







IECEX TEST REPORT COVER




ExTR Reference Number.....:	GB/EXV/ExTR18.0010/00	
ExTR Free Reference Number	R1477/A/1	
Compiled by + signature (ExTL)	Jamie Bunnell	
Reviewed by + signature (ExTL).....:	Diego H de Oliveira	
Approved by + signature (ExCB) ...:	S L Clarke CEng MSc	
Date of issue	24/04/2018	
Ex Testing Laboratory (ExTL)	ExVeritas Limited	
Address	Unit 18, Abenbury Way, Wrexham Industrial Estate, Wrexham LI13 9UZ, United Kingdom	
Ex Certification Body (ExCB)	ExVeritas Limited	
Address	Unit 18, Abenbury Way, Wrexham Industrial Estate, Wrexham LI13 9UZ, United Kingdom	
Applicant's name.....:	SAFT Limited	
Address	River Drive, South Shields, Tyne & Wear NE33 2TR, United Kingdom	
Standards associated with this ExTR package	IEC 60079-0:2011, IEC 6007911:2011 EN 60079-0:2012, EN 60079-11:2012	
Clauses considered	EN/IEC 60079-0 Clauses 23, 24, 26 EN/IEC 60079-11 Clauses 7.4, 10.5.1, 10.5.2, 10.5.3 b)	
Test Report Form Number	ExTR Cover_7 (released 2018-02)	
Related Amendments, Corrigenda or ISHs	IEC 60079-0:2011/COR1:2012, IEC 60079-0:2011/ISH1:2013, IEC 60079-0:2011/COR2:2013, IEC 60079-0:2011/ISH2:2014	
Test item description.....:	LiSOCl ₂ Primary cells	
Model/type reference	LS 14500	
Code (e.g. Ex __ II__ T__).....:	Ex ia I/IIC/IIIC Ta = -20°C to +60°C	
Rating.....:	Nominal voltage: 3.6 V Peak open-circuit voltage: 3.9 V	

ExTR Package Contents	
Assembled ExTR documents and Additional reference material:	
IECEX Test Report Cover	
IECEX Test Report of Partial Testing: IEC 60079-11:2011	
ATTACHMENT A – PHOTOGRAPHS	
ATTACHMENT B – DECISION SHEETS AND INTERPRETATIONS APPLIED	

Manufacturer's name	SAFT Limited
Address	River Drive, South Shields, Tyne & Wear NE33 2TR, United Kingdom
Trademark	
Certificate No. (optional)	N/A - IECEX TEST REPORT of PARTIAL TESTING
QAR Reference No. (optional)	N/A - IECEX TEST REPORT of PARTIAL TESTING
Particulars: Test item vs. Test requirements	
Classification of installation and use	N/A - PARTIAL TESTING
Ingress protection	N/A - PARTIAL TESTING
Rated ambient temperature range (°C).....	+20°C to +60°C
Rated service temperature range (°C) for Ex Components	+20°C to +60°C
General remarks:	
The test results presented in this ExTR package relate only to the item or product tested.	
<ul style="list-style-type: none"> ▪ "(See Attachment #)" refers to additional information appended to the ExTR package. ▪ "(See appended table)" refers to a table appended to the ExTR package. ▪ Throughout this ExTR package, a point is used as the decimal separator. ▪ <i>Where the term "N/A" appears in any part of an ExTR package, it indicates that the associated issue was considered "Not applicable" to the involved evaluation.</i> ▪ <i>In accordance with IECEX 02, a Receiving ExCB may request a sample of the Ex equipment and copies of the documentation referred to in an ExTR Cover.</i> 	
The technical content of this ExTR package shall not be reproduced except in full without the written approval of the Issuing ExCB and ExTL.	
General product information:	
3.6 V Primary lithium-thionyl chloride (Li-SOCI ₂), High energy density, R6 – AA size bobbin cell not fitted with internal limiting device.	
Copy of Marking Plate:	
N/A - PARTIAL TESTING.	
Details regarding 'trade agent' / 'local assembler' application in accordance with OD 203:	
N/A	
Testing not fully performed by ExTL staff at the above ExTL address:	
N/A	

