

Portable Ni-Cd, Ni-MH and Li-ion Worldwide Selector Guide



S A F T

The right battery

for every application

Saft, a worldwide leader in the design, development and manufacture of portable power systems, has developed a broad range of high performance nickel-cadmium, nickel-metal hydride, and lithium-ion cells to meet the requirements of a wide range of applications. Saft's full range of cells and battery pack solutions use both proven and innovative technologies for exceptional performance tailored to your specific needs. For the best and latest rechargeable button, cylindrical and prismatic cells in a wide range of capacities, look no further than Saft.

Saft batteries offer exceptional performance:

- ▼ constant voltage during discharge
- ▼ high power
- ▼ a broad temperature range (-40°C to +65°C)
- ▼ a lifetime often outlasting the equipment they serve
- ▼ zero maintenance
- ▼ extremely high reliability
- ▼ long cycle life (over 500 charge-discharge cycles)
- ▼ excellent long term storage

Saft factories are certified ISO 9001.



Saft meets all your needs

Saft's solutions are customer-driven. Our standard batteries and special power assemblies are engineered to meet the growing power needs of portable and cordless communications, recreation, personal computing and security. Saft batteries can be found in:

Communications

Includes cellular and cordless phones, Personal Communication systems (PCs), private mobile radios, portable fax machines, pagers and military transceivers.

Electronics

Includes notebook computers and personal digital assistants, medical electronics, portable handheld terminals, gas detectors and other instrumentation equipments.

Audio/video

Includes camcorders, portable TV's, CD players and personal stereos, and digital cameras.

Security devices

Includes emergency lighting units, computer back-up systems, portable lanterns, automobile and other alarms.

Power tools

Includes cordless drills, sanders, screwdrivers, lawn and other gardening equipment.

Home appliances

Includes cordless vacuum cleaners, shavers, toothbrushes and more.

Battery powered toys

Includes electronic games, walkman, radio-controlled cars, boats and planes.

Memory back-up

Includes all memory back-up applications such as computers, fax machines, alarms, payphones and cash registers.

Mobility

Includes E-bikes and other light electric vehicles.



A full-cycle, total product commitment

Naturally, the use of rechargeables is an environment-friendly act since the batteries can be used over and over again. In addition, Saft is extremely sensitive to protecting nature through the battery's entire life cycle. Saft factories strictly adhere to environmental regulations concerning air, water, ground and solid-waste standards. When batteries have given their best through existing national collection and recycling organisms (i.e. RBRC in US, S.C.R.A. in France, and others in European countries), Saft offers a collection and treatment service to recycle Ni-Cd and Ni-MH batteries safely and efficiently. Saft also operates a recycling plant in Sweden, in Oskarshamn.

