

Safety Manual

Operational Information and Safety Precautions for General Equipment

Issue B2

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The Sonardyne 24-hour helpline is answered at the UK Headquarters during normal office hours (08:00 to 17:00). Outside these hours, your call is automatically transferred to an agency, which logs the details of your emergency and alerts the appropriate Sonardyne personnel.

Our aim is to make sure emergency requests are dealt with immediately during office hours, and are responded to within 30 minutes at all other times.

Please note the helpline is for emergency use only.

If you require non-emergency product support, please contact your nearest Sonardyne office.

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Note



Email and telephone support is available during normal UK office hours (08:00 to 17:00).

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Amendment History

The amendment history records all amendments and additions made to this manual.

Issue	Revision	Date	Comments	Section	Page
A	0	11/04/2012	Initial Issue	All	All
B	0	21/05/2012	Complete review of manual; datasheets and MCDS certificates Appendices added	All	All
B	1	05/07/2016	Battery datasheets updated and general update	All	All
B	2	22/07/2019	Battery datasheets updated and general update	All	All

Section 1 – Introduction

1.1 General Operational Safety Precautions

This Safety Manual provides information and safety precautions for operating and servicing Sonardyne products. Sonardyne products can contain hazardous energy and must only be opened by qualified service personnel.

Operators and Service personnel must be familiar with the information detailed in this manual before using or servicing Sonardyne equipment.

Additional information including warnings and cautions (if applicable) is included in the relevant product user, operating or maintenance manual for the specific equipment and must be read and fully understood before operating the equipment.

Documentation must be consulted whenever the warning symbol  is found on the equipment, in order to find out the nature of the potential hazard and any precautions which have to be taken.

Sonardyne equipment should not be used outside of the manufacturer's specifications as the equipment could be damaged or its operation impaired.

The safety of any system incorporating any Sonardyne equipment is the responsibility of the assembler of the system.

It is the operator's responsibility to conduct Hazard Identification and Risk Analysis for all conditions.

1.2 General Safety Precautions

The general safety precautions that follow are not equipment or installation specific.

Before the installation or use of equipment the facilities local Health and Safety legislation, regulations, Safe Working Procedures and Practices must be understood and followed.

All procedures and practices contained in this Safety Manual must be read and fully understood.

It is the RESPONSIBILITY OF ALL PERSONS working on or near an installation to make sure they:

- Work with and obey all persons that have responsibilities for the safe operation of the applicable installation.
- Report any defect of any equipment that can cause danger to the health, safety or welfare of persons that work on or may be affected by the installation or equipment.
- Use equipment only for the purpose for which it is intended.
- Do not act in a way on or near the installation, that could cause a danger to you or other persons that work on or near the installation.
- Do not cause any equipment used on or near an installation to be unsafe.
- Do not remove any WARNING signs without permissions.
- Do not remove or alter any safety equipment without permissions.
- Do not disconnect or connect any power source without permissions.

1.2.1 Hazard Appreciation

Subsea equipment remains safe in use when operated and handled within standard operating procedures and written guidelines, therefore in normal operation little threat is posed to the safety of personnel or instruments. However, all subsea units are capable of posing a threat to personal safety, particularly when pressure housings become internally pressurised. Great care must be taken when

this happens, or is suspected to have happened, since the pressures present within the instrument are likely to be extremely high. Internal pressure problems may also be aggravated by unknown chemical hazards if battery breakdown has occurred.

- The following non-exhaustive list gives examples of typical hazardous situations:
- All deteriorated/failed batteries (not just lithium batteries)
- High voltages being present when the equipment is transmitting, particularly on the transmitter PCB and transducer.
- A pressure housing becoming internally pressurised by water pressure due to a leak
- A pressure housing becoming internally pressurised due to battery failure
- Charging of non-rechargeable battery packs/cells
- Using equipment or instrumentation outside the design parameters
- Using equipment or instrumentation beyond the load bearing limits
- Failing to maintain equipment reducing its load bearing capability
- Using unauthorised components or inferior parts in critical assemblies, e.g. release systems, battery packs etc.

1.3 General Handling of Equipment

Do not allow instruments to be dropped or exposed to shock damage which can cause sensitive internal components to fail. Note that minor damage to metal finishes often creates burrs which can present a hazard to unprotected hands, other parts of the body and to components such as O-rings.

Control the local working environment with good house-keeping practices to prevent slips, trips or falls, and make sure ropes or cables which are attached to equipment are positioned safely to prevent entanglement.

Do not allow any tools or equipment to block any access routes or impede normal traffic flows in a gangway or on a stairway.

Water tightness of instruments depends on fine surface finishes, accurate dimensional tolerances and cleanliness of components. When dismantling equipment care should always be taken to protect surface finishes. The disassembly process should be carried out in a well-ventilated area with as few personnel in the vicinity as possible.

Servicing must always be carried out by suitably qualified and experienced personnel.

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Section 2 – Pressure Housings

2.1 Introduction

Subsea equipment fitted with a pressure housing is subject to a vast range of externally applied pressures and is susceptible to internal pressure build up, for example, if a leak occurs or the instrument's battery malfunctions/fails, resulting in venting. Internal pressure presents a potentially dangerous situation and all appropriate safety measures must be enforced.

WARNINGS

-  **Fumes given off by malfunctioning/failed batteries, particularly lithium based, pose a health hazard. Make sure the area is well ventilated and the appropriate personal protective equipment, such as gloves, aprons and goggles, are worn.**
-  **When an instrument has leaked it often behaves like a valve, i.e. water pressure causes a rise in internal pressure which cannot then escape because the point of leakage becomes sealed. When this happens the instrument is potentially dangerous and all precautions described in this section must be followed.**

Any instrument recovered that is not operable should be suspected of leaking and being flooded. There may be no prior indication of the presence of a build-up of internal pressure. First indications may be the endcap(s) of the instrument being forced out of the housing under pressure during the dismantling process.

Complete removal of an endcap's retaining mechanism means it becomes unconstrained and therefore free to be discharged from its housing under high internal pressure; an uncontrolled and potentially dangerous situation.

Symptoms that indicate a higher risk of internal pressure include:

- Equipment that failed when deployed, in transit or storage.
- Equipment stored for a long time with batteries connected.
- Equipment having suffered physical damage.

WARNING

-  **Do not transport equipment that is internally pressurised.**
-

2.2 Instruments fitted with a Pressure Relief Vent Valve

Pressure relief vent valves are fitted into all subsea equipment housings containing batteries. They comprise a valve with dual O-rings and a vent hole behind the second O-ring. The pressure relief vent valve is designed so it can operate automatically to release any internal pressure, or it can be manually withdrawn, using a screw, to the point where the relief hole becomes open to the atmosphere and allows internal pressure to dissipate. The valve is normally retained to the instrument by means of a retaining spring preventing it from being completely extracted.

A normal functioning instrument may emit a short audible rush of air when the pressure relief vent valve is operated. A longer rush of air/gas indicates a pressurised instrument, in which case the work area must be ventilated while the air/gas is discharged. Internal pressure dissipates to atmosphere in a very short time and may be accompanied by water, debris, fumes, noise etc.

WARNING

 **Risk of Toxic Gases.** When operating the pressure release vent valve, ensure the work environment is well ventilated and only necessary authorised personnel are present as toxic gases may be released. Ensure personal protective equipment, such as gloves and eye protection are worn.

2.3 Instruments not fitted with a Pressure Relief Vent Valve

Some older Sonardyne instruments are not fitted with a pressure relief vent valve.

If an instrument indicates, or is suspected of being pressurised and does not have a pressure relief vent valve fitted, contact the Sonardyne Emergency Support Line (+44 (0) 1252 877600) in the first instance for advice on the correct course of action to follow.

2.4 Dismantling Precautions (Instrument fully functioning)

The techniques for retaining endcaps in the pressure housings differ for instrument types; refer to the instrument's user manual for the dismantling procedure.

The normal procedure before opening any underwater instrument is to wash the instrument in clean fresh water to remove any salt, sand/silt and marine growth and then dry it with a lint free cloth. The instrument should only be opened in a clean, well-ventilated, dry area.

To ease dismantling and release any slight internal pressure that may have built up during normal operation, the pressure relief vent valve should be operated as described in *Instruments fitted with a Pressure Relief Vent Valve* on the previous page and in the instrument's user manual.

WARNING

 **Do not stand directly in front of the end cap during removal.** There is potential for the endcap to be ejected forcibly without notice due to internal pressure.

2.5 Dismantling Precautions (instrument known or suspected to be pressurised)

The techniques for retaining endcaps in the pressure housings differ for instrument types; refer to the instrument's user manual for the dismantling procedure.

The normal procedure before opening any underwater instrument is to wash the instrument in clean fresh water to remove any salt, sand/silt and marine growth and then dry it with a lint free cloth. The instrument should only be opened in a clean, well-ventilated, dry area.

If an instrument is known, or suspected to be internally pressurised through water ingress or battery failure, additional precautions must be taken.

Remove the instrument to a well-ventilated location away from other working personnel.

WARNING

 **Do not attempt to dismantle or perform any maintenance activity on an instrument that has a hot housing. The instrument must be cooled before proceeding.**

If the instrument housing is hot, this indicates recent or current active internal chemical action and it must not be dismantled. Wear the appropriate personal protective equipment such as gloves and lower the instrument overboard into the water for several hours or until it has cooled. Refer to the battery manufacturer's SDS/BIS (see *Safety Datasheets/Battery Information Sheets* on page 22).

To release internal pressure operate the pressure relief vent valve as described in *Instruments fitted with a Pressure Relief Vent Valve* on page 9. If there is no significant pressure dissipation and no fumes indicating a battery failure, the instrument can be dismantled; refer to the instrument's user manual for the dismantling procedure. If a pressure relief vent valve is not fitted follow the precautions described in *Instruments not fitted with a Pressure Relief Vent Valve* on the previous page.

If chemical fumes are present when the pressure relief vent valve is released, or there are deposits around the vent exterior, these are signs that the battery has vented due to water ingress or battery failure. In these circumstances the battery pack and internal electronics may have been severely damaged.

Take extreme care when removing the endcap. There may be a possibility of some internal pressure remaining, due to the pressure relief vent valve being blocked with products of the internal chemical reaction.

If a removed battery is found to be leaking, it must be placed in a sealable plastic bag and covered with a mixture of neutralizing agent (soda ash or baking soda) and absorbent material (vermiculite) and then placed in a secondary bag for additional containment. The battery should be classified as hazardous waste and disposed of in accordance with local health and safety, and environmental regulations.

Any spilled electrolyte must be absorbed/neutralized using absorbent material and neutralizing agent. The contaminated absorbent must be placed into a sealable bag and then placed in a secondary bag for additional containment, and disposed as hazardous waste. The contaminated area can be cleaned with water or an ammonia-based cleaner.

The electronics, end caps and pressure housings should be thoroughly cleaned with fresh water.

Section 3 – Electronic Hazards

3.1 High Voltages

3.1.1 High Voltage Awareness

Operation of Sonardyne equipment does not present any danger to users in normal use. Where permitted, if the internal electronics chassis is removed from its housing for maintenance, high voltages are present when transmitting, particularly on the transmitter PCB and transducer. The following warning symbol , when found on the equipment, indicates high voltage awareness is required.

3.1.2 Storage Capacitors

Subsea equipment incorporates capacitors which are capable of storing large quantities of electrical energy. Avoid contact or inadvertent discharge during dismantling.

3.1.3 Handling of Electronic Components

Most of the circuits in subsea equipment use CMOS logic, which is easily damaged by static discharge or excessive supply voltage. The best action for electronics is **no handling**.

CAUTION

 **Electrostatic Discharge (ESD) precautions (grounded wrist strap) must be taken before handling circuit boards or modules.**

Field servicing cannot compare in efficiency and accuracy with the original factory calibration and therefore field servicing should be limited to checking correct calibration/operation (within the limits of the test gear available) and repair by exchange of PCBs or modules.

