

SAFETY MANUAL

Equipment General Operational and Safety Precautions

Issue B Rev 0

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CONTACTING THE SONARDYNE SUPPORT TEAM

24-hour Emergency Telephone Helpline: +44 (0) 1252 877600

The Sonardyne 24-hour helpline is answered at the UK Headquarters during normal office hours (08:00 to 17:00 GMT). 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. Alternatively, contact the Sonardyne Head Office:

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NOTE



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

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AMENDMENT HISTORY

All amendments and additions will be issued with a new copy of this sheet, recording the history of amendments

[illegible]

SECTION 1 – INTRODUCTION

1 Introduction

This Safety Manual gives a general outline for operational and servicing requirements for all Sonardyne products. Sonardyne products can contain hazardous energy and may only be opened by qualified service personnel.

Operators and service personnel must be familiar with all information detailed in this manual.

Sonardyne equipment should not be used outside of the manufacturers 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 users responsibility to conduct Hazard Identification and Risk Analysis for all conditions. This Safety Manual provides guidance for procedures of Safety.

1.1 Subsea Equipment General Operational and Safety Precautions

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

Additional information, if applicable, is included in the relevant sections of the specific product operating and maintenance manuals.

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.

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 understood.

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

- DO** Work with and obey all persons that have responsibilities for the safe operation of the applicable installation.
- DO** 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.
- DO** 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

1.3 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, should the equipment be found to be inoperable, there is a high indication that the equipment has flooded. 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 **dangerous**. 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 batteries pose a health risk – not just lithium batteries.
- high voltages are present when the equipment is transmitting, particularly on the transmitter PCB and transducer.
- a pressure housing may become internally pressurised by water pressure, following a leak
- a pressure housing may become internally pressurised due to battery malfunction
- 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 the equipment may reduce its load bearing capability
- using unauthorised components or inferior parts in critical assemblies, e.g. release systems

1.4 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 a unit 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. Generally when dismantling equipment care should always be taken and protection given to these areas. 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.

SECTION 2 – ELECTRONIC HAZARDS

2 High Voltages

2.1 High Voltage awareness

Operation of this equipment does not present any danger to users in normal use. If the internal electronics chassis is removed from its housing for maintenance, the user should be aware that high voltages are present when transmitting, particularly on the transmitter PCB and transducer.

The following warning symbol , when found on the equipment, indicates where high voltage awareness is required.

2.2 Storage Capacitors

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

2.3 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. 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 PCB's or modules.

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

SECTION 3 – PRESSURE HOUSINGS

3 Introduction

All sub-sea equipment fitted with pressure housings are subject to a vast range of externally applied pressures and are susceptible to internal pressure rise if, for example, a leak occurs or the unit's battery destructs. Internal pressure presents a **potentially dangerous situation** and all appropriate **safety measures must be enforced**.

WARNINGS



Fumes given off by deteriorated batteries, particularly Lithium based, pose a health hazard. Make sure the area is well ventilated and the required Personal Protective Equipment, such as gloves, aprons and goggles, are worn.



When a unit 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.

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

Complete removal of an end-cap'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 which is internally pressurised.

Do not attempt to dismantle any piece of equipment without permission or instructions, particularly the transducers. The transducers contain oil and are vacuum sealed, and require specialised maintenance.

3.1 Instruments fitted with Pressure Relief Vent Valves

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 normally 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 atmosphere and allows internal pressure to dissipate. The valve is retained to the equipment normally by means of a retaining spring preventing it from being completely extracted.

A normal unit may emit an audible rush of air when the Pressure Relief Vent Valve is operated, but it will typically only last for 1 second maximum. A longer rush of air/gas indicates a pressurised unit, in which case ventilate the area, and let the remaining pressure out of the unit. Internal pressure dissipates to atmosphere in a very short time and may be accompanied by water, debris, fumes, noise etc.

Do not allow unnecessary personnel to enter the vicinity of the work or to be anywhere near dissipating gases and debris.

3.2 Instruments not fitted with Pressure Relief Vent Valves

A few products are not fitted with Pressure Relief Vent Valves for product specific reasons (e.g. older classified equipment, ex-rated equipment). Some have indications of, but do not release, internal pressure .

If a product indicates, or is suspected of, internal pressure with no pressure relief vent valve fitted, the operator must contact the Sonardyne Emergency Support Line - +44 (0) 1252 877600 in the first instance for advice and the correct course of action to take.

3.3 Precautions (Instrument fully functioning)

The techniques for retaining end-caps in the pressure housings differ from product to product, and detailed instructions on opening the pressure housing are given in the servicing section of the individual product manuals.

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 **Section 3.1**.

WARNING

 **Do not stand directly in front of the end cap during removal. There is potential for the end-cap to be ejected suddenly by internal pressure.**

When removing the end-cap it is recommended to stand to one side, and not inline. This will avoid potential injury if the end-cap is ejected by any remaining internal pressure.

3.4 Precautions (instrument known or suspected to be pressurised)

If an instrument is known, or suspected to be internally pressurised through water ingress or battery venting, 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 a product that has a hot housing. The product must be cooled extensively before proceeding. Make sure Personal Protective Equipment is worn.**

If the housing is hot, indicating recent or current active internal chemical action, do not attempt to open. Wear the appropriate Personal Protective Equipment such as gloves and lower the housing overboard into water for several hours minimum or until it has cooled. Refer to the battery manufacturer's material safety data sheet (MSDS) (see **Appendix A**).

To release internal pressure operate the Pressure Relief Vent Valve as described in **Section 3.1**. If there is no significant pressure dissipation and no fumes indicating a battery malfunction, the unit can be dismantled, refer to the specific product manual for the dismantling procedure. To release internal pressure if a Pressure Relief Vent Valve is not fitted follow the precautions described in **Section 3.2**.

If there are any chemical fumes when the vent plug is released, or signs of deposit around the vent exterior, these are signs the battery has vented due to water ingress or electronic/battery malfunction. In these circumstances the battery pack and internal electronics may have been severely damaged.

Take extreme care when removing the end cap, using any additional precautions detailed in the individual product manuals. There may be a possibility of some residual pressure remaining, within the housing, if during operation of the Pressure Relief Vent Valve, it becomes blocked with the products of the internal chemical reaction.

If a removed battery is found to be leaking, place the battery in a sealable plastic bag and cover with a mixture of neutralizing agent (soda ash or baking soda) and absorbent material (vermiculite) and place in a secondary bag for additional containment. The battery should then be classified as hazardous waste and disposed 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 is then placed into a sealable bag, using a secondary bag for additional containment, and disposed of as hazardous waste. The areas can be cleaned with water or an ammonia-based cleaner.

The electronics, end caps and pressure housings should be thoroughly hosed down with clean fresh water.

SECTION 4 – BATTERIES

4 Batteries General

4.1 Use of Appropriate Battery Types

WARNING



Do not fit unauthorised battery pack types into an instrument.

Sonardyne equipment uses a variety of battery types. In some instrument designs only one type of battery pack is authorised for use but others will accommodate rechargeable, Alkaline or 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 battery packs which are not authorised or are not constructed to Sonardyne's build standards invalidate any warranty.

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

Figure 4-1 – Example of a Lithium Battery Identification Label

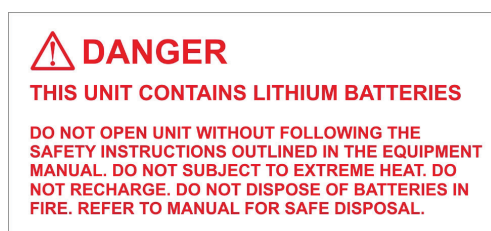
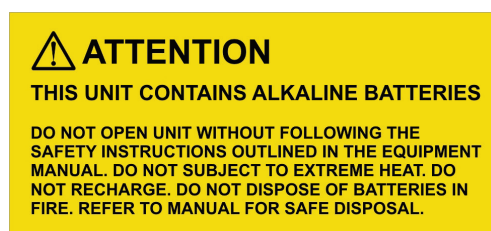


Figure 4-2 – Example of a Lithium-ion Identification Label



Figure 4-3 – Example of an Alkaline Battery Identification Label



4.2 Primary Lithium (Li) Batteries

Two types of Primary Lithium batteries cells (LS and LSH) are used throughout Sonardyne products depending on the application requirements. The 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 cell types used are: LSH14 (Size C) and LSH20 (Size D).

The following table provides an overview of the cell types, their use and the quantities used for each application:

Table 4-1 – Primary Lithium Battery Application Usage

Battery Cell Type	Application	Stock Number	Quantity
LS26500 (Size C)	C Cell x4 Stick Lithium	641-1984	4
LS33600 (Size D)	Data Logger 10 Cell Ring Assembly	641-3423	10
	Data Logger Lithium Battery	650-2592	10
LSH14 (Size C)	Battery Pack Lithium AODC Transponder	640-061C	8
	Battery Pack Lithium DORT and ORT Transponders	640-5681	12
	Battery Pack Assembly Lithium BPT Transponder	641-3302	4
LSH20 (Size D)	Battery Assembly Lithium Basic	641-3491	48
	UK PMT Lithium Battery Segment	641-3585	12
	Son Inc PMT Battery Pack Assembly	64113545	72
	Compatt 6 Battery Lithium	641-0127	40
	Compatt 6 Battery Pack Lithium	641-0162	12
	SEM Lithium Battery Pack	620-7201	20
	Short PGT Battery Pack Lithium	641-2236	7
	Battery Pack Lithium Std C5	641-2801	40
	Battery Pack Lithium Midi C5	641-2922	12
	Battery Pack Assembly Lith	641-3082	48
	Battery Stack 4 Lith D Cells	641-3323	4

Datasheets for all cell types of Primary Lithium Batteries are available in **Appendix B**.

4.2.1 Safety Precautions for Primary Lithium (Li) Batteries

Primary (non-rechargeable) Lithium Batteries are often referred to as Lithium Metal Batteries.

WARNING

 **Lithium based batteries become hazardous (fire and corrosion) if exposed to air and water. If damaged they may emit fumes. Consult the battery manufacturer's Material Safety Data Sheets (MSDS) prior to operating Lithium based battery products.**

Special precautions and regulations apply to transport, handling and disposal of primary Lithium products.

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

WARNING

 **Use extreme caution when dismantling equipment suspected of flooding. The internal pressure increase could result in components becoming projectiles when released, causing injury. Personal Protective Equipment, such as gloves and goggles, should be worn.**

Where a battery powered underwater instrument is suspected of flooding, extreme caution must be exercised in opening the instrument in case an internal pressure has developed, which might cause the components to fly apart, causing damage or injury. Release of cell contents within the pressure vessel is very unlikely to cause hazard but the following safety procedures should be followed.

The Material Safety Data Sheets (MSDS) for Primary Lithium batteries (e.g. models LSH20 (D), LSH14 (C), LS26500 (C), LS33600 (D) and LS14500 (AA)) are attached in **Appendix A**.

4.2.2 Opening a Primary Lithium Battery Powered Instrument

The normal procedure before opening any underwater instrument is to wash the equipment in clean fresh water to remove any salt deposits, and then dry it. The instrument should only be opened in clean, well-ventilated, dry surroundings.

If the instrument seems unexpectedly hot, it may indicate that the batteries are damaged. The instrument should be taken outdoors away from personnel and must not be opened until it has cooled, either by applying copious quantities of water (e.g. fire hose) or by suspending it in the sea.

All **precautions outlined in Section 3.4** should be applied during dismantling processes if it is suspected that internal pressure is present.

4.2.3 Fault Procedures

WARNING

 **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-SOCl₂ 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 first warning message at the start of this section, or the cell manufacturer's safety data sheet. Once the temperature has dropped and it is deemed safe to do so, the cell or battery can be disposed of following local hazardous waste requirements. Suitable personal protective equipment, such as gloves, apron and goggles, should be worn when handling suspect cells/batteries and if the skin has come into contact with the electrolyte, it should be washed thoroughly with water.

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

4.2.4 Primary Lithium Batteries Storage Instructions

Primary Lithium batteries should be stored in their original containers, in a well-ventilated, dry area, where the temperature should be as cool as possible to maximise shelf life. Observe the manufacturers minimum and maximum storage temperatures.

CAUTION

 **Do not expose batteries to extreme temperatures, in excess of 70°C, to prevent reduction in battery life.**

Cells and batteries, and hence the whole Sonardyne instrument, should not be exposed to temperatures in excess of 70°C. Instruments should not be left on deck in strong sunlight such that they become hot to the touch.

Short term storage of Primary Lithium batteries should be stored in a dry location with low humidity, no corrosive gases, and at a temperature range of -20°C to +45°C.

CAUTION

 **Storing batteries in a location where humidity is high or where temperatures fall below -20°C or rise above +45°C is not advised.**

Primary Lithium battery packs should be stored at +20°C, and in a humidity-controlled atmosphere to prevent passivation developing, which can reduce actual operating life, and in extreme cases may cause the unit to malfunction once deployed.

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

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.

4.2.5 Transporting Primary Lithium Products

The current regulations and information below is provided for guidance only. Note that data sheets 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.
- **By Sea:** International Maritime Dangerous Goods Code
- **By Air:** IATA Dangerous Goods Regulations

The following Primary Lithium batteries have Transportation Certificates to show they comply with the requirements of UN Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, Fourth Revision, 2003, Ref ST/SG/AC. 10/11 Rev 4.

- C-size cells type LS26500 cells, whatever their finish mode (with and without end-tabs or wiring and connector assemblies, etc.).
- C-size spiral cells type LSH 14 with a 5 A protection fuse.
- D-size cells type LSH20 with a 5 A protection fuse arranged in a series/parallel arrangement with additional diode and polyswitch protection.
- AA size cells type LS14500 arranged in a series/parallel arrangement with additional diode and polyswitch protection.

Copies of the certificates are provided in **Appendix E** – they detail nominal voltage, capacity, energy and the equivalent Lithium Metal content.

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.

4.3 Lithium Ion (Li+) Batteries

In a Lithium 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.

Lithium Ion Battery datasheets are available in **Appendix C**.

4.3.1 Safety Precautions for Lithium Ion (Li+) Batteries

WARNING



Do not attempt to recharge Li-ion batteries with any other type of recharging equipment. Only use the charging equipment supplied with the product.

Lithium Ion batteries, also known as Li-ion, are a rechargeable battery technology. Use only approved battery chargers for the specific battery pack.

Additional information applicable to Li-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

Website: www.saftbatteries.com

And

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

Website: www.panasonic.com/batteries

Special precautions and regulations apply to transport, handling and disposal of Lithium ion based products.

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

Where a battery powered underwater instrument is suspected of flooding, caution must be used when opening the instrument in case internal pressure may have developed. This may cause the components to fly apart. If a cell leaks within a pressure vessel it is very unlikely to cause a hazard if the safety precautions are followed.

All **precautions outlined in Section 3.4** should be applied during dismantling processes if it is suspected that internal pressure is present.

The Material Safety Data Sheet for Lithium Ion Batteries is available in **Appendix A**.

4.3.2 Procedure for Handling Shorting or Over-heating

WARNINGS



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.



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

If a cell or battery is shorted or starts to heat up, it should be disconnected 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 first warning message at the start of this section, or the cell manufacturer's safety data sheet. Once the temperature has dropped and it is deemed safe to do so, the cell or battery can be disposed of. Suitable protection clothing should be worn when handling suspect cells/batteries and if the skin has come into contact with the electrolyte, it should be washed thoroughly with water.

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

4.3.3 Lithium Ion Batteries Storage Temperature

To preserve battery life, Lithium Ion Batteries should be stored at a nominal 40% state of charge.

The Sonardyne instrument should not be exposed to temperatures outside the range -20°C to +60°C (-4°F to 140°F) or as detailed in the specific product manual.

Lithium Ion battery packs should be stored at +20°C (68°F) in a humidity controlled atmosphere to prevent reduction in battery life.

Instruments should be cooled to room temperature or below before being opened.

When charging Lithium 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.

When storing batteries for more than 1 year, charge 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 Based Products

The current regulations and information below is provided for guidance only. Quantities of Lithium Ion per battery pack cannot be verified by Sonardyne Ltd. When transporting Lithium Ion 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.
- **By Sea:** International Maritime Dangerous Goods Code
- **By Air:** IATA Dangerous Goods Regulations

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

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.

4.3.5 Disposal of Lithium Ion Batteries

WARNING



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

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

4.4 Other Battery Types used in Equipment

Other types of batteries that can be found installed in Sonardyne equipment are Alkaline and Nickel Metal Hydride (NiMH).

The Alkaline battery is a non-rechargeable battery. At the end of its useful life it must be bagged and disposed of as hazardous waste, in accordance with local Health and Safety regulations.

WARNING



Do not attempt to recharge Alkaline batteries.

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

WARNING



Do not attempt to recharge NiMH batteries with any other type of recharging equipment. Only use the charging equipment supplied with the product.

NiMH batteries should be replaced when they fail to hold their charge.

4.5 Charging of Batteries in Sealed Containers

Batteries/Cells may give off gases when recharged. As a general rule, sealed containers **MUST** be allowed to vent to atmosphere during the charging process.

Some instruments may be fitted with safety features which prevent the possibility of problems caused by gases vented by batteries. Detailed charging procedures for the particular instrument should be carefully followed.

Equipment fitted with a Pressure Relief Vent Valve must be checked to make sure the vent valve has seated properly following recharging of the batteries.

4.6 Attempting to Charge Non-Rechargeable Battery Pack

WARNING



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

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.

Battery packs **MUST NOT** be reconfigured from one type to another, e.g. NiMH to Alkaline or Lithium. Alkaline or Lithium cells may be inadvertently charged.

4.7 Handling of Used Batteries

Batteries should not be discharged below their end point voltage. To do so 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 from the sea it should be opened, and the battery voltage(s) 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 for signs of corrosion, such as at solder joints, as a sign of any slight leakage.

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 users must maintain a separate record of time elapsed whilst battery is installed and connected, plus estimates of the number of interrogations.

4.8 Re-Connecting a Partially Used Battery

Calculate if the remaining battery life will allow your next mission to be safely accomplished. If so, note the date of re-connection, both on the battery label and in written records, against the serial number of the instrument.

4.9 Fitting a New Battery

Note the date a new battery is connected and therefore starts to supply current. Write this date on the battery label and also in your written records.

4.10 Battery Pack Fuses

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

4.11 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' 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 4-2 – 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
	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.

SECTION 5 – EQUIPMENT ENVIRONMENTAL LIMITATIONS

5 Environmental Limitations

5.1 Storage Temperature Limits

Equipment may be stored at temperatures in the range -20 C to + 60°C. 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.

Spare battery packs should be stored at room temperature, in an environment with a controlled humidity level.

5.2 Instrument Load Bearing Capability

Navigational Transponders are **NOT** normally designed to take in-line loads greater than the maximum up-thrust 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 6 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.