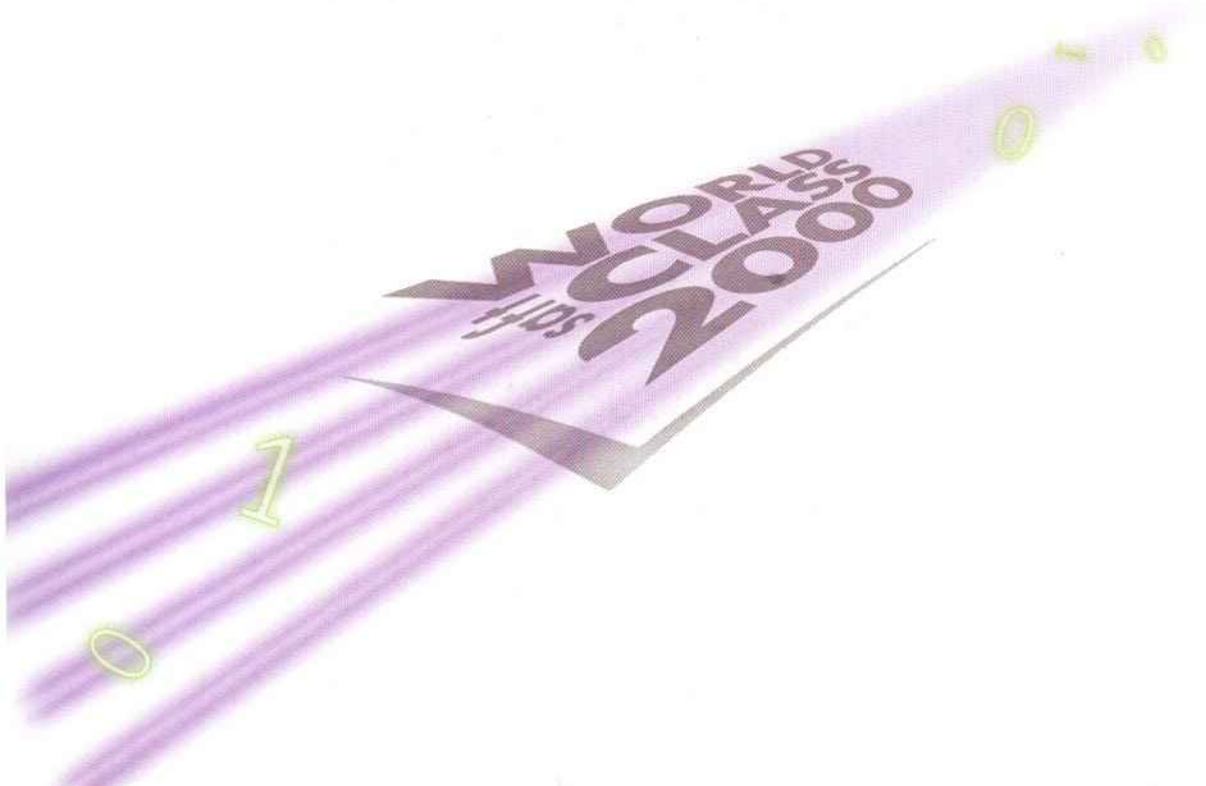
You can also consult: oecd.org/ehs/nicd/nicdloc.htm

In other countries without organizations, Saft is here to provide you information.

Application									
VR	▼	▼	▼	▼	▼	▼	▼	▼	▼
VRE	▼	▼	▼	▼	▼	▼	▼	▼	▼
VE/VSE	▼	▼	▼	▼	▼	▼	▼	▼	▼
VH	▼	▼	▼	▼	▼			▼	▼
VT				▼					▼
GB/HB	▼	▼							▼
MP	▼	▼	▼			▼	▼	▼	

▼ Possible

▼ Recommended



Power solutions for people on the move

STANDARD | VR and VRE series

Ni-Cd Engineered for cycling applications, Saft's standard series can be used for a wide range of applications. In addition, the VRE series is well-adapted for applications requiring a permanent charge (C/20 to C/15) at temperatures of up to +35°C. These two standard series have been produced in hundreds of millions of units for many years, with a high level of reliability. They offer an excellent cost/performance ratio.



Nominal voltage: 1.2 Volt/cell

Saft type	Size	IEC Capacity at 0.2C rate		Standard charge		Quick or fast charge		Internal impedance m Ω	Max. Dimensions for bare cells		Approx weight (g)
		Typical (mAh)	Minimum (mAh)	Current (mA)	Time (h)	Current (mA)	Time (h)		Diameter (mm)	Height (mm)	
VR											
▼ VR 1/3AA	1/3AA	140	110	11	16	130	~1	37	13.6	16.8	7
▼ VR 1/2C	1/2C	840	700	70	16	233	~4	-	25.6	24.0	37
▼ VR 2/3D	2/3D	2850	2500	250	16	2500	~1	3.3	32.4	43.3	103
▼ VR 4 D	D	4500	4000	400	16	4000	~1	3.1	32.4	60.3	145
▼ VR 7 FL	F	7700	7000	700	16	3500	~2.5	2.7	32.4	89.1	228
▼ VR 10SF	SF	11600	10000	1000	16	-	-	2.0	41.2	89.0	390
VRE											
▼ VRE AAA	AAA	240	220	22	16	70	~4	20	10.7	44.5	10
▼ VRE 1/3AA	1/3AA	145	130	13	16	130	~1	48	13.6	16.8	7
▼ VRE 1/2AA	1/2AA	350	300	30	16	100	~4	30	14.0	29.8	12
▼ VRE 1/2AA 350	1/2AA	380	350	35	16	150	~4	30	14.0	29.8	14
▼ VRE AA 600	AA	660	600	60	16	600	~1	16	14.0	49.2	20
▼ VRE AA 700H	AA	780	700	70	16	233	~4	21	14.0	50.2	22
▼ VRE AA 600*	AA	700	600	60	16	600	~1	16	14.0	49.2	20
▼ VRE AA 700*	AA	780	700	70	16	700	~1	14	14.0	49.2	21
▼ VRE Cs 1300R	Cs	1450	1300	130	16	1300	~1	6	22.2	42.2	46
▼ VRE Cs 1400	Cs	1600	1400	140	16	1400	~1	6	22.2	42.2	49
▼ VRE Cs 1800	Cs	1800	1700	170	16	1700	~1	5	22.2	42.2	50
▼ VRE C	C	2550	2300	230	16	800	3~4	8	25.6	47.9	77
▼ VRE 1/2D	1/2D	2550	2400	240	16	800	3~4	18	32.3	36.8	82
▼ VRE D**	D	5000	4500	450	16	900	3~4	4	32.3	58.6	134

