

Saft. Rechargeable Battery Systems Handbook



SaFT

Saft, your partner for reliable, intelligent, eco-designed rechargeable battery systems.

Why choose Saft Rechargeable Battery Systems?

Saft is a world leader in high-quality rechargeable batteries

With 80 years of work in this field, our expertise and experience in designing, developing and manufacturing robust and reliable cells and battery systems are unequaled.

Saft is focused on professionals

Our work today is entirely dedicated to delivering products and solutions conceived for professional applications and adapted to the unique needs of a wide variety of users.

Saft is your partner, not just your supplier

If one of our standard offers doesn't suit your needs, we will work with you to conceive, design and produce a customized solution that does. We can combine our strengths to work closely with your teams to create and build a battery system custom made for your unique requirements, and designed to cost.

Saft is close to you

In an industry where most manufacturing and assembly is done manually in the Far East, Saft is the only industrial company to remain located in Europe, with state-of-the-art, fully automated factories in Nersac, Poitiers and Bordeaux, France. Saft also has battery assembly facilities in the United States, China and many other countries. Saft's worldwide network means faster delivery times and a highly competitive cost/quality ratio.

Saft does it all

Saft conceives, designs, produces and delivers products. By controlling and supervising the entire end-to-end value chain, we are able to keep a very close watch on quality. Furthermore, the ever-increasing demand for higher-power and higher-energy battery solutions drives us to continuously and heavily invest in research and development. We are always looking for new and better ways to meet your needs.

Saft batteries are intelligent

Choosing Saft means getting more than just batteries. We provide you with a highly advanced and innovative battery system. The technological expertise inside each makes for an intelligent turnkey solution that communicates with other applications, controls its charge and discharge and understands what needs to be done

... so you don't have to.

Saft is serious about the environment

An industry pioneer in eco-designed products, Saft is working hard to build batteries that meet the goals of sustainable development. Rechargeable batteries are by design kind to the environment, since they can be used many times before needing to be disposed. But when such batteries have finally given their best, Saft works through several national collection and recycling organizations (RBRC in the US, SCRELEC in France, and others in various European countries) to offer a collection and treatment service. In addition, Saft factories adhere strictly to environmental regulations concerning air, water, ground and solid waste standards.



The right battery

for all of your needs

Saft's complete offer includes standard as well as customized battery systems built with Nickel-Cadmium, Nickel Metal-Hydrate and Lithium-ion technologies, all using Saft's intelligent engineering design and state-of-the-art battery management solutions.

Whatever your application, whatever your specifications, whatever your need, there is a Saft battery that fits.

Saft batteries can be found in...

Buildings and industrial plants

Alarms, UPS, back-up systems and more.

Emergency and security systems

Exit signs, emergency fixtures, conversion kits, alarms and more.

Personal mobility

E-bikes, e-scooters, underwater scooters, electrical wheelchairs, lift systems for disabled persons and other personal electric vehicles.

Professional tools

Construction, agriculture, gardening and many other professional tools.

Professional electronics

Vacuum cleaners, personal care equipment, hand held terminals, audio and video equipment, flashlights, diving and mine lamps and more.

Medical

Drug dispensers, cardiac defibrillators, respirators, homecare ventilators, medical carts, monitoring and diagnosis equipment and more.

Military and defense

Robots, portable radio communication equipment and more.

Marine

Signaling, UPS, back-up systems and more.

Telecommunication

Cellular and cordless phones, personal communication systems, private mobile radios, back-up systems for telecom networks and more.

		Building & industrial plants	Emergency & security systems	Personal mobility	Professional tools	Professional electronics	Medical	Military & Defense	Marine	Telecommunication
Ni-Cd	VRE				●	●	●	●	●	●
	VE							●	●	●
	VSE					●	●	●		●
	VT	●	●			●	●		●	
	VNT	●	●							
	VST		●							
Ni-MH	VH			●	●	●	●	●	●	●
	VHT	●	●							●
Li-ion	MP	●		●		●	●	●	●	●
	VL			●		●	●	●		

Ni-Cd

STANDARD VRE series

Originally engineered for use in cycling, Saft's Standard Series can be used for a wide range of applications.