<p>National differences considered as part of this evaluation:</p> <p>N/A</p>
<p>“Specific Conditions of Use” / “Schedule of Limitations”:</p> <ul style="list-style-type: none"> When the cells are designed to be used with products for explosive atmospheres, the product design in combination with these cells shall be evaluated according to the applicable standards considered for the product from the series IEC 60079. This report provides the results of the applicable tests and assessments according to the requirements from IEC 60079-0:2011 and IEC 60079-11:2011.
<p>Routine tests:</p> <p>N/A</p>
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Technical Documents			
Title:	Drawing No.:	Rev. Level:	Date:
Primary lithium battery LS 14500 datasheet	31064-2-0909	-	September 2009

		IECEX TEST REPORT of PARTIAL TESTING
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Applicant's name.....:	SAFT Limited	
Address	River Drive, South Shields, Tyne & Wear NE33 2TR, United Kingdom	
Standards.....:	IEC 60079-0:2011, IEC 6007911:2011 EN 60079-0:2012, EN 60079-11:2012	
Test Report Form Number.....:	ExTR Partial Testing_2 (released 2018-02)	
Related Amendments, Corrigenda or ISHs	N/A	
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<p>Possible test case verdicts:</p> <p>- test case does not apply to the test item:N / A</p> <p>- test item does meet the requirement:Pass</p> <p>General remarks:</p> <p>The test results presented in this ExTR of Partial Testing relate only to the item or product tested, and do not represent a complete evaluation and testing of the item or product.</p> <ul style="list-style-type: none"> ▪ "(see Attachment #)" refers to additional information appended to this document. ▪ "(see appended table)" refers to a table appended to this document. ▪ Throughout this document, a point is used as the decimal separator. <p>The technical content of this ExTR of Partial Testing shall not be reproduced except in full without the written approval of the Issuing ExCB and ExTL.</p>
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IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
23	APPARATUS INCORPORATING CELLS AND BATTERIES		
23.1	General	Requirements from 23.2 to 23.3 considered on this evaluation, as applicable.	PASS
23.3	Cell types	Model LS 14500 manufactured by SAFT Limited. Type: Lithium Thionyl Chloride (LiSOCl ₂) primary cells IEC 60086-4. Nominal voltage: 3.6 V (Defined for temperatures assessment). Peak open-circuit voltage: 3.9 V (Defined for spark hazards assessment).	PASS
23.8	Leakage	Refer to the clause 10.5.3 of IEC 60079-11. No leakage observed in the short-circuit test.	PASS
24	DOCUMENTATION	The documents provided cover the relevant aspects considered for this evaluation.	PASS
25	COMPLIANCE OF PROTOTYPE OR SAMPLE WITH DOCUMENTS		PASS
26	TYPE TESTS		
26.1	General	The applicable mandatory tests according to the standards IEC 60079-0 and IEC 60079-11 have been applied.	PASS
26.2	Test configuration	The tests have been performed in the most unfavourable configuration.	PASS

Measurement Section, including Additional Narrative Remarks (as deemed applicable)

No additional remarks. The details about the tests carried out according to this standard are in the next pages.

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
7.4	Primary and secondary cells and batteries	See below sub-clauses	PASS
7.4.1	General	Lithium Thionyl Chloride (LiSOCl ₂) primary cells IEC 60086-1 Type E (3.6V to 3.9V).	PASS
7.4.2	Battery construction	The cells have been examined and they were considered as according to this clause.	PASS
7.4.3	Electrolyte leakage and ventilation	The cells have been submitted to the leakage test from clause 10.5.2 and no leakage has been noticed. The requirements for ventilation are not applicable for this individual cell.	PASS
7.4.4	Cell voltages	The open circuit voltage of the cells are confirmed as matching the cell voltage indicated in Table 11 of IEC 60079-0.	PASS
7.4.5	Internal resistance of cell or battery	Internal resistance determined according to this clause and 10.5. The minimum resistance determined from the test results is 0.7658 Ω.	PASS
10.5	Tests for cells and batteries	See below sub-clauses.	PASS
10.5.1	General	Refer to Appendix A.	PASS
10.5.2	Electrolyte leakage test for cells and batteries	Refer to Appendix A.	PASS
10.5.3 b)	Spark ignition and surface temperature of cells and batteries	Refer to Appendix A.	PASS