* Those cells, VRE AA 600 and VRE AA 700 are also available with a high top. Diameter is similar. The projection of the top is 1.7 ± 0.2 mm, the flat area diameter is 4.0 mm, and the total height of the cell 49.9 ± 0.3 mm. Another cell, with a high top, is also available for cordless and DECT phones for continuous charge: VRE AAH 700C. Please consult Saft.

** Enhanced version with a minimum IEC capacity of 5000 mAh (typical IEC: 5400 mAh) now under development.

▼ Available for North America only.

Note: Specifications are subject to modification without notice for further improvement.

HIGH TEMPERATURE | VT series

Ni-Cd These cells accept a permanent charge (C/20 to C/15) for a minimum of 4 years in high-temperature environments (up to +40°C) such as security lighting equipment. Improved versions of the cells, such as the VTD 70, can withstand a constant temperature of up to +55°C with a similar lifetime when permanently charged. Temperatures up to +60°C are permitted for short durations.



Nominal voltage: 1.2 Volt/cell

Saft type	Size	IEC Capacity at 0.2C rate		Standard charge		Permanent charge		Internal impedance m Ω	Max. Dimensions for bare cells		Approx weight (g)
		Typical (mAh)	Minimum (mAh)	Current (mA)	Time (h)	Current (mA)	Time (h)		Diameter (mm)	Height (mm)	
VT											
▼ VT AA	AA	700	600	60	16	30	-	16	14.0	50.2	20
▼ VT Cs	Cs	1350	1200	120	16	60	-	12	22.2	42.2	45
▼ VT Cs 1500	Cs	1700	1500	150	16	75	-	8	22.2	42.2	48
▼ VT Cs HC	Cs	1750	1600	160	16	80	-	7	22.2	42.2	49
▼ VTC	C	2500	2200	220	16	110	-	14	25.6	47.9	75
▼ VT 1/2D	1/2D	2500	2200	220	16	110	-	10	32.3	36.8	80
▼ VTD	D	4300	4000	400	16	200	-	7	32.3	60.3	132
▼ VTD 70	D	4550	4000	400	16	200	-	6	32.4	60.3	134
▼ VTD	D	4400	4000	400	16	200	-	7	32.3	58.6	134
▼ VTD U	D	4700	4000	400	16	200	-	6	32.3	58.6	136
▼ VTF	F	7600	7000	700	16	350	-	5	32.4	91.1	210

HIGH ENERGY | VE and VSE series

Ni-Cd With the VE series, Saft upgraded its standard technology: it boosted capacity by 10 to 15% without increasing volume, while at the same time maintaining performance levels in terms of repeated recharge capacity, internal resistance, overall operating temperature range, and fast-charge capability. The VSE series uses advanced nickel foam electrode technology providing both fast charge and higher capacity meeting the needs of today's light and compact portable equipment.