5.3.5 Total Up-thrust

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.

Total Up-thrust =

(Minimum nett buoyancy of the Float) - (the weight of the instrument + inserts in water)

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

5.3.6 Float Storage Conditions

When storing Floats make sure the storage temperature conditions are within the 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 as this will cause damage to the floats.

5.3.7 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 – MATERIAL/PRODUCT SAFETY DATA SHEETS

A SAFT MATERIAL/PRODUCT SAFETY DATA SHEETS

A.1 Material Safety Datasheet for LS/LSH Products

A.2 Material Safety Datasheet for Lithium Ion Products



Material/Product Safety Data Sheet **(MSDS-PSDS)**

LS/LSH Products	Lithium/Thionyl chloride single cells and multi-cell battery packs
Revision 10 Date 02/2011	

1. Identification of the Substance or Preparation and Company				
Product	Primary Lithium/Thionyl chloride unit cells and multi-cell battery packs (Li-SOCl₂)			
Production sites	Saft Ltd. River Drive Tyne & Wear South Shields NE33 2TR – UK Ph. : +44 191 456 1451 Fax : +44 191 456 6383	Saft Rue Georges Leclanché BP 1039 86060 Poitiers cedex 9 France Ph. : +33 (0)5 49 55 48 48 Fax : +33 (0)5 49 55 48 50	Saft America Inc 313 Crescent Street Valdese NC 28690 – USA Ph. : +1 828 874 4111 Fax : +1 828 874 2431	Saft Batteries Co., Ltd Zhuhai Free Trade Zone Lianfeng Road Zhuhai 519030 Guangdong Province China Ph. : +86 756 881 9318 Fax : +86 756 881 9328
www.saftbatteries.com (section “Contact”)				
Emergency contact	For chemical emergency ONLY (spill, leak, fire, exposure or accident), call CHEMTREC at: International: +1-703-527-3887 Within the USA: 1-800-424-9300			

2. Hazards Identification
Do not short circuit, recharge, puncture, incinerate, crush, immerse, force discharge or expose to temperatures above the declared operating temperature range of the product. Risk of fire or explosion. The Lithium-Thionyl chloride batteries described in this Safety Data Sheet are sealed units which are not hazardous when used according to the recommendations of the manufacturer.
Under normal conditions of use, the electrode materials and liquid electrolyte they contain are not exposed to the outside, provided the battery integrity is maintained and seals remain intact. Risk of exposure only in case of abuse (mechanical, thermal, electrical) which leads to the activation of safety valves and/or the rupture of the battery container. Electrolyte leakage, electrode materials reaction with moisture/water or battery vent/explosion/fire may follow, depending upon the circumstances.

3. Composition & Information on Ingredients					
Each cell consists of a hermetically sealed metallic container containing a number of chemicals and materials of construction of which the following could potentially be hazardous upon release.					
Ingredient	Content	CAS No.	CHIP Classification		
Lithium (Li)	3.5-5%	7439-93-2			F; R14/15 C; R34 R14/15, R21, R22, R35, R41, R43 S2, S8, S45



Thionyl chloride (SOCl_2)	40-46%	7719-09-7			C; R14, R21, R22, R35, R37, R41, R42/43 S2, S8, S24, S26, S36, S37, S45
Aluminum chloride anhydrous (AlCl_3)	1-5%	7446-70-0			R14, R22, R37, R41, R43. S2, S8, S22, S24, S26, S36, S45
Carbon (C_n)	3-4%	1333-86-4			NONE KNOWN
Amount varies depending on cell size.					

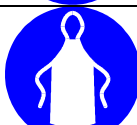
4. First Aid Measures	
Inhalation	Remove from exposure, rest and keep warm. In severe cases obtain medical attention.
Skin contact	Wash off skin thoroughly with water. Remove contaminated clothing and wash before re-use. In severe cases obtain medical attention.
Eye contact	Irrigate thoroughly with water for at least 15 minutes. 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	
CO_2 extinguishers or, even preferably, copious quantities of water or water-based foam, can be used to cool down burning Li- SOCl_2 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.	
Extinguishing media	Use water or CO_2 on burning Li- SOCl_2 cells or batteries and class D fire extinguishing agent only on raw lithium.

6. Accidental Release Measures	
Remove personnel from area until fumes dissipate. Do not breathe vapours or touch liquid with bare hands. If the skin has come into contact with the electrolyte, it should be washed thoroughly with water. Sand or earth should be used to absorb any exuded material. Seal leaking battery and contaminated absorbent material in plastic bag and dispose of as Special Waste in accordance with local regulations.	



7. Handling and Storage	
Handling	Do not crush, pierce, short (+) and (-) battery terminals with conductive (i.e. metal) goods. Do not directly heat or solder. Do not throw into fire. Do not mix batteries of different types and brands. Do not mix new and used batteries. Keep batteries in non conductive (i.e. plastic) trays.
Storage	Store in a cool (preferably below 30°C) and ventilated area, away from moisture, sources of heat, open flames, food and drink. Keep adequate clearance between walls and batteries. Temperature above 100°C may result in battery leakage and rupture. Since short circuit can cause burns, leakage and rupture hazard, keep batteries in original packaging until use and do not jumble them.
Other	Lithium-Thionyl chloride batteries are not rechargeable and should not be tentatively charged. Follow Manufacturers recommendations regarding maximum recommended currents and operating temperature range. Applying pressure on deforming the battery may lead to disassembly followed by eye, skin and throat irritation.

8. Exposure Controls & Personal Protection					
Occupational exposure standard		Compound	8hr TWA	15min TWA	SK
		Sulfur dioxide	1 ppm	1 ppm	-
		Hydrogen chloride	1 ppm	5 ppm	-
	Respiratory protection	In all fire situations, use self-contained breathing apparatus.			
	Hand protection	In the event of leakage wear gloves.			
	Eye protection	Safety glasses are recommended during handling.			
	Other	In the event of leakage, wear chemical apron.			

9. Physical and Chemical Properties	
Appearance	Cylindrical or prismatic shape
Odour	If leaking, gives off a pungent corrosive odour.
pH	Not applicable
Flash point	Not applicable unless individual components exposed
Flammability	Not applicable unless individual components exposed
Relative density	Not applicable unless individual components exposed
Solubility (water)	Not applicable unless individual components exposed
Solubility (other)	Not applicable unless individual components exposed



10. Stability and Reactivity	
Product is stable under conditions described in Section 7.	
Conditions to avoid.	Heat above 100 (150°C for the LSH 20-150 cells and the battery packs assembled from them) or incinerate. Deform. Mutilate. Crush. Pierce. Disassemble Recharge. Short circuit. Expose over a long period to humid conditions.
Materials to avoid	Oxidising agents, alkalis, water. Avoid electrolyte contact with aluminum or zinc.
Hazardous decomposition Products	Hydrogen (H ₂) as well as Lithium oxide (Li ₂ O) and Lithium hydroxide (LiOH) dust is produced in case of reaction of <i>lithium metal</i> with water. Chlorine (Cl ₂), Sulfur dioxide (SO ₂) and Disulfur dichloride (S ₂ Cl ₂) are produced in case of thermal decomposition of <i>Thionyl chloride</i> above 140°C. Hydrochloric acid (HCl) and Sulfur dioxide (SO ₂) are produced in case of reaction of <i>Thionyl chloride</i> with water at room temperature. Hydrochloric acid (HCl) fumes, Lithium oxide, (Li ₂ O), Lithium hydroxide (LiOH) and Aluminum hydroxide (Al(OH) ₃) dust are produced in case of reaction of <i>Lithium tetrachloroaluminate (LiAlCl₄)</i> with water.

11. Toxicological Information	
Signs & symptoms	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	
Mammalian effects	None known if used/disposed of correctly.
Eco-toxicity	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	
Do not incinerate, or subject cells to temperatures in excess of 100°C. Such abuse can result in loss of seal, leakage, and/or cell explosion. Dispose of in accordance with appropriate local regulations.	



14. Transport Information

Note : when manufacturing a new battery pack, one must assure that it is tested in accordance with the UN Model Regulations, Manual of Tests and Criteria, Part III, subsection 38.3

Label for conveyance	For the single cell batteries and multicell 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 multicell 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	UN 3090 (shipment of cells and batteries <i>in bulk</i>) UN 3091 (cells and batteries <i>contained in equipment or packed with it</i>)
Shipping names	Lithium Metal Batteries
Hazard classification	Depending on their lithium metal content, some single cells and small multicell battery packs may be non-assigned to Class 9 (Refer to Transport Certificate)
Packing Group	II
IMDG Code	3090 (Li batteries) 3091 (Li batteries contained in equipment or packed with it)
CAS	
EmS No.	F-A , S-I
Marine pollutant	No
ADR Class	Class 9

15. Regulatory Information

Regulations specifically applicable to the product:

- ACGIH and OSHA: see exposure limits of the internal ingredients of the battery in section 8.
- 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

Risk phrases	Lithium (Li)	R14/15 R21 R22 R35 R41 R42/43	Reacts violently with water, liberating extremely flammable gases. Harmful in contact with skin. Harmful if swallowed. Causes burns. Risk of serious damage to eye. May cause sensitization by inhalation and skin contact.
	Thionyl chloride (SOCl ₂)	R14 R22 R35 R37 R41 R42/43	Reacts with water. Harmful if swallowed. Causes burns. Irritating to respiratory system. Risk of serious damage to eye. May cause sensitization by inhalation and skin contact.
	Aluminum chloride anhydrous (AlCl ₃)	R14 R22 R37 R41 R43	Reacts with water. Harmful if swallowed. Irritating to respiratory system. Risk of serious damage to eye. May cause sensitization by skin contact.



Safety phrases	Lithium (Li)	S2 S8 S45	Keep out of reach of children Keep away from moisture In case of incident, seek medical attention.
	Thionyl chloride (SOCl ₂)	S2 S8 S24 S26 S36 S37 S45	Keep out of reach of children. Keep away from moisture. Avoid contact with skin. In case of contact with eyes, rinse immediately with plenty of water. Wear suitable protective clothing. Wear suitable gloves. In case of incident, seek medical attention.
	Aluminum chloride anhydrous (AlCl ₃)	S2 S8 S22 S24 S26 S36	Keep out of reach of children. Keep away from moisture. Do not breathe dust. Avoid contact with skin. In case of contact with eyes, rinse immediately with plenty of water. Wear suitable protective clothing.
UK regulatory references	Classified under CHIP		

16. Other Information

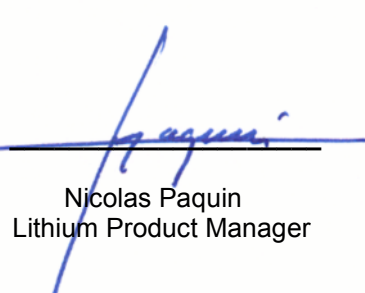
This information has been compiled from sources considered to be dependable and is, to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty (either expressed or implied) or guarantee is made to the accuracy, reliability or completeness of the information contained herein.

This information relates to the specific materials designated and may not be valid for such material 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 information. Saft does not offer warranty against patent infringement.

Edition 10 – February 2011

Signature


Nicolas Paquin
Lithium Product Manager



Material/Product Safety Data Sheet **(MSDS-PSDS)**

MP / VL products	Lithium-Ion single cells and multi-cell battery pack
Revision 8	
Date 02/2009	

1. Identification of the Substance or Preparation and Company			
Product	Rechargeable lithium-ion single cells and multi-cell battery packs		
Production sites	<table><tr><td>Saft America Inc. 313 Crescent Street Valdese North Carolina 28690 USA Tel. No. +1 (828) 874 4111 Fax No. +1 (828) 874 2431</td><td>Saft Rue Georges Leclanché BP 1039 86060 Poitiers cedex 9 FRANCE +33 (0)5 49 55 48 48 +33 (0)5 49 55 48 50</td></tr></table>	Saft America Inc. 313 Crescent Street Valdese North Carolina 28690 USA Tel. No. +1 (828) 874 4111 Fax No. +1 (828) 874 2431	Saft Rue Georges Leclanché BP 1039 86060 Poitiers cedex 9 FRANCE +33 (0)5 49 55 48 48 +33 (0)5 49 55 48 50
Saft America Inc. 313 Crescent Street Valdese North Carolina 28690 USA Tel. No. +1 (828) 874 4111 Fax No. +1 (828) 874 2431	Saft Rue Georges Leclanché BP 1039 86060 Poitiers cedex 9 FRANCE +33 (0)5 49 55 48 48 +33 (0)5 49 55 48 50		
www.saftbatteries.com (section "Contact")			
Emergency contacts	+1 (703) 527 3887 (CHEMTREC U.S. Service Center) within the USA : 800 424 9300		

2. Composition and Information on Ingredients				
Each cell consists of a hermetically sealed metallic container containing a number of chemicals and materials of construction of which the following could potentially be hazardous upon release. There is no potential for exposure to these ingredients unless the cell leaks, or opens, following high temperature, mechanical or electrical abuse.				
Ingredient	Content* (wt. %)	CAS #	ACGIH (TLV)	OSHA (PEL)
Lithium metal	0 <i>(in spite of their name, these batteries do not contain lithium metal)</i>			
LiCoO ₂ <i>(Lithium cobalt oxide)</i>	19-35 %	12190-79-3	0.02 mg/m ³ 8 hours as dust and fumes	5 mg/m ³ as dust and fumes
Organic solvents	12-15 % EA (Ethyl Acetate) EC (Ethylene Carbonate) DMC <i>(Di Methyl Carbonate)</i>	141-78-6 96-49-1 616-38-6	None established	None established
LiPF ₆ <i>(Lithium Hexafluoro phosphate)</i>	≈ 3 %	21324-40-3	None established	None established



PVDF	< 1 %	24937-79-9	None established	None established
Copper (Cu)	9-18 %	7440-50-8	0.2 mg/m ³ as fume 1.0 mg/m ³ as dust and mist	0.1 mg/m ³ as fume 1.0 mg/m ³ as dust and mist
Aluminium (Al)	17-27 %	7429-50-5	10.0 mg/m ³ , as dust	2.0 mg/m ³ , as soluble salt
Graphite and Carbon	13-18%	7782-42-5 1333-86-4	3.5 mg/m ³ , TWA for carbon	2.0 mg/m ³ , as dust
Steel, Nickel, and inert components	Balance		Balance	

* Quantities may vary a little with cell model

ACGIH : American Council of Governmental Industrial Hygienists

TLV : Threshold Limit Value is personal exposure limit, determined y ACGIH.

3. Hazards Identification

The rechargeable lithium-ion batteries described in this Product Safety Data Sheet are sealed units which are not hazardous when used according to the recommendations of the manufacturer and as long as their integrity is maintained.

Do not short circuit, puncture, incinerate, crush, immerse in water, force discharge or expose to temperatures above the declared operating temperature range of the product. Risk of fire or explosion.

Under normal conditions of use, the active materials and liquid electrolyte contained in the cells and batteries are not exposed to the outside, provided the battery integrity is maintained and seals remain intact. Risk of exposure only in case of abuse (mechanical, thermal, electrical) which leads to the activation of safety valves and/or the rupture of the battery container. Electrolyte leakage, electrode materials reaction with moisture/water or battery vent/explosion/fire may follow, depending upon the circumstances.

4. First Aid Measures (in case of leaking or accidentally opened cells)

In case of accumulator breakage or burst, please evacuate employees from the contaminated area and ensure maximal ventilation in order to break-up corrosive gas, smoke and unpleasant odors.

If it occurs, by accident, following measures must be taken:

Inhalation	Not anticipated under normal use. Remove from exposure. Remove to fresh air. Rest and keep warm. In severe cases obtain medical attention.
Skin contact	Not anticipated under normal use. Wash off skin thoroughly with water. Remove contaminated clothing and wash before reuse. In severe cases obtain medical attention.
Eye contact	Not anticipated under normal use. Irrigate thoroughly with water for at least 15 minutes. Obtain medical attention.
Ingestion	Not anticipated under normal use. 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

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.

6. Accidental Release Measures

In case of electrolyte leakage from a cell or battery, do not inhale the gas as possible.

Remove personnel from area.

If the skin has come into contact with the electrolyte, it should be washed thoroughly with water.

Using protective glasses and gloves, sand or earth should be used 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

Handling	Do not crush, pierce, short (+) and (-) battery terminals with conductive (i.e. metal) goods, which would end up into excessive heating. Do not directly heat or solder. Do not throw into fire. Do not mix batteries of different types and brands. Do not mix new and used batteries. Keep batteries in non conductive (i.e. plastic) trays. Do not disassemble, mutilate or mechanically abuse cells and batteries.
Storage	Store in a cool (preferably below 30°C) and ventilated area, away from moisture, sources of heat, open flames, food and drink. Keep adequate clearance between walls and batteries. Temperature above 70°C may result in battery leakage and rupture. Since short circuit can cause burn, leakage and rupture hazard, keep batteries in original packaging until use and do not jumble them.
Other	Follow Manufacturers recommendations regarding maximum recommended currents and operating temperature range. Applying pressure on deforming the battery may lead to disassembly followed by eye, skin and throat irritation. Do not immerse in water. The Li-ion cells and batteries are not designed to be recharged from external power sources besides specific Li-ion charger models approved by Saft. Connecting to inappropriate power supplies can result in fire or explosion.

8. Exposure Controls & Personal Protection

Occupational exposure standard	See section 2
---------------------------------------	---------------



	Respiratory protection	In all fire situations, use self-contained breathing apparatus.
	Hand protection	In the event of leaking or ruptured cells, wear gloves.
	Eye protection	Safety glasses are recommended in case of leaking or ruptured cells
	Other	In the event of leakage or ruptured cells, wear chemical apron.

9. Physical and Chemical Properties

Note: The following points are not applicable unless in case of leaking or damaged batteries with internal components sipping out.

Appearance	Solid object with cylindrical or prismatic shape
Odour	Odourless (unless in case of damaged product with leaking electrolyte)
pH	Not applicable
Flash point	Not applicable
Flammability	Not applicable
Relative density	> 2 g/cm ³
Solubility (water)	Not applicable, unless inner components are exposed
Solubility (other)	Not applicable

10. Stability and Reactivity

The product is stable under conditions described in Section 7.

Conditions to avoid.	Heating above 70°C or incinerate. Deformation. Mutilation. Crushing. Piercing. Disassembly. Short circuiting. Exposition over a long period to humid conditions.
Materials to avoid	Strong mineral acids, alkali solutions, strong oxidising materials and conductive materials
Hazardous decomposition Products	HF, CO, CO ₂

11. Toxicological Information

Signs & symptoms	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	
Mammalian effects	None known if used/disposed of correctly.
Eco-toxicity	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
Do not incinerate, or subject cells to temperatures in excess of 70°C. Such abuse can result in loss of seal, leakage, and/or cell explosion. Dispose of or recycle in accordance with appropriate local regulations.