Section 4 – Batteries

4.1 Use of Appropriate Battery Types

WARNING



Do not fit unauthorised battery pack types into equipment.



Battery packs must not be reconfigured from one type to another, e.g. NiMH to alkaline or lithium as this may lead to alkaline or lithium cells being inadvertently charged.

Sonardyne equipment uses a variety of battery types including: rechargeable, alkaline and lithium based packs. Instruments must **not** be fitted with alternative battery pack types unless they are specifically designed to use them.

Note



Damage caused by using unauthorised battery packs will invalidate any warranty.

To identify the type of battery installed, a label is attached on the outside of the equipment. Examples of the labels used are shown below:

Figure 4–1 Example of a Lithium Battery Identification Label

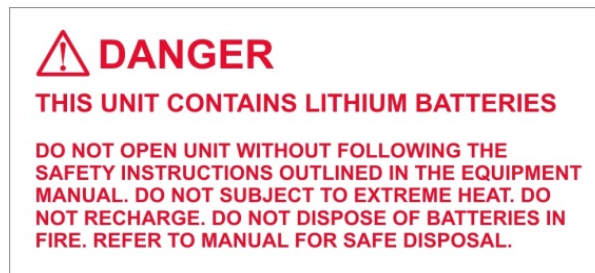
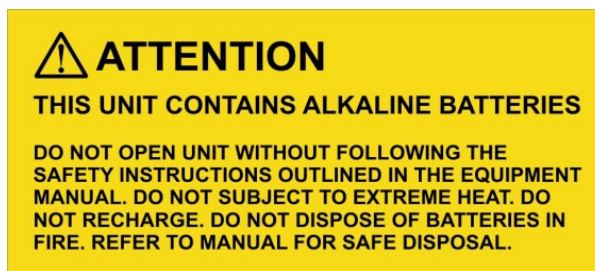


Figure 4–2 Example of a Lithium-ion (Li-ion) Battery Identification Label



Figure 4–3 Example of an Alkaline Battery Identification Label



4.2 Primary Lithium (Li) Batteries

4.2.1 Lithium Battery Types

Primary (non-rechargeable) lithium batteries are often referred to as lithium metal batteries.

Two types of primary lithium cells (LS and LSH) are used throughout Sonardyne products depending on the application requirements. The LS cell types used are: LS26500 (Size C), LS33600 (Size D) and LS14500 (Size AA).

The LSH cells are designed for applications requiring higher continuous currents. The LSH cell types used are: LSH14 (Size C) and LSH20 (Size D).

4.2.2 Safety Precautions for Primary Lithium (Li) Batteries

WARNINGS



Fire, explosion and burn hazard. Do not recharge, short circuit, crush, disassemble, heat above 100°C, incinerate or expose battery contents to water.



Lithium based batteries become hazardous (fire and corrosion) if exposed to air and water and if damaged may emit fumes. Consult the battery manufacturer's Safety Datasheet/Battery Information Sheet prior to operating lithium based battery products.

Special precautions and regulations apply to the transport, handling and disposal of primary Lithium products; see *Transporting Primary Lithium Batteries* on the next page.

Lithium batteries are powerful sources of electrical energy and should be handled with care to avoid short-circuiting.

When a battery powered underwater instrument is suspected of flooding, extreme caution must be exercised when opening the instrument in case it is internally pressurised; see *Dismantling Precautions (Instrument fully functioning)* on page 10 and *Dismantling Precautions (instrument known or suspected to be pressurised)* on page 10.

Safety Datasheets/Battery Information Sheets for primary lithium cells and batteries are shown in *Lithium Cells and Batteries* on page 22.

Primary lithium cell specifications are shown in *Lithium Cells* on page 38.

4.2.3 Fault Procedures

WARNINGS



If a cell is ruptured, potentially flammable materials may be exposed.



For primary lithium battery packs, CO2 extinguishers or, even preferably, copious quantities of water or water based foam, can be used to cool down burning LI-SOCI2 cells and batteries, as long as the extent of the fire has not progressed to the point that the lithium metal they contain is exposed (marked by deep red flames). Do not use for this purpose sand, dry powder or soda ash, graphite powder or fire blankets. Use only metal (Class D) extinguishers on raw lithium.



There is a risk of burns and injury when handling hot batteries; suitable personal protective equipment, such as gloves, aprons and goggles, must be worn.

If a cell or battery is shorted or starts to heat up, it should be disconnected from the transponder immediately and removed to the outdoors or to a well-ventilated area to cool down. Tongs, or a shovel, are recommended for this purpose. Should the battery overheat significantly or catch fire, use the fire-fighting media as described in the above Warning, or the cell manufacturer's safety datasheet. Once

the temperature has dropped and it is deemed safe to do so, the cell or battery can be disposed of as described in *Disposal of Primary Lithium Batteries* on the next page.

Charging of Non-Rechargeable Battery Packs

WARNING



Do not attempt to charge non-rechargeable batteries or battery packs.

Non-rechargeable cells exhibit a range of unpredictable characteristics if any attempt is made to charge them. Very high pressures and temperatures can occur in an instrument often some-time after the attempt to charge them has terminated.

Attempts to charge a primary battery may lead to an imbalance within the cell potentially leading to gas generation and in extreme cases explosion.

4.2.4 Primary Lithium Batteries Storage Instructions

Primary Lithium batteries should be stored in their original containers, in a clean, dry, cool, ventilated area, where the temperature should be as cool as possible to maximise shelf life and not exceed 30°C.

CAUTION



Battery life may be reduced if exposed to temperatures in excess of 30°C.

Instruments with batteries installed should not be left on deck in strong sunlight such that they become hot to the touch.

Observe the manufacturers minimum and maximum storage temperatures.

Store all primary lithium battery packs in an isolated area, away from combustible materials. Store depleted cells in an area separate from fresh cells. Allow space for complete encapsulation with Lith-X in the event of a fire.

Any primary lithium battery storage area should have immediate access to both a class D and an ABC fire extinguisher. Refer to the battery manufacturer's specifications for extinguishing fires containing this battery type.

Instruments should be cooled to normal room temperature or lower before being opened for battery replacement.

4.2.5 Transporting Primary Lithium Batteries

The current regulations and the information below is provided for guidance only. Note that datasheets concerning quantities of lithium per cell are available from cell manufacturers and these may change without prior notice, therefore the quantities of lithium per battery pack cannot be verified by Sonardyne Ltd.

When transporting lithium based products it is the operator's responsibility to comply with local, national and international regulations in force at the time of transport.

- By Road: ADR European Agreement concerning the International Carriage of Dangerous Goods by Road Regulations (<http://www.unece.org>)
- By Sea: International Maritime Dangerous Goods Code (<http://www.imo.org>)
- By Air: IATA Dangerous Goods Regulations (<http://www.iata.org>)

Transportation Certificates for cells are shown in . The certificates detail nominal voltage, capacity, energy and the equivalent Lithium Metal content. Transportation certificates for battery packs used in Sonardyne equipment are available on request from Sonardyne Support.

The IATA Dangerous Goods Regulations Section II, Packing Instructions 967, Note A154 states that lithium batteries identified by the manufacturer as being defective for safety reasons, or that have been damaged, that have the potential of producing a dangerous evolution of heat, fire or short circuit are forbidden for transport.

4.2.6 Disposal of Primary Lithium Batteries

WARNING



Do not dispose of primary Lithium batteries in a fire as there is a potential risk of battery explosion.

Cells and batteries must be disposed of in accordance with local health and safety, and environmental regulations regarding hazardous substances. Packaging suitable for the storage and transport of Lithium cells/batteries must be used at all times when not installed in an instrument.

Suitable personal protective equipment, such as gloves, apron and goggles, should be worn when handling suspect cells/batteries. If the skin has come into contact with the electrolyte, it should be washed thoroughly with clean water.

4.3 Lithium Ion (Li+) Batteries

In a lithium ion (li-ion) cell, the negative electrode (anode) is graphite and the positive electrode (cathode) is a lithium-bearing metal compound. Li-ion cells have an exceptional cycling aptitude owing to the stable electrode structure. Charging and discharging involves exchange of lithium ions between the electrodes via the electrolyte. Because of the high output voltage (up to 4.2 V), a non-aqueous electrolyte is used, mainly comprising a mixture of organic carbonates.

Safety Information for li-ion cells and batteries are shown in *Lithium-ion Cells and Batteries* on page 31.

Li-ion cell specifications are shown in *Lithium-ion Cells* on page 38.

4.3.1 Safety Precautions for Lithium Ion (Li+) Batteries

Refer to *Safety Precautions for Primary Lithium (Li) Batteries* on page 14.

WARNINGS



Only charge li-ion batteries using the charging equipment supplied; do not attempt to charge li-ion batteries using any other type of charging equipment.

4.3.2 Fault Procedures

Refer to *Fault Procedures* on page 14.

WARNING



Dry chemical type or CO2 extinguishers, Halon, or copious quantities of water or water-based foam can be used to cool down burning li-ion cells and batteries. During water application, caution should be exercised as burning pieces of flammable particles may be ejected from the fire. In case of fire, it is recommended to wear self-contained breathing apparatus to avoid contact with irritant fumes. Evacuate all persons from immediate area of fire. Do not re-enter the area until it has been adequately purged of the fire vapour and extinguishing agent.

4.3.3 Lithium Ion Batteries Storage Instructions

Refer to *Primary Lithium Batteries Storage Instructions* on the previous page

When charging li-ion batteries for the first time after long-term storage, deactivation of reactants may lead to increased battery voltage and decreased battery capacity. It is possible to restore batteries to their original performance by repeating several cycles of charging and discharging.

For long-term storage of more than one year, li-ion batteries should be charged at least once a year to prevent leakage and deterioration in performance due to self-discharging. Batteries stored whilst connected to equipment and batteries containing sophisticated battery management electronics may need to be monitored and charged several times a year to avoid technical and performance difficulties.

4.3.4 Transporting Lithium Ion Batteries

Transporting Lithium Ion Batteries above

The IATA Dangerous Goods Regulations Section II, Packing Instructions 967, Note A164 states that li-ion batteries and cells contained in equipment, must have the battery electrically disconnected and exposed terminals protected before transportation.

4.3.5 Disposal of Lithium Ion Batteries

Refer to *Disposal of Primary Lithium Batteries* on the previous page.

4.4 Alkaline and Nickel Metal Hydride (NiMH) Batteries

Other battery types installed in Sonardyne equipment are Alkaline and Nickel Metal Hydride (NiMH).

4.4.1 Alkaline Batteries

WARNING



Do not attempt to charge alkaline batteries.

Alkaline batteries are non-rechargeable. They must be disposed of as hazardous waste, in accordance with local health and safety, and environmental regulations.

4.4.2 Nickel Metal Hydride (NiMH) Batteries

WARNING



Only charge NiMH batteries using the charging equipment supplied; do not attempt to charge NiMH batteries using any other type of charging equipment.

Nickel Metal Hydride (NiMH) batteries are rechargeable. Sonardyne supplies the correct charging equipment with any equipment containing NiMH batteries.

NiMH batteries should be replaced when they fail to hold their charge. They must be disposed of as hazardous waste, in accordance with local health and safety, and environmental regulations.

4.5 Charging Batteries in Sealed Containers

Batteries may give off gases when charged. As a general rule, sealed containers must be allowed to vent to atmosphere during the charging process.

Some equipment may be fitted with safety features which prevent the possibility of problems caused by gases vented by batteries. Refer to the equipment user manual for the correct charging procedure.

Equipment fitted with a pressure relief vent valve must be checked to make sure the vent valve is seated properly following recharging of the batteries.

4.6 Reconnecting a Partially Used Battery

When reconnecting a partially used battery, calculate if the remaining battery life will allow the next mission to be safely accomplished. If so, note the date of reconnection, both on the battery label and in written records, against the serial number of the instrument.

4.7 Batteries – End of Life

Discharging batteries below their end point voltage can lead to internal corrosion and leakage of electrolyte in certain types of cells. Although there is very little gas to cause a pressure rise under these conditions, the electrolyte leakage will cause severe corrosion.