Nominal voltage: 1.2 Volt/cell

Saft type	Size	IEC Capacity at 0.2C rate		Standard charge		Quick or fast charge		Internal impedance m Ω	Max. Dimensions for bare cells		Approx weight (g)
		Typical (mAh)	Minimum (mAh)	Current (mA)	Time (h)	Current (mA)	Time (h)		Diameter (mm)	Height (mm)	
VE											
▼ VE 2/3A	2/3A	670	600	60	16	600	~1	25	16.7	28.0	18
▼ VE 4/5A	4/5A	1050	1000	100	16	1200	~1	21	16.7	42.3	27
▼ VE Cs	Cs	1560	1400	140	16	1680	~1	5	22.2	42.2	48
▼ VE C	C	2400	2200	220	16	2200	~1	5	25.6	47.9	75
▼ VE D	D	5100	4500	450	16	4500	~1	2.6	32.4	58.8	150
VSE											
▼ VSE AA*	AA	980	940	94	16	940	~1	16	14.0	49.2	22
▼ VSE 4/5A	4/5A	1300	1200	120	16	1200	~1	17	16.7	42.3	28

* This cell, VSE AA, is also available with a high top. Diameter is similar. The projection of the top is 1.7 ± 0.2 mm, the flat area diameter is 4.0 mm, and the total height of the cell 49.9 ± 0.3 mm.

Enhanced version with a minimum capacity of 1000 mAh (typical IEC: 1050 mAh) now under development.

▼ Available for North America only.

Note: Specifications are subject to modification without notice for further improvement.

Li-ion Prismatic MP series

SUPER HIGH ENERGY | VH series

Ni-MH Saft's range of Ni-MH cylindrical cells is being extended. Manufactured for use in high capacity, the cells are designed for telecommunications and other portable applications which demand fast charge and discharge over a prolonged lifetime. The latest VH Cs 3000 is designed for applications requiring fast charge and high discharge rates (40 A), and specially targets cordless power tools applications, radio control models and portable medical equipment.



Nominal voltage: 1.2 Volt/cell

Saft type	Size	IEC Capacity at 0.2C rate		Standard charge		Quick or fast charge		Internal impedance m Ω	Max. Dimensions for bare cells			Approx weight (g)
		Typical (mAh)	Minimum (mAh)	Current (mA)	Time (h)	Current (mA)	Time (h)		Diameter (mm)	Height (mm)		
VH												
VH AAA 650	AAA	700	650	65	16	650	~1	25	10.1	44.3	12	
VH AA*	AA	1300	1200	120	16	1200	~1	21	14.0	49.2	25	
VH AA 1500*	AA	1500	1400	140	16	1400	~1	20	14.0	49.2	26	
VH 4/5A	4/5A	1720	1600	160	16	1600	~1	25	16.7	42.3	33	
VH Cs 3000	Cs	2820	2630	300	16	2000/1000	~1.75/3.50	5	22.2	42.4	59	
Under development												
VH AAA 700	AAA	750	700	70	16	700	~1	22	10.1	44.3	12	
VH 4/5 Cs 2000	4/5 Cs	2000	1800	200	16	650	~3.5	<5	22.2	~33.0	45	
VH D 8500	D	8500	8000	850	16	4000	~2.3	4	32.3	58.6	160	
VH F 13000	F	13000	12000	1300	16	4000	~3.5	~4	32.3	89.1	250	

* Those cells, VH AA and VH AA 1500, are also available with a high top. Diameter is similar. The projection of the top is 1.7 ± 0.2 mm, the flat area diameter is 4.0 mm, and the total height of the cell is 49.9 ± 0.3 mm.

BUTTON | GB series

Ni-Cd GB button cells have been designed to produce a permanent charge to supply back-up memory for both consumer and industrial applications.



Nominal voltage: 1.2 Volt/cell

Saft type	Size	IEC Capacity at 0.2C rate		Standard charge		Permanent charge		Internal impedance m Ω	Max. Dimensions for bare cells			Approx weight (g)
		Typical (mAh)	Minimum (mAh)	Current (mA)	Time (h)	Current (mA)	Time (h)		Diameter (mm)	Height (mm)		
GB												
GB 280	-	310	280	28	16	0.9-9.3	-	-	23.2	9.5	12.5	

BUTTON | HB series

Ni-MH HB button cells can produce as the GB button cell, the permanent charge to supply back-up memory for both consumer and industrial applications. They have been developed using the nickel-metal hydride technology. Assembly has been engineered to facilitate insertion into integrated circuits.



Nominal voltage: 1.2 Volt/cell

Saft type	Size	IEC Capacity at 0.2C rate		Standard charge		Permanent charge		Internal impedance m Ω	Max. Dimensions for bare cells			Approx weight (g)
		Typical (mAh)	Minimum (mAh)	Current (mA)	Time (h)	Current (mA)	Time (h)		Diameter (mm)	Height (mm)		
HB												
HB 70	-	80	70	7	16	-	-	-	15.6	6.1	3.5	
Under development												
HB 210	-	-	210	21	16	-	-	-	23.2	6.7	9.5	

Note: Specifications are subject to modification without notice for further improvement.