14. Transport Information	
Note: when manufacturing a new battery pack, one must assure that it is tested in accordance with the UN Model Regulations, Manual of Tests and Criteria, Part III, subsection 38.3	
Label for conveyance	For the single cell batteries and multi-cell battery packs that are non-restricted to transport, use lithium-ion batteries inside label. For the single cell batteries and multicell battery packs which are restricted to transport (assigned to the Miscellaneous 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 number	UN 3480, for Li-ion batteries transported in bulk UN 3481, for Li-ion batteries contained in equipment or packed with it
Shipping name	Lithium-ion batteries
Hazard classification	Depending on their nominal energy, some single cells and small multi-cell battery packs may be non- assigned to Class 9 (Refer to Transport Certificate)
Packing group	II
IMDG Code	9033
CAS	
EmS No.	4.1-06
Marine pollutant	No
ADR Class	Class 9

15. Regulatory Information
Regulations specifically applicable to the product: - ACGIH and OSHA: see exposure limits of the internal ingredients of the battery in section 2. - IATA/ICAO (air transportation): UN 3480 or UN 3481 - IMDG (sea transportation) : UN 3480 or UN 3481 - Transportation within the US-DOT, 49 Code of Federal Regulations

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.
This information relates to the specific materials designated and may not be valid for such material 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 information. Saft does not offer warranty against patent infringement.

Edition 8 – February 2009

Signature

A handwritten signature in blue ink, appearing to read 'N. Paquin', written over a horizontal line. The signature is stylized with a large, sweeping 'N' and a cursive 'Paquin'.

Nicolas Paquin
Lithium Product Manager

APPENDIX B – PRIMARY LITHIUM BATTERY DATASHEETS

B PRIMARY LITHIUM BATTERIES

B.1 LS33600

B.2 LS26500

B.3 LSH 14

B.4 LSH 20

B.5 LS14500

Primary lithium battery

LS 33600

3.6 V Primary lithium-thionyl chloride (Li-SOCl₂)
High energy
D-size bobbin cell



Benefits

- High voltage response, stable during most of the lifetime of the application
- Wide operating temperature range (-60°C/85°C)
- Easy integration in compact system
- Low self-discharge rate (less than 1 % after 1 year of storage at + 20°C)

Key features

- Stainless steel container
- Hermetic glass-to-metal sealing
- Built-in safety vent
- Finish with or without flat positive end
- Non-flammable electrolyte
- Compliant with IEC 60086-4 safety standard and IEC 60079-11 intrinsic safety standard
- Underwriters Laboratories (UL) Component Recognition (File Number MH 12609)
- Restricted for transport (Class 9)

Main applications

- Utility metering
- Automatic meter readers
- Buoys
- Measuring equipment
- Industrial applications
- Professional electronics
- Marine equipment

Optional upon request

- Low magnetic version

Cell size references

D

Electrical characteristics

(typical values relative to cells stored for one year or less at + 30°C max.)

Nominal capacity (at 5 mA + 20°C 2.0 V cut-off. The capacity restored by the cell varies according to current drain, temperature and cut-off)	17.0 Ah
Open circuit voltage (at + 20°C)	3.67 V
Nominal voltage (at 0.7 mA + 20°C)	3.6 V
Nominal energy	61.2 Wh

Pulse capability: Typically up to 400 mA
(400 mA/0.1 second pulses, drained every 2 mn at + 20°C from undischarged cells with 10 µA base current, yield voltage readings above 3.0 V. The readings may vary according to the pulse characteristics, the temperature, and the cell's previous history. Fitting the cell with a capacitor may be recommended in severe conditions. Consult Saft)

Maximum recommended continuous current (to maintain cell heating within safe limits. Battery packs may imply lower level of maximum current and may request specific thermal protection. Consult Saft)	250 mA
---	--------

Storage (recommended) (for more severe conditions, consult Saft)	+ 30°C (+ 86°F) max
---	---------------------

Operating temperature range (Operation above ambient T may lead to reduced capacity and lower voltage readings at the beginning of pulses. Consult Saft)	- 60°C/+ 85°C (- 76°F/+ 185°F)
---	-----------------------------------

Physical characteristics

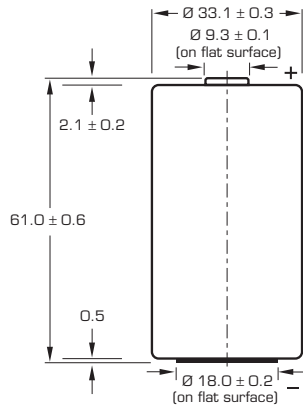
Diameter (max)	33.4 mm (1.32 in)
Height (max)	60.2 or 61.6 mm (2.37 in or 2.42 in) depending on finish type
Typical weight	90 g (3.2 oz)
Li metal content	approx. 4.5 g

Available termination suffix	CN, CNR CNA (AX) FL
------------------------------	---------------------------

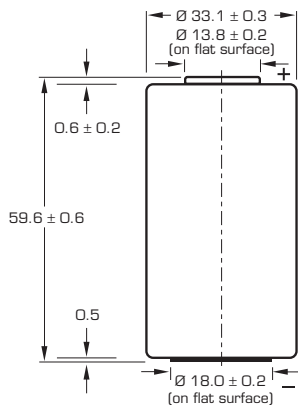
radial tabs
axial leads
flying leads... etc.



LS 33600



Finished version with protruding positive end cap



Finished version with flat positive end cap

Dimensions in mm.

Storage

- The storage area should be clean, cool (*preferably not exceeding +30°C*), dry and ventilated.

Warning

- Fire, explosion and burn hazard.
- Do not recharge, short circuit, crush, disassemble, heat above 100°C (212°F), incinerate, or expose contents to water.
- Do not solder directly to the cell (*use tabbed cell versions instead*).

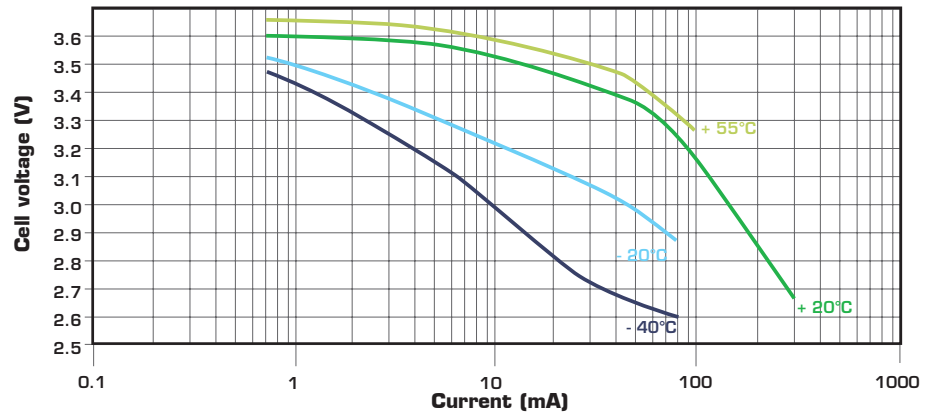
Saft

Specialty Battery Group

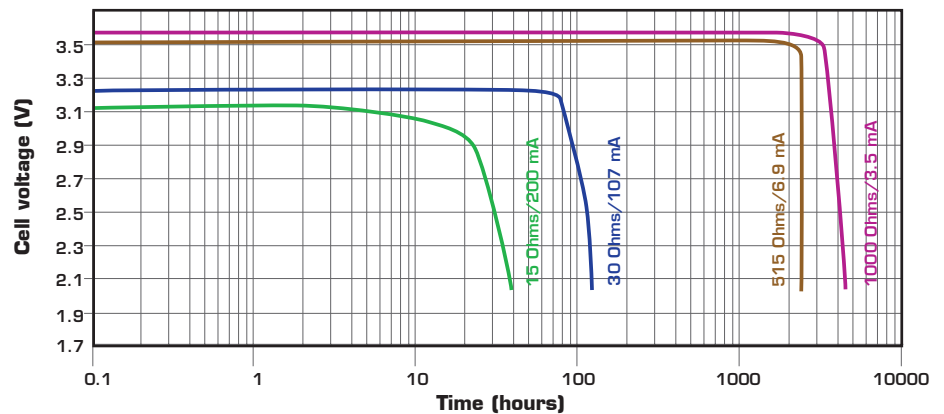
12, rue Sadi Carnot
93170 Bagnolet - France
Tel.: +33 (0)1 49 93 19 18
Fax: +33 (0)1 49 93 19 69

www.saftbatteries.com

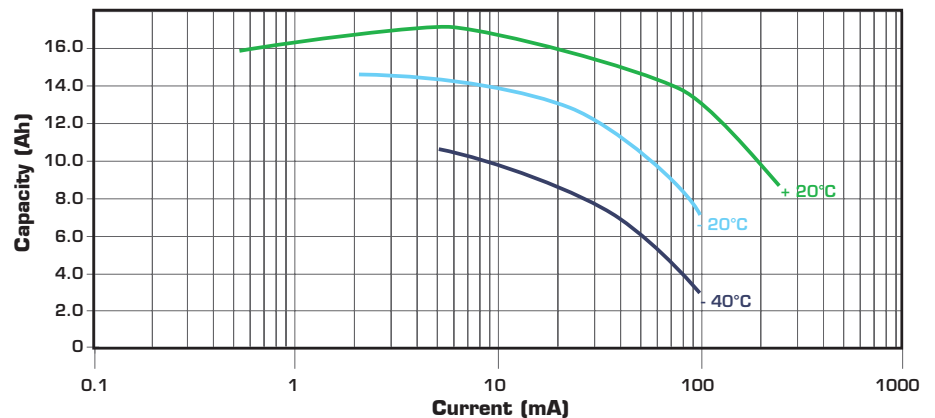
Voltage plateau versus Current and Temperature (at mid-discharge)



Typical discharge profiles at +20°C



Restored Capacity versus Current and Temperature (2.0 V cut-off)



Doc. N° 31007-2-0710

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

For more details on primary lithium technologies please refer to Primary Lithium Batteries Selector Guide Doc N° 31048-2.

Published by the Communications Department.

Photo credit: Saft

Société anonyme au capital de 31 944 000 €
RCS Bobigny B 383 703 873

Produced by Arthur Associates Limited.



Primary lithium battery

LS 26500

3.6 V Primary lithium-thionyl chloride (Li-SOCl₂)
High energy density
C-size bobbin cell



Benefits

- High voltage response, stable during most of the lifetime of the application
- Wide operating temperature range (-60°C/+85°C)
- Low self-discharge rate (less than 1 % after 1 year of storage at +20°C)
- Easy integration into compact systems
- Superior resistance to atmospheric corrosion

Key features

- Stainless steel container and end caps (low magnetic signature)
- Hermetic glass-to-metal sealing
- Non-flammable electrolyte
- Underwriters Laboratories (UL) Component Recognition
- Compliant with IEC 60086-4 safety standard and IEC 60079-11 intrinsic safety standard
- Restricted for transport (Class 9)

Main applications

- Utility metering
- Automatic meter readers
- Buoys
- Measuring equipment
- Industrial applications
- Professional electronics

Optional upon request

- Low magnetic version

Cell size references

C

Electrical characteristics

(typical values relative to cells stored for one year or less at +30°C max.)

Nominal capacity 7.7 Ah

(at 4 mA +20°C 2.0 V cut-off. The capacity restored by the cell varies according to current drain, temperature and cut-off)

Open circuit voltage (at +20°C) 3.67 V

Nominal voltage (at 0.5 mA +20°C) 3.6 V

Nominal energy 27.72 Wh

Pulse capability: Typically up to 300 mA (300 mA/0.1 second pulses, drained every 2 mn at +20°C from undischarged cells with 10 µA base current, yield voltage readings above 3.0 V. The readings may vary according to the pulse characteristics, the temperature, and the cell's previous history. Fitting the cell with a capacitor may be recommended in severe conditions. Consult Saft)

Maximum recommended continuous current 150 mA

(Higher currents possible, consult Saft)

Storage (recommended) +30°C (+86°F) max
(for more severe conditions, consult Saft)

Operating temperature range -60°C/+85°C
(Operation above ambient T may lead to reduced capacity and lower voltage readings at the beginning of pulses. Consult Saft)
(-76°F/+185°F)

Physical characteristics

Diameter (max) 26.0 mm (1.02 in)

Height (max) 49.1 mm or 50.4 mm
(1.93 in or 1.98 in)
depending on finish type

Typical weight 48 g (1.7 oz)

Li metal content approx. 2.0 g

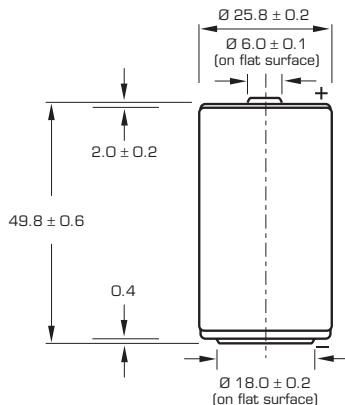
Available termination suffix

CNR
3 PF, 3 PF RP
CNA (AX)
FL

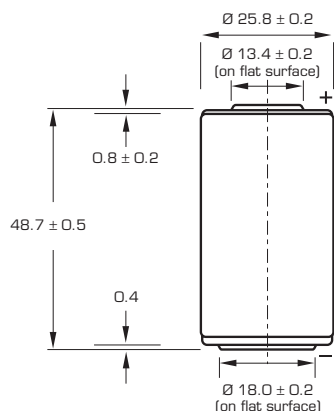
radial tabs
radial pins
axial leads
flying leads... etc.



LS 26500



Finished version with protruding positive end cap



Finished version with flat positive end cap

Dimensions in mm.

Storage

- The storage area should be clean, cool (preferably not exceeding +30°C), dry and ventilated.

Warning

- Fire, explosion and severe burn hazard.
- Do not recharge, short circuit, crush, disassemble, heat above 100°C (212°F), incinerate, or expose contents to water.
- Do not solder directly to the cell (use tabbed cell versions instead).

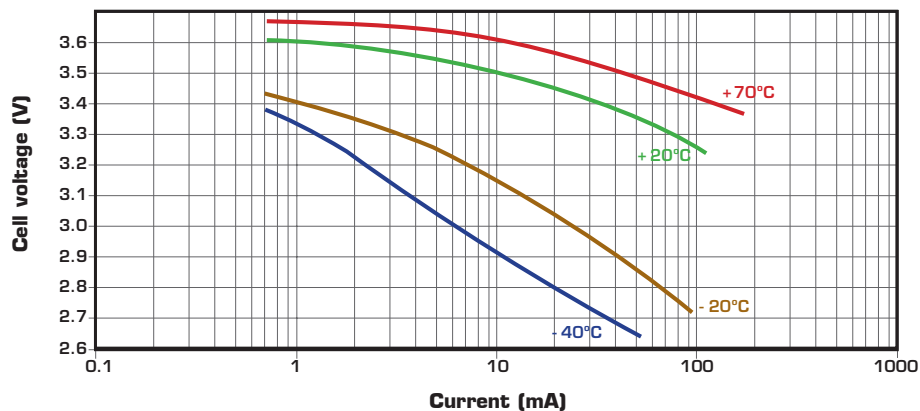
Saft

Specialty Battery Group

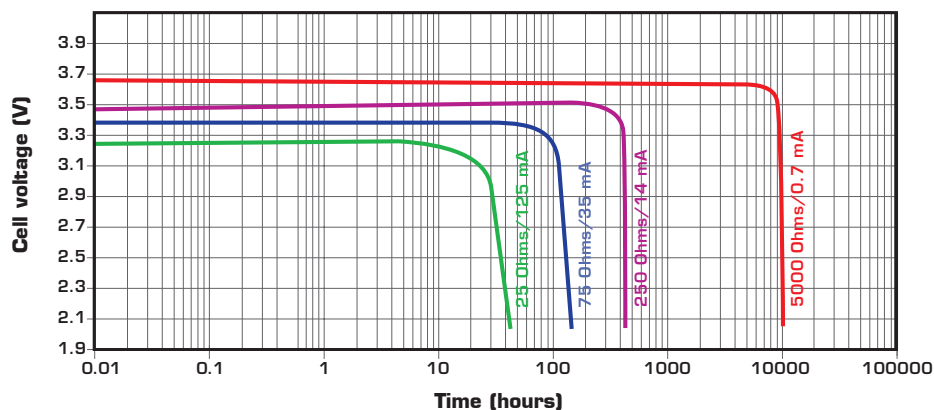
12, rue Sadi Carnot
93170 Bagnolet - France
Tel.: +33 (0)1 49 93 19 18
Fax: +33 (0)1 49 93 19 69

www.saftbatteries.com

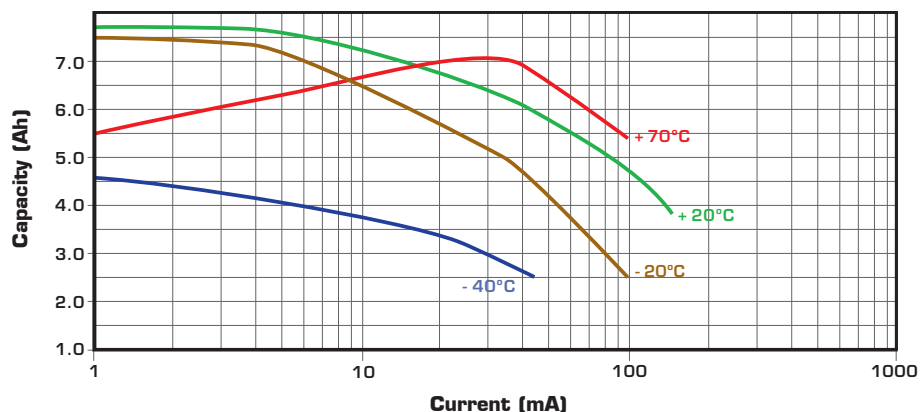
Voltage plateau versus Current and Temperature (at mid-discharge)



Typical discharge profiles at +20°C



Restored Capacity versus Current and Temperature (2.0 V cut-off)



Doc. N° 31016-2-0510

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For more details on primary lithium technologies please refer to Primary Lithium Batteries Selector Guide Doc N° 31048-2.

Photo credit: Saft

Société anonyme au capital de 31 944 000 €
RCS Bobigny B 383 703 873

Produced by Arthur Associates Limited.