Measurement Section, including Additional Narrative Remarks (as deemed applicable)**APPENDIX A: Description of product****A.1 General overview**

The Model LS 14500 manufactured by SAFT Limited is according to the Table 11 of the IEC 60079-0 and provide the following parameters:

- Nominal voltage: 3.6 V
- Peak open-circuit voltage: 3.9 V

A.2 Spark ignition considerations

According to the clause 10.5.3 of IEC 60079-11, cells that shall not be changed in the explosive atmosphere, the spark ignition discharge at the terminals of a single cell does not required to be tested, if the peak open-circuit voltage of the cell is no greater than 4.5 V. According to the Table 11 of IEC 60079-0 this cell type cannot provide more than 3.9 V and the conformance with this specification was confirmed in the measurements during the test from clause 10.5 of IEC 60079-11 (refer to the Appendix B.1), so the spark test was not required for the individual cell evaluation.

A.3 Thermal ignition consideration

Ten samples of the model LS 14500 have been submitted to the short-circuit test from clause 10.5.3 of IEC 60079-11. The maximum surface temperature evidenced at $T_a = +60^\circ\text{C}$ was $+105.7^\circ\text{C}$. Refer to the Appendix B.3 for more details about this test.

APPENDIX B: Tests**B.1. Cells conditioning test – Clause 10.5 of IEC 60079-11**

ExVeritas Internal Reference: TR0512
Test Date: 27/03/2018
Report Date: 05/04/2018
Equipment under Test: 10 Samples of SAFT 14500 LiSOCl₂ Primary cells
Sample(s) ID: EXV1181B to EXV1181K

Customer: SAFT Ltd.

Ambient Conditions:

Lab Temperature:	(18 ± 2) °C
Lab Humidity:	(50 ± 5) % R.H.
Lab Absolute Pressure:	≈ 103 kPa

*Table 1: Environmental conditions of test area***Test Method:**

Fifteen individual samples were supplied for evaluation against IEC 60079-11:2011, clause 10.5 (outlined in TP0512). Each sample is a primary lithium-thionyl chloride AA-size bobbin cell with a nominal open circuit voltage of 3.6 V. Each sample was supplied wrapped in a protective plastic retail covering.

Each cell is placed into an adjustable rig consisting of two brass hex screws and solid copper bus bars connected together by a very low resistance mercury switch. Each sample had its plastic exterior cover partially removed to expose the metallic surface of the cell, enabling the placement of a thermocouple secured with polyimide tape to the cell in order to record the exterior temperature of the cell under test. The assembly including the sample under test was then placed in a forced air circulated oven at the test temperature until the cell exterior thermocouple had reached thermal equilibrium with the oven thermocouple attached to the middle shelf (a rate of 2 K/h in accordance to 26.5.1 of IEC 60079-0).

The mercury switch is then tilted sufficiently to close the circuit, completing a short circuit between the two terminals of the battery. During the short circuit test, a current clamp is used to measure the maximum current through the wires of the mercury switch, while a secondary multimeter measures the volt drop across the short circuit link. This is to ensure the voltage drop across the link is compliant with the standard (no more than 15% of cell e.m.f. dropped across link). The temperature is sampled once every second using a data logger. Each tested cell is then left face down on a piece of blotting paper for 12 hours to capture any potential electrolyte leakage.

Following completion of the test any hand-written results were scanned into the ExVeritas project file. The temperature logger raw data files were transposed into Microsoft Excel for analysis. The battery internal resistance is calculated using from the results, and maximum temperature was taken from the raw data.

Instruments:

Test Equipment	Serial number	UKAS calibration due
Thermocouple wire (T2)	198374	30/01/2019
Thermocouple wire (T1)	198374	30/01/2019
Mercury switch	N/A	N/A
Fluke clamp meter	1635077	30/05/2019
Fluke 287 multi-meter	36400004	24/11/2019
Fluke 87	463636	07/09/2019
BTM-4208SD Data logger	198374	30/01/2019
Oven	N/A	Indication only
Battery test assembly	N/A	N/A

Table 2: Instruments used during lab test

Results

A complete summary of results is contained within table 3. The sample EXV1181B yielded the maximum temperature recorded according to table 3 105.7 °C, and there was no electrolyte leakage observed after 12 hours. The maximum measured internal resistance was 1.12 Ohms, and the lowest was 0.7658 Ohms. Chart 1 below illustrates temperature vs time for sample EXV1181B .