PRISMATIC | MP series

Li-ion Saft designed the MP range to meet the energy needs of sophisticated portable electronic applications. MP cells are unique in the world in offering the most energy efficient format for rechargeable lithium-ion technology. With a typical capacity ranging from 2.3 to 5.5 Ah, MP cells provide up to three times more power than other technologies.

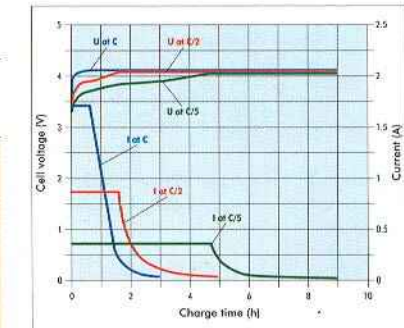


Nominal voltage: 3.6 Volt/cell

Saft type	Capacity at 0.2C rate		Maximum Discharge Current (mA)	Minimum Discharge Voltage (V)	Internal impedance m Ω	Max. Dimensions for bare cells			Approx weight (g)	
	Typical (mAh)	Minimum (mAh)				Thickness (mm)	Width (mm)	Height (mm)		
MP										
MP 144350	2300	2100	up to 2C	2.7	100	13.8	42.6	50.0	66	
MP 174865	3800	3500	up to 2C	2.7	100	18.0	47.8	65.0	120	
MP 176065	5500	5200	up to 2C	2.7	50	18.0	59.8	65.0	150	

Saft Medium Prismatic batteries have the following charge specifications:

Model	Charge Method	Charging Voltage	Charging Current	Operating Temperature	End of charge detection Low current	End of charge detection Timer
MP 144350	Constant Current/ Constant Voltage (CCCV)	4.1V \pm 0.04V per cell	1 C max.	Charge 0°C to +50°C Discharge -30°C to +60°C	30 mA	To be set as a function of the charging current:
MP 174865					70 mA	1C \rightarrow 3 to 4 h
MP 176065					100 mA	0.5C \rightarrow 4 to 5 h 0.2C \rightarrow 7 to 8 h



Charge characteristics to 4.1V at 20°C at various current

Saft MP batteries can be pulse-charged for faster charging. Please consult your local Saft representative for details.

18V to 24V (depending on number of cells in series) is the maximum voltage that can be applied to the protection circuit. Please consult your local Saft representative for details.

* Please also consult Saft brochure *Medium Prismatic lithium-ion batteries* for more information.

Note: Specifications are subject to modification without notice for further improvement.

Ni-Cd and Ni-MH charging methods

Portable batteries can be charged at different rates. Applications determine the time of charge and the complexity of the charger, with the rate of charge extending from 15-30 hours down to 30 minutes for an ultra-fast charge. The standard rate of charge for most cycling applications is between C/10 and C/20. With the vastly increased use of portable appliances, there is demand for chargers to provide much faster charging rates up to 4C (i.e., 15 minutes ultra-fast charge). Whatever the rate, it is vital to design chargers to ensure secure operation without overcharging.

Permanent charge

When the charge is continuously maintained, regardless of state of charge, the recommended charging rate is from C/20 to C/15.

Standard charge*

The standard charge is 16 hours. Recommended rate is C/10, which may be applied to all sealed cells and batteries at temperatures between 0°C and +50°C, whatever the initial state of charge.

Quick charge*

Applies only to cells designated as "quick chargeable" and at temperatures in the +5°C to +50°C range. Charge 4-5 hours at C/3 or 7-8 hours at C/5, depending on cell type. Appropriate cut-off method (timer or more sophisticated) is required.

Fast charge*

Fast charge takes from 1 hour to 2 hours. This kind of charge is applicable only to cells designated as rechargeable at such a rate. One or preferably more than one control circuit to terminate the fast charge is necessary. The most suitable cut-off techniques are based on voltage or temperature detection.

* Trickle charge

Following standard and quick chargers, a "trickle charge", a continuous charge at a low rate (C/40 to C/20), is recommended in order to compensate for self-discharge, maintain the battery in a fully-charged state, and balance the cells. For fast and ultra-fast chargers, a trickle charge is mandatory.