The VRE Series is particularly well adapted for cycling applications requiring a rapid charge. Our VRE Standard Series' high levels of reliability have been

time-tested and proven: hundreds of millions of units have been delivered over the years. They offer an excellent cost/performance ratio.

	Saft Type	IEC Capacity at 0.2C rate		Standard charge (16h)	Quick or fast charge		Typical internal impedance	Max. dimensions for bare cells		Typical weight	
		Nominal voltage 1.2 volts/cell	Typical (mAh)	Minimum (mAh)	Current (mA)	Current (mA)	Est. time (h)	(mOhm)	Diameter (mm)	Height (mm)	(g)
VRE	VRE 1/3 AA		165	150	15	150	1	60	14.0	17.0	7
→	VRE 1/2 AA		330	300	30	300	1	24	14.5	28.6	12
→	VRE AA 700⁽¹⁾		780	700	70	700	1	14	14.0	49.2	21
→	VRE Cs		1400	1300	130	1300	1	6	22.2	42.2	43
→	VRE Cs 1600		1600	1500	150	1500	1	5	22.2	42.2	48
→	VRE Cs 1800		1800	1700	170	1700	1	5	22.2	42.2	49
→	VRE C		2550	2300	230	2300	1	5	25.3	49.5	75
→	VRE 1/2 D		2550	2400	240	800	2-3	10	32.2	36.6	80
→	VRE D		5100	4500	450	4500	1	4	32.2	58.6	140
→	VRE D 5500		5500	5000	500	5000	1	4	32.2	58.6	150
→	VRE F		8800	8000	800	8000	1	4	32.2	89.2	220



(1) Also available with a high top. Diameter is similar.

(2) Also available with a low top.

(3) Up to +40° C temperature environment.

(4) Up to +55° C temperature environment.

HIGH TEMPERATURE VT / VNT / VST Series

The solutions in these series are perfectly suited to emergency and security equipment in compliance with International (IEC 61951), US (UL 924) and Japanese (JISC 8705) standards. These batteries

have been designed to accept a permanent charge (C/20 to C/15) for a minimum of four years in high-temperature environments (up to 40°C/104°F). Higher-end versions of the cells, such as "U" and "70" models, can even withstand a constant temperature

of up to 55°C/131°F with a similar life expectancy when permanently charged. The new VNT series benefits from innovative PNE (Plastic-bonded Nickel Electrode) technology, a new positive electrode, offering improved energy density.

Saft Type		IEC Capacity at 0.2C rate		Standard charge (16h)	Recommended permanent charge		Typical internal impedance	Max. dimensions for bare cells		Typical weight	
		Nominal voltage 1.2 volts/cell	Typical [mAh]	Minimum [mAh]	Current [mA]	Current [mA]	Time [h]	[mOhm]	Diameter [mm]	Height [mm]	[g]
VT	VT AA		700	600	60	30	-	45	14.0	50.2	26
→	VT Cs		1350	1200	120	60	-	12	22.2	42.2	45
→	VT Cs 1500		1650	1500	150	75	-	7	22.2	42.2	47
→	VT Cs 1500 U ⁽⁴⁾		1650	1500	150	75	-	8	22.2	42.2	48
→	VT Cs 1600		1750	1600	160	80	-	7	22.2	42.2	49
→	VT C 2500		2700	2500	250	125	-	6	25.3	49.5	75
→	VT 1/2 D		2500	2200	220	110	-	10	32.2	36.8	80
→	VT D ⁽³⁾		4300	4000	400	200	-	6	32.2	60.3	120
→	VT D 70 ^(2 & 4)		4500	4000	400	200	-	6	32.2	60.3	128
→	VT D U ⁽⁴⁾		4700	4100	400	200	-	5	32.2	58.6	136
→	VT F ⁽³⁾		7500	7000	700	350	-	5	32.2	91.1	196
→	VT F 70 ⁽⁴⁾		7700	7000	700	350	-	5	32.2	89.2	196
VST	VST AA		860	800	80	40	-	30	14.0	49.2	26
VNT	VNT Cs ⁽³⁾		1650	1600	160	80	-	8	22.2	42.2	45
Consult Saft	VNT Cs U ⁽⁴⁾		1650	1600	160	80	-	8	22.2	42.2	45
Consult Saft	VNT C U ⁽⁴⁾		2650	2500	250	125	-	8	25.3	49.5	75
	VNT D ^(2 & 3)		4250	4000	400	200	-	6	32.2	60.3	115
Consult Saft	VNT D U ^(2 & 4)		4250	4000	400	200	-	6	32.2	60.3	115

