 | 15.95 | 195 | 7.68 | | | 252 | 9.92 | 372 | 14.65 | | | | | | | | | | | | | 16.8 | 37.0 |
| SUN⊕ 415 | 415 | 384 | 405 | 15.95 | 195 | 7.68 | 146 | 5.75 | 278 | 10.95 | | | | | | | | | | | | | | | 18.3 | 40.4 |
| SUN⊕ 460 | 460 | 427 | 405 | 15.95 | 195 | 7.68 | 159 | 6.26 | 304 | 11.97 | | | | | | | | | | | | | | | 19.8 | 43.7 |
| SUN⊕ 505 | 505 | 469 | 405 | 15.95 | 195 | 7.68 | 171 | 6.73 | 328 | 12.91 | | | | | | | | | | | | | | | 21.4 | 47.2 |
| SUN⊕ 555 | 555 | 512 | 405 | 15.95 | 195 | 7.68 | 183 | 7.21 | 353 | 13.90 | | | | | | | | | | | | | | | 23.0 | 50.7 |
| SUN⊕ 645 | 645 | 597 | 405 | 15.95 | 195 | 7.68 | 219 | 8.62 | | | | | | | | | | | | | | | | | 28.2 | 62.2 |
| SUN⊕ 735 | 735 | 682 | 405 | 15.95 | 195 | 7.68 | 244 | 9.61 | | | | | | | | | | | | | | | | | 31.3 | 69.0 |
| SUN⊕ 830 | 830 | 768 | 405 | 15.95 | 195 | 7.68 | 268 | 10.55 | | | | | | | | | | | | | | | | | 34.5 | 76.1 |
| SUN⊕ 920 | 920 | 853 | 405 | 15.95 | 195 | 7.68 | 304 | 11.97 | | | | | | | | | | | | | | | | | 39.6 | 87.3 |
| SUN⊕ 1110 | 1110 | 1024 | 405 | 15.95 | 195 | 7.68 | 352 | 13.86 | | | | | | | | | | | | | | | | | 46.0 | 101 |