Primary lithium battery

LSH 14

3.6 V Primary lithium-thionyl chloride (Li-SOCl₂)
High power
C-size spiral cell



Benefits

- High voltage response, stable during most of the lifetime of the application
- High drain/pulse capability
- Wide operating temperature range (-60°C/85°C)
- Easy integration in compact system
- Low self-discharge rate (less than 3 % after 1 year of storage at + 20°C)

Key features

- Stainless steel container
- Hermetic glass-to-metal sealing
- Built-in safety vent
- Finish with 5 A fuse
- Non-flammable electrolyte
- Underwriters Laboratories (UL) Component Recognition (File Number MH 12609)
- Compliant with IEC 60086-4
- Restricted for transport (Class 9)

Main applications

- Radiocommunication and other military applications
- Alarms and security systems
- Beacons and emergency location transmitters
- GPS
- Metering systems
- Sonobuoys
- Automotive telematics
- Pipeline inspection

NATO stock number
6135 12 306 4125

Cell size references

UM2 - R14 - C

Electrical characteristics

(typical values relative to cells stored for one year or less at + 30°C max.)

Nominal capacity (at 15 mA + 20°C 2.0 V cut-off. The capacity restored by the cell varies according to current drain, temperature and cut-off)	5.8 Ah
Open circuit voltage (at + 20°C)	3.67 V
Nominal voltage (at 1 mA + 20°C)	3.6 V

Pulse capability: Typically up to 2000 mA (2000 mA/0.1 second pulses, drained every 2 mn at + 20°C from undischarged cells with 10 µA base current, yield voltage readings above 3.0 V. The readings may vary according to the pulse characteristics, the temperature, and the cell's previous history. Fitting the cell with a capacitor may be recommended in severe conditions. Consult Saft)

Maximum recommended continuous current (to maintain cell heating within safe limits. Battery packs may imply lower level of maximum current and may request specific thermal protection. Consult Saft)	1300 mA
---	---------

Storage (recommended) (for more severe conditions, consult Saft)	+ 30°C (+ 86°F) max
---	---------------------

Operating temperature range (Operation at extreme T may lead to reduced capacity and lower voltage readings at the beginning of pulses. Consult Saft)	- 60°C/+ 85°C (- 76°F/+ 185°F)
--	-----------------------------------

Physical characteristics

Diameter (max)	26.0 mm (1.02 in)
Height (max)	50.4 mm (1.98 in)
Typical weight	51 g (1.8 oz)
Li metal content	approx. 1.7 g

Available termination suffix

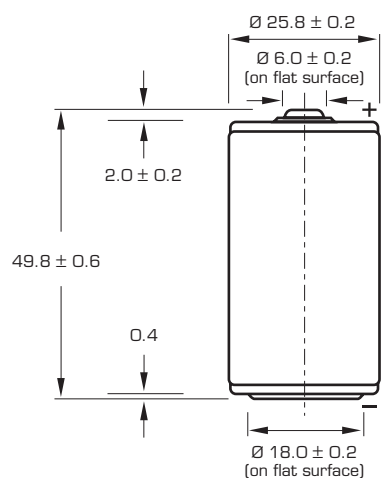
CN, CNR
3PF, 3 PF RP
CNA (AX)
FL

radial tabs
radial pins
axial leads
flying leads ...etc.



saft

LSH 14



Dimensions in mm.

Storage

- The storage area should be clean, cool (preferably not exceeding + 30°C), dry and ventilated.

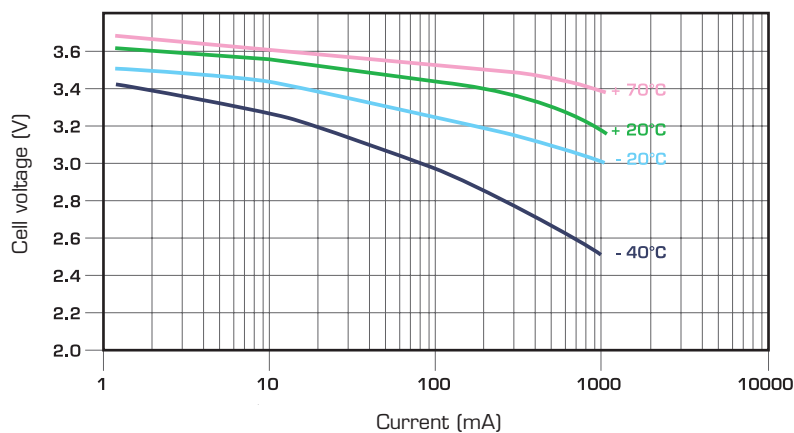
Warning

- Fire, explosion and burn hazard.
- Do not recharge, short circuit, crush, disassemble, heat above 100°C (212°F), incinerate, or expose contents to water.
- Do not solder directly to the cell (use tabbed cell versions instead).

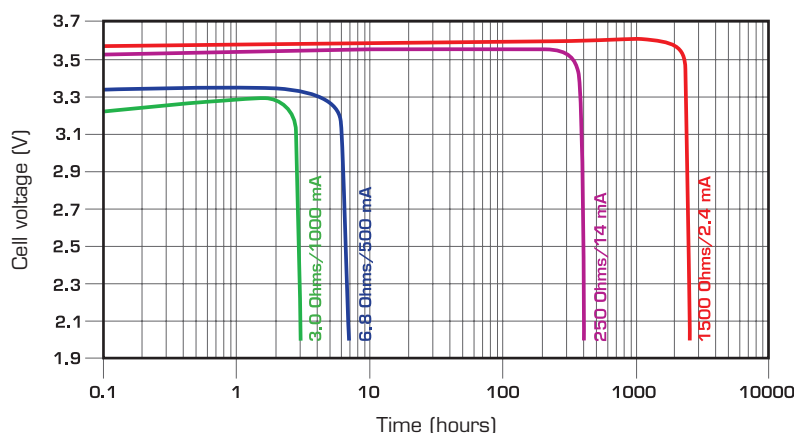
Saft Specialty Battery Group

12, rue Sadi Carnot
93170 Bagnolet - France
Tel +33 (0)1 49 93 19 18
Fax +33 (0)1 49 93 19 69

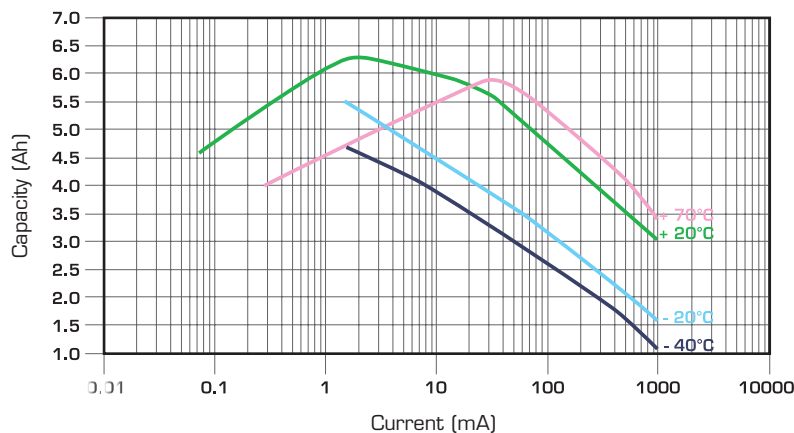
www.saftbatteries.com



Voltage plateau versus Current and Temperature (at mid-discharge)



Typical discharge profiles at +20°C



Restored Capacity versus Current and Temperature (2.0 V cut-off)

Doc. N° 31013-2-0607

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RCS Bobigny B 383 703 873

Produced by Arthur Associates



Primary lithium battery

LSH 20

3.6 V Primary lithium-thionyl chloride (Li-SOCl₂)
High power
D-size spiral cell



Benefits

- High voltage response, stable during most of the lifetime of the application
- High drain/pulse capability
- Wide operating temperature range (-60°C/+85°C)
- Easy integration into compact systems
- Low self-discharge rate (less than 3% after 1 year of storage at +20°C)

Key features

- Stainless steel container
- Hermetic glass-to-metal sealing
- Built-in safety vent
- Finish with 5 A fuse
- Non-flammable electrolyte
- Underwriters Laboratories (UL) Component Recognition (File Number MH 12609)
- Restricted for transport (Class 9)

Main applications

- Radiocommunication and other military applications
- Alarms and security systems
- Beacons and emergency location transmitters
- GPS
- Metering systems
- Sonobuoys
- Tracking systems
- GSM communication

NATO stock number
6135 14 440 1213

Cell size references

UM1 - R20 - D

Electrical characteristics

(typical values relative to cells stored for one year or less at +30°C max.)

Nominal capacity	13.0 Ah
------------------	---------

(at 15 mA +20°C 2.0 V cut off. The capacity restored by the cell varies according to current drain, temperature and cut off)

Open circuit voltage (at +20°C)	3.67 V
---------------------------------	--------

Nominal voltage (at 2 mA +20°C)	3.6 V
---------------------------------	-------

Pulse capability: Typically up to 4000 mA (4000 mA/0.1 second pulses, drained every 2 mn at +20°C from undischarged cells with 10 µA base current, yield voltage readings above 3.0 V. The readings may vary according to the pulse characteristics, the temperature, and the cell's previous history. Fitting the cell with a capacitor may be recommended in severe conditions. Consult Saft)

Maximum recommended continuous current (to maintain cell heating within safe limits. Battery packs may imply lower level of maximum current and may request specific thermal protection. Consult Saft)	1800 mA
--	---------

Storage (recommended) (for more severe conditions, consult Saft)	+30°C (+86°F) max
--	-------------------

Operating temperature range (Operation above ambient T may lead to reduced capacity and lower voltage readings at the beginning of pulses. Operation with current continuously above 1 A may restrict upper T range. Consult Saft)	-60°C/+85°C (-76°F/+185°F)
--	-------------------------------

Physical characteristics

Diameter (max)	33.4 mm (1.32 in)
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Height (max)	61.6 mm (2.42 in)
--------------	-------------------

Typical weight	100 g (3.5 oz)
----------------	----------------

Li metal content	approx. 3.8 g
------------------	---------------

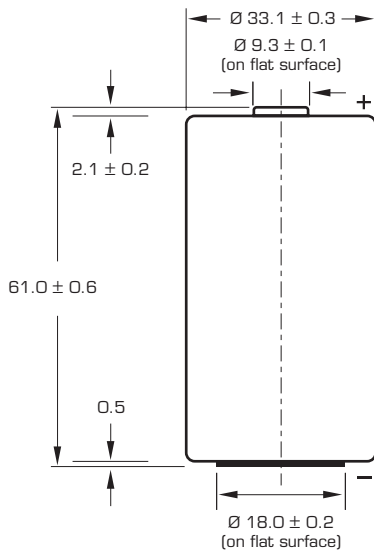
Available termination suffix

CN, CNR
CNA (AX)
FL

radial tabs
axial leads
flying leads ...etc.



LSH 20



Dimensions in mm.

Storage

- The storage area should be clean, cool (preferably not exceeding +30°C), dry and ventilated.

Warning

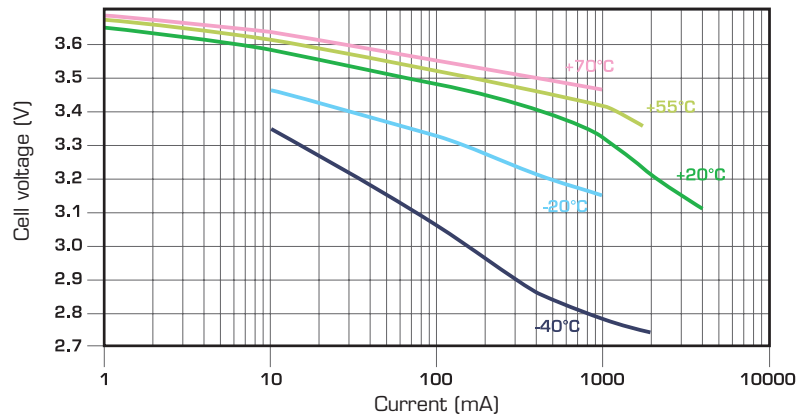
- Fire, explosion and burn hazard.
- Do not recharge, short circuit, crush, disassemble, heat above 100°C (212°F), incinerate, or expose contents to water.
- Do not solder directly to the cell (use tabbed cell versions instead).

Saft

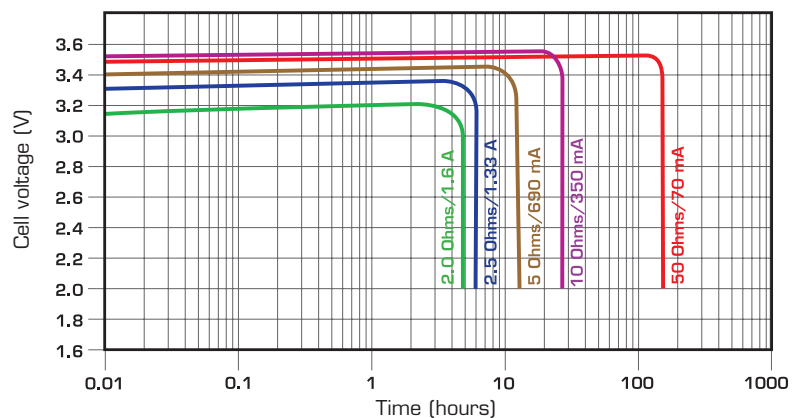
Specialty Battery Group

12, rue Sadi Carnot
93170 Bagnolet - France
Tel +33 (0)1 49 93 19 18
Fax +33 (0)1 49 93 19 69

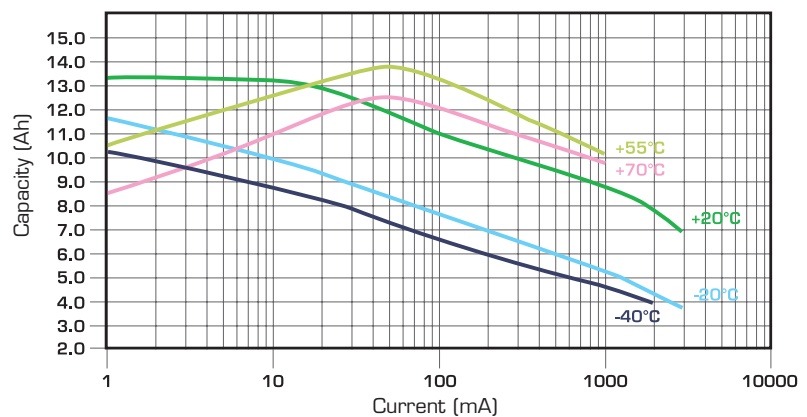
www.saftbatteries.com



Voltage plateau versus Current and Temperature (at mid-discharge)



Typical discharge profiles at +20°C



Restored Capacity versus Current and Temperature (2.0 V cut off)

Doc. N° 31015-2-1006

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For more details on primary lithium technologies please refer to Primary Lithium Batteries Selector Guide Doc N° 31048-2.

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Photo credit: Saft

Société anonyme au capital de 31 944 000 €
RCS Bobigny B 383 703 873

Produced by Arthur Associates



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Primary lithium battery

LS 14500

3.6 V Primary lithium-thionyl chloride (Li-SOCl₂)
High energy density
AA-size bobbin cell



Benefits

- Enhanced capacity
- High voltage response, stable during most of the lifetime of the application
- Wide operating temperature range (-60°C/+85°C)
- Low self-discharge rate (less than 1 % after 1 year of storage at +20°C)
- Easy integration into compact systems
- Superior resistance to atmospheric corrosion

Key features

- Stainless steel container and end caps (low magnetic signature)
- Hermetic glass-to-metal sealing
- Non-flammable electrolyte
- Compliant with IEC 60086-4 safety standard and IEC 60079-11 intrinsic safety standard (class T3 assignment)
- Underwriters Laboratories (UL) Component Recognition
- Non-restricted for transport/ Non-assigned to Class 9 according to the UN Recommendations on the transport of dangerous goods – Model Regulations
- Manufactured in France, UK, China

Main applications

- Utility metering
- Automatic meter reading
- Alarms and security devices
- Tollgate systems
- Memory back-up
- Tracking systems
- Automotive electronics
- Professional electronics

Cell size references

R6 - AA

Electrical characteristics

(typical values relative to cells stored for one year or less at +30°C max.)

Nominal capacity (at 2 mA +20°C 2.0 V cut-off. The capacity restored by the cell varies according to current drain, temperature and cut-off)	2.6 Ah
Open circuit voltage (at +20°C)	3.67 V
Nominal voltage (at 0.2 mA +20°C)	3.6 V
Nominal energy	9.36 Wh

Pulse capability: Typically up to 250 mA (250 mA/0.1 second pulses, drained every 2 mn at +20°C from undischarged cells with 10 µA base current, yield voltage readings above 3.0 V. The readings may vary according to the pulse characteristics, the temperature, and the cell's previous history. Fitting the cell with a capacitor may be recommended in severe conditions. Consult Saft)

Maximum recommended continuous current (Higher currents possible, consult Saft)	50 mA
Storage (recommended) (for more severe conditions, consult Saft)	+30°C (+86°F) max
Operating temperature range (Operation above ambient T may lead to reduced capacity and lower voltage readings at the beginning of pulses. Consult Saft)	-60°C/+85°C (-76°F/+185°F)

Physical characteristics

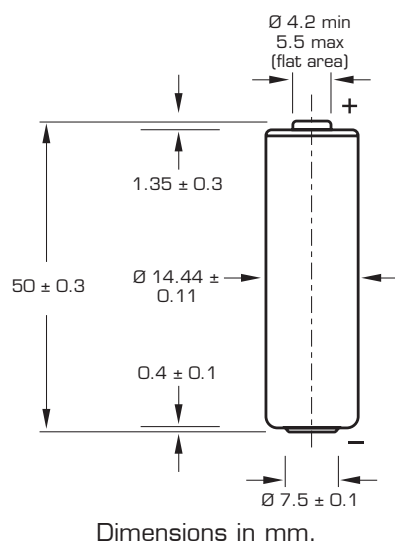
Diameter (max)	14.55 mm (0.57 in)
Height (max)	50.3 mm (1.98 in)
Typical weight	16.7 g (~ 0.6 oz)
Li metal content	approx. 0.7 g

Available termination suffix

CN, CNR	radial tabs
2 PF, 3 PF, 3 PF RP, 4 PF	radial pins
CNA (AX)	axial leads
FL	flying leads...etc.



LS 14500



Storage

- The storage area should be clean, cool (*preferably not exceeding +30°C*), dry and ventilated.

Warning

- Fire, explosion and burn hazard.
- Do not recharge, short circuit, crush, disassemble, heat above 100°C (212°F), incinerate, or expose contents to water.
- Do not solder directly to the cell (*use tabbed cell versions instead*).