Key:

Voc	Battery open circuit voltage at test temperature
Isc	Maximum short circuit current through the short circuit link
Vtest	The voltage drop over the short circuit link
RInt	Internal resistance calculated as Voc divided by Isc
% of cell e.m.f.	Vtest as a percentage of cell open circuit voltage
T1	Maximum oven test temperature
T2	Maximum exterior cell temperature

Sample	Voc (V)	Isc (A)	Vtest (V)	Rint (Ω)	% of cell e.m.f.	T1 ($^{\circ}$ C)	T2 ($^{\circ}$ C)
EXV1181B	3.6675	3.3890	0.0500	1.0822	1.4%	64.6	105.7
EXV1181C	3.6640	3.6070	0.0550	1.0158	1.5%	65.3	95.0
EXV1181D	3.6590	3.9740	0.0670	0.9207	1.8%	64.6	101.3
EXV1181E	3.6650	4.7680	0.0950	0.7687	2.6%	62.3	101.0
EXV1181F	3.6660	3.7790	0.0720	0.9701	2.0%	63.9	102.9
EXV1181G	3.6630	3.6000	0.0700	1.0175	1.9%	64.7	103.6
EXV1181H	3.6780	4.8030	0.0870	0.7658	2.4%	67.5	101.2
EXV1181I	3.6950	4.3010	0.0950	0.8591	2.6%	61.2	100.8
EXV1181J	3.6890	3.2930	0.0690	1.1203	1.9%	62.5	95.4
EXV1181K	3.6630	4.0080	0.0840	0.9139	2.3%	63.9	102.9

Table 3: A complete table of result

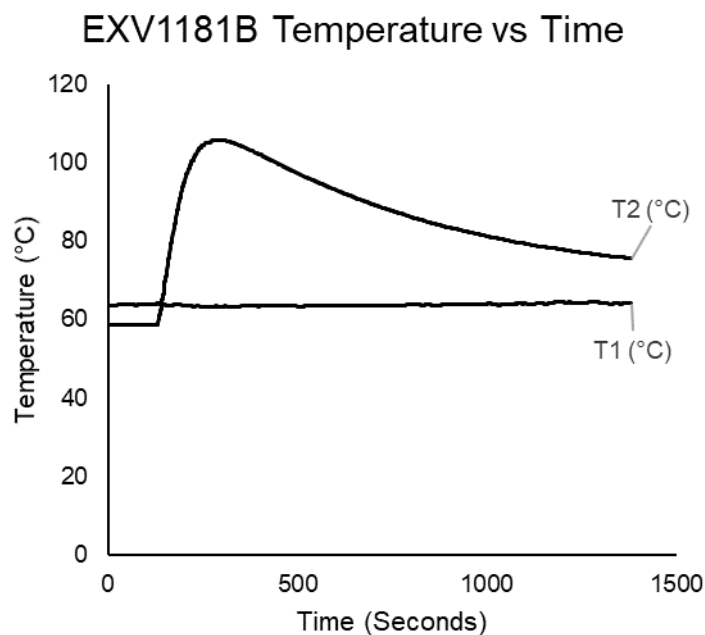


Chart 1: Temperature vs time for EXV1181B

ATTACHMENT A - PHOTOGRAPHS

Photograph 1 – Illustrates the battery held in place by the test rig



Drawing reference: 31064-2-0909

ATTACHMENT B – DECISION SHEETS AND INTERPRETATIONS APPLIED

Standard and Version / Document / Topic	Clauses of Standard	Decision Sheet	DS Issue Date	Key Words
IEC 60079-0 All editions IEC 60079-11 All editions	5, 7.6	2016/002	2016 11	FMEA (Failure Mode Effect Analysis)
IEC 60079-0:2011	30	2015/017	2015 10	Manufacturer, instructions
IEC 60079-11:2011	7.6 (d)	2012/009	2012 09	Standards
IEC 60079-0:2011	7.1.2	2011/002	2011 07	Plastic, elastomeric, QAR
IEC 60079-11:2011	7.4.2	2010/003	2010 03	Pressure, container