**Sunica.plus complies with IEC 62259 standard.**

## Derating factor according to temperature and end voltage

For typical solar application with
3 days or more backup time



# Cell performance in amperes at +20°C ± 5°C (+68°F ± 9°F)

**for fully charged cells after a constant current charge according to IEC 62259 standard.**

**d = days / h = hours**

| | End voltage = 1.14 V | | | | | | | | | End voltage = 1.16 V | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sunica.plus type** | **2 d 48 h** | **3 d 72 h** | **4 d 96 h** | **5 d 120 h** | **6 d 144 h** | **7 d 168 h** | **8 d 192 h** | **9 d 216 h** | **10 d 240 h** | **2 d 48 h** | **3 d 72 h** | **4 d 96 h** | **5 d 120 h** | **6 d 144 h** | **7 d 168 h** | **8 d 192 h** | **9 d 216 h** | **10 d 240 h** |
| SUN⊕ 45 | 0.94 | 0.64 | 0.48 | 0.39 | 0.33 | 0.28 | 0.25 | 0.22 | 0.20 | 0.92 | 0.63 | 0.47 | 0.39 | 0.33 | 0.28 | 0.25 | 0.22 | 0.20 |
| SUN⊕ 90 | 1.86 | 1.26 | 0.95 | 0.77 | 0.65 | 0.56 | 0.49 | 0.44 | 0.40 | 1.82 | 1.25 | 0.94 | 0.77 | 0.64 | 0.56 | 0.49 | 0.44 | 0.40 |
| SUN⊕ 105 | 2.19 | 1.49 | 1.11 | 0.90 | 0.76 | 0.66 | 0.58 | 0.52 | 0.47 | 2.15 | 1.47 | 1.10 | 0.90 | 0.76 | 0.65 | 0.58 | 0.52 | 0.47 |
| SUN⊕ 140 | 2.80 | 1.90 | 1.43 | 1.15 | 0.98 | 0.85 | 0.74 | 0.66 | 0.60 | 2.75 | 1.88 | 1.41 | 1.15 | 0.97 | 0.84 | 0.74 | 0.66 | 0.60 |
| SUN⊕ 185 | 3.74 | 2.54 | 1.91 | 1.54 | 1.31 | 1.13 | 0.99 | 0.89 | 0.80 | 3.67 | 2.52 | 1.89 | 1.54 | 1.29 | 1.12 | 0.99 | 0.89 | 0.80 |
| SUN⊕ 230 | 4.66 | 3.17 | 2.37 | 1.92 | 1.63 | 1.41 | 1.23 | 1.10 | 0.99 | 4.57 | 3.14 | 2.35 | 1.92 | 1.61 | 1.39 | 1.23 | 1.10 | 0.99 |
| SUN⊕ 275 | 5.60 | 3.80 | 2.85 | 2.30 | 1.96 | 1.69 | 1.48 | 1.33 | 1.19 | 5.49 | 3.77 | 2.83 | 2.30 | 1.94 | 1.68 | 1.48 | 1.33 | 1.19 |
| SUN⊕ 320 | 6.56 | 4.46 | 3.34 | 2.70 | 2.29 | 1.98 | 1.73 | 1.56 | 1.40 | 6.44 | 4.42 | 3.31 | 2.70 | 2.27 | 1.96 | 1.73 | 1.56 | 1.40 |
| SUN⊕ 370 | 7.46 | 5.07 | 3.80 | 3.07 | 2.60 | 2.25 | 1.97 | 1.77 | 1.59 | 7.32 | 5.02 | 3.77 | 3.07 | 2.58 | 2.23 | 1.97 | 1.77 | 1.59 |
| SUN⊕ 415 | 8.40 | 5.71 | 4.28 | 3.46 | 2.93 | 2.54 | 2.22 | 1.99 | 1.79 | 8.24 | 5.65 | 4.24 | 3.46 | 2.91 | 2.51 | 2.22 | 1.99 | 1.79 |
| SUN⊕ 460 | 9.34 | 6.35 | 4.76 | 3.84 | 3.26 | 2.82 | 2.47 | 2.21 | 1.99 | 9.16 | 6.29 | 4.71 | 3.84 | 3.23 | 2.80 | 2.47 | 2.21 | 1.99 |
| SUN⊕ 505 | 10.26 | 6.97 | 5.23 | 4.22 | 3.58 | 3.10 | 2.71 | 2.43 | 2.19 | 10.06 | 6.90 | 5.18 | 4.22 | 3.55 | 3.07 | 2.71 | 2.43 | 2.19 |
| SUN⊕ 555 | 11.20 | 7.61 | 5.71 | 4.61 | 3.91 | 3.38 | 2.96 | 2.65 | 2.39 | 10.99 | 7.54 | 5.65 | 4.61 | 3.88 | 3.35 | 2.96 | 2.65 | 2.39 |
| SUN⊕ 645 | 13.06 | 8.87 | 6.65 | 5.37 | 4.56 | 3.94 | 3.45 | 3.10 | 2.79 | 12.81 | 8.79 | 6.59 | 5.37 | 4.52 | 3.91 | 3.45 | 3.10 | 2.79 |
| SUN⊕ 735 | 14.92 | 10.14 | 7.60 | 6.14 | 5.21 | 4.51 | 3.94 | 3.54 | 3.18 | 14.63 | 10.04 | 7.53 | 6.14 | 5.16 | 4.47 | 3.94 | 3.54 | 3.18 |
| SUN⊕ 830 | 16.80 | 11.41 | 8.56 | 6.91 | 5.87 | 5.07 | 4.44 | 3.98 | 3.58 | 16.48 | 11.31 | 8.48 | 6.91 | 5.81 | 5.03 | 4.44 | 3.98 | 3.58 |
| SUN⊕ 920 | 18.66 | 12.68 | 9.51 | 7.68 | 6.52 | 5.64 | 4.93 | 4.42 | 3.98 | 18.30 | 12.56 | 9.42 | 7.68 | 6.46 | 5.59 | 4.93 | 4.42 | 3.98 |
| SUN⊕ 1110 | 22.40 | 15.52 | 11.41 | 9.22 | 7.82 | 6.77 | 5.92 | 5.31 | 4.78 | 21.97 | 15.08 | 11.31 | 9.22 | 7.75 | 6.70 | 5.92 | 5.31 | 4.78 |