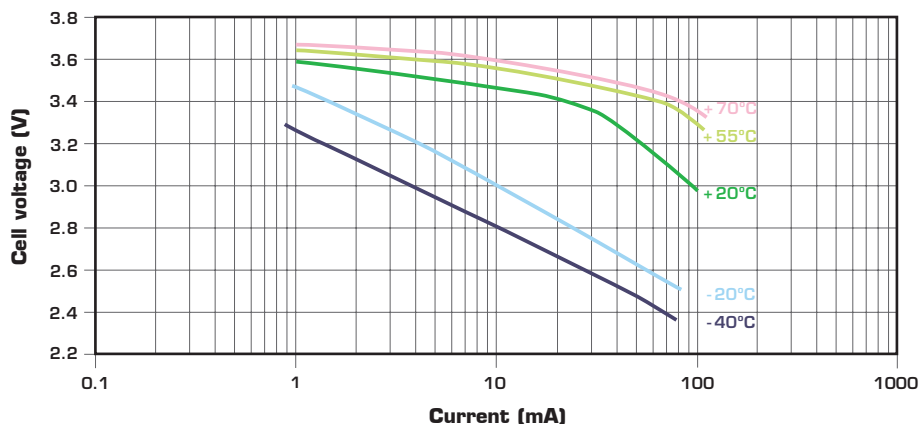
Saft

Specialty Battery Group

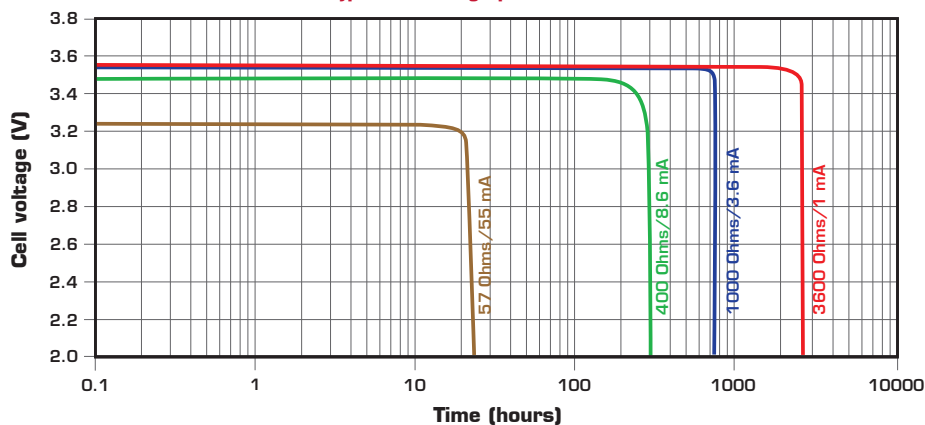
12, rue Sadi Carnot
93170 Bagnolet - France
Tel.: +33 (0)1 49 93 19 18
Fax: +33 (0)1 49 93 19 69

www.saftbatteries.com

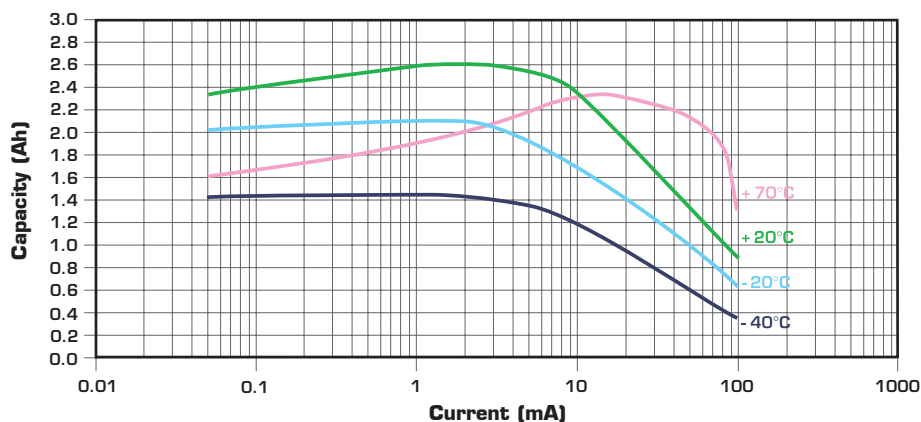
Voltage plateau versus Current and Temperature (at mid-discharge)



Typical discharge profiles at +20°C



Restored Capacity versus Current and Temperature (2.0 V cut-off)



Doc. N° 31064-2-0909

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For more details on primary lithium technologies please refer to Primary Lithium Batteries Selector Guide Doc N° 31048-2.

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Photo credit: Saft

Société anonyme au capital de 31 944 000 €
RCS Bobigny B 383 703 873

Produced by Arthur Associates Limited.



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APPENDIX C – TRANSPORTATION CERTIFICATES

C PRIMARY LITHIUM BATTERY TRANSPORTATION CERTIFICATES

C.1 LS33600

C.2 LS26500

C.3 LS14500

C.4 LSH14

C.5 LSH20

TRANSPORTATION CERTIFICATE

This is to certify that Sonardyne battery type 8154-004 has been subjected to and has met the requirements of:

UN recommendations on the transport of dangerous goods, Manual of Tests and Criteria 4th Revision edition – 2003 – Ref ST/SG/AC 10/11 Rev 4

As detailed in external test house report 100893 dated 24 July 2007 covering tests T1 to T5 inclusive.

Product Description

Primary (non rechargeable) Lithium-Thionyl Chloride (Li-SOCl₂) D-sized cells type LSH33600 arranged in series/parallel arrangement with additional diode and polyswitch protection.

Sonardyne Type Number	Pack	8154-004
Sonardyne reference number	CPN	641-3422
Nominal Voltage	Volts	24.0
Nominal Capacity	Ah	34
Equivalent Lithium Metal Content	Grams	63
Nominal Energy	Wh	816
Maximum Recommended	A	0.5
Continuous Discharge Current		

Product Classification

Since the packs pass the UN-defined transport tests and because their lithium content is above the 2 gram limit, these are declared non-exempt from the Dangerous Goods Regulations. They are restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT etc) in charge of regulating the transportation of dangerous goods.

Signed on Behalf of Sonardyne International Limited

Peter Williams: Director



dated 13th November 2007

Chris Martin: Quality Coordinator



dated 13th November 2007

F085-A-QLD.doc

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TRANSPORTATION CERTIFICATE

This is to certify that Sonardyne battery type 8154 meets the requirements of UN recommendations on the transport of dangerous goods, Manual of Tests and Criteria 4th Revision edition – 2003 – Ref ST/SG/AC 10/11 Rev 4.

The battery when assembled from batteries that have previously passed all applicable tests, has an aggregate lithium content of more than 500g and is classified as a "large" battery within the Regulations, and requires no further testing.

The pack is assembled from 10-off type 8154-004 (CPN 641-3422) connected in parallel in modules that have been previously tested as detailed in external test house report 100893 dated 24 July 2007 covering tests T1 to T5 inclusive.

The assembled pack is equipped with a system for monitoring the battery and prevents short circuits, or over-discharge between the batteries in the assembly and any overheating of the battery assembly.

Product Description

Primary (non rechargeable) Lithium-Thionyl Chloride (Li-SOCl₂) D-sized cells type LSH33600 arranged in series/parallel arrangement with additional diode and polyswitch protection.

Sonardyne Type Number	Pack	8154
Sonardyne reference number	CPN	620-7194
Nominal Voltage	Volts	24.0
Nominal Capacity	Ah	340
Equivalent Lithium Metal Content	Grams	630
Nominal Energy	Wh	8160
Maximum Recommended	A	3.0
Continuous Discharge Current		

Product Classification

Since the packs pass the UN-defined transport tests and because their lithium content is above the 2 gram limit, these are declared non-exempt from the Dangerous Goods Regulations. They are restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT etc) in charge of regulating the transportation of dangerous goods.

Signed on Behalf of Sonardyne International Limited

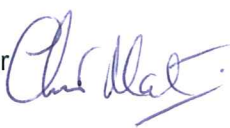
Peter Williams: Director



dated 3rd March 2008

Chris Martin:

Quality Coordinator



dated 3rd March 2008

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TRANSPORTATION CERTIFICATE

Ref. TC-LS 33600C 01/2008- 4

This is to certify that the Saft cell type, **LS 33600C**, that just differs from the standard LS 33600 cell type by less than 20% in anode and cathode mass, can be assimilated, without any additional specific testing, to the standard LS 33600 cell that has been subjected and has met the requirements of :

- UN Recommendations on the transport of dangerous goods, Model Regulations 12th Revised edition - 2001 - Ref. ST/SG/AC.10/1/Rev. 12, *(which has now been replaced, without any change regarding Lithium batteries, by the 15th Revised edition - 2006 - Ref. ST/SG/AC.10/1/Rev. 15),*
- UN Recommendations on the transport of dangerous goods, Manual of Tests and Criteria 3rd Revised edition - 1999 - Ref. ST/SG/AC.10/11/Rev. 3, amended per Addendum 2, Annex 4 – Ref. ST/SG/AC.10/27/Add.2 *(which has now been replaced, without any change regarding Lithium batteries, by the 4th Revised edition - 2003 - Ref. ST/SG/AC.10/11/Rev. 4),*

as detailed in Saft-Poitiers internal report P 0256/03, dated 06/2003.

Concerned Part Numbers

All the following LS 33600C individual cell versions that just vary by their termination mode and labeling: 04522Z, 04647D, 04648E, 04649F, 04650G, 04711S, 04713U, 05016S, 05536J, 05542Q.

Product Description

Individual primary (non-rechargeable), Lithium-Thionyl Chloride (Li-SOCl₂) D-sized single cell, without protection devices

Nominal Voltage	3.6 Volts
Nominal Capacity	18.5 Ah
Lithium metal content	4.9 grams
Nominal energy	18.5 x 3.6 = 66.6 Wh
Maximum recommended continuous discharge current	80 mA

Product Classification

By similarity with the already tested LS 33600 cell and since its lithium content is also above the 1 gram limit, **the LS 33600C individual cell in all of its finish versions, is declared non-exempt from the Dangerous Goods Regulations. It is restricted to transport/ assigned to Class 9**, and must be packed in accordance with the relevant packing instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT, etc.) in charge of regulating the transportation of dangerous goods.

Signed on Behalf of Saft, Specialty Battery Group

Pascal Hans SBG Quality Manager

dated 15/01/2008

Alain Kerouanton SBG Lithium Product Manager

dated 15/01/2008



TRANSPORTATION CERTIFICATE

Ref. TC - LS26500 10/2009- 5

This is to certify that the Saft cell type, **LS26500**, has been subjected and has met the requirements of the UN Recommendations on the Transport of Dangerous Goods, Part III, sub-section 38.3, Manual of Tests and Criteria - 4th Revised edition - 2003 - Ref. ST/SG/AC.10/11/Rev. 4

The results are detailed in Saft-Poitiers internal report P0140-03, dated 03/2003.

Concerned Part Numbers : 04232F, and all the part numbers relative to single LS26500 cells, whatever their finish mode (with and without end-tabs or wiring and connector assemblies, etc.).

Product Description

Primary (non-rechargeable), Lithium-Thionyl Chloride (Li-SOCl₂) C-sized single cell.

Nominal Voltage	3.6 Volts
Nominal Capacity	7.7 Ah
Lithium metal content	2.0 grams
Nominal energy	27.7 Wh

Product Classification

Worldwide, besides the United States of America

Since it passes the UN-defined transport tests, but has a lithium metal content above the 1 gram limit, the **LS26500 single cell, in all of its finished versions**, according to the current UN Recommendations on the Transport of Dangerous Goods - Model regulations, **is declared non-exempt from the Dangerous Goods Regulations. It is restricted to transport / assigned to Class 9** and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT, etc.) that are in charge of regulating the transportation of dangerous goods.

Within the United States of America

The U.S. DOT CFR 49 Regulations, Parts 171, 172, 173 and 175, are governing the transportation of lithium cells and batteries. Special Provision 188 (in Part 172.102) **defines the LS26500 single lithium metal cell, in all of its finished versions, as belonging to the "medium primary lithium cell" category**, and details the requirements to be met for the different transportation conditions.

Signed on Behalf of Saft, Specialty Battery Group

Pascal Hans SBG Quality Manager

dated 20/10/2009

Nicolas Paquin SBG Lithium Product Manager

PO : Y. Chartier

dated 20/10/2009

TRANSPORTATION CERTIFICATE

This is to certify that Sonardyne battery type 7835-007 has been subjected to and has met the requirements of:

UN recommendations on the transport of dangerous goods, Manual of Tests and Criteria 4th Revision edition – 2003 – Ref ST/SG/AC 10/11 Rev 4

Test results are detailed in external test house reports 101570 dated 22/Nov/2010, covering tests T1 to T5 inclusive.

Product Description

Primary (non rechargeable) Lithium-Thionyl Chloride (Li-SOCl₂) AA-sized cells type LS14500, arranged in series/parallel arrangement with additional diode and polyswitch protection.

Sonardyne Type Number	Pack	7835-007
Sonardyne reference number	CPN	640-8515
Nominal Voltage	Volts	14.4
Nominal Capacity	Ah	5.2
Equivalent Lithium Metal Content	Grams	5.6
Nominal Energy	Wh	75
Maximum Recommended	A	0.14
Continuous Discharge Current		
External Test House report number		101570

Product Classification

Since the packs pass the UN-defined transport tests and because their lithium content is above the 2 gram limit, these are declared non-exempt from the Dangerous Goods Regulations. They are restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT etc) in charge of regulating the transportation of dangerous goods.

The packs can be shipped inside other equipment provided that the rules of the various bodies for transport "inside equipment" are adhered to. In particular the pack(s) should not be connected to equipment which could result in "accidental actuation" unless a Safety Case has been written to ensure the packs cannot overheat in a fault condition.

Signed on Behalf of Sonardyne International Limited

David Lawes: Director



dated 23rd November 2010

Chris Martin: Quality Coordinator



dated 23rd November 2010

F093-A-QLD

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TRANSPORTATION CERTIFICATE

This is to certify that Sonardyne battery type 7815-006 has been subjected to and has met the requirements of:

UN recommendations on the transport of dangerous goods, Manual of Tests and Criteria 4th Revision edition – 2003 – Ref ST/SG/AC 10/11 Rev 4

As detailed in external test house report 101623 dated 18 March 2011, covering tests T1 to T5 inclusive.

Product Description

Primary (non rechargeable) Lithium-Thionyl Chloride (Li-SOCl₂) AA-sized cells type LS14500 arranged in a series/parallel arrangement with additional diode and polyswitch protection.

Sonardyne Type Number		7815-006	
Sonardyne Stock Code	CPN	640-8864	
Nominal Voltage	Volts	14.1	6.9
Nominal Capacity	Ah	2.6	7.8
Maximum recommended continuous discharge current	mA	70	210
Nominal Energy	Wh	74.9	
Equivalent Lithium Metal content	grams	5.6	
External Test House report number		101623	

Product Classification

Since the packs pass the UN-defined transport tests and because their lithium content is above the 2 gram limit, these are declared non-exempt from the Dangerous Goods Regulations. They are restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT etc) in charge of regulating the transportation of dangerous goods.

Signed on Behalf of Sonardyne International Limited

David Lawes: Director



dated 21st March 2011

Chris Martin: Quality Coordinator



dated 21st March 2011

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TRANSPORTATION CERTIFICATE

This is to certify that Sonardyne battery type 7192-010 has been subjected to and has met the requirements of:

UN recommendations on the transport of dangerous goods, Manual of Tests and Criteria 4th Revision edition – 2003 – Ref ST/SG/AC 10/11 Rev 4

As detailed in external test house report 100876 dated 29 May 2007 covering tests T1 to T5 inclusive.

Product Description

Primary (non rechargeable) Lithium-Thionyl Chloride (Li-SOCl₂) C-sized cells type LSH14 with 5 A protection fuse arranged in series/parallel arrangement with additional diode and polyswitch protection.

Sonardyne Type Number	Pack	7192-010
Sonardyne reference number	CPN	640-061C
Nominal Voltage	Volts	14.5
Nominal Capacity	Ah	11
Equivalent Lithium Metal Content	Grams	13
Nominal Energy	Wh	160
Maximum Recommended	A	1.3
Continuous Discharge Current		

Product Classification

Since the packs pass the UN-defined transport tests and because their lithium content is above the 2 gram limit, these are declared non-exempt from the Dangerous Goods Regulations. They are restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT etc) in charge of regulating the transportation of dangerous goods.

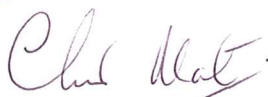
Signed on Behalf of Sonardyne International Limited

Peter Williams: Director



dated 11th June 2007

Chris Martin: Quality Coordinator



dated 11th June 2007

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TRANSPORTATION CERTIFICATE

This is to certify that Sonardyne battery type 8054-029 has been subjected to and has met the requirements of:

UN recommendations on the transport of dangerous goods, Manual of Tests and Criteria 4th Revision edition – 2003 – Ref ST/SG/AC 10/11 Rev 4

As detailed in external test house report 100916 dated 3 September 2007 covering tests T1 to T5 inclusive.

Product Description

Primary (non rechargeable) Lithium-Thionyl Chloride (Li-SOCl₂) C-sized cells type LSH14 with 5 A protection fuse arranged in series/parallel arrangement with additional diode and polyswitch protection.

Sonardyne Type Number	Pack	8054-029
Sonardyne reference number	CPN	641-3302
Nominal Voltage	Volts	14.5
Nominal Capacity	Ah	5.5
Equivalent Lithium Metal Content	Grams	6.8
Nominal Energy	Wh	79
Maximum Recommended	A	1.3
Continuous Discharge Current		

Product Classification

Since the packs pass the UN-defined transport tests and because their lithium content is above the 2 gram limit, these are declared non-exempt from the Dangerous Goods Regulations. They are restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT etc) in charge of regulating the transportation of dangerous goods.

Signed on Behalf of Sonardyne International Limited

Peter Williams: Director



dated 13th November 2007

Chris Martin: Quality Coordinator



dated 13th November 2007

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TRANSPORTATION CERTIFICATE

Ref. TC-LSH 14 10/2008 - 4

This is to certify that the Saft cell type, **LSH 14**, has been subjected and has met the requirements of the UN Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, 4th Revised edition - 2003 - Ref. ST/SG/AC.10/11/Rev. 4, as detailed in Saft-Poitiers internal reports P 0087/01 and P0188/01.

Concerned Part Numbers

All the part numbers relative to single LSH 14 cells, whatever their finish mode (with and without end-tabs or wiring and connector assemblies, etc.).

Product Description

Individual primary (non-rechargeable), Lithium-Thionyl Chloride (Li-SOCl₂) C-sized spiral cell, with a 5A protection fuse.

