Function test 'ONOS Charge Safe'

Lithium charge and storage system

Report number C 2010-2E-RA-001 d.d. 9 September 2021

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Lithium charge and storage system

Principal	Qivelo Europe BV
Report number	C 2010-2E-RA-001
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1 Introduction

Qivelo Europe BV developed the 'ONOS Charge Safe'. Batteries for electrical bicycles can be stored and charged in this ONOS Charge Safe. The storage (and charging) of batteries involves risks. The main risk concerns a thermal runaway of a battery. The ONOS Charge Safe is designed to safely store and charge batteries. In case of an outbreak of a lithium fire, caused by a thermal runaway of the battery, the ONOS Charge Safe is designed to control this fire for a minimum of one hour.

At this moment no standard is available that prescribes which requirements such a storage must meet. In consultation with the client, Peutz set up an experiment in which the functioning of the ONOS Charge Safe was tested. It was investigated to what extend the ONOS Charge Safe provides protection in case of a thermal runaway of a battery in the ONOS Charge Safe. The experiment was performed in the Laboratory for Fire Safety of Peutz bv in Molenhoek, the Netherlands.

This report provides a detailed description of the performed tests and the test results.

2 Specifications

2.1 'ONOS Charge Safe'

The ONOS Charge Safe consists of several parts, which are described below. Pictures of the ONOS Charge Safe can be found in appendix 1. All information regarding the materials of which the ONOS Charge Safe is made has been provided by the client.

The functioning of the ONOS Charge Safe is described as follows by the client. The ONOS Charge Safe has a smoke detector inside. As soon as the detector detects smoke, the power is cut off (the charging of the batteries stops) and the mechanical ventilation stops. At the extraction point of the ventilator is a fire damper with a fusible link mounted. If the temperature in the ONOS Charge Safe rises, the fire damper will close automatically. The aerosol unit will be activated at a temperature of 88 °C through linear heat detection. This will extinguish the fire as early as possible to prevent greater damage. The aerosol should control the fire for a minimum of 60 minutes. This gives enough time to take action.

2.1.1 Casing

The outside of the ONOS Charge Safe consists of cold-rolled steel sheets, type DC01-A-m, with a thickness of 1.0 mm. A drawing with dimensions of the casing is shown in appendix 2. The ONOS Charge Safe has on the inner side removable steel sheets on all sides. Behind these inner sheets (between the inner and outer sheets) a calcium silicate board (type Promatect-100) is placed next to the outer sheet. On top of the casing, a round hole of 100 mm is present. The DFI ProFireBox is placed in this hole. In the DFI ProFireBox a ventilator is mounted with a fire damper underneath. A smaller hole is present in one side of the casing. This hole is used for thermocouples and power supply during the test. The remaining opening was sealed with fire retardant sealant.

The door of the ONOS Charge Safe is attached to the casing with four stainless steel hinges of type Argenta 89x89x2.5 12 mm din LS. A door closer of type Assa Abloy DC135 is fitted inside the casing. The door contains two holes for the door handle and the cylinder. The door handle was attached during the test, but the cylinder was not (this can be ordered as an option). The hole for the cylinder was covered by the calcium silicate board inside the door. Three shelves were present in the ONOS Charge Safe during the test. A drawing of the shelves is shown in appendix 2. On the bottom of the ONOS Charge Safe was a steel receptacle placed. During the built-up, foaming strips were stuck in the door frame. These strips foam up in case of heat and seal openings in the door frame.

2.1.2 Electrical (fire alarm) installation

The DFI ProFireBox is placed on top of the ONOS Charge Safe. An overview of the electrical connections of the DFI ProFireBox is shown in appendix 2. The power supply of the DFI ProFireBox is 220 V. Inside the box, the electricity is distributed into the different parts of the system. A socket inside the ONOS Charge Safe is connected to the DFI ProFireBox. This allow charging of the batteries inside the ONOS Charge Safe.