| | End voltage = 1.18 V | | | | | | | | | End voltage = 1.20 V | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sunica.plus type** | **2 d 48 h** | **3 d 72 h** | **4 d 96 h** | **5 d 120 h** | **6 d 144 h** | **7 d 168 h** | **8 d 192 h** | **9 d 216 h** | **10 d 240 h** | **2 d 48 h** | **3 d 72 h** | **4 d 96 h** | **5 d 120 h** | **6 d 144 h** | **7 d 168 h** | **8 d 192 h** | **9 d 216 h** | **10 d 240 h** |
| SUN⊕ 45 | 0.89 | 0.62 | 0.47 | 0.38 | 0.32 | 0.28 | 0.24 | 0.22 | 0.20 | 0.82 | 0.57 | 0.43 | 0.36 | 0.31 | 0.27 | 0.24 | 0.21 | 0.19 |
| SUN⊕ 90 | 1.75 | 1.22 | 0.93 | 0.76 | 0.64 | 0.55 | 0.48 | 0.43 | 0.39 | 1.61 | 1.13 | 0.86 | 0.71 | 0.61 | 0.53 | 0.46 | 0.42 | 0.38 |
| SUN⊕ 105 | 2.06 | 1.43 | 1.09 | 0.89 | 0.75 | 0.65 | 0.57 | 0.51 | 0.46 | 1.90 | 1.33 | 1.01 | 0.83 | 0.72 | 0.62 | 0.55 | 0.49 | 0.44 |
| SUN⊕ 140 | 2.64 | 1.83 | 1.40 | 1.14 | 0.96 | 0.83 | 0.73 | 0.65 | 0.59 | 2.43 | 1.71 | 1.29 | 1.07 | 0.92 | 0.79 | 0.70 | 0.63 | 0.57 |
| SUN⊕ 185 | 3.53 | 2.45 | 1.87 | 1.52 | 1.28 | 1.11 | 0.97 | 0.87 | 0.78 | 3.24 | 2.28 | 1.73 | 1.43 | 1.22 | 1.06 | 0.94 | 0.84 | 0.76 |
| SUN⊕ 230 | 4.39 | 3.05 | 2.33 | 1.90 | 1.60 | 1.38 | 1.21 | 1.08 | 0.98 | 4.04 | 2.84 | 2.15 | 1.78 | 1.52 | 1.32 | 1.16 | 1.05 | 0.94 |
| SUN⊕ 275 | 5.28 | 3.66 | 2.80 | 2.28 | 1.92 | 1.66 | 1.45 | 1.30 | 1.17 | 4.85 | 3.41 | 2.59 | 2.13 | 1.83 | 1.58 | 1.40 | 1.26 | 1.13 |
| SUN⊕ 320 | 6.19 | 4.29 | 3.28 | 2.68 | 2.25 | 1.95 | 1.70 | 1.53 | 1.38 | 5.69 | 4.00 | 3.03 | 2.50 | 2.15 | 1.86 | 1.64 | 1.47 | 1.33 |
| SUN⊕ 370 | 7.03 | 4.88 | 3.73 | 3.04 | 2.56 | 2.21 | 1.94 | 1.74 | 1.56 | 6.46 | 4.55 | 3.45 | 2.84 | 2.44 | 2.11 | 1.86 | 1.67 | 1.51 |
| SUN⊕ 415 | 7.92 | 5.49 | 4.20 | 3.42 | 2.88 | 2.49 | 2.18 | 1.96 | 1.76 | 7.28 | 5.12 | 3.88 | 3.20 | 2.75 | 2.38 | 2.10 | 1.88 | 1.70 |
| SUN⊕ 460 | 8.81 | 6.11 | 4.67 | 3.81 | 3.20 | 2.77 | 2.42 | 2.17 | 1.96 | 8.10 | 5.69 | 4.31 | 3.56 | 3.05 | 2.64 | 2.34 | 2.10 | 1.89 |
| SUN⊕ 505 | 9.67 | 6.71 | 5.13 | 4.18 | 3.52 | 3.04 | 2.66 | 2.39 | 2.15 | 8.89 | 6.25 | 4.74 | 3.91 | 3.35 | 2.90 | 2.56 | 2.30 | 2.07 |
| SUN⊕ 555 | 10.56 | 7.32 | 5.60 | 4.57 | 3.84 | 3.32 | 2.91 | 2.61 | 2.35 | 9.71 | 6.83 | 5.17 | 4.27 | 3.66 | 3.17 | 2.80 | 2.51 | 2.26 |
| SUN⊕ 645 | 12.31 | 8.54 | 6.53 | 5.32 | 4.48 | 3.87 | 3.39 | 3.04 | 2.74 | 11.32 | 7.96 | 6.03 | 4.98 | 4.27 | 3.70 | 3.26 | 2.93 | 2.64 |
| SUN⊕ 735 | 14.07 | 9.76 | 7.46 | 6.08 | 5.12 | 4.42 | 3.87 | 3.47 | 3.13 | 12.93 | 9.09 | 6.89 | 5.68 | 4.88 | 4.22 | 3.73 | 3.35 | 3.01 |
| SUN⊕ 830 | 15.84 | 10.99 | 8.40 | 6.85 | 5.76 | 4.98 | 4.36 | 3.91 | 3.52 | 14.56 | 10.24 | 7.76 | 6.40 | 5.49 | 4.75 | 4.20 | 3.77 | 3.39 |
| SUN⊕ 920 | 17.59 | 12.20 | 9.33 | 7.61 | 6.40 | 5.53 | 4.84 | 4.34 | 3.91 | 16.17 | 11.37 | 8.62 | 7.11 | 6.10 | 5.28 | 4.66 | 4.19 | 3.77 |
| SUN⊕ 1110 | 21.12 | 14.65 | 11.20 | 9.13 | 7.68 | 6.64 | 5.81 | 5.21 | 4.69 | 19.41 | 13.65 | 10.35 | 8.53 | 7.32 | 6.34 | 5.60 | 5.03 | 4.52 |