Nominal Voltage	3.6 Volts
Nominal Capacity	5.7 Ah
Lithium metal content	1.80 gram
Nominal energy	5.7 x 3.6 = 21.7 Wh
Maximum recommended continuous discharge current	1.3 A

Product Classification

Worldwide, besides the United States of America

Since it passes the UN-defined transport tests, but has a lithium metal content above the 1 gram limit, **the LSH 14 single cell, in all of its finished versions, according to the current UN Recommendations on the Transport of Dangerous Goods - Model regulations, is declared non-exempt from the Dangerous Goods Regulations. It is restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT, etc.) that are in charge of regulating the transportation of dangerous goods.**

Within the United States of America

The U.S. DOT CFR 49 Regulations, Parts 171, 172, 173 and 175, are governing the transportation of lithium cells and batteries. Special Provision 188 (in Part 172.102) **defines the LSH 14 single lithium metal cell, in all of its finished versions, as belonging to the "medium primary lithium cell" category, and details the requirements to be met for the different transportation conditions.**

Signed on Behalf of Saft, Specialty Battery Group

Pascal Hans

SBG Quality Manager

dated 08/10/2008

Alain Kerouanton

SBG Lithium Product Manager

dated 08/10/2008



TRANSPORTATION CERTIFICATE

Ref. TC - LSH 14 "Light" 08/2009- 2

This is to certify that the Saft cell type, LSH 14 "Light", has been subjected and has met the requirements of the UN Recommendations on the Transport of Dangerous Goods, Part III, sub-section 38.3, Manual of Tests and Criteria - 4th Revised edition - 2003 - Ref. ST/SG/AC.10/11/Rev. 4

The results are detailed in Saft-Poitiers internal report P0152-03, dated 03/2003.

Concerned Part Numbers : 05140W, and all the part numbers relative to single LSH 14 "Light" cells, whatever their finish mode (with and without end-tabs or wiring and connector assemblies, etc.).

Product Description

Primary (non-rechargeable), Lithium-Thionyl Chloride (Li-SOCl₂) C-sized spiral cell, with a 5A protection fuse.

Nominal Voltage	3.6 Volts
Nominal Capacity	3.6 Ah
Lithium metal content	0.99 grams
Nominal energy	13 Wh
Maximum recommended continuous discharge current	1.3 A

Product Classification

Worldwide, besides the United States of America

Since it passes the UN-defined transport tests, and thanks to its lithium content below the 1 gram limit, the LSH14 "Light" cell in all its finish versions, according to the current UN Recommendations on the transport of dangerous goods - Model Regulations, is declared **non-restricted to transport / non-assigned to Class 9**. For transportation, the cells must be packed in accordance with Clause 188 of the above mentioned UN Model Regulations.

Within the United States of America

The U.S. DOT CFR 49 Regulations, Parts 171, 172, 173 and 175, are governing the transportation of lithium cells and batteries. Special Provision 188 (in Part 172.102) defines the LSH14 "Light" cell and its finishing versions as belonging to the "small lithium cells and batteries" category, and details the requirements to be met for the different transportation conditions. (Note: Primary lithium batteries are forbidden for transport aboard passenger aircraft within the USA).

Signed on Behalf of Saft, Specialty Battery Group

Pascal Hans SBG Quality Manager

dated 18/08/09

Nicolas Paquin SBG Lithium Product Manager

dated 18/08/09


PO: Y. Chartier


TRANSPORTATION CERTIFICATE

This is to certify that Sonardyne battery types 7978-031, 8000-006, 8000-402, 8057-002 and 8057-009 have been subjected to and have met the requirements of:

UN recommendations on the transport of dangerous goods, Manual of Tests and Criteria 4th Revision edition – 2003 – Ref ST/SG/AC 10/11 Rev 4

As detailed in external test house reports 100592 and 100593 dated 31/10/2005, 100726 dated 10/07/2006 and 100748 dated 27/07/2006 for tests T3 Vibration and T4 Shock together with 100643 dated 03/03/2006 covering tests T1 to T5 inclusive.

Product Description

Primary (non rechargeable) Lithium-Thionyl Chloride (Li-SOCl₂) D-sized cells type LSH20 with 5 A protection fuse arranged in series/parallel arrangement with additional diode and polyswitch protection.

Sonardyne Type Number	Pack	7978-031	8000-006	8000-402	8057-002	8057-009
Sonardyne reference number	CPN	641-2236	641-2801	641-2922	641-3270	641-3343
Nominal Voltage	Volts	25.2	14.5	14.5	14.5	14.5
Nominal Capacity	Ah	13	130	39	156	312
Equivalent Lithium Metal Content	Grams	28	160	48	192	384
Nominal Energy	Wh	327	1872	561.6	2246	4452
Maximum Recommended	A	1.8	3	3	3	3
Continuous Discharge Current						

Product Classification

Since the packs pass the UN-defined transport tests and because their lithium content is above the 2 gram limit, these are declared non-exempt from the Dangerous Goods Regulations. They are restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT etc) in charge of regulating the transportation of dangerous goods.

Signed on Behalf of Sonardyne International Limited

Peter Williams: Director



dated 28th September 2006

Chris Martin: Quality Coordinator



dated 28th September 2006

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TRANSPORTATION CERTIFICATE

This is to certify that Sonardyne battery type 8136-003 has been subjected to and has met the requirements of:

UN recommendations on the transport of dangerous goods, Manual of Tests and Criteria 4th Revision edition – 2003 – Ref ST/SG/AC 10/11 Rev 4

As detailed in external test house report 100917 dated 3 September 2007 covering tests T1 to T5 inclusive.

Product Description

Primary (non rechargeable) Lithium-Thionyl Chloride (Li-SOCl₂) D-sized cells type LSH20 with 5 A protection fuse arranged in series/parallel arrangement with additional diode and polyswitch protection.

Sonardyne Type Number	Pack	8136-003
Sonardyne reference number	CPN	620-7201
Nominal Voltage	Volts	14.5
Nominal Capacity	Ah	65
Equivalent Lithium Metal Content	Grams	80
Nominal Energy	Wh	936
Maximum Recommended	A	3.0
Continuous Discharge Current		

Product Classification

Since the packs pass the UN-defined transport tests and because their lithium content is above the 2 gram limit, these are declared non-exempt from the Dangerous Goods Regulations. They are restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT etc) in charge of regulating the transportation of dangerous goods.

Signed on Behalf of Sonardyne International Limited

Peter Williams: Director



dated 13th November 2007

Chris Martin: Quality Coordinator



dated 13th November 2007

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TRANSPORTATION CERTIFICATE

This is to certify that Sonardyne battery types 8300-006 and 8300-004 are manufactured with only minor changes from battery types 8000-006 and 8000-402 respectively which have been previously subjected to and have met the requirements of:

UN Recommendations on the Transport of Dangerous Goods, Manual of tests and criteria, Fourth Revision, 2003, Ref. ST/SG/AC.10/11 Rev. 4

The changes for the new versions do not affect the number or type of cells or any other change which might affect the results of the tests.

Test Results are as detailed in external test house reports 100643 dated 3/Mar/2006 and 100954 dated 12/Dec/2007 covering tests T1 to T5 inclusive.

Product description

Primary (non-rechargeable) Lithium Thionyl Chloride (Li-SOCl₂) D-size cells type LSH20 with a 5A protection fuse arranged in a series/parallel arrangement with additional diode and polyswitch protection.

Sonardyne Type Number	Pack	8300-006	8300-004
Sonardyne Reference Number	CPN	641-0127	641-0162
Nominal Voltage	Volts	14.5	14.5
Nominal Capacity	Ah	130	39
Equivalent Lithium Metal content	grams	160	48
Nominal Energy	Wh	1872	561.6
Maximum Recommended Continuous Discharge Current	A	3	3

Product Classification

Since the packs pass the UN-defined transport tests and because their Lithium content is above the 2 gram limit, these are declared non-exempt from the Dangerous Goods Regulations. They are restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT etc.) in charge of regulating the transportation of dangerous goods.

Signed on behalf of Sonardyne International Ltd

David Lawes: Director



dated 22nd June 2010

Chris Martin: Quality Coordinator



dated 22nd June 2010

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TRANSPORTATION CERTIFICATE

This is to certify that Sonardyne battery types 7978-031, 8000-006 and 8000-402 have been subjected to and have met the requirements of:

UN recommendations on the transport of dangerous goods, Manual of Tests and Criteria 4th Revision edition – 2003 – Ref ST/SG/AC 10/11 Rev 4

As detailed in external test house reports 100643 dated 03/Mar/2006, 100954 dated 12/Dec/2007 and 100955 dated 12/Dec/2007, covering tests T1 to T5 inclusive.

Product Description

Primary (non rechargeable) Lithium-Thionyl Chloride (Li-SOCl₂) D-sized cells type LSH20 with 5 A protection fuse arranged in series/parallel arrangement with additional diode and polyswitch protection.

Sonardyne Type Number	Pack	7978-031	8000-006	8000-402
Sonardyne reference number	CPN	641-2236	641-2801	641-2922
Nominal Voltage	Volts	25.2	14.5	14.5
Nominal Capacity	Ah	13	130	39
Equivalent Lithium Metal Content	Grams	28	160	48
Nominal Energy	Wh	327	1872	561.6
Maximum Recommended	A	1.8	3	3
Continuous Discharge Current				
External Test House report number		100955	100643	100954

Product Classification

Since the packs pass the UN-defined transport tests and because their lithium content is above the 2 gram limit, these are declared non-exempt from the Dangerous Goods Regulations. They are restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT etc) in charge of regulating the transportation of dangerous goods.

Signed on Behalf of Sonardyne International Limited

David Lawes:

Director



dated 25th June 2010

Chris Martin:

Quality Coordinator



dated 25th June 2010

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TRANSPORTATION CERTIFICATE

This is to certify that Sonardyne battery types 8306-007 have been subjected to and have met the requirements of:

UN recommendations on the transport of dangerous goods, Manual of Tests and Criteria 4th Revision edition – 2003 – Ref ST/SG/AC 10/11 Rev 4

Test results are detailed in external test house reports 101495 dated 27/Aug/2010, covering tests T1 to T5 inclusive.

Product Description

Primary (non rechargeable) Lithium-Thionyl Chloride (Li-SOCl₂) D-sized cells type LSH20 with 5 A protection fuse arranged in series/parallel arrangement with additional diode and polyswitch protection.

Sonardyne Type Number	Pack	8306-007
Sonardyne reference number	CPN	641-3585
Nominal Voltage	Volts	14.5
Nominal Capacity	Ah	13
Equivalent Lithium Metal Content	Grams	45.6
Nominal Energy	Wh	188
Maximum Recommended	A	5.4
Continuous Discharge Current		
External Test House report number		101495

Product Classification

Since the packs pass the UN-defined transport tests and because their lithium content is above the 2 gram limit, these are declared non-exempt from the Dangerous Goods Regulations. They are restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT etc) in charge of regulating the transportation of dangerous goods.

The packs can be shipped inside other equipment provided that the rules of the various bodies for transport "inside equipment" are adhered to. In particular the pack(s) should not be connected to equipment which could result in "accidental actuation" unless a Safety Case has been written to ensure the packs cannot overheat in a fault condition.

Signed on Behalf of Sonardyne International Limited

David Lawes: Director



dated 2nd September 2010

Chris Martin: Quality Coordinator



dated 2nd September 2010

F092-A-QLD.doc

Sonardyne International Limited
Blackbushe Business Park
Yateley, Hampshire
GU46 6GD United Kingdom

T. +44 (0) 1252 872288
F. +44 (0) 1252 876100
www.sonardyne.com

Registered in England
Number 01299452
VAT Registration Number
GB 591 691 6950 04



TRANSPORTATION CERTIFICATE

This is to certify that Sonardyne battery type 8156-070-01 has been subjected to and has met the requirements of:

UN recommendations on the transport of dangerous goods, Manual of Tests and Criteria 4th Revision edition – 2003 – Ref ST/SG/AC 10/11 Rev 4

As detailed in external test house report 101619 dated 06/Apr/2011, covering tests T1 to T5 inclusive.

Product Description

Primary (non rechargeable) Lithium-Thionyl Chloride (Li-SOCl₂) D-sized cells type LSH20 with 5 A protection fuse arranged in series/parallel arrangement with additional diode and polyswitch protection.

Sonardyne Type Number		8156-070-01
Sonardyne Stock Code	CPN	641-3491
Nominal Voltage	Volts	14
Nominal Capacity	Ah	156
Equivalent Lithium Metal content	grams	182.4
Nominal Energy	Wh	2184
Maximum recommended continuous discharge current	A	21.6
External Test House report number		101619

Product Classification

Since the packs pass the UN-defined transport tests and because their lithium content is above the 2 gram limit, these are declared non-exempt from the Dangerous Goods Regulations. They are restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT etc) in charge of regulating the transportation of dangerous goods.

Signed on Behalf of Sonardyne International Limited

David Lawes: Director



dated 6th April 2011

Chris Martin: Quality Coordinator



dated 6th April 2011

F095-A-QLD.doc

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TRANSPORTATION CERTIFICATE

Ref. TC-LSH 20 01/2009- 10

This is to certify that the Saft cell type, **LSH 20**, has been subjected and has met the requirements of the UN Recommendations on the Transport of Dangerous Goods, Part III, sub-section 38.3, Manual of Tests and Criteria - 4th Revised edition - 2003 - Ref. ST/SG/AC.10/11/Rev. 4

The results are detailed in Saft-Poitiers internal report P0468-06, dated 08/2006.

Concerned Part Numbers : 03577R, and all the part numbers relative to single LSH 20 cells, whatever their finish mode (with and without end-tabs or wiring and connector assemblies, etc.).

Product Description

Primary (non-rechargeable), Lithium-Thionyl Chloride (Li-SOCl₂) D-sized spiral cell, with a 5A protection fuse.

Nominal Voltage	3.6 Volts
Nominal Capacity	13.0 Ah
Lithium metal content	3.78 grams
Nominal energy	46.8 Wh
Maximum recommended continuous discharge current	1.8 A

Product Classification

Worldwide, besides the United States of America

Since it passes the UN-defined transport tests, but has a lithium metal content above the 1 gram limit, **the LSH 20 single cell with a 5A protection fuse, in all of its finished versions, according to the current UN Recommendations on the Transport of Dangerous Goods - Model regulations, is declared non-exempt from the Dangerous Goods Regulations. It is restricted to transport / assigned to Class 9** and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT, etc.) that are in charge of regulating the transportation of dangerous goods.

Within the United States of America

The U.S. DOT CFR 49 Regulations, Parts 171, 172, 173 and 175, are governing the transportation of lithium cells and batteries. Special Provision 188 (in Part 172.102) **defines the LSH 20 single lithium metal cell, in all of its finished versions, as belonging to the "medium primary lithium cell" category**, and details the requirements to be met for the different transportation conditions.

Signed on Behalf of Saft, Specialty Battery Group

Pascal Hans SBG Quality Manager

dated 23/01/2009

Nicolas Paquin SBG Lithium Product Manager

dated 23/01/2009

TRANSPORTATION CERTIFICATE

This is to certify that Sonardyne battery types 7885-176 and 8005-020 have been subjected to and have met the requirements of:

UN recommendations on the transport of dangerous goods, Manual of Tests and Criteria 4th Revision edition – 2003 – Ref ST/SG/AC 10/11 Rev 4

As detailed in external test house reports 100838 and 100839 dated 23rd January 2007 for tests T1 to T5 inclusive.

Product Description

Primary (non rechargeable) Lithium-Thionyl Chloride (Li-SOCl₂) cells arranged in series.

Sonardyne Type Number	Pack	7885-176	8005-020
Sonardyne reference number	CPN	641-1984	641-1873
Nominal Voltage	Volts	14.4	14.4
Nominal Capacity	Ah	7.7	19
Equivalent Lithium Metal Content	Grams	8	20
Nominal Energy	Wh	110	274
Maximum Recommended	A	0.15	0.20
Continuous Discharge Current			

Product Classification

Since the packs pass the UN-defined transport tests and because their lithium content is above the 2 gram limit, these are declared non-exempt from the Dangerous Goods Regulations. They are restricted to transport / assigned to Class 9 and must be packed in accordance with the Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT etc) in charge of regulating the transportation of dangerous goods.