After recovering an instrument, the battery voltage(s) should be checked while still connected to see if it is above the end point voltage for that type of cell. Disconnect and mark as usable or not with date of disconnection noted both on the pack and in written records. Check the instrument, including solder joints for signs of corrosion.

The remaining life of a battery depends on both time and, for a transponder, the number of times it has been interrogated. Some transponders keep their own record of battery usage, but a separate record should be maintained consisting of time elapsed whilst battery is installed and connected, plus estimates of the number of interrogations .

4.8 Fitting a New Battery

Refer to the equipment user manual for the instructions on how to fit a new battery.

Make a note of the date when a new battery is connected. Write this date on the battery label and also in your written records.

4.9 Battery Pack Fuses

A number of Sonardyne battery packs have carefully selected, highly-reliable fuses soldered onto the diode-board of the pack. The fuses can be either resettable "Polyfuse" devices, or "Littelfuse" devices. If a fuse has blown due to mishandling, it may be replaced by an identically specified fuse type; the rating must not on any account be increased.

4.10 WEEE Directive

A number of Sonardyne battery packs may have the WEEE (Waste from Electrical and Electronic Equipment Directive 2002/96/EC) 'crossed out wheelie bin logo' marked on them.

This logo indicates that the batteries must not be disposed of in a landfill. If the logo has a black solid line under it, this indicates that the equipment was manufactured after 13 August 2005, after the directive came into force and that the equipment must not be disposed of in a landfill.

Table 4-1 WEEE Directive 2002/96/EC Logo Definitions

Symbol	Definition
	The WEEE Directive (Waste from Electrical and Electronic Equipment Directive) 2002/96/EC used on equipment to show the product must not be disposed of in landfill. The logo is defined in detail in the European Standard EN50419

Table 4–1 WEEE Directive 2002/96/EC Logo Definitions (continued)

Symbol	Definition
	The same as the WEEE Directive (detailed above) but the bottom bar is added to indicate equipment that has been manufactured after 13 August 2005, after the Directive came into force. This must not be disposed of in landfill.

4.11 Additional Battery Manufacturer Information

Additional information applicable to lithium and lithium-ion cells is available from:

Saft Headquarters
12, rue Sadi Carnot
93170 Bagnolet
France

Tel: +33 (0)1 49 93 19 18
Fax: +33 (0)1 49 93 19 50
<http://www.saftbatteries.com>

Panasonic Batteries
Panasonic Industrial Company
A Division of Panasonic Corporation of North America
5201 TollView Drive, 1F-3
Rolling Meadows, IL-60008
Toll Free: 877-726-2228
Fax: 847-468-5750
e-mail: oembatteries@us.panasonic.com
<http://www.panasonic.com/batteries>

E-One Moli Energy Corp.
10 Dali 2nd Rd., Shan-Hwa
Tainan County
Taiwan, R.O.C,
Tel: 886-6-505-0666
Fax: 886-6-505-0777
<http://www.molicel.com/>

allbatteries/Enix Energies
Unit 20, Monkspath Business Park
Highlands Road
West Midlands
B90 4NZ
Tel: +44 121 5068619
<http://www.allbatteries.com>

Section 5 – Equipment Environmental Limitations

5.1 Storage Temperature Limits

Equipment must be stored according to the specifications quoted in the equipment manual/datasheet. It should be noted however that lines connecting pressure transducers to a transponder may become partly filled with seawater during service. This cannot easily be expelled and may therefore freeze if transponders are stored at sub-zero temperatures after recovery from the sea.

Batteries should be stored in their original containers, in a clean, dry, cool, ventilated area, where the temperature should be as cool as possible to maximise shelf life and not exceed 30°C. Refer to the battery manufacturers specifications for battery storage.

5.2 Instrument Load Bearing Capability

Navigational Transponders are **not** normally designed to take in-line loads greater than the maximum upthrust applied by the floatation equipment. The carrying straps, if fitted, are for ease of manual handling and the range of transducer guards selected for their acoustic properties.

WARNING



Do not exceed the Working Load Limit capabilities of release mechanisms, or additional lifting equipment.

The Working Load Limit (WLL) capability of the release mechanism built into many instruments, can only be used for in-line lifting operations if a suitably-rated, approved, lifting strap, transducer guard, buoyancy collar eyes or other safe method is selected.

It is the responsibility of the Responsible Body at the worksite to make sure the condition of the equipment is acceptable and that a safe lifting method has been devised for any particular operation.

Sonardyne's range of Oceanographic Release Transponders have been designed specifically for in-line lifting operations.

Appropriate shackles must be used in release systems to ensure freedom from corrosion. It is important to note that instruments, their release mechanisms and shackles form part of an integrated and complete system.

5.3 Floatation Equipment

5.3.1 Introduction

Floatation equipment is fitted to subsea transponders in order to aid their recovery once a deployment is complete. A nett up-thrust requirement is given in manuals and technical data for any particular instrument. The following guidelines are given to assist operators in their understanding of the general requirements.

5.3.2 Float Inspection

The float lifting eyes and attachment bolts can be susceptible to corrosion. To guarantee safe operation, the float lifting eyes and attachment bolts must be inspected prior to use, any indication of corrosion and the lifting eyes and bolts must be replaced.

5.3.3 Minimum Nett Buoyancy of Floats

Floats are described as having a minimum nett buoyancy in seawater and this is the figure quoted in Sonardyne float technical data and by the float manufacturer. Total up-thrust can be calculated by

knowing this figure, e.g., a float with 30 kilogram nett buoyancy in sea water supporting a load with weight in sea water of 30 kilogram would result in neutral buoyancy, i.e. no nett up-thrust.

5.3.4 Float Inserts

Float collar Inserts are used to allow floats of larger internal bore to be used with housings of nominal six inches diameter. The weight in water of an insert is usually slightly positive and this will be additional to the weight of the instrument being supported by the float. Two inserts will result in approximately 0.5 kilogram reduction in nett up-thrust.

Nett Upthrust

The difference between the nett buoyancy of the float and the total weight of an object, or objects, in water that it is supporting, e.g.

Nett Upthrust = (minimum nett buoyancy of the float) - (the weight of the instrument + the float inserts in water)

e.g. 30 kg - (11.2+ 0.5) kg = 17.3 kg nett upthrust

Float Storage Conditions

Floats should be stored within the temperature range -6 to +65°C. Floats are not hygroscopic and should not therefore be affected by moisture in air.

CAUTION



Do not stack the floats on top of each other or store in direct sunlight.

Float Over-Pressure

The maximum water depth quoted for a float must not be exceeded. Over-pressured floats are forced to absorb water and their weight in air thus increases. All floats should be weighed prior to use to check that they are maintaining their original manufactured weight.

Appendix A – Safety Datasheets/Battery Information Sheets

A.1 Lithium Cells and Batteries



Battery Information Sheet

Primary Li-SOCl₂ single cells and multi-cell battery packs

According to REACH regulation (EC 1907/2006, Art 31) and to OSHA regulation (29 CFR 1910.1200), batteries are **ARTICLES** with no intended release. As such, they are not covered by legal requirements to generate and supply an SDS or an MSDS.

This Battery Information Sheet is provided solely as information document for the purpose of assisting our customers.

1. IDENTIFICATION

1.1 Product

Lithium-thionyl dichloride primary unit cells and multi-cell battery systems composed of these cells

1.2 Supplier

Headquarters Address Phone/Fax	Saft S.A.S. 26 quai Charles Pasqua, 92300 LEVALLOIS-PERRET – France Phone / Fax : +33 1 58 63 16 00/+33 1 58 63 16 18
Factory Address Phone/Fax	Saft Poitiers Rue Georges Leclanché, BP 1039, 86060 POITIERS Cedex 9 – France +33 (0)5 49 55 48 48 /+33 (0)5 49 55 48 50
Factory Address Phone/Fax	Saft Ltd. River Drive, Tyne & Wear, SOUTH SHIELDS, NE33 2TR – United Kingdom +1 44 191 456 1451/+1 44 191 456 6383
Factory Address Phone/Fax	Saft America Inc. 313 Crescent Street, VALDESE, NC 28690 – USA +1 828 874 4111/+1 828 874 2431
Factory Address Phone/Fax	Saft Batteries Co., Ltd. Zhuhai Free Trade Zone, Lianfeng Road, ZHUHAI 519030, Guangdong Province – China +86 756 881 9318/+86 756 881 9328
Factory Address Phone/Fax	Tadiran Batteries Ltd. 34 Y. Rabin Avenue – KIRYAT EKRON 76950 - Israel +972 894 44374/+972 894 13066
Factory Address Phone/Fax	Tadiran Batteries GmbH Industriestrasse 22, D-63654 BÜDINGEN – Germany +49 (0)6 042 954 599/+49 (0)6 042 954 190

1.3 Emergency contact For chemical emergency ONLY (in case of spill, leak, fire, exposure or accident) call CHEMTREC at:
International: +1-703-527-3887 for English
Within the USA: +1-800-424-9300



2. HAZARD IDENTIFICATION

The Li-SOCl₂ batteries described in this Battery Information Sheet are sealed units which are not hazardous under normal operating conditions in accordance with manufacturer's recommendations, as stated in the user's manual or other similar documentation. Under normal use, the battery integrity is maintained and the active components it contains are isolated from the outside.

In particular, the battery should not be submitted to any mechanical (opening, puncture, immersion), thermal (burning, heating to temperatures above the normal temperature range of the product) or electrical abuse (short-circuit, recharge, forced discharge), which will lead to the activation of safety valves and/or the rupture of the battery container.

Any accidental release of the inner components of the cell, or their combustion products could be highly hazardous. Battery content exposition to air humidity/liquid water may be followed by severe battery vent/explosion/fire, depending on the hazard causes and circumstances.

Protection from charging:

Whenever lithium batteries are not the single power source in a circuit, the following measures recommended by Underwriters Laboratories are relevant. The cells should not be connected with an electrical power source that would increase the load through the cells. The electronic circuit shall include one of the following:

- A. Two suitable diodes or the equivalent in series with the cells to prevent any reverse (charging) current. The second diode is used to provide protection in the event that one would fail. Quality control, or equivalent procedures, shall be established by the device manufacturer to check that the diode polarity is correct for each unit.

Or

- B. A blocking diode or the equivalent to prevent any reverse (charging) current and a resistor to limit current in case of diode failure. The resistor should be sized to limit the reverse (charging) current to the maximum value according to the data sheet of the cell.

3. COMPOSITION, INFORMATION OR INGREDIENTS

Each unit cell consists of a hermetically sealed metallic can containing a number of chemicals and materials of construction of which the following are potentially hazardous upon release to air.

Component	CAS Number	EINECS/ELINCS	Content (wt. %)*
Lithium metal	7439-93-2	231-102-5	2-6
Thionyl dichloride	7719-09-7	231-748-8	18-47
Aluminium chloride	7446-70-0	231-208-1	1-5
Gallium chloride	13450-90-3	236-610-0	0-2
Lithium chloride	7447-41-8	231-212-3	1-2
Carbon	1333-86-4	215-609-9	2-5
PTFE	9002-84-0	N/A	0-1
Stainless steel, Nickel and inert material	N/A	N/A	remainder

* Quantities may vary with cell model



4. FIRST AID MEASURES (not anticipated under normal use)

4.1 Electrolyte contact

EYE CONTACT: Immediately flush with plenty of water for at least 15 minutes and get medical attention.

SKIN CONTACT: Remove contaminated clothing and immediately flush with plenty of water for at least 15 minutes. In severe cases, get medical attention.

INHALATION: Contents of an opened cell may cause respiratory tract and mucus membrane irritation. Remove from exposure, rest and keep warm. Immediately inhale Cortisone spray. In severe cases, track medical surveillance for 48 hours.

INGESTION: Wash out mouth thoroughly with water and give plenty of water to drink. Get medical attention.