HIGH ENERGY VE and VSE series

Saft's VE Series benefits from significant technological upgrades. For example, this series shows a

10% to 15% capacity improvement, and yet its high performance levels are maintained. Saft's VSE Series uses advanced nickel foam electrode

technology, meeting the needs of light and compact portable equipment with both a fast charge and higher capacity.

Saft Type		IEC Capacity at 0.2C rate		Standard charge (16h)	Quick or fast charge		Typical internal impedance	Max. dimensions for bare cells		Typical weight	
		Nominal voltage 1.2 volts/cell	Typical [mAh]	Minimum [mAh]	Current [mA]	Current [mA]	Est. time [h]	[mOhm]	Diameter [mm]	Height [mm]	[g]
VE	VE 2/3 A		670	600	60	600	1	25	16.7	28.0	18
→	VE C		2400	2200	220	2200	1	5	25.3	49.5	75
VSE	VSE AA ⁽¹⁾		980	940	94	940	1	16	14.0	49.2	22
→	VSE A		1850	1700	170	1700	1	17	17.0	49.5	35

Ni-MH



Super High Energy and High Energy Back-Up VH and VHT Series

Designed for high energy, high power portable applications demanding fast charges and discharges over an extended

lifetime, Saft's line of Ni-MH VH cylindrical cells benefit from all of our technological expertise. The VH Cs, VH D and VH F Series are specifically designed for cordless power tools, personal mobility and other professional applications.

The VHT Series has been engineered for long life and to accept a permanent charge at high temperatures, such as in emergency back-up and photovoltaic applications.

	Saft Type	IEC Capacity at 0.2C rate		Standard charge (16h)	Quick or fast charge		Typical internal impedance	Max. dimensions for bare cells		Typical weight
		Nominal voltage 1.2 volts/cell	Typical [mAh]	Minimum [mAh]	Current [mA]	Current [mA]	Est. time [h]	(mOhm)	Diameter (mm)	Height (mm)
VH	VH AAA ⁽¹⁾	680	650	65	650	1	50	10.5	43.7	13
→	VH AA 1500 ⁽¹⁾	1500	1400	140	1400	1	20	14.0	49.2	26
→	VH AA 1700	1700	1600	160	1600	1	20	14.0	49.2	26
→	VH 4/3 A	3750	3700	370	2000	1-2	20	17.0	67.0	53
→	VH Cs 3200 XL	3200	3000	300	3000	1-2	4	22.0	42.7	58
→	VH Cs 3500	3500	3200	320	3000	2-3	4	22.0	42.7	59
→	VH D 9500 XP	9500	9000	900	5000	2-3	3	32.2	58.6	168
→	VH F 16000 XP	16000	15000	1500	5000	3-4	3	32.2	89.2	265

XP : Extended Power - XL : Extended Life

VHT	VHT AA	1150	1100	110	-	-	18	14.0	49.2	24
→	VHT Cs	2200	2000	200	-	-	5	22.0	42.7	48
→	VHT 7/5 Cs	4200	4000	400	-	-	20	22.2	60.0	74
→	VHT F	11000	10000	1000	-	-	5	32.3	89.2	215

Button range - HB Series

HB nickel metal-hydride button cells have been designed to provide

a permanent charge to supply back-up memory for professional applications. Assembly has been

engineered to facilitate insertion into integrated circuits.

	Saft Type	IEC Capacity at 0.2C rate		Standard charge (16h)	Quick or fast charge		Typical internal impedance	Max. dimensions for bare cells		Typical weight
		Nominal voltage 1.2 volts/cell	Typical [mAh]	Minimum [mAh]	Current [mA]	Current [mA]	Time [h]	(mOhm)	Diameter (mm)	Height (mm)
HB	HB 80	80	70	7	-	-	-	15.5	6.0	4
→	HB 250	250	240	25	-	-	-	25.1	6.7	10
→	HB 350	380	350	35	-	-	-	25.1	8.8	10

Smart VH module

The Smart VH module benefits from Saft's latest improvements regarding cells, housing, connections and electronic devices, ensuring safety, cycle and calendar life, reliability and cost control.