Signed on Behalf of Sonardyne International Limited

Peter Williams: Director



dated 21st February 2007

Chris Martin: Quality Coordinator



dated 21st February 2007

F080-A-QLD.doc

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Registered in England
Number 01299452
VAT Registration Number
GB 591 691 6950 04



APPENDIX D – LITHIUM ION PRODUCT DATASHEETS

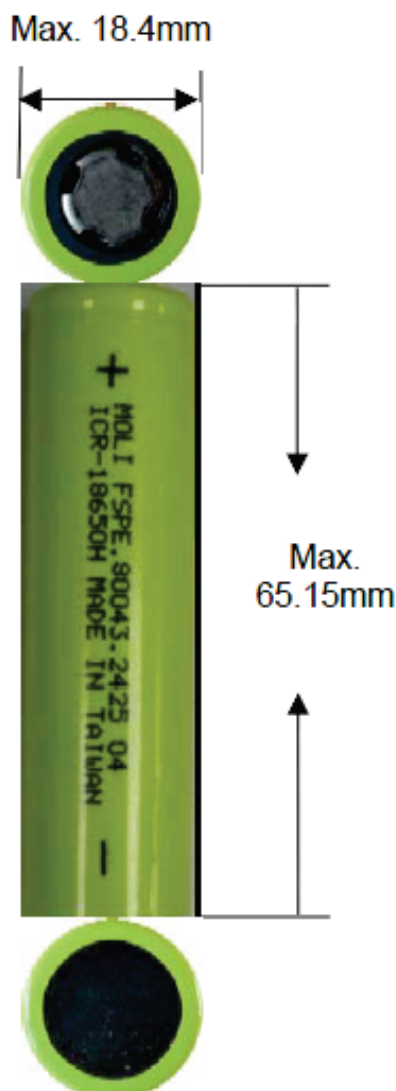
D LITHIUM ION BATTERIES

D.1 Model ICR18650H

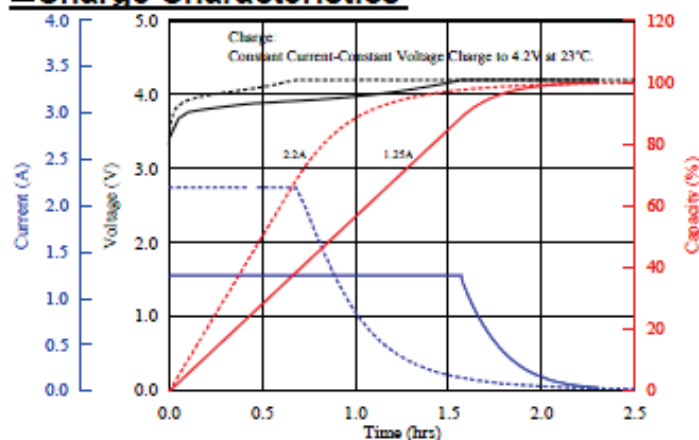
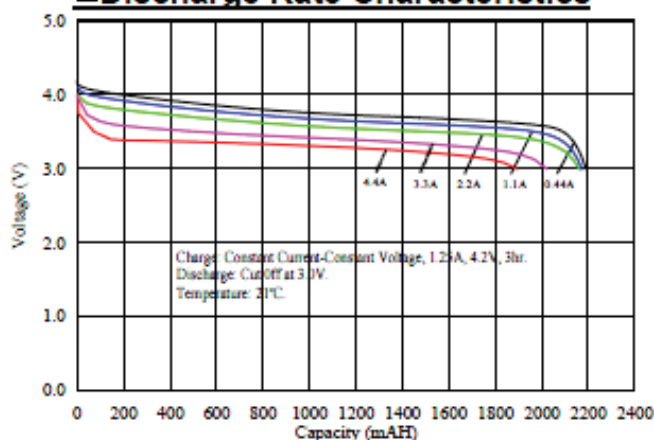
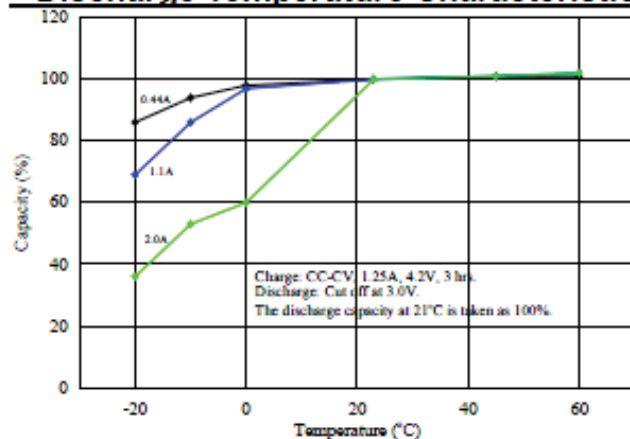
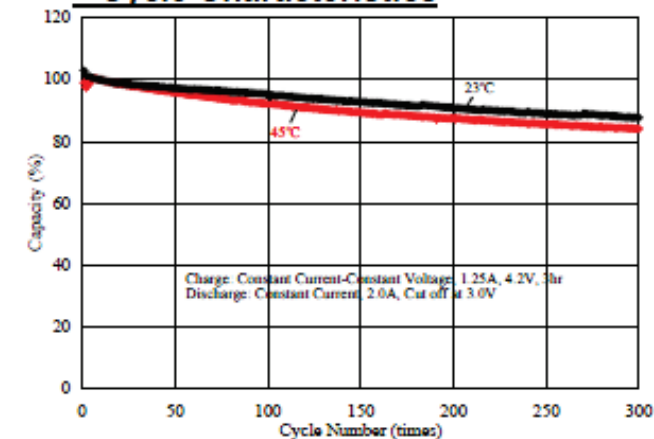
D.2 MP 144350

■ CELL SPECIFICATIONS

Shape / Can material		Cylindrical / Steel
Typical Capacity		2200mAh
Minimum Capacity		2100mAh
Nominal Voltage		3.7V
Charge Voltage		4.2V $\pm$ 0.05V
Charge Current		Less than 2.2A
Charge Time		3.0 hrs
Discharging current (Max.)		5.0 A ($\leq 45^{\circ}\text{C}$)
		4.0 A ($\leq 60^{\circ}\text{C}$)
Discharge Cutoff Voltage		3.0V
Temperature	Charge	0°C to 45°C
	Discharge	-20°C to 60°C
	Storage	-20°C to 60°C
Weight (Max.)		47.1g
Dimensions	Diameter (Max)	18.40mm
	Height (Max.)	65.15mm
Energy	Volumetric	496 Wh/l
Density	Gravimetric	182 Wh/kg



Note: The **ICR18650H** cylindrical cell consists of a lithium cobalt oxide positive electrode and a graphitic carbon negative electrode providing 3.7volts and 2200mAh. This cell design requires pack control circuitry. Various protection circuit modules are available for applications of multiple series and parallel configurations. In order to ensure safe use of cell, be sure to consult with **E-One Moli Energy** regarding charging and discharging specifications and contact E-One Moli Energy in advance when designing a device with this cell.

■ Charge Characteristics**■ Discharge Rate Characteristics****■ Discharge Temperature Characteristics****■ Cycle Characteristics****Molice ICR18650H Applications:**

- * Notebook
- * Portable VCD/DVD player
- * HID handy flash
- * Camcorder
- * Medical devices

E-ONE MOLI ENERGY CORP was established in 1998 by Koo's Group. Under the brand name Molice, E-One Moli Energy is well-recognized as a leading Li-ion battery manufacturer. To serve world-wide customers, production sites are located in Vancouver, Canada and Southern Taiwan Science Park, Tainan, Taiwan. Each site is equipped with local Research & Development and Application Service Groups. Safety and reliability are the main strengths of E-One Moli Energy products. We strive to provide superior energy solutions with high performance and quality products that serve our customers' needs.

■ Taiwan Plant
10 Dali 2nd Rd., Shan-Hwa,
Tainan County, Taiwan, R.O.C.
Tel: 886-6-505-0666
Fax: 886-6-505-0777
<http://www.e-one.com.tw>

■ Canada Plant
20,000 Stewart Crescent
Maple Ridge, B.C., Canada, V2X 9E7
Tel: 1-604-466-6654
Fax: 1-604-466-6600
<http://www.molienery.com>

■ Headquarter
10F, 113, Sec.2, Zhong Shan N Rd.,
Taippei, Taiwan, R.O.C.
Tel: 886-2-2567-3500
Fax: 886-2-2567-6500

□ Agency:

Rechargeable lithium-ion battery

MP 144350

High performance
Medium Prismatic cell



Benefits

- Extended autonomy and life for mobile systems
- Wide operating temperature range
- Recommended for ruggedized designs
- Easy integration into compact and light systems

Key features

- Very high energy density (344 Wh/l and 143 Wh/kg)
- Unrivalled low temperature performance
- Excellent charge recovery after long storage, even at high temperature
- Maintenance-free
- Long cycle life (over 80 % initial capacity after 500 cycles at 100 % DoD)
- Non-restricted for transport
- Underwriters Laboratories (UL) Component Recognition (File Number MH 12609)

Main applications

- Mobile asset tracking
- Small UPS
- Soldier of the future equipment
- Portable radios
- Professional portable lighting
- Bar code readers
- Portable payment terminal

Electrical characteristics

Nominal voltage (0.5 A rate at 20°C)	3.75 V
Typical capacity 20°C (at 0.5 A 20°C 2.5 V cut-off)	2.60 Ah (when charged up to 4.2 V) 2.35 Ah (when charged up to 4.1 V)

Mechanical characteristics (Unsleeved 100 % charged cell)

Thickness (max)	14.5 mm
Width (max)	43 mm
Height (max)	50 mm
Typical weight	68 g
Lithium equivalent content	0.8 g
Volume	28 cm ³
Nominal energy	10 Wh

Operating conditions

Charge method	Constant Current/Constant Voltage
Charge voltage	4.20 +/- 0.05 V
Maximum recommended charge current	2.6 A (C rate)
Charge temperature range*	-20°C to +60°C
Time at 20°C	To be set as a function of the charge current: C rate → 2 to 3 h C/2 rate → 3 to 4 h C/5 rate → 6 to 7 h

Maximum continuous discharge current*	5.0 A (~2C rate)
Pulse discharge current	up to 10 A (~4C rate)
Discharge cut-off voltage	2.5 V
Discharge temperature range	-50°C to +60°C

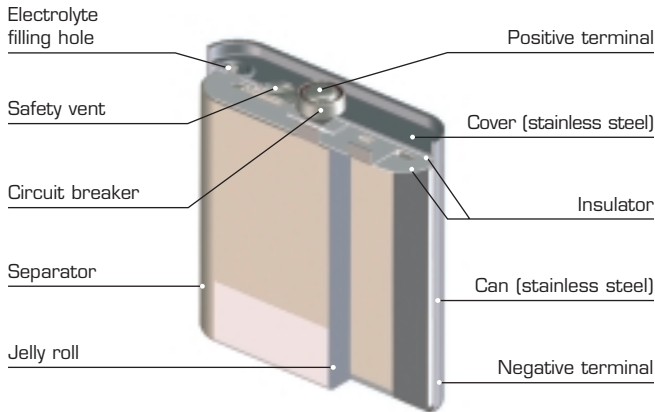
* Consult Saft for optimized charging below 0°C



MP 144350

Technology

- Graphite-based anode
- Lithium Cobalt oxide-based cathode
- Electrolyte: organic solvents
- Built-in redundant safety protections
- Batteries assembled from MP cells feature an electronic protection circuit



Built-in protection devices ensure safety in case of:

- Exposure to heat
- Exposure to direct sunlight for extended periods of time
- Short circuit
- Overcharge
- Overdischarge

When handling Saft MP batteries:

- Do not solder directly to cell terminal
- Do not disassemble
- Do not remove the protection circuit
- Do not incinerate

Transportation and storage:

- Store in a dry place at a temperature preferably not exceeding 30°C
- For long-term storage, keep the battery within a (30 ± 15) % state of charge

Saft

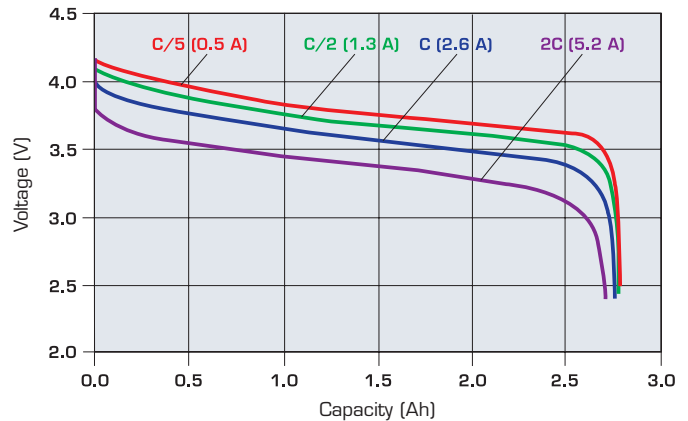
Specialty Battery Group

12, rue Sadi Carnot
93170 Bagnolet - France
Tel.: +33 (0)1 49 93 19 18
Fax: +33 (0)1 49 93 19 69

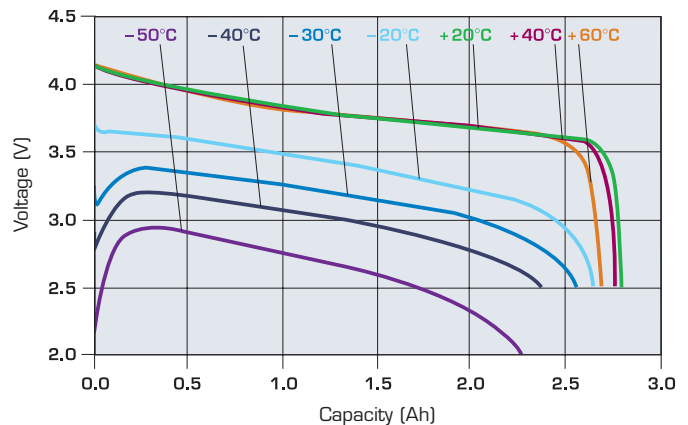
313, Crescent Street
Valdese, NC 28690 - USA
Tel.: +1 (828) 874 41 11
Fax: +1 (828) 879 39 81

www.saftbatteries.com

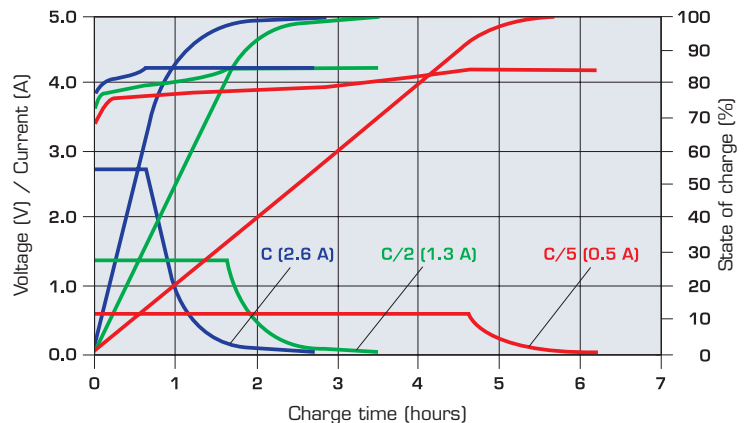
Capacity versus current at +20°C



Typical discharge profiles (0.5 A - C/5 rate)



Charge characteristics to 4.2 V at +20°C at C, C/2, and C/5 rates



Doc. N° 54044-2-1107

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

Published by the Communications Department.

Photo credit: Saft.

Société anonyme au capital de 31 944 000 €
RCS Bobigny B 383 703 873

Produced by Arthur Associates.

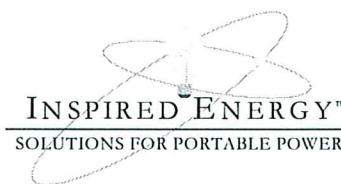


APPENDIX E – LITHIUM ION BATTERY SHIPPING GUIDELINES

E LITHIUM ION BATTERY GUIDELINES

E.1 Guidelines for Shipping, Handling, Storage & Disposal of Inspired Energy Lithium Ion Battery

Guidelines For Shipping, Handling, Storage & Disposal of Your Inspired Energy Lithium Ion Battery



Shipping

All Inspired Energy, Li Ion battery packs have been tested in accordance with the UN Manual of tests and Criteria part III subsection 38.3 (ST/SG/AC.10/11/Rev.3) - more commonly known as the UN T- tests; and have been found to comply with the stated criteria. As a result they can be shipped unrestricted internationally by any means. A copy of the compliance certificate may be downloaded from the product pages on our website.



Inspired Energy Lithium Ion batteries are packaged in accordance with the UN requirements for packaging Lithium-Ion batteries. When re-shipping the same guidelines must be followed.

If packed in boxes containing up to 12 battery packs, the box is required to have strong outer packaging with physical separation of the individual batteries to prevent short circuits.

If packed in boxes containing more than 12 battery packs, the packaging must additionally be capable of surviving a 1.2m drop without the contents shorting, and must weigh less than 10kg/22lb.

In addition the contents must be identified as being Lithium Ion batteries (Not Lithium) and the box

accompanied by a document identifying the contents as being Lithium Ion batteries (Usually the packing slip). An example of the label used by Inspired Energy is shown above.

We do not recommend that Li Ion batteries be installed into your device prior to shipping.

You may encounter misunderstanding amongst shipping companies who are not familiar with the differences between Lithium, Lithium-metal and Lithium-Ion batteries, & may need to assist them by explaining the difference.

“Small” Lithium-Ion batteries are not regulated (i.e. they have no transportation restrictions) as long as they meet these 3 criteria:

- 1) Each individual Li-ion battery pack contains less than 100Wh (Watt-hours) of energy.
- 2) The battery has been tested to the UN/DOT transportation tests (commonly known as the UN T-Tests).
- 3) They are packaged as detailed above

To find out how much energy is in your Inspired Energy battery, please refer to the appropriate product page at www.inspiredenergy.com - you'll find the watt-hour rating listed in the specification summary. In addition every Inspired Energy Lithium Ion battery has the watt hour rating embossed into the plastic case adjacent to the connector. This conforms to the requirements for marking the Wh rating on the battery pack.

To avoid confusion when reviewing IATA packaging instructions, we recommend that you also review the IATA Guidance Document on Transportation of Lithium Batteries as this is necessary to establish the hazardous goods shipping exemption for our <100Wh Lithium Ion batteries.

Inspired Energy 25440 NW 8th Place, Newberry, FL 32669
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www.inspiredenergy.com

Guidelines For Shipping, Handling, Storage & Disposal of Your Inspired Energy Lithium Ion Battery



Storage

Inspired Energy Lithium Ion battery packs can be stored from -20°C to +60°C at up to 80% relative humidity. However they are best stored below 21°C in a cool, dry, well-ventilated facility free from corrosive gas or vapor.

Storage at elevated temperatures (Above 45°C) may degrade battery performance and reduce battery life. Storage at low temperatures may affect initial battery performance.

Handling

- Avoid shorting the battery
- Avoid exposing the battery to excessive shock or vibration
- Do not use modified chargers
- Do not use any battery that has been damaged in any way
- Do not immerse the battery in water
- Do not expose to, or dispose of, the battery in fire
- Do not disassemble or deform the battery
- Keep the battery out of the reach of children
- Always charge in accordance with the manufacturer's instructions, using specified chargers only

Disposal

All Inspired Energy Lithium Ion batteries are classified by the US federal government as non-hazardous waste and are safe for disposal in the normal municipal waste stream.

These batteries, however, do contain recyclable materials and are accepted for recycling by a number of regional battery recycling programs. (Charges may apply for these services.)

In North America contact the Rechargeable Battery Recycling Corporation (RBRC) at www.rbrc.org

In Europe contact the European Portable Battery Association. (EPBA) www.epbaeurope.org

Transportation Regulations for Lithium Ion Batteries

The international regulations covering the transport of rechargeable lithium ion batteries are the:

- UN Recommendations on the Transport of Dangerous Goods Model Regulations
- UN Manual of Tests and Criteria 4th Revised Ed. (2003) (Often called the "UN T-Tests")
- IMDG (International Maritime Dangerous Goods) Code.
- ICAO (International Civil Aviation Organization) Technical Instructions
- IATA (International Air Transport Association) Dangerous Goods Regulations

The domestic US regulations covering transportation & packaging of lithium ion batteries are contained in Part 49 of the Code of Federal Regulations, (49 CFR Sections 100-185) of the U.S. Hazardous Materials Regulations (HMR). Sections 173.185, 172.101 & 172.102 issued by the Office of Hazardous Materials Safety

Although the domestic regulations are based on the international UN Recommendations there are differences.

These shipping regulations apply to everyone shipping a lithium ion battery: cell manufacturers, battery assemblers, distributors, OEMs, retail establishments & end users - no exceptions. Fines have been established for non-conformance.

Guidelines For Shipping, Handling, Storage & Disposal of Your Inspired Energy Lithium Ion Battery



All lithium ion batteries are classified for transportation domestically & internationally by the amount of "Equivalent Lithium" or the amount of energy that they contain.