FURTHER TREATMENT: All cases of eye contamination, persistent skin irritation and casualties who have swallowed this substance or have breathed its vapours should be seen by a Doctor.

4.2 Lithium metal contact

EYE CONTACT: Immediately flush with large quantities of water for at least 15 minutes, with open eyelids, and get medical attention.

SKIN CONTACT: Remove particles of lithium from skin as quick as possible. Immediately flush with plenty of water for at least 15 minutes and get medical attention.

INHALATION/INGESTION: Contents of an opened cell may cause respiratory tract and mucus membrane irritation. Remove from exposure, rest and keep warm. Immediately inhale Cortisone spray. In severe cases, track medical surveillance for 48 hours.

5. FIRE FIGHTING MEASURES (not anticipated under normal use)

EXTINGUISHING MEDIA:

- During a fire with lithium batteries, using large amounts of cold water or water-based foam has some cooling effect and is effective to prevent fire expansion as long as the extent of the fire has not progressed to the point that the lithium metal they contain is exposed (as marked by appearance of deep red flames). Do not use warm or hot water.
- Lith-X Class D extinguishers are effective on fires involving only a few lithium batteries.
- Do not use CO₂ or Halon-type extinguishers.
- Do not use sand, dry powder or soda ash, graphite powder or fire blankets.
- **Use only class D metal extinguishers on raw lithium metal.**

SPECIAL FIRE FIGHTING PROCEDURES:

- Fire fighters should wear approved/certified positive pressure self-contained breathing apparatus.
- Full protective clothing is necessary to prevent potential body contact with electrolyte solution.
- During water spraying, caution is advised as burning pieces of lithium may be ejected from the fire.



- It is permissible to use any class of extinguishing medium, specified above, on these batteries or their packing material. Cool exterior of batteries if exposed to fire to prevent rupture.
- If the cells or batteries are not located at the center of the fire, copious amounts of water may be supplied using a diffuser type nozzle so that the cells remain cool during the fire containment and extinction. A sprinkler system should be suitable for this purpose, the critical factor being that the lithium cells do not experience temperatures above the melting point of lithium (180°C).
- Small amounts of water should never be used such as the volumes contained within portable fire extinguishers. Standard dry powder extinguishers are ineffective. It should be kept in mind that a hazard of hydrogen formation exists whenever hot lithium metal comes into contact with water.

6. ACCIDENTAL RELEASE MEASURES (not anticipated under normal use)

INDIVIDUAL PRECAUTIONS: Evacuate the employees from area until fumes dissipate. In case of electrolyte leakage from a cell or battery, do not inhale vapors or touch liquid with bare hands. In case of skin or eye contact, inhalation or ingestion, follow the measures described in section 12.

ENVIRONMENTAL PRECAUTION: Avoid sewage, surface water and underground water contamination. Avoid ground and atmosphere contamination.

WAYS OF CLEANING: With protective glasses and gloves, use absorbent material (sand, earth, chalk (CaCO₃) or lime (CaO) powder or Vermiculite) to absorb any exuded material. Seal leaking battery (unless hot) and contaminated absorbent material tight in plastic bag, and dispose of as hazardous waste in accordance with local regulations. Electrolyte traces may be wiped off dryly using household paper. Rinse with water afterwards.

7. HANDLING AND STORAGE

IMPORTANT NOTICE: Lithium-thionyle chloride batteries are not rechargeable and should not be tentatively charged or recharged. Manufacturer's recommendations should be followed regarding maximum current and operating

temperature range. Applying pressure or deforming the battery may lead to disassembly and cause eye, skin and throat irritation.

STORAGE: Store in a cool, regulated (preferably below 21°C and in any case below 30°C), dry and ventilated area, away from possible sources of heat, open flames, food and drink. Avoid exposure to direct sunlight for long periods. Temperatures above 100°C (or higher for High Temperatures cells and batteries such as the LSH20-150 cell- refer to individual data sheets for maximum temperatures) may cause leakage and rupture, and result in shortened battery service life. Keep proper clearance space between batteries and walls. Since short circuit can cause burn hazard, leakage or explosion hazard, keep batteries in original packaging until use and do not mix them.

HANDLING:

- Do not open the battery system.
- Do not crush or pierce the cells.
- Do not short (+) or (-) terminal with conductors.
- Do not reverse the polarity.
- Do not submit to excessive mechanical stress.
- Do not mix batteries of different types or mix new and old ones together.
- Do not use the unit without its electronic management system.



- Do not expose the unit to water or condensation.
- Do not directly heat, solder or throw into fire. Such unsuitable use can cause leakage or spout vaporized electrolyte fumes and may cause fire or explosion.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION* (not anticipated under normal use)

	Respiratory protection	In all fire situations, use self-contained breathing apparatus
	Hand protection	In case of leakage wear protective gloves
	Eye protection	Safety glasses are mandatory during handling
	Other	In the event of leakage or ruptured cells, wear a rubber apron and protective clothes.

*AFNOR pictograms

Occupational exposure standard:

Compound	8 hour TWA	15 min TWA	SK
Sulfur Dioxide	1 ppm	1 ppm	-
Hydrogen chloride	1 ppm	5 ppm	-

9. PHYSICAL AND CHEMICAL PROPERTIES

The lithium-thionyl chloride cell or battery described by this Battery Information Sheet is a sealed unit when offered for sale. It is a manufactured “article” and does not expose the user to hazardous chemicals when used in accordance with manufacturer specifications.

Appearance – Cylindrical shape

Odour – If leaking, gives off a pungent corrosive odour

Flash point – Not applicable

Boiling Point – Not applicable

Vapor Pressure – Not applicable

pH – Not applicable

Solubility (in water) – Not applicable

Flammability – Not applicable

Melting Point – Not applicable

Vapor Density – Not applicable

Specific Gravity – Not applicable

Solubility (other) – Not applicable

10. STABILITY AND REACTIVITY

The battery system is stable when handled and stored according to section 4.

MATERIALS TO AVOID: Oxidizing agents, bases, water. Avoid electrolyte contact with aluminium or zinc.

CONDITIONS TO AVOID: Do not heat above 100°C (or higher (150°C) for High Temperatures cells and batteries such as the LSH20-150 cell- refer to individual data sheets for maximum temperatures) or incinerate. Do not disassemble, crush, pierce, short, charge or recharge. Avoid mechanical or electrical abuse.



HAZARDOUS DECOMPOSITION PRODUCTS: Hydrogen (H_2) as well as lithium oxide (Li_2O) and lithium hydroxide ($LiOH$) dust are produced in case of reaction of lithium metal with water (hydrolysis).

Chlorine (Cl_2), sulfur dioxide (SO_2) and disulfur dichloride (S_2Cl_2) are produced in case of thermal decomposition of thionyl dichloride above $100^\circ C$. Hydrochloric acid (HCl) and sulfur dioxide (SO_2) are produced in case of reaction of thionyl dichloride with water at room temperature.

Hydrochloric acid (HCl) fumes, lithium oxide (Li_2O), lithium hydroxide ($LiOH$) and aluminium hydroxide ($Al(OH)_3$) dust are produced in case of reaction of lithium tetrachloroaluminate ($LiAlCl_4$) with water.

11. TOXICOLOGICAL INFORMATION

There is no risk, unless the battery ruptures. In the event of accidental exposure to internal contents, corrosive fumes will cause severe skin, eye and mucous membrane irritation. Medical conditions are generally aggravated by exposure to battery internal contents: eczema, skin allergies, lung injuries, asthma and other respiratory disorders may occur. Overexposure may cause symptoms of non-fibrotic lung injury and ingestion can cause tissue damage to throat and gastro-respiratory tract.

12. ECOLOGICAL INFORMATION

The batteries do not contain mercury, cadmium or other heavy metals.

Eco-toxicity	None known if used/disposed of correctly.
Mammalian affects	None known if used/disposed of correctly.
Bioaccumulation potential	None known if used/disposed of correctly.
Environmental fate	None known if used/disposed of correctly.

13. DISPOSAL CONSIDERATIONS

Batteries do not contain hazardous materials according to EC Directives 91/157/EEC, 93/86/EEC, and 2002/95/EC (RoHS Directive). Battery recycling is either mandatory or recommended: The European Directive 2006/66/EC has been implemented by most EC member states.

Dispose of in accordance with local laws and regulations. Store material for disposal as indicated in Section 4. A disposal service is offered upon request by Tadiran Batteries.

Do not incinerate, or subject cells to temperatures in excess of $100^\circ C$ (or $150^\circ C$ for LSH20-150 cells and the battery packs assembled from them). Such abuse can result in loss of seal, electrolyte leakage and/or violent disassembly with risk of material projections.

For additional information a Technical Notice is available upon request.

See the section on "Sustainability & Environment" on <https://www.saftbatteries.com/about-us/environmental-responsibility>

The recycling of batteries must only be conducted by fully trained personnel of licensed recyclers. Attempting to dismantle batteries or modules into individual cells may lead to serious injuries or death due to high electrical voltage and/or energy.

14. TRANSPORTATION INFORMATION

Note: when manufacturing a new battery pack, one must assure that it has fulfilled the tests according to the UN Model Regulations, Manual of Tests and Criteria, Part III, subsection 38.3.



14.1 United Nations Class

For the single cell batteries and multi-cell battery packs that are non-restricted to transport (non-assigned to the Miscellaneous Class 9), use lithium batteries inside label.

For the single cell batteries and multi-cell battery packs which are restricted to transport (assigned to Class 9), use Class 9 Miscellaneous Dangerous Goods and UN Identification Number Labels.

In all cases, refer to the product transport certificate issued by the manufacturer.

UN Numbers:	3090	LITHIUM METAL BATTERIES: Shipment of cells and batteries <i>in bulk</i>
	3091	LITHIUM METAL BATTERIES CONTAINED IN EQUIPMENT or LITHIUM METAL BATTERIES PACKED WITH EQUIPMENT: Cells and batteries <i>contained in equipment or packed with it</i>
Shipping name	LITHIUM METAL BATTERIES	
Hazard Classification:	9	
	Depending on their lithium metal content, some single cells and small multi-cell battery packs may be non-assigned to Class 9. Refer to Transport Certificate.	
Packaging:	Group II	

14.2 International agreements

By Air International:	IATA/ICAO: UN 3090 or UN3091
By Sea International:	IMDG: UN 3090 or UN 3091
European road transportation:	ADR
European rail transportation:	RID

15. REGULATORY INFORMATION

Regulations specifically applicable to the product:

- ACGIH and OSHA: see exposure limits of the internal components of the battery in section 14.
- IATA/ICAO (air transportation): UN 3090 or UN 3091.
- IMDG (sea transportation) : UN 3090 or UN 3091.
- Transportation within the US-DOT, 49 Code of Federal Regulations
- UK regulatory references: Classified under CHIP.
- Battery Directive (2006/66/EC): see section 9

16. OTHER INFORMATION

This information has been compiled from sources considered to be dependable and is, to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, neither exhaustively nor perfect reliability can be granted. Information does not imply implicit or specific warranty of it.



This information relates to the specific products designated and may not be valid for such products used in combination with any other materials or in any process. It is the user's responsibility to satisfy himself as to the suitability and completeness of this information for his particular use.

Saft does not accept liability for any loss or damage that may occur, whether direct, indirect, incidental or consequential, from the use of this battery information sheet provided as a service to our customers. Saft does not offer warranty against patent infringement.



Saft S.A.S.

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www.saftbatteries.com

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Data in this document is subject to change without notice and becomes contractual only after written confirmation.

A.2 Lithium-ion Cells and Batteries



Battery Information Sheet

Rechargeable lithium-ion cells, modules and battery systems

According to REACH regulation (EC 1907/2006, Art 31) and to OSHA regulation (29 CFR 1910.1200), batteries are **ARTICLES** with no intended release. As such, they are not covered by legal requirements to generate and supply an SDS or an MSDS.

This Battery Information Sheet is provided solely as an informational document for the purpose of assisting our customers.