The technological advancement of the Smart VH modules allows several batteries to be used in parallel for increased capacity, to communicate with an application and to deliver high current (40 A). Specially designed for personal

mobility applications, they have a long life, high reliability and require zero maintenance. The Smart VH module is also suitable for all applications requiring power and autonomy.

Electrical characteristics	Smart VH Module with						
	VH D			VH F			
Configuration	10S	20S	30S	10S	20S	30S	
Nominal voltage (V)	12	24	36	12	24	36	
Typical capacity at C/3 drain rate after full charge at 3A at +20°C (Ah)	9			15			
Minimum capacity at end of life (Ah)	6			10			
Specific energy (Wh/kg)	51	57	58	56	62	64	
Energy density (Wh/dm ³)	83	103	112	106	124	135	
Mechanical characteristics							
Height (mm)	H	99	159	219	129	219	309
Length (mm)	L	178					
Width (mm)	W	73.5					
Weight (kg)		2.1	3.8	5.6	3.2	5.8	8.4
Volume (l)		1.3	2.1	2.9	1.7	2.9	4.0

Li-ion range

MP / VL series

As part of its ongoing commitment to advanced technology systems, Saft offers a range of powerful rechargeable lithium-ion systems. With their greater energy density, lower weight and longer life,

lithium-ion systems represent a real breakthrough, answering new needs and opening up new applications. Lithium-ion systems are fully integrated, innovative, intelligent and safe. Li-ion technology must be

accurately managed in operation, as it does not allow for over-charge, over-discharge or over-current. Saft Li-ion systems include both cells and electronic protection circuit boards for these reasons.

	Saft type	Rated Capacity at 0.2C rate	Charge Method: Constant Current / Constant Voltage			Max. Dimensions for bare cells				Typical weight ⁽⁷⁾ (g)
			Max Voltage (V)	Max Current (mA)	Time (h)	Thickness (mm)	Width (mm)	Diameter (mm)	Height ⁽⁷⁾ (mm)	
MP	MP 144350	2600	4.2	2600	3	14.5	43.0	-	50.0	68
→	MP 174565 Integration™	5000	4.2	5000	3	19.5	45.0	-	68.35	105
→	MP 174865 IS⁽⁶⁾	4800	4.1	5000	3	19.0	48.0	-	65.0	124
→	MP 176065 Integration™	7000	4.2	7000	3	19.2	60.0	-	68.35	146
VL	VL 18650	2200	4.2	2150	3	-	-	18.4	65.5	48
→	VL 18650 2400	2400	4.2	2300	3	-	-	18.4	65.1	46.5
→	VL 34570	5400	4.2	5400	3	-	-	34.2	59.43	125

Electronic protection circuit boards

Configuration	Serial Min/Max parallel	1S	1S	2S	3S	4S	5S	6S	7S	8S
		1P	2P / 4P	1P / 4P	1P / 2P	1P / 2P	1P / 2P	1P / 2P	1P / 2P	1P / 2P
Charge	Max current (A)	1.5	4	4	4	4	4	3	3	3
Discharge	Min/Max continuous current for energy cells (A) ⁽⁵⁾	up to 1.5	1.5 / 6	1.5 / 6	up to 6	up to 6	up to 6	up to 3	up to 3	up to 3
	Max peak current (A/ms)	-	20 A / 1 ms	20 A / 1 ms	20 A / 1 ms	20 A / 1 ms	20 A / 1 ms	20 A / 1 ms	20 A / 1 ms	20 A / 1 ms
Availability		available	available	available	to be developed	to be developed	to be developed	available	available	available

(5) depending on ambient temperature of cells, and parallel configuration. (6) IS = Compliant with the EN 50020 "Intrinsic Safety" Standard (class TB) for ATEX applications.

(7) Integration™ = Height & weight values include protection circuits.

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