Recommended cut-off methods

Charge data

Charge time	Temperature range	VR/VE/VRE	VSE	VT	VH (b)	GB/HB
Permanent	See data sheet	Yes	Yes	Yes	Acceptable (c)	Yes
Standard 16h	0°C to +50°C	Time	Time	Timer	Timer	Timer
Quick 7-8h	+5°C to +50°C	Timer	Timer (8 hours)	Timer (8 hours)	Timer	
Quick 4-5h	+5°C to +50°C	Timer or dT / dt	Timer	dT / dt	-ΔV	
	+5°C to +35°C	-ΔV or PKV	-ΔV or PKV			
Fast 1 to 2h (a)	+10°C to +40°C	-ΔV or PKV	-ΔV or PKV		-ΔV	
	+10°C to +50°C	dT / dt	dT / dt		dT / dt, PKV	

(a) If C > 4.5 Ah limited 2h (b) Maximum recommended temperature limited at: +40°C, -ΔV recommended (5mV maximum per cell) (c) With limited performances.

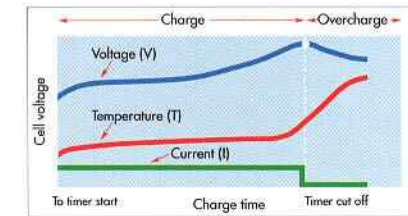
Ni-Cd and Ni-MH cut-off methods

There are three main charge cut-off methods for Ni-Cd and Ni-MH batteries based on a control of the following parameters: time, voltage or temperature.

Time cut-off techniques

Control by timer

For moderate charge rates (not higher than C/5 in general), a timer can be used to cut off the charge, or to reduce the charge current to the trickle charge. It can be used also as an auxiliary method associated to another one.

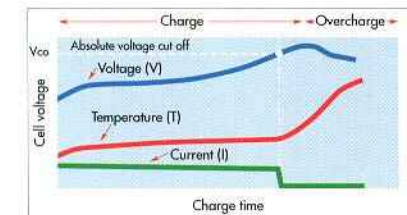


Charge control by timer

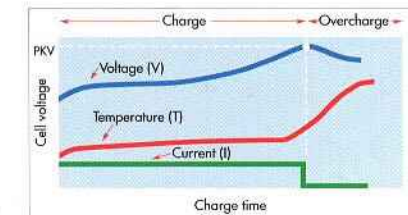
Voltage cut-off techniques

Cut-off based on voltage detection

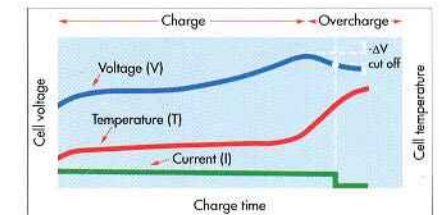
Absolute voltage detection: the detection level is difficult to manage due to charge voltage fluctuations related to current, temperature, electrode technologies, storage or cell aging. This method is used only as an additional criteria to



Detection of absolute voltage



Detection of peak voltage (PKV)



Detection of negative variation of battery voltage (-ΔV)

avoid hydrogen generation during charge at low temperature (below 0°C).

Peak voltage detection (PKV): the charge is stopped when the charge voltage reaches its highest point by detecting a singular point related to the variation of derivated value of dV/dt or d²V/dt².

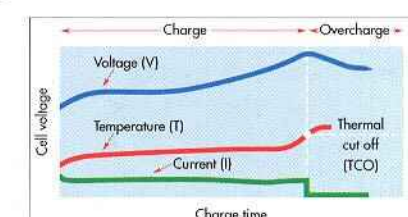
Detection of negative variation of battery voltage (-ΔV)

A constant current charge is stopped when the voltage curve inverts, giving a -10 mV voltage drop for Ni-Cd, and a -5 mV voltage drop for Ni-MH batteries.

Temperature cut-off techniques

Cut-off based on temperature detection

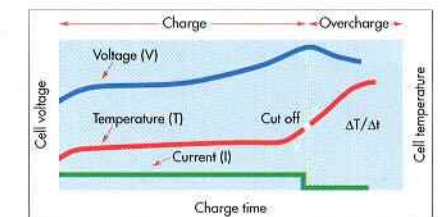
Absolute temperature detection (TCO): the charge is stopped when the battery reaches a predetermined temperature which is usually set at +45°C. However, this method is not very accurate as it may result in an insufficient charge or an excessive overcharging, according to high or low temperature respectively. TCO is more generally used as an additional back-up method.