1. IDENTIFICATION

1.1 Product

Lithium-Ion rechargeable cells and modules or battery systems composed of these cells

1.2 Supplier

Headquarters Address Phone/Fax	Saft S.A.S. 26 Quai Charles Pasqua, 92300 LEVALLOIS-PERRET – France Phone/Fax: +33 (0)1 58 63 16 00 /+33 (0)1 58 63 16 50
Factory Address Phone/Fax	Saft Bordeaux 111-113, boulevard Alfred Daney, 33074 BORDEAUX - France +33 (0)5 57 10 64 00 /+33 (0)5 57 10 68 77
Factory Address Phone/Fax	Saft Jacksonville 13575, Waterworks street, JACKSONVILLE, FL 32221 - USA +1 904 861 1501/+1 904 772 1463
Factory Address Phone/Fax	Saft Nersac Zone industrielle, 16440 NERSAC - France +33 (0)5 45 90 50 26 /+33 (0)5 45 90 50 71
Factory Address Phone/Fax	Saft Raskovice Raskovice 247, 73904 PRAZMO - Czech Republic +420 558 426 257/+420 558 692 226
Factory Address Phone/Fax	Saft Poitiers Rue Geoges Leclanché – BP n°1039, 86060 POITIERS Cedex 9 - France +33 (0)5 49 55 48 48 /+33 (0)5 49 55 48 50
Factory Address Phone/Fax	Saft Cockeysville 107 Beaver Court, COCKEYSVILLE, MD 21030 - USA +1 410 771 3200/+1 410 771 1144
Factory Address Phone/Fax	Saft Valdese 313 Crescent Street, VALDESE, NC 28690 - USA +1 828 874 4111/+1 828 874 2431
Factory Address Phone/Fax	Friemann & Wolf Batterietechnik GmbH (a company of the Saft Group) Industriestrasse 22, 63654 BÜDINGEN - Germany +49 (0)6042 954 150 / +49 (0)6042 954 490



1.3 Emergency contact

Chemtrec US Service within USA-Canada: +800 424 93 00/outside : +1-703-527-3887

In case of an incident and/or accident involving the battery, this telephone number is available 24 hours a day and is monitored at all times by a person who has comprehensive emergency response and accident mitigation information for the battery or can immediately call upon a person who possesses such knowledge and information.

If needed, the fire brigade may also be called in case of an incident/accident involving the battery.

2. HAZARD IDENTIFICATION

2.1 At cell level

Not chemically dangerous during normal use in accordance with Saft recommendations as stated in the user manuals or other similar documentation. In particular, the battery should not be opened or burned. Exposure to the ingredients contained inside the cells or combustion products could be harmful.

EYE CONTACT: contents of an opened cell inside a battery can cause eye irritation. Dust may cause inflammation of eyelids

SKIN CONTACT: Electrolyte solution contained inside cells can cause skin irritation. Contact with positive active material may in addition cause allergic dermatitis or irritation to skin.

INHALATION: Contents of an opened cell can cause respiratory tract and mucus membrane irritation. Overexposure to lithiated nickel compounds may cause an allergic response. If gas is generated during battery disassembly, throat irritation may occur.

2.2 At module and battery system level

HIGH VOLTAGE: Always use the large battery systems in a restricted access area. Only authorized people aware of high voltage hazards and trained to work on such systems are allowed to enter in the battery area.

TEMPERATURE: Do not place the batteries on or near fires or other high-temperature locations (> 70°C for VL and VES cells, > 85°C for extended temperature MP range [with xtd extension] and > 125°C for high temperatures VL cells [with – 125 extension]). Doing so may cause the batteries to overheat or ignite. Using the batteries in this manner may also result in a loss of performance and a shortened battery life.

3. COMPOSITION, INFORMATION OR INGREDIENTS

3.1 At cell level

Component	CAS Number	EINECS/ELINCS	Content (wt. %)*
Lithiated metal compounds (NCA,NMC, LFP, LCO)	N/A	N/A	15-30
Organic Electrolyte	N/A	N/A	10-20
Carbon, as Graphite	7440-44-0	231-153-3	10-25
Copper	7440-50-8	231-159-6	1-30
Aluminium	7429-90-5	231-072-3	1-20
Stainless, Nickel and inert material	N/A	N/A	remainder

* Quantities may vary a little with cell model

3.2 At module and battery system level

Depending on the type of battery system, the battery may contain either a glycol ethylene based coolant or a refrigerated coolant.



4. FIRST AID MEASURES (not anticipated under normal use)

EYE CONTACT: Immediately flush eyes with copious amount of water for at least 15 minutes. Seek immediate medical attention.

SKIN CONTACT: Remove contaminated clothing and flush affected areas with plenty of water for at least 15 minutes. Wash skin with soap and water. If skin irritation persists, call for a medical attention.

INHALATION: Remove to fresh air and seek immediate medical attention. Obtain medical advice.

INGESTION: Clear mouth with water and afterwards drink plenty of water. Do not induce vomiting. Seek immediate medical attention.

5. FIRE FIGHTING MEASURES (not anticipated under normal use)

EXTINGUISHING MEDIA:

- Small fires: use A,B or C type fire extinguisher, inert gas (for instance blend of argon and nitrogen), CO₂, dry chemical powder or foam extinguishers
- Large fires: use large quantities of water for the surrounding fire and to prevent propagation. If water is used on batteries in operation, caution should be taken to avoid the electrical hazard that may be present.

SPECIAL FIRE FIGHTING PROCEDURES: Fire fighters should wear self-contained breathing apparatus.

Use approved / certified vapour respirator to avoid breathing toxic fumes. Wear protective clothing and equipment to prevent potential body contact with electrolyte solution. It is permissible to use any class of extinguishing medium, specified above, on these batteries or their packing material. Cool exterior of batteries if exposed to fire to prevent rupture.

PARTICULAR HAZARDS RESULTING FROM EXPOSURE TO THE SUBSTANCE/PREPARATION, TO COMBUSTION AND GAS PRODUCTS: The cell can spout vaporized or decomposed electrolyte fumes with fire when being heated over +100°C (+212°F) (over 125°C for high temperatures VL cells [with – 125 extension]) or disposed in fire. Solvents within the electrolyte are flammable liquids and must be kept away from any kind of ignition source.

6. ACCIDENTAL RELEASE MEASURES (not anticipated under normal use)

INDIVIDUAL PRECAUTIONS: Evacuate the employees from the contaminated area until fumes dispersal. In case of electrolyte leakage from a cell or battery, do not inhale the gas as possible. In case of skin or eye contact, inhalation or ingestion, follow the measures described in section 4.

ENVIRONMENTAL PRECAUTION: Avoid sewage, surface water and underground water contamination. Avoid ground and atmosphere contamination.

CLEANING PROCEDURE: Use protective glasses and gloves, use absorbent material (sand, earth or vermiculite) to absorb any exuded material. Seal leaking battery (unless hot) and contaminated absorbent material in plastic bag and dispose of as Special waste in accordance with local regulations.

7. HANDLING AND STORAGE

IMPORTANT NOTICE: The battery should not be opened without Saft approval. The battery should not be destroyed or incinerated since the battery may cause fire or the ingredients contained in the cells could be harmful if exposed.



STORAGE : Store in a cool, dry and ventilated area. Elevated temperatures can shorten battery life. Since short circuit can cause burn hazard, leakage or venting hazard, keep batteries in original packaging until use and do not jumble them.

HANDLING :

- Do not short (+) and (-) terminal with conductors.
- Do not short (-) terminal and the can of aluminium can cells with conductors
- Do not short (+) terminal and the can of stainless steel can cells with conductors
- Do not reverse the polarity
- Do not mix different type batteries or mix new and old ones together.
- Do not open the battery system or modules
- Do not use the unit without its electronic management system.
- Do not submit to excessive mechanical stress.
- Do not expose the unit to water or condensation
- Do not directly heat, do not solder or throw into fire. Such unsuitable use can cause leakage or spout vaporized electrolyte fumes and may cause fire or explosion.
- Immediately disconnect the batteries if, during operation, they emit an unusual smell, feel hot, change shape, or appear abnormal in any other way. Contact Saft if any of these problems are observed.

CHARGING/DISCHARGING : Charge with charger designed specifically for this battery. Do not overcharge as venting and combustion can occur. Do not over-discharge. Discharge limits are dependent on the specific product. Refer to Saft Instructions.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION* (not necessary under normal use)

Handle an opened battery only in a well ventilated place.

	Respiratory protection	In case of incident or after an abusive use, in case of leaking or ruptured cells, use a gas mask which covers the whole face and equipped with ABEK type filters or an escape mask such as a Self-Contained Breathing Apparatus. Fire fighters should wear self-contained breathing apparatus.
	Hand protection	Use polypropylene, polyethylene, rubber or Viton gloves when handling leaking or ruptured cells.
	Eye protection	In case of incident or after an abusive use, in case of leaking or ruptured cells, wear safety glasses with protected side shields or a mask covering the whole face when handling leaking or ruptured cells
	Other	In the event of leaking or ruptured cells, wear a rubber apron and protective clothes.

*AFNOR pictograms

9. PHYSICAL AND CHEMICAL PROPERTIES

The lithium-Ion cell or battery described by this Battery Information Sheet is a sealed unit when offered for sale. It is a manufactured "article" and does not expose the user to hazardous chemicals when used in accordance with the manufacturer specifications.

Boiling Point – Not applicable
Vapor Pressure – Not applicable
Specific Gravity – Not applicable

Melting Point – Not applicable
Vapor Density – Not applicable



10. STABILITY AND REACTIVITY – the battery system is stable when handled and stored according to section 7

MATERIALS TO AVOID: Oxidizing agents, acids, bases and reducing agents.

CONDITIONS TO AVOID: Avoid exposing battery to fire or high temperature. Do not disassemble, crush or short or install with incorrect polarity. Avoid mechanical or electrical abuse.

HAZARDOUS DECOMPOSITION PRODUCTS: Lithium hexafluorophosphate may react with water in the atmosphere and produce some traces of hydrogen fluoride, which do not worsen the gas toxicity. Thermal decomposition of the cell may release of electrolyte liquid and vapour, harmful materials, and dusts.

11. TOXICOLOGICAL INFORMATION

Risk of irritation occurs only if the cell is mechanically, thermally or electrically abused to the point of compromising the integrity of the enclosure. If this occurs, irritation to the skin, eyes and respiratory tract may occur.

12. ECOLOGICAL INFORMATION

None known if used/disposed of correctly

13. DISPOSAL CONSIDERATIONS

Battery recycling is either mandatory (European Directive 2006/66/EC) or recommended.

Batteries should be fully discharged prior to disposal and terminals should be protected.

The recycling of batteries must only be conducted by fully trained personnel of licensed recyclers. Attempting to dismantle batteries or modules into individual cells may lead to serious injuries or death due to high electrical voltage and/or energy.

Dispose in accordance with local laws and regulations. Store material for disposal as indicated in Section 7.

Do not dump into any sewers, on the ground or into any body of water.

See the section on "Environmental Responsibility" on <https://saftbatteries.com/about-us/environmental-responsibility>

14. TRANSPORTATION INFORMATION

14.1 Regulatory Framework

Shipment of new and used Lithium-ion cells and batteries are classified as Dangerous Goods under the UN model regulation.

- If shipped as such, UN Dangerous Goods Entry is: UN 3480
- If shipped contained in equipment or packed with equipment, UN Dangerous Goods Entry is: UN 3481
- If shipped contained in a vehicle, the vehicle is category UN3171 (battery powered vehicle for full electrical type) or UN3166 (flammable... powered vehicle for hybrid type).

Packaging Group II applies in most situations.

Modal international and national regulations governing transportation by air, sea, road and rail (ICAO/IATA, IMDG, ADR, RID...) are legally binding and persons offering lithium-ion cells and batteries for transport must comply with all requirements governing such activity, including but not limited to special provisions, packing instructions, labelling and training.



14.2 Overview

Persons offering Lithium cells or batteries for transport need to properly determine the applicable provisions and instructions. More information is available in the official documentation for this purpose

(<http://www.unece.org/trans/danger/danger.html>).