## Sizing

Saft find the optimum battery solution by calculating –

I load
x
1/temperature derating factor
x
1/charge derating factor*
x
requested design margin
=
current value to select in the performance table

*The typical value is 90% when using the recommended charge voltage

## Recommended charge voltage

| **Battery system** | | 12 V | 24 V | 48 V |
|---|---|---|---|---|
| **Number of cells** | | 9 | 18 | 36 |
| **Daily Depth of Discharge (% of $C_{120}$)** | 5 to 10% | 13.5 V | 27 V | 54 V |
| | 10 to 15% | 13.95 V | 27.9 V | 55.8 V |
| | 15 to 25% | 14.4 V | 28.8 V | 57.6 V |

**Saft is committed to the highest standards of environmental stewardship.**

Implementing this commitment to minimise the impact of its products and operations on the environment means that Saft gives priority to recycled over unrecycled raw materials, reduces its plant releases into the environment year after year, minimizes water usage, and ensures that its customers have recycling solutions for their batteries at the end of their lives.

Regarding industrial Ni-Cd batteries, Saft has had partnerships for many years with collection companies in most EU countries as well as in North America. This collection network receives and dispatches our customers' batteries at the end of their lives to fully approved recycling facilities, in compliance with the Laws governing transboundary waste shipments. Saft offers these services free of charge to its customers.

Please find a list of our collection points on our web site.

In other countries, Saft assists its customers in finding environmentally sound recycling solutions. Please contact your sales representative for further information.

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