Thermal cut-off (TCO)

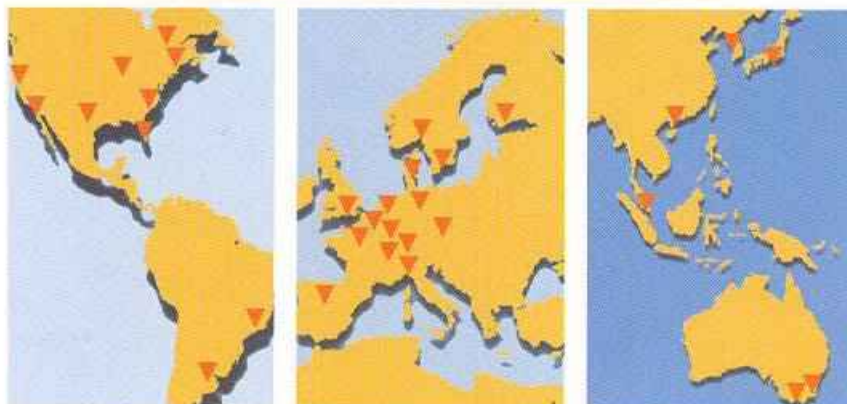
Detection of positive variation of temperature (ΔT/Δt)

the charge is stopped when the variation of temperature over time reaches a predetermined value (in general 0.5 to 1°C/minute) depending on the battery's thermal characteristics and design.



Detection of positive variation in battery temperature as a function of time (ΔT/Δt)

Serving your needs around the world



Saft, Alcatel's battery activity, holds a leading position in the worldwide marketplace of self-contained energy solutions. Saft's product range includes portable power sources, industrial and advanced technology batteries and power systems.

SAFT PORTABLE BATTERY NETWORK

Headquarters in FRANCE

Saft Portable Battery Group

156 avenue de Metz
93230 Romainville
Tel.: +33 (0)1 49 15 36 00

OEM/Telecom B.U.
Fax: +33 (0)1 49 15 35 38
N° Vert: 0 800 50 98 37

Customer Service:
Tel.: +33 (0)5 45 90 50 26
Fax: +33 (0)5 45 90 37 68

Lithium Battery Group:
Fax: +33 (0)1 49 15 36 24

AUSTRALIA

Saft Australia Pty Ltd

Seven Hills, NSW 2147
Tel.: (61-2) 96 74 07 00
Fax: (61-2) 96 20 99 90

Saft Australia Pty Ltd

Fitzroy North, VIC 3068
Tel.: (61-3) 94 86 47 11
Fax: (61-3) 94 86 47 22

CANADA

Saft division

Mississauga, Ontario
L5R 3N6
Tel.: 1 (905) 502 7845
Fax: 1 (905) 502 7846

CHINA

Saft Hong Kong Ltd

Kwun Tong, Kowloon
Tel.: (852) 27 96 99 32
Fax: (852) 27 98 06 19
shk-sales-hong-kong@saft.alcatel.com.hk

Saft Warehousing & Trade

Wai Gao Qiao Free Trade Zone
Shanghai 200131
Tel.: (86-21) 58 66 79 35
Fax: (86-21) 58 66 64 03
ss@saft.alcatel.com.hk

GERMANY

Saft GmbH

63814 Mainaschaff
Tel.: +49 60 21 70 70
Fax: +49 60 21 707 85
Klaus.Lueders@alcatel.de

ITALY

Saft S.p.A.

20059 Vimercate (Mi)
Tel.: (39-039) 686 92 75
Fax: (39-039) 686 38 47
valerio.telo@ilvhge.net.it.alcatel.it

JAPAN

Sumitomo Corporation

Chiyoda-ku, Tokyo 101
Tel.: (81.3) 32 30 70 05
Fax: (81.3) 32 37 53 70

KOREA

Saft Korea Co Ltd

430017 Kyunggi-Do
Tel.: (82-343) 441 11 34
Fax: (82-343) 441 11 39
saftkor@unitel.co.kr

NETHERLANDS

Saft B.V.