Consideration must inter alia be given to:

- The mode of transport: air (IATA), sea (IMDG), road (ADR) or rail (RID),
- The country of origin and of destination,
- The applicable UN code and related description: Lithium-ion cells or batteries shipped as such, shipped contained in equipment, or packed with equipment, or shipped in a vehicle,
- The status of the good: new cells or batteries, spent or waste cells or batteries, damaged or defective cells or batteries, prototype for testing, short production run or commercial series product,
- UN test certification status of the cell or the battery.

15. REGULATORY INFORMATION

Marking Consideration

European Union: According to directive 2006/66/EC, the batteries have to be marked with the crossed-out wheel bin symbol.

Lithium-ion batteries, which contain electronic modules (e.g. PCM) and which are subject to the EMC directive 93/97/EEC, must be approved and must be marked with the CE marking.

16. OTHER INFORMATION

This information has been compiled from sources considered to be dependable and is, to the best of our knowledge, accurate and reliable as of the date compiled. However, neither complete exhaustiveness nor perfect reliability can be granted. The communication of this information does not constitute an implicit or specific warranty.

This information relates to the specific products it is applicable to and may be invalid for these products when used in combination with any other equipment or in any process. It is the user's responsibility to satisfy himself as to the suitability and completeness of this information for his particular use.

Saft does not accept liability for any loss or damage that may occur, whether direct, indirect, incidental or consequential, from the use of this battery information sheet provided as a service to our customers. Saft does not offer warranty against patent infringement.

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Edition: August 2017
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Data in this document is subject to
change without notice and
becomes contractual only after
written confirmation.

Appendix B – Cell Specifications

B.1 Lithium Cells

Lithium cells used with Sonardyne products are described in *Table B–1* below. Refer to the manufacturers website for the latest specifications, safety, datasheet and transportation certificate or contact [Sonardyne Support](#) for more information.

Table B–1 Lithium Cells

Manufacturer	Type	Voltage	Size	Manufacturers Website
Saft	LS33600	3.6 V	D Bobbin	https://www.saftbatteries.com/
	LS26500		C Bobbin	
	LSH20		D Spiral	
	LSH14		C Spiral	
	LSH14 Light		C Spiral	
	LS14500		AA Bobbin	

B.2 Lithium-ion Cells

Lithium-ion cells used with Sonardyne products are described in *Table B–2* below. Refer to the manufacturers website for the latest specifications, safety, datasheet and transportation certificate or contact [Sonardyne Support](#) for more information.

Table B–2 Lithium-ion Cells

Manufacturer	Type	Voltage	Size*	Link
Saft	MP144350	3.75 V	L 55.5 mm W 43.9 mm H 14.9 mm	https://www.saftbatteries.com/
Molicel	ICR18650H	3.7 V	Dia 18.4 mm H 65.2 mm	http://www.molicel.com/ca/
Varta	LPP503759 DL	3.7 V	L 59.5 mm W 37.5 mm H 5.2 mm	http://www.varta.com/
Panasonic	NCR18650B	3.7 V	Dia 18.5 mm L 65.3 mm	https://eu.industrial.panasonic.com/
Inspired Energy	NL2024HD22	14.4 V	L168 mm W107 mm H22 mm	https://www.inspired-energy.com Datasheet
Enix	MGL28321	15.0 V	-	MGL28321 Safety Information MGL28321 Datasheet **

*Sizes shown are approx; see manufacturers datasheet for exact sizes.

**Safety information and datasheet for this battery are not published and are included in this document (see following pages).

B.2.1 MGL28321 Safety Information



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1. Identification Of Substance

Product Details

Product Name: LI-MN BATTERY

Product Model: 10440 350mah

Manufacturer/Supplier By: SHENZHEN FEST TECHNOLOGY CO., LTD

Baoshan Industrial Park, Longhua, Bao'an, Shenzhen, Guangdong, China

Tel & Emergency Tel: +86-755-89304183

Fax: +86-755-27764602

2. Composition/Data On Components

COMPONENT	CAS #	% by wt.
Lithium Cobaltat Dioxide	12190-79-3	38.80%
Aluminum	7429-90-5	5.56%
PVDF	24937-79-9	1.17%
Graphite	7782-42-5	24.2%
Copper	7440-50-8	9.6%
SBR	9003-55-8	1.76%
Polyethylene	9002-88-4	0.09%
Polypropylene	9003-07-0	0.80%
Lithium Hexafluorophoshate	21324-40-3	15.30%
Electrolyte Carbonate Carbonate	/	2.72%

3. Hazards Identification



HEALTH	2
FIRE	2
REACTIVITY	0

Information pertaining to particular dangers for man and environment:

The product has to be labeled due to the calculation procedure of international guidelines.

Irritating to skin.

Risk of serious damage to eyes.

May cause sensitization by inhalation and skin contact.

Classification system:

The classification was made according to the latest editions of international substances lists, and expanded upon from



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company and literature data.

4. First aid Measures

Eyes:	Irrigate thoroughly with water for at least 15 minutes. Obtain medical attention.
Skin:	Wash off skin thoroughly with water. Remove contaminated clothing and wash before reuse. In severe cases obtain medical attention.
Inhalation:	Remove from exposure, rest and keep warm. In severe cases obtain medical attention.
Ingestion:	Wash out mouth thoroughly with water and give plenty of water to drink. Obtain medical attention.
Further treatment:	All cases of eye contamination, persistent skin irritation and casualties who have swallowed this substance or been affected by breathing its vapours should be seen by a Doctor.

5. Fire Fighting Measures

Hazardous Combustion Products:	When burned, hazardous products of combustion including fume of carbon monoxide and carbon dioxide can occur.
Extinguishing Media:	Water, carbon dioxide, dry chemical or foam.
Basic Fire Fighting Procedures:	Wear NIOSH/MSHA approved positive pressure self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.

6. Accidental Release Measures

Person related measures:	Wear personal protective equipment adapted to the situation (protection gloves, face protection, breathing protection).
Environment protection measures:	Bind released ingredients with powder (rock salt, sand). Dispose off according to the local law and rules. Avoid leached substances to penetrate into the earth, canalization or water. If battery casing is dismantled, small amounts of electrolyte may leak. Package the battery tightly including ingredients together with lime, sand or rock salt.
Treatment for cleaning:	Then clean with water.

7. Handling And Storage

Guideline for safe handling:

Always follow the warning information on the batteries and in the manuals of devices. Only use the recommended battery types.



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Keep batteries away from children.

For devices to be used by children, the battery casing should be protected against unauthorized access.

Unpacked batteries shall not lie about in bulk.

In case of battery change always replace all batteries by new ones of identical type and brand.

Do not swallow batteries.

Do not throw batteries into water.

Do not throw batteries into fire.

Avoid deep discharge.

Do not short-circuit batteries

Use recommended charging time and current.

Storage:

Storage preferably at room temperature (approx. 20°C).

Avoid large temperature changes.

Do not store close to heating devices.

Avoid direct sunlight. At higher temperature the electrical performance may be reduced.

Storage of unpacked batteries can cause short circuit and heat generation.

Storage of large amounts: If possible, store the batteries in original packaging (because of short circuit protection and exemptions according to transport regulations).

A fire alarm is recommended.

For automatic fire extinction consider chapter 5 "Fire fighting measures".

8. Exposure Controls And Personal Protection

Under normal conditions (during charge and discharge) release of ingredients does not occur.

In the event of release of ingredients, the following TLVs have to be considered (U.S.A.):

Material TLV*

Cobalt and compounds: 0.1 mg/m³ (TWA)

Graphite: C 5.0 mg/m³ (TWA)

*Source: OSHA CFR 29 1910.1000 Table Z-1, 2 or 3 3-01-2007.

9. Physical And Chemical Properties

Nominal Voltage: 3.7V

Capacity: 350mah

Watt-hour: 1.295WH

Appearance characters: Multi-color with odorless battery



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10. Stability And Reactivity

Thermal decomposition /

conditions to be avoided:

No decomposition if used according to specifications.

Dangerous Reactions:

No dangerous reactions known.

Dangerous products of

decomposition:

No dangerous decomposition products known.

11. Toxicological Information

Primary irritant effect:

None, unless battery ruptures. In the event of exposure to internal contents, corrosive fumes will be very irritating to skin, eyes and mucous membranes. Overexposure can cause symptoms of non-fibrotic lung injury and membrane irritation.

Inhalation:

Lung irritant.

Skin contact:

Skin irritant

Eye contact:

Eye irritant.

Ingestion:

Tissue damage to throat and gastro-respiratory tract if swallowed.

**Medical conditions generally
aggravated by exposure:**

In the event of exposure to internal contents, eczema, skin allergies, lung injuries, asthma and other respiratory disorders may occur.

12. Ecological Information

General notes:

Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.

13. Disposal Considerations

Waste Disposal Method:

Waste Lithium ion batteries are classified by the federal government as non-hazardous waste and are safe for disposal in the normal municipal waste stream.

Large quantities of open batteries should be treated as hazardous waste.

Dispose of in accordance with state regulations.

Do not incinerate, since batteries may explode at excessive temperatures.

14. Transport Information

Lithium ion batteries are tested according to IATA dangerous goods regulations 57th edition and all applicable carrier and government regulations and 38.3 of the "UN Manual of Tests and Criteria" for compliance with the requirements of special provisions ADR 188, IMDG 188, DOT / 49 CFR §173.102, 49 CFR Part 171 Subpart C. 49 CFR Parts



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171–180, 49 CFR 175 and the requirements of IATA DGR packing instruction 965 Section IB or 966 Section I. Corrugated Box (Thickness > 6mm). Each package is labeled with lithium battery handling label UN CLASS: UN3480 or UN3481. Positive test results required for classification as “non-restricted” are stated in dedicated “Declarations of Conformity”. In addition, the following conditions for non-dangerous goods classification are fulfilled by our products in original

Each consignment is accompanied with a document with an indication that:

the package contains lithium ion cells;

the package must be handled with care, and that a flammability hazard exists if the package is damaged;

special procedures must be followed in the event the package is damaged, to include inspection and repacking if necessary; and a telephone number for additional information.

Transport fashion: By air, by sea.

15. Regulations

• Sara

• Section 355 (extremely hazardous substances):

None of the ingredient is listed.

• Section 313 (Specific toxic chemical listings):

None of the ingredient is listed.

• TSCA (Toxic Substances Control Act):

None of the ingredient is listed.

Material Safety Data Sheets (MSDS) are a sub-requirement of the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR Subpart 1910.1200. This Hazard Communication Standard does not apply to various subcategories including anything defined by OSHA as an "article". OSHA has defined "article" as a manufactured item other than a fluid or particle; (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g. minute or trace amounts of a hazardous chemical, and does not pose a physical hazard or health risk to employees. Because all of our batteries are defined as "articles", they are exempted from the requirements of the Hazard Communication Standard.



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16. Other Information

The above information is based on the data of which we are aware and is believed to be correct as of the data hereof. Since this information may be applied under conditions beyond our control and with which may be unfamiliar and since data made available subsequent to the data hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.



B.2.2 MGL28321 Datasheet

LI—MN battery
Specification

锂猛电池
规格书

Model/型号：IMR10440

Capacity/容量：350mAh

Voltage/电压：3.7V

Prepared By/Date 编制/日期	Checked By/Date 审核/日期	Approved By/Date 批准/日期

Amendment Records (修正记录)				
Edition (版本)	Description (记述)	Prepared by (编制)	Approved by (批准)	Date (日期)
A	First Edition			

[键入文字]

1 Scope（使用范围）

This specification is applied to the reference battery in this Specification and manufactured by Shenzhen Fest Technology Co.,Ltd.