The equivalent lithium content for lithium ion cells and batteries is calculated as follows:

$$0.3 \times \text{rated cell capacity (Ah)} \times \text{number of cells in the battery} = \text{"Equivalent Lithium" (g)}$$

The amount of energy in a battery is calculated as follows:

$$\text{Rated battery capacity (Ah)} \times \text{battery voltage (V)} = \text{Energy in Watt-hours (Wh)}$$

There is no provision made in any of the regulations covering rechargeable lithium ion batteries to adjust the shipping requirements based on the state of charge of the product being shipped. A fully discharged battery has exactly the same shipping requirements as a fully charged battery.

Domestic US Transportation Regulations for Lithium Ion Battery Packs		
Equivalent Lithium Content / Energy	Shipping Classification / Testing Requirements	Special Packaging / Markings
Small Lithium Ion Batteries: ≤8.0 grams or less than 100Wh	Batteries that pass UN Tests are classified as not regulated & can be shipped as regular non-hazardous cargo.	Packages containing more than 12 batteries must meet packaging, marking, and documentation requirements.
Medium Lithium Ion Batteries 8 - 25 grams	Batteries must pass UN T-Tests. From Oct 1, 2008 Batteries must be shipped as Class 9 hazardous materials unless transported by motor vehicle or rail car. <i>See note below</i>	Requires Class 9 markings, label, special packaging, and documentation unless transported by motor vehicle or rail car under Special Provision 189
Large Lithium Ion Batteries >25 grams	Batteries must pass UN T1-T8 Tests and be shipped as a Class 9 hazardous material.	Requires Class 9 markings, label, special packaging, and documentation

ICAO Technical Instructions for Commercial Airline Carry-on & Checked Baggage		
Equivalent Li Content	Carry-On	Checked Baggage
≤8.0 g or less than 100Wh	Batteries within a portable electronic device + spare batteries allowed (qty unspecified)	Batteries within a portable electronic device allowed. Spare batteries prohibited
8 - 25g	Batteries within a portable electronic device + up to 2 spare batteries allowed	prohibited
> 25g	prohibited	prohibited
<i>Note: spare batteries must be individually protected so as to prevent short circuits and placed in carry-on baggage only. It is recommended to carry-on & not to check portable electronic devices & batteries.</i>		

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www.inspiredenergy.com

Guidelines For Shipping, Handling, Storage & Disposal of Your Inspired Energy Lithium Ion Battery



U.S. Postal Service Regulations for Lithium Ion Battery Packs		
Equivalent Lithium Content	Shipping Classification / Testing Requirements	Special Packaging / Markings
≤ 8.0 grams	May be mailed by surface or air. / Batteries must pass UN T-Tests. Batteries.	- The package may not contain more than 3 batteries. - Batteries must be sealed, separated & cushioned to prevent short circuit. - Batteries properly installed in the device they operate must be protected from damage and short circuit, and the device must be protected against accidental activation. - Packages must have complete delivery & return addresses. The outside of the package must be marked on the address side "Package Contains Lithium-ion Batteries (no lithium metal)." - Damaged or Recalled batteries may not be mailed
> 8 grams	May not be Mailed	

International Transportation Regulations for Lithium Ion Battery Packs		
Energy	Shipping Classification / Testing Requirements	Special Packaging/Markings
$< 100\text{Wh}$	Cells and batteries must pass UN T-Tests to enable them to be shipped as non hazardous goods.	Packages containing more than 12 batteries must meet packaging, marking, and documentation requirements.
$> 100\text{Wh}$	Cells and batteries must pass UN T-Tests and be shipped as UN3480 hazardous materials	Requires UN3480 markings, label, special packaging, and documentation

The UN T-Tests:

The UN T1-T8 Tests are summarized at the end of this document. They must be performed once for each battery of a given design, and must be completed prior to shipment. Although the lithium ion CELL may have passed the UN T-tests this does not bestow certification for a battery pack which must be separately tested. A new battery must be re-tested if it differs from a previously tested type by:

- A change of more than 0.1 g or 20% by mass, whichever is greater, to the cathode, to the anode, or to the electrolyte; or
- A change that would materially affect the test results,

Batteries shipped to a testing facility may be shipped only by highway and must be shipped as UN 3480 hazardous materials.

T-Test Deadlines:

- The T-Test requirements are currently in effect for all international shipments.
- The U.S. DOT lithium battery final rule of August 9th 2007 extended the testing deadline: lithium ion batteries with no more than 8 grams of equivalent lithium content do not require testing until October 1st 2009. Note - this only applies to domestic shipping - international regulations do NOT allow this extended deadline.

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www.inspiredenergy.com

Guidelines For Shipping, Handling, Storage & Disposal of Your Inspired Energy Lithium Ion Battery



- In addition, the IMDG Code exempts batteries that were manufactured before January 1st 2003 from T-testing until December 31st 2013 only if they are shipped by sea under the IMDG Code.

Marking, Packing, and Shipping Requirements for Non-Hazardous Lithium ion Batteries

Packages containing more than lithium ion batteries must:

1. Be marked to indicate that they contain lithium ion batteries and that special procedures should be followed in the event that the package is damaged.
2. Be accompanied with a document indicating that packages contain lithium batteries and that special procedures should be followed in the event a package is damaged;
3. Be capable of withstanding a 1.2 meter (3.9 ft.) drop test in any orientation without damage to batteries contained in the package, without shifting of the contents that would allow short circuiting and without release of the contents
4. Not exceed 10 kg (22 lbs.)

Hazardous Goods Shipping

(Note: Inspired Energy does not manufacture any batteries which require hazardous goods shipping.)

- Any lithium ion batteries that do not qualify for an exemption under the definitions above must be shipped as hazardous goods under the hazardous goods code UN 3480.
- If the batteries must be shipped as hazardous materials, then any equipment containing them must also be shipped as hazardous materials.
- Anyone packing or shipping hazardous goods must complete a hazardous materials training course which must be renewed every three years in the U.S. and every two years under the international regulations.

Additional Resources:

<http://hazmat.dot.gov>
http://safetravel.dot.gov/whats_new_batteries.html
www.iata.org/whatwedo/cargo/dangerous_goods/index.htm
www.chemtrec.com
www.phmsa.dot.gov
www.fmcsa.dot.gov/safety-security/hazmat/complyhmregs.htm

This document pertains to rechargeable Lithium Ion Batteries ONLY. The requirements & regulations are different for rechargeable lithium ion cells, rechargeable lithium metal cells & batteries, & non-rechargeable lithium cells & batteries.

While every attempt is made to ensure accuracy and timeliness, the information provided herein is for guidance only. No representation, claim or guarantee is made by Inspired Energy for accuracy, completeness, applicability, currency or compliance to regulations which are subject to change. Inspired Energy shall not be liable for any inclusions, omissions, errors or outdated information. This document does not constitute, and should not be considered as legal advice. In all cases we recommend that you fully research the topic and seek appropriate advice from regulatory authorities to ensure your compliance with all applicable regulations.

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Guidelines For Shipping, Handling, Storage & Disposal of Your Inspired Energy Lithium Ion Battery

UN T-Tests			
Test Title	Procedure	Test Sample Size	Pass Requirement
T1: Altitude Simulation	Store @ $\leq 11.6\text{kPa}$ or less for $\geq 6\text{hrs}$ @ $20 \pm 5^\circ\text{C}$	4 batteries, cycle 1 fully charged 4 batteries, cycle 50 fully charged	No mass loss, leakage, venting, rupture, disassembly, or fire & OCV after test $\geq 90\%$ OCV before test
T2: Thermal Shock (follows test 1)	Store for $\geq 6\text{hrs}$ @ $75 \pm 2^\circ\text{C}$, Store for $\geq 6\text{hrs}$ @ $-40 \pm 2^\circ\text{C}$. Interval between extremes $\leq 30\text{mins}$. Repeat 10 times.	4 batteries, cycle 1 fully discharged 4 batteries, cycle 50 fully discharged Same 8 fully charged batteries Same 8 fully discharged batteries	No mass loss, leakage, venting, rupture, disassembly, or fire As above for fully charged batteries As above for fully discharged batteries
T3: Vibration (follows test 2)	Sinusoidal vibration, logarithmic sweep of 7Hz-200Hz-7Hz in 15minutes. Repeat 12 times in each of 3 perpendicular axes	Same 8 fully charged batteries Same 8 fully discharged batteries	As above for fully charged batteries As above for fully discharged batteries
T4: Shock (follows test 3)	Half Sine shock of peak acceleration of 150G duration 6ms. 3 shocks in positive direction & 3 shocks in negative direction in each of 3 perpendicular axes: A total of 18	Same 8 fully charged batteries Same 8 fully discharged batteries	As above for fully charged batteries As above for fully discharged batteries
T5: Short Circuit (follows test 4)	Stabilize the battery at $55 \pm 2^\circ\text{C}$. Short circuit the battery with $< 0.1\Omega$ for $\geq 1\text{hr}$ or until 1hr after the battery case has returned to $55 \pm 2^\circ\text{C}$. Observe for 6hrs.	Same 8 fully charged batteries Same 8 fully discharged batteries	external temp $\leq 170^\circ\text{C}$, no disassembly, no rupture, no fire within 6hrs of test.
T6: Impact Cell level test - done by Cell mfr. Not required if cell already has approval	15.8mm dia bar placed on the cell & 9.1kg mass dropped onto bar from a height of $61 \pm 2.5\text{cm}$ 15.8mm dia bar placed on the cell & 9.1kg mass dropped onto bar from a height of $61 \pm 2.5\text{cm}$. Test repeated on two axes	Cylindrical cells used in batteries: 5 cells, cycle 1, 50% charged plus 5 cells, cycle 50, fully discharged. Prismatic cells used in batteries: 10 cells, cycle 1, 50% charged plus 10 cells, cycle 50, fully discharged.	external temp $\leq 170^\circ\text{C}$, no disassembly, no rupture, no fire within 6hrs of test.
T7: Overcharge Can follow test 5 if undamaged	Charge @ $20^\circ\text{C} \pm 5^\circ\text{C}$ @ twice the manufacturers recommended charge current.	4 new or undamaged batteries from 1-5, cycle 1 fully charged 4 new or undamaged batteries from 1-5, cycle 50 fully charged	No Disassembly & No Fire within 7 days of the test
T8: Forced Discharge Cell level test - done by Cell mfr. Not required if cell already has approval	@ $20^\circ\text{C} \pm 5^\circ\text{C}$, connect each cell in series with a 12V DC power supply at an initial current equal to the manufacturers max rated discharge current for a time equal to the rated capacity divided by the initial test current.	Ten cells, Cycle 1, fully discharged Ten cells cycle 50 fully discharged	No Disassembly & No Fire within 7 days of the test

APPENDIX F – TRANSPORTATION CERTIFICATES

F LITHIUM ION BATTERY TRANSPORTATION CERTIFICATES

F.1 MP144350 Lithium Ion Transportation Certificate

F.2 292393 TDG Lithium Ion Transportation Certificate

F.3 292661 TDG Lithium Ion Transportation Certificate

F.4 700006 TDG Lithium Ion Transportation Certificate



TRANSPORTATION CERTIFICATE

Ref. TC - 4s1p MP 144350 01/2009-5

This is to certify that several Saft battery packs of the **4s1p MP 144350** type, assembled from four MP 144350 cells in series, share the same MP 144350 component cell, the same four cells in series assembly with electronic protection circuitry construction, than the already tested 4s1p MP 144350 battery pack P/N 06634R that has been subjected and has met the requirements of the UN Recommendations on the transport of dangerous goods, Part III, sub-section 38.3, "Manual of Tests and Criteria" - 4th Revised edition - 2003 - Ref: ST/SG/AC.10/11/Rev. 4.

The results obtained for the 4s1p MP 144350 battery pack P/N 06634R are detailed in the Saft-Poitiers internal report R0073-04, dated 02/2004.

It follows that these results are also applicable, without any additional testing, to the 4s1p MP 144350 similar battery packs whose Part Numbers are given here under.

Concerned Part Numbers 06576F, 06634R, 06731S, 06776P, 06779S, 06806V, 06929U, 06854V, 07006D, 07049Y, 07058H, 07110M, 07155J, 07164T, 07238V, 07418H, 07432X, 08031H, 08068Q, 08087R, 08111R, 08123D, 08151H, 08158Q, 08221F, 08247H, 08287Z

Product Description

Rechargeable lithium-ion battery packs assembled from four MP 144350 cells in series.

Nominal Voltage	15 Volts
Nominal Capacity	2.6 Ah
Nominal energy	39 Wh
Maximum recommended continuous discharge current	5 A

Product Classification

By similarity with the already tested 4s1p MP 144350 battery pack P/N 06634R that passes the above-mentioned UN transport tests, and since their nominal energy is below the 100Wh limit, all the **4s1p MP 144350** battery packs whose P/N are given above, are declared exempt from the Dangerous Goods Regulations. They are **non-restricted to transport / non-assigned to Class 9**.

They must be packed in accordance to the clauses of the UN Recommendations on the Transport of Dangerous Goods, Model Regulations 15th Revised edition - 2007 - Ref. ST/SG/AC.10/1/Rev.15., and with the relevant Packing Instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT, ect ...) in charge of regulating the transportation of dangerous goods.

Signed on Behalf of Saft, Specialty Battery Group

Pascal Hans SBG Quality Manager

dated 30/01/2009

Nicolas Paquin SBG Lithium Product Manager

dated 05/02/2009

Specialty Battery Group – Rue Georges Leclanché BP 1039 – 86060 Poitiers Cedex 09 – France

Transportation Certificate **Ref. 292393 - TDG**

This is to certify that the Allbatteries/Enix Energies battery pack detailed below, has been subjected to and has met the requirements of the UN Recommendations on the transport of dangerous goods, Part III, sub-section 38.3, "Manual of Tests and Criteria" - 5th Revised edition 2009 (ST/SG/AC.10/11/Rev.5)

Part Number: 292393

Product Description:

Lithium ion battery	
Nominal Voltage:	15.0 V
Nominal Capacity:	2.2 Ah
Nominal Energy:	33.0 Wh

Product Classification

Since the above battery pack passes the above mentioned UN transport tests and since its nominal energy is below the 100 Wh limit, P/N 292393, is declared exempt from the Dangerous Goods Regulations. **It is non-restricted to transport/not assigned to Class 9.**

It must be packed in accordance to the clauses of the current applicable UN Recommendations on the transport of Dangerous Goods. Model Regulations and Packing Instructions issued by the bodies in charge of regulating the transportation of dangerous goods (IATA-ICAO, IMO, ADR, US-DOT, etc.) and with the relevant requirements of national Dangerous Goods Regulations.

Signed on Behalf of Allbatteries UK Ltd/Enix Energies



Neil Scholey
Technical Manager

Date: 10th January 2011

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All business is conducted to our terms and conditions.

Transportation Certificate Ref. 292661 - TDG

This is to certify that the Allbatteries/Enix Energies battery pack detailed below, has been subjected to and has met the requirements of the UN Recommendations on the transport of dangerous goods, Part III, sub-section 38.3, "Manual of Tests and Criteria" - 4th Revised edition – 2003 (ST/SG/AC.10/11/Rev.4)

Part Number: 292661

Product Description:

Lithium ion battery
Nominal Voltage: 15.0 V
Nominal Capacity: 2.2 Ah
Nominal Energy: 33.0 Wh

Product Classification

Since the above battery pack passes the above mentioned UN transport tests and since its nominal energy is below the 100 Wh limit, P/N 292661, is declared exempt from the Dangerous Goods Regulations. **It is non-restricted to transport/not assigned to Class 9.**

It must be packed in accordance to the clauses of the current applicable UN Recommendations on the transport of Dangerous Goods. Model Regulations and Packing Instructions issued by the bodies in charge of regulating the transportation of dangerous goods (IATA-ICAO, IMO, ADR, US-DOT, etc.) and with the relevant requirements of national Dangerous Goods Regulations.

Signed on Behalf of Allbatteries UK Ltd/Enix Energies



Neil Scholey
Technical Manager

Date: 24th June 2009

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Transportation Certificate Ref. 700006 - TDG

This is to certify that the Allbatteries/Enix Energies battery pack detailed below, has been subjected to and has met the requirements of the UN Recommendations on the transport of dangerous goods, Part III, sub-section 38.3, "Manual of Tests and Criteria" - 4th Revised edition – 2003 (ST/SG/AC.10/11/Rev.4)

Part Number: 700006

Product Description:

Lithium ion battery
Nominal Voltage: 15.0 V
Nominal Capacity: 2.2 Ah
Nominal Energy: 33.0 Wh

Product Classification

Since the above battery pack passes the above mentioned UN transport tests and since its nominal energy is below the 100 Wh limit, P/N 700006, is declared exempt from the Dangerous Goods Regulations. **It is non-restricted to transport/not assigned to Class 9.**

It must be packed in accordance to the clauses of the current applicable UN Recommendations on the transport of Dangerous Goods. Model Regulations and Packing Instructions issued by the bodies in charge of regulating the transportation of dangerous goods (IATA-ICAO, IMO, ADR, US-DOT, etc.) and with the relevant requirements of national Dangerous Goods Regulations.

Signed on Behalf of Allbatteries UK Ltd/Enix Energies



Neil Scholey
Technical Manager

Date: 19th June 2009

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All business is conducted to our terms and conditions.

GLOSSARY OF TERMS

Definitions of Loads, Loading and General Terms

Term	Definition
Battery	A battery is considered one or more cells which are electrically connected together by permanent means, including case, terminals and marking.
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.
Cell	A cell means a single encased electrochemical unit (one positive and one negative electrode) which exhibits a voltage differential across its two terminals.
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.

Term	Definition
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
AC/DC	Alternating Current / Direct Current
Ah	Amperes per hour
A/R	As Required
Assy	Assembly
Aux	Auxiliary
Bd	Baud
BOP	Blow Out Preventer
bps	bits per second
BS	British Standard
Cg/COG	Centre of Gravity
cm	centimetre
COR	Centre of Rotation
COSHH	Control of Substances Hazardous to Health
dB	Decibel
°C	Degree Centigrade / Celsius
°F	Degree Fahrenheit
DWG	Drawing
f	frequency
Fig.	Figure
g	gram
GA	General Arrangement
HDR	High Data Rate
Hz	Hertz
in.	inch
kg	kilogram
kHz	kilo Hertz
kN	kilo Newton
lb	pound
lbf in.	pounds force inch
lbf/in ²	pounds force / square inch
m	metre
m/s	metres per second

Abbreviation	Definition
Max.	Maximum
µs	Microsecond
mg	milligram
Min.	Minimum
mm	millimetre
ms	millisecond
mW	milliwatt
Nm	Newton metre
No.	Number
OEM	Original Equipment Manufacture
OIM	Offshore Installation Manager
UM	User Manual
PM	Phase Modulation
PPE	Personal Protective Equipment
ppm	parts per million
psi	pounds per square inch
s	second
STBD	Starboard
SV	Sound Velocity
SWL	Safe Working Load
T	Tonne
V	Volt
Wh	Watt hour

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