1160 AB Zwanenburg
Tel.: (31-23) 515 08 00
Fax: (31-23) 515 08 62
remco.bakker@saft.alcatel.fr

NORWAY

Saft AS

0753 Oslo
Tel.: (47-22) 51 15 50
Fax: (47-22) 51 15 40

SINGAPORE

Saft Singapore Pte Ltd

349562 Singapore
Tel.: (65) 846 57 52
Fax: (65) 746 67 72
ssp-pbg-sales@saft.alcatel.com.sg

SPAIN/PORTUGAL

Saft Iberica SL

01010 Vitoria
Tel.: (34-945) 21 41 10
Fax: (34-945) 21 41 11
e.idealmentia@snib.es

SWEDEN

Saft AB

171 04 Solna
Tel.: (46-8) 59 84 97 50
Fax: (46-8) 59 84 97 55
mattias.soderstrom@saft.alcatel.se

UNITED KINGDOM

Saft Ltd

Hainault, Ilford
Essex IG 6 3XJ
Tel.: (44-181) 498 11 77
Fax: (44-181) 498 11 15
sales@saft.alcatel.co.uk

USA

Saft America Inc.

OEM/Telecom B.U.
San Diego, CA 92173
Tel.: (1-619) 661 79 92
Fax: (1-619) 661 50 96
sales.pbd@saft.alcatel.com

Lithium Battery Group

Valdese, North Carolina,
28690
Tel.: (1-828) 874 41 11
Fax: (1-828) 874 24 31

SAFT PORTABLE BATTERY AGENTS

ARGENTINA

CH Sistemas

Electronicos
1187 Buenos Aires
Tel.: (54-114) 962 16 25
Fax: (54-114) 962 16 27

AUSTRIA

SED Produktionsgesellschaft

1230 Wien
Tel.: (43-1) 616 03 03 27
Fax: (43-1) 616 03 03 6
sed@vienna.at

BELGIUM

Helpelec

1200 Brussels
Tel.: (32-2) 762 33 38
Fax: (32-2) 762 37 01
helpelec@compuserve.com

BRAZIL

Barasch Sylmar

05021 Sao Paulo
Tel.: (55-11) 864 63 66
Fax: (55-11) 864 63 66

CZECH REPUBLIC

Bateria Slany

27444 Slany
Tel.: (420-314) 522 849
Fax: (420-314) 522 868
palaba@mbox.vol.cz

DENMARK

Scansupply A/S

3460 Birkerød
Tel.: (45) 45 82 50 90
Fax: (45) 45 82 54 40
flemming@scansupply.dk

FINLAND

Hansabattery Oy

02320 Espoo
Tel.: (358-9) 26 06 52 90
Fax: (358-9) 26 06 52 99
hans.sandstrom@hansabattery.fi

SOUTH AFRICA

Uniross Batteries (PTY) Ltd

PO Box 28861 Pretoria
Tel.: (27-12) 327 32 66
Fax: (27-12) 327 32 94

SWITZERLAND

Leclanché SA

1401 Yverdon-Les-Bains
Tel.: (41) 24 44 72 272
Fax: (41) 24 44 72 350

SAFT PORTABLE BATTERY NORTH AMERICA

Saft America Inc.

Portable Battery Division
2155 Paseo de las Americas
#31 San Diego, CA 92173
Tel.: (619) 661-7992
(800) 328-6807
Fax: (619) 661-5096
Customer service:
(800) 328-9146

CANADA

Mississauga, Ontario

Tel.: 1-800-399-7238
Ext.: 3336

MIDWEST

Naperville, Illinois

Tel.: 1-800-399-7238
Ext.: 3396

NORTHEAST

Salem, New Hampshire

Tel.: 1-800-399-7238
Ext.: 3354

NORTHWEST

San Francisco, California

Tel.: 1-800-399-7238
Ext.: 3329

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Marietta, Georgia

Tel.: 1-800-399-7238
Ext.: 3351

Palm Harbor, Florida

Tel.: 1-800-399-7238
Ext.: 3100

SOUTHWEST

Dallas, Texas

Tel.: 1-800-399-7238
Ext.: 3356

WEST

Camarillo, California

Tel.: 1-800-399-7238
Ext.: 3088

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www.saft.alcatel.com

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