本规格书适用于本书中所提及的深圳费思特科技有限公司制造的电池。

2 Product Specification（产品技术规格）

Table 1（表 1）

No. (序号)	Item (项目)	General Parameter (常规参数)		Remark (备注)
1	Rated Capacity (额定容量)	Typical (标称容量)	350mAh	Standard discharge（0.2C） after standard charge (标准充电后 0.2C 标准放 电)
		Minimum (最小容量)	320mAh	
2	Nominal Voltage	3.7V		Mean Operation Voltage

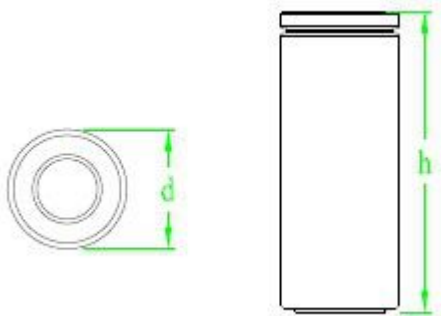
[键入文字]

	(正常电压)		(即工作电压)
3	Voltage at end of Dischargr (放电终止电压)	3.0V	Discharge Cut-off Voltage (放电截止电压)
4	Charging at end of Voltage (充电最高电压)	4.20V	
5	Standard charge (标准充电)	Constant Current 0.2C Constant Voltage 4.20V 0.02C cut-off (持续电流: 0.2C 持续电压: 4.20V 截止电流: 0.02C)	Charge time: Approx 6.0h (充电时间: 大约 6 个小时)
6	Standard discharge (标准放电)	Constant Current 0.2C end Voltage 3.0V (持续电流: 0.2C 截止电压 3.0V)	

Continuous the table 1 (续表 1)

No. (序号)	Item (项目)	General Parameter (常规参数)	Remark (备注)
7	Fast charge (快速充电)	Constant Current 1C Constant Voltage 4.20V 0.02C ₅ A cut-off (持续电流: 1C 持续电压: 4.20V 截止电流: 0.02C)	Charge time: Approx 2.5h (充电时间: 大约 2.5 个小时)
8	Fast discharge (快速放电)	Constant Current 1C end Voltage 3.0V (持续电流: 1C 截止电压 3.0V)	
9	Maximum Continuous Charge Current (最大充电持续电流)	1C	
10	Maximum Continuous Discharge Current (最大放电持续电流)	4C	瞬间最大电流 5C
11	Operation Temperature	Charge (充电): 0~45℃	60±25%R.H. Bare Cell

	Range (工作温度范围)	Discharge (放电): -10~60℃	(单体电池储存湿度范围)
12	Storage Temperature Range (储存温度范围)	Less than 1 year: -20~25℃ (小于 1 年: -20~25℃)	60±25%R.H. at the shipment state (出货状态时的湿度范围)
		Less then 3 months: -20~40℃ (小于 3 个月: -20~40℃)	
13	Weight (重量)		FYI
14	Pack Dimension (包装后尺寸)	Height: (h) (高度): 43.8±0.3mm	Initial Dimension (初始尺寸)
		Width: (d) (直径): 10.1±0.2mm	



3 Performance And Test Conditions (电池性能及测试条件)

Standard Test Conditions (标准测试条件)

Test should be conducted with new batteries within one week after shipment from our factory and the cell shall not be cyded more than five times before the test. Unless otherwise specified,test and measurement shall be done under temperature of 20±5℃ and relative humidity of 45~48%.if it is judged that the test results are not affected by such conditions,the tests may be conducted at temperature 15~30℃ and humidity 25~85%R. H.

测试必须使用出厂时间不超过一个星期的新电池，且未进行过 5 次以上的充放电循环。除非特别说明，否则测试会在温度 20±5℃，相对湿度在 45~85%的条件下进行。如果经鉴定测试结果不受上述条件影响，测试也可以在温度 15~30℃，相对湿度在 25~85%RH 的条件下进行。

Measuring Instrument or Apparatus (测量器具及设备)

Dimension Measuring Insrtument (尺寸测量器具)

The dimension measurement shall be implemented by instruments with equal or more precision scale of 0.01mm.

尺寸测量器具的精度等级应不小于 0.01mm。

3.2.2 Voltager (伏特计)

Standard class specified in the national standard or more sensitive class having inner impedance more than 10k Ω/V.

按照国家标准指定规格等级或采用灵敏度更高的，测量电压时内阻不应小于 $10\text{k}\Omega/\text{V}$ 。

Ammeter（安培计）

Standard class specified in the national standard or more sensitive class.Total external resistance including ammeter and wire is less than 0.01Ω .

按照国家标准指定规格等级或采用灵敏度更高的，包括电流表及电线在内的总外阻应小于 0.01Ω 。

Impedance Meter（电阻计）

Impedance shall be measured by a sinusidal alternating current method(1kHz LCR meter)
内阻测试仪测量原理应为交流阻抗法（1kHz LCR）。

Standard Charge/Discharge（标准充放电）

Standard charge: Test procedure and its criteria are referred as follows:

标准充电：测试过程即标准如下：

0.2 C

Charging shall consist of charging at a 0.2 C constant current rate until the cell reaches 4.20V. The cell shall then be charged at constant voltage of 4.20 volts while tapering the charge current. Charging shall be terminated when the charging current has tapered to 0.02 C.Charge time: Approx 6.0h,The cell shall demonstrate no permanent degradation when charged between 0°C and 45°C .

电池先 0.2C 恒流充至 4.20V，当充电电流逐渐减小时，再以 4.20V 恒压充至电流减小到 0.02 C，充电时间大约为 6 个小时。在 0°C - 45°C 内，充电电池应没有永久损害。

Standard Discharge（标准放电）

0.2 C

Cells shall be discharged at a constant current of 0.2 C to 3.0 volts @ $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

电池以 0.2 C 恒流放电至 3.0V，@ $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$ 。

If no otherwise specified, the rest time between Charge and Discharge amount to 30min.

如果没有特别说明，电池充放电间隔时间为 30 分钟。

Appearance（外观）

There shall be no such defect as flaw,crack,rust,leakage,which may adversely affect commercial value of battery.

电池外观应没有划痕、破裂、污迹、生锈、漏液等影响市场的缺陷存在。

Initial Performance Test（初始性能测试）

Table 2（表 2）

Item (项目)	Test Method Condition (测试方法及条件)	Requirements (要求)
(1) Open-circuit Voltage (开路电压)	The open-circuit voltage shall be measured within 24 hours after standard charge. (标准充电后 24 小时内测量开路电压)	
(2) Internal impedance (初始内阻)	Internal resistance measured at AC 1KHz after 50% charge. (半充电状态下，测量其 AC 1KHz 下的交流阻抗)	
(3) Minimal Rated Capacity (最小额定容量)	The capacity on 0.2 C discharge till the voltage tapered to 2.0V shall be measured after rested for 30min then finish standard charge. (标准充电后，搁置 30 分钟，测量 0.2 C 放电至 3.0V 截	Discharge Capacity(放电容量)

	止电压所放出的容量)	
--	------------	--

Temperature Dependence of discharge capacity (放电温度特性)

Cells shall be standard charged and discharged @ 0.2 C to 3.0 volts.Except to be discharged at temperaures per Table 3. Cells shall be stored for 3 hours at the test temperature prior to discharging and then shall be discharged at the test temperture.The capacity of a cell at each temperture shall be compared to the capacity achieved at 23℃ and the percentage shall be calculated.Each cell shall meet or exceed the requirements of Table 3.

电池按标准充电。按表 3 的温度中放电，电池必须先在该试验温度中放置 3 个小时。在每一个温度中的放电容量应不小于表 3 的要求。

Table 3 (表 3)

Discharge Temperature (放电温度)	-10℃	0℃	23℃	60℃
Discharge Capacity(0.2 C) (放电容量/0.2 C)	70%	80%	100%	95%

Cycle Life and Date (循环寿命以及倍率)

Table 4 (表 4)

No. (序号)	Item (项目)	Criteria (标准)	Test Conditions (测试条件)
1	Cycle Life (循环寿命) (0.5 C)	Higher than 80% of the Initial Capacities of the Cells (初始容量的 80%)	Carry out 300 cycle Charging/Discharging in the below condition. ◆ Charge:Standard ◆ Discharge:0.5 Cto 3.0V ◆ Rest Time between charge/discharge:30min. ◆ Temperayure:20±5℃ 循环 300 次 充放电按以下条件: ◆ 充电: 标准充电, ◆ 放电: 0.5C 放至 3.0V ◆ 搁置: 30min ◆ 温度: 20±5℃
2	Leakage-Proof (漏液试验)	No leakage (visual inspection) (没有漏液/目测)	After full charge with standard charge,store at 60 ±3℃,60±10%RH for 1 month. 标准充电条件下, 充满电后在温度 60±3℃,湿 度 60±10%RH 下储存一个月

4. Mechanical characteristics and Safety Test (安全测试及机械特性)

Table5 (表 5) (Mechanical characteristics)

No. (序号)	Item (项目)	Test Method and Condition (测试方法及条件)	Criteria (标准)
1	Vibration Test 振动测试	After standard charging, fixed the cell to vibration table and subjection cycling that the frequency is to be varied at the rate of 1Hz per minute between 10Hz and 55Hz, the excursion of the vibration is 1.6mm. The cell shall be vibrated for 30 minutes per axis of XYZ axes. 将标准充电后的电池固定在振动台上, 沿 X、Y、Z 三个方向各振动 30 分钟, 振幅 1.6mm, 振动频率为 10Hz~55Hz, 每分钟变化 1Hz。	No leakage 无泄漏 No fire 不起火
2	Drop Test 跌落测试	The cell is to be dropped from a height of 1 meter twice onto concrete ground. 将标准充电后的电池从 1 米高度跌落至混凝土地面 2 次	No explosion, No fire, 无爆炸、 无起火、

Table 6 (表 6) (Safety Test)

Item (项目)	Battery Condition (电池要求)	Test Method (测试方法)	Requirements (要求)
Crush (挤压试验)	Fresh, Fully charged (充满电的新电池)	Crush between two flat plates. Applied force is about 13kN (1.72Mpa) for 30min. (电池放置在两块平面金属板间, 施加 13kN (1.72Mpa) 的作用力, 且持续保持 30 分钟)	No explosion, No fire (无爆炸, 无起火)
Short Circuit (短路试验 20°C)	Fresh, Fully charged (充满电的新电池)	Each test sample battery, in turn, is to be short-circuited by connecting the (+) and (-) terminals of the battery with a Cu wire having a maximum resistance load of 0.1Ω. Test are to be conducted at room temperature (20°C ± 2°C). (在常温下约 20 ± 2°C, 依次把每个样品电池正负极用铜线连接起来, 是电池外部短路, 线路总电阻不超过 0.1Ω)	No explosion, No fire. The Temperature of the surface of the Cells are lower than 150°C (无起火, 无爆炸, 电池表面温度应低于 150°C)
Short Circuit (短路试验 60°C)	Fresh, Fully charged (充满电的新电池)	Each test sample battery, in turn, is to be short-circuited by connecting the (+) and (-) terminals of the battery with a Cu wire having a maximum resistance load of 0.1Ω. Test are to be conducted at temperature (60°C ± 2°C). (在温度约 60 ± 2°C 下, 依次把每个样品电池正负极用铜线连接起来, 是电池外部短路, 线路总电阻不超过 0.1Ω)	No explosion, No fire. The Temperature of the surface of the Cells are lower than 150°C (无起火, 无爆炸, 电池表面温度应低于 150°C)

		总电阻不超过 0.1 Ω)	低于 150℃)
Impact (冲击试验)	Fresh,Fully charged (充满电的新电池)	A 56mm diameter bar is inlayed into the bottom of a 10Kg weight.And the weight is to be dropped from a height of 1m onto a sample battery and then the bar will be across the center of the sample.(用一条直径为 56mm 的圆棒放置在电池中央, 将一 10 公斤的重锤从 1 米的高度垂直落下在电池的中心位置)	No explosion,No fire (无起火, 无爆炸)
Forced Discharge (过放试验)	Fresh,Fully charged (充满电的新电池)	Discharge at a current of 1 C for 2.5h. (以 1 C 的电流放电 2.5 小时)	No explosion,No fire (无起火, 无爆炸)

5. Protection circuit (保护电路)

5.1 PCM Specification (保护板说明)

Item (项目)	Test Condition (测试条件)
Over charge Protection (过充电保护)	The battery should be charged under 4.0V/1C.The charging should be shut off when the internal cell voltage becomes more than the specified protection voltage. (电池在不大于 4.20V/1C 的情况下充电, 当电池电压高于指定保护电压时, 充电就会停止)
Overs discharge Protection (过放电保护)	The battery should be discharged with 1C,The discharging should be shut off when the internal cell voltage becomes less than the specified protection voltage. (电池在 1C 的电流下放电, 当电池电压低于指定保护电压时, 放电就会停止)
Short protection (短路保护)	After rated charge,(+) and (-) terminals are connected with 10m Ω mental resistor or equivalence. (额定充电后, 用 10m Ω 的电阻器连接电池的正负极, 电池符合标准要求)

5.2 PCM Standard (保护板标准)

Symbol (符号)	Name (名称)	MIN. (最小值)	TYP. (典型值)	MAX. (最大值)	Unit (单位)
Vdet 1	Over-Charge detect voltage (过充保护电压)				V
Vdet 2	Over-discharge detect voltage (过放保护电压)				V
Vdet 3	Over-current detect voltage (过流检测电压)				V
I _{BC}	Excess Current threshold (最大过流值)				A
R _D	Internal resistance in normal operation				m Ω

	(导通内阻)				
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6. Handling of Cells (电池操作注意事项)

Prohibition short circuit (禁止电池短路)

Never make short circuit cell. It generates very high current which causes heating of the cells and may cause electrolyte leakage are very dangerous.

The Li-Fe tabs may be easily short-circuited by putting them on conductive surface.

Such outer short circuit may lead to heat generation and damage of the cell.

An appropriate circuitry with PCM shall be employed to protect accidental short circuit of the battery pack.

避免电池短路。短路会产生很高的电流而使电池发热以及电解液泄漏，产生有毒气体使非常危险的。极片连接在导电物体表面很容易短路，外部短路会导致发热及损害电池。选用一个适当的保护电路可以在意外短路时保护电池。

7. Notice for Designing Battery Pack (电池外壳设计注意事项)

7.1 Pack toughness (外壳坚韧度)

Battery pack should have sufficient strength and the Li-Fe cell inside should be protected from mechanical shocks.

电池外壳应该有足够的机械强度，使铁锂电池免受机械撞击。

7.2 Cell fixing (电池的固定)

The Li-Fe cell should be fixed to the battery pack by its large surface area.

No cell movement in the battery pack should be allowed.

电池最大面积的一面应该固定在外壳上，安装后电池不能有松动。

7.3 Inside design (外壳内部设计)

No sharp edge components should be inside the pack containing the Li-Fe cell.

外壳内安装电池的部位不应有锋锐边。

7.4 Tab connection (极片连接)

Spot welding is recommended for Li-Fe tab connection method.

Battery pack should be designed that shear force are not applied to the Li-Fe tabs.

If apply manual solder method to connect tab with PCM, below notice is very important to ensure battery

◆ • performance:

◆ • The solder iron should be temperature controlled and ESD safe;

- ◆ • Soldering temperature should not exceed 350℃;
- ◆ • Soldering time should not be longer than 3s;
- ◆ • Soldering times should not exceed 5 times,Keep battery tab cold down before next time soldirectly g;
- ◆ • Directly heat cell body is strictly prohibited,Battery may damaged by heat above approx.100℃.

建议使用点焊焊接方法：外壳设计应考虑使极片不受外力。

如果使用人工焊接保护板，下面的注意事项对于确保电池性能非常重要：

- ◆ • 焊接烙铁的温度必须可控且可防静电；
- ◆ • 焊接时对烙铁的温度不能超过 350℃；
- ◆ • 焊锡时间不能超过 3 秒钟；
- ◆ • 焊锡次数不能超过 5 次，待极片冷却后才能进行下一次焊锡；
- ◆ • 严禁直接加热电池，高于 100℃会损害电池。

7.5 For mishaps（针对意外事件）

Battery pack should be designed not to generate heat even when leakage occurs due to mishaps.

- 1) Isolate PCM (Protection Circuit Module) form leaked electrolyte as perfectly as perfectly as possible.
- 2) Avoid narrow spacing between bare circuit patterns with different voltage.(Including around connector)
- 3) Li-Fe battery should not have liquid from electrolyte,but in case if leaked electrolyte as possible touch bare circuit patterns,higher potential terminal material may dissolve and precipitate at the lower potential terminal,and may cause short circuit,The design of the PCM must have this covered.

发生意外时，外壳设计应考虑即使在电池出线漏液时也不会发热。

- 1) 尽量把保护电路与渗透的电解液隔离开。
- 2) 在不同的电压情况下避免出现小间距的裸露电路—包括插头的周围。
- 3) 锂电池不应该有来自电解液的液体，但是一旦发生电解液渗透触及裸露电路，高电势端接子材料可能会溶解然后沉淀到低电势端接子，可能会造成短路。保护板的设计须含有覆盖保护层。

8. Notice for Assembling Battery Pack（电池装配注意事项）

Shocks,high temperature,or contacts of sharp edge components should not be allowed in battery pack assembling process.

在电池装配过程中不允许撞击、高温或接触尖锐部分。

9. Others（其它）

9.1 Cell connection（电池连接）

- 1) Direct soldering of wire leads or devices to the cell is strictly prohibited.
- 2) Lead tabs with pre-soldering may cause damage of components,such as separator and insulator.by heat generation.

1) 严禁直接焊接引线或设备到电池上。

2) 极片在焊接引线之前应该先点焊到电池上，直接与电池热焊接，产生的热量会使电池的隔离体及绝缘体受损。

9.2 Prevention of short circuit within a battery pack（电池内部的短路预防）

Enough insulation layers between wiring and the cells shall be used to maintain extra safety protection.

The battery pack shall be structured with no short circuit within the battery pack ,which may cause generation of smoke or firing.

在电池和引线之间应该有足够的绝缘层用于安全保护。电池的包装构成应没有导致起烟起火的短路情况。

9.3 Prohibition of disassembly（禁止拆卸）

1) Never disassemble the cells

The disassembling may generate internal short circuit in the cell,which may cause gassing,firing,explosion,or

other problems.

2) Electrolyte is harmful

Li-Fe battery should not have liquid from electrolyte flowing, but in case the electrolyte come into contact with the skin, or eyes, physicians shall flush the electrolyte immediately with fresh water and medical advice is to be sought.

1) 不要拆卸电池。

拆卸电池会发生电池内部短路，会引起起火、爆炸、有害气体或其它问题。

2) 电解液是有害的。

9.4 Prohibition of dumping of cells into fire (不要把电池倾倒入火中)

Never incinerate nor dispose the cells in fire. These may cause explosion of the cells, which is very dangerous and is prohibition.

不要把电池扔入火中，容易引起爆炸。

9.5 Battery cells replacement (更换电池)

The battery replacement shall be done only by either cells supplier or device supplier and never be done by the user.

更换电池应由电池生产商或设备供应商完成，用户不用自行更换。

9.6 Prohibition of use of damaged cells (禁止使用损坏的电池)

The cells might be damaged during shipping by shock. If any abnormal features of the cells are found such as damages in a plastic envelop of the cell, deformation of the cell package, smelling of an electrolyte, an electrolyte leakage and others, the cells shall never be used any more.

The cells with a smell of the electrolyte or a leakage shall be placed away from fire to avoid firing or explosion.

电池可能在出货途中碰撞而受损。如果发现电池有异常，例如包装损坏、包装包裹变形，有电解液的味道、发现漏液等等，不要再使用这些电池。如果有电解液的味道或出现漏液，电池放置应该远离火源避免起火爆炸。

10. Period of Warranty (保质期)

The period of warranty is half a year from the date of shipment. Sanchuan guarantees to give a replacement in case of cells with defects proven due to manufacturing process instead of the customer abuse and misuse.

电池的保质期从出货之日算起为半年。如果证明电池的缺陷是在制造过程中形成的而不是由于用户滥用及错误使用造成，本公司负责退换电池。

11. Storing the Batteries (电池的存放)

The batteries should be stored at room temperature, charged to about 30% to 50% of capacity.

We recommend that batteries be charged about once per half a year to prevent over discharge.

电池应当在温室下存放，应充到 30% 至 50% 的电量。如长时间储存，建议每半年充一次电，以防止电池过放电。

12. Other The Chemical Reaction (其它的化学反应)

Because batteries utilize a chemical reaction, battery performance over time even if stored for a long period of time without being used. In addition, if the various usage conditions such as charge, ambient temperature, etc. are not maintained within the specified ranges the life expectancy of the battery may be shortened or the device in which the battery is used may be damaged by electrolyte leakage. If the batteries cannot maintain a charge for long periods of time, even when they are charged correctly, this may indicate it is time to change the battery.

由于电池是利用化学反应的原理，所以随时间的增加电池的性能会降低，即使是存放很长一段时

间而不使用。如果使用条件如充电、放电及周围环境温度等情形不在指定的使用范围内，会缩短电池的使用寿命，或者会产生漏液导致设备损坏。如果电池长时间不能充电，即使充电方法正确，就要更换电池了。

13. Note: (注释)

Any other items which are not covered in this specation shall be agreed by both parties.

本说明书包括事项应由双方协议确定。

Definitions

Definitions of Loads, Loading and General Terms

Term	Definition
Breaking Load / Static Failure Load	The load that induces structural failure in one or more parts of the instrument causing the load to part from the release mechanism.
Competent Person	An individual who, by way of training and/or experience, is knowledgeable of applicable standards, is capable of identifying workplace hazards relating to the specific operation, is designated by the employer, and has authority to take appropriate actions.
Dynamic Load	A time varying load resulting from the motion and inertia of connected masses and forcing functions such as wave action on the vessel. This may include transient and steady state harmonically alternating loads.
Maximum Buoyancy for Release / Release Loads	The maximum in-line load the whole assembly can release whilst guaranteeing safe and reliable operation. Note that as the load is released in water this is determined by the maximum up-thrust from the buoyancy. The maximum in-line load the instrument can withstand and successfully release without overloading any part of the release mechanism or demanding an unsupportable quantity of energy from the battery supply (at its specified end point).
Proof Load	The load to which the actual unit has been tested in the factory. This load should be periodically applied to demonstrate the unit is still in a safe condition. This is usually twice the WLL.
Responsible Body	The Responsible Body is the organisation responsible for Health and Safety for lifting operations at the worksite.
Safe Working Load (SWL)	The maximum load (as determined by a competent person) that an item of lifting equipment may raise, lower or suspend under particular service conditions, e.g. the SWL can be lower than, but can never exceed the WLL.
Shock Load or Snatch Load	A time transient load generally caused by the sudden acceleration (positive or negative) of the load. Examples are the sudden snatch of a load off the deck or a sudden arrest of a load falling under gravity.
Static Load	An unvarying long term load
Working Load Limit (WLL)	The maximum recommended working load. This is set as a maximum 25% of the Breaking Load and allows for factors such as corrosion, fatigue shock loads, harmonic loads, manufacturing defects and material defects. Please note this does not account for extreme offshore service conditions.

Abbreviations

Abbreviation	Definition
BIS	Battery Information Sheet
°C	Degree Centigrade/Celsius
Hz	Hertz
kg	kilogram
kHz	kilo Hertz
Lith-X	Ansul Lith-X Class D extinguishing agent was developed for use on lithium fires and will also extinguish magnesium, sodium, and potassium fires

Abbreviation	Definition
mm	millimetre
NiMH	Nickel Metal Hydride
PCB	Printed Circuit Board
ppm	parts per million
SDS	Safety Datasheet
SWL	Safe Working Load
V	Volt
WEEE	Waste from Electrical and Electronic Equipment Directive 2002/96/EC
WLL	Working Load Limit

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