An extraction ventilator (220 V) of type Sunon AC axial is attached on top of the ONOS Charge Safe. This fan has a flowrate of 40 – 68 m^3 per hour. The fan was not a part of the DFI ProFireBox during the test, but it will be part of the DFI ProFireBox in the final version of the ONOS Charge Safe. This is also visible on the drawings in appendix 2. A fire damper of type Rft SC+60 L is placed under the extraction ventilator (inside the ONOS Charge Safe). This fire damper is classified as EI 60 in two directions. The fire damper contains a bi metal, causing it to close automatically when the temperature inside the ONOS Charge Safe rises.

In the ONOS Charge Safe is a smoke detector of type FireAngel ST-630-INT (including W2 module) installed on the 'ceiling'. This smoke detector is connected to a relay in the DFI ProFireBox on top of the ONOS Charge Safe. The relay is of type FireAngel WRLYB-1EU. As soon as the smoke detector detects any smoke, the power circuit is cut off by the relay. As a result of this, the ventilator stops and the electricity of the socket is removed (the charging of the batteries stops).

2.1.3 Extinguishing system AF-X Fireblocker

The ONOS Charge Safe has an AF-X Fireblocker aerosol extinguishing system installed inside on the 'ceiling' of the ONOS Charge Safe. Linear heat detection is also present next to the aerosol unit. If the linear heat detection detects a temperature of 88 °C, a signal is sent to the AF-X TEC Panel. The AF-X TEC Panel automatically gives an order to the AF-X Fireblocker n_CS to start extinguishing. The AF-X Fireblocker will start extinguishing the fire with which the fire and thermal runaway are controlled. The capacity of the used aerosol unit is sufficient for the content of the ONOS Charge Safe. A calculation of this is provided by the client and is shown in appendix 3. In this calculation, a lithium fire has been taken into account. Photo's of the extinguishing system are shown in appendix 1.

2.2 Batteries

Batteries of type Apollo 10INR19/66-5 were used for the tests. The specifications of the batteries are shown in figure 2.1. These type of batteries consists of 50 cells. To be able to overload the batteries, the Battery Management System (BMS) was removed from the batteries.

f2.1 Specifications batteries

3 Test description

3.1 Test setup

The ONOS Charge Safe is built up in the Laboratory for Fire Safety of Peutz. Three batteries were placed in the middle of the ONOS Charge Safe. The middle of the three batteries was prepared with two glow plugs of type YOU.S Y.S112 (BMS was also removed). The batteries are shown in figure 3.1.

f3.1 Prepared batteries in ONOS Charge Safe

To monitor the temperature during the test, a total of 12 thermocouples were installed. An overview of the positions of the thermocouples is given in table 3.1. The test was recorded with two video cameras. One camera was placed in the test area, aimed at the ONOS Charge Safe and the other camera was mounted inside the ONOS Charge Safe.

t3.1 Position thermocouples

Thermocouple	Position
1	Hanging inside ONOS Charge Safe left side
2	Hanging inside ONOS Charge Safe right side
3	Inside on ceiling
4	On left battery
5	On middle battery
6	On right battery
7	Underside shelf, under middle battery
8	On middle battery besides glow plug
9	Outside on top ONOS Charge Safe
10	Outside on side ONOS Charge Safe
11	Outside on door
12	Outside on ONOS Charge Safe next to door

3.2 Test protocol

The test consisted of two parts. First, the prepared battery was overcharged until the internal protection interrupted the circuit and the charging stopped. After this it was not possible to continue the overcharging process. At that moment the second part of the test started, in which the first of the two glow plugs was activated. After the first glow plug burned out, a switch was made to the second glow plug. As soon as the thermal runaway started, the power supply of the glow plug and the battery was immediately removed. A Power Supply SM6020 was used to overcharge the battery and to active the glow plugs.

During the process the temperature was monitored at the 12 positions, see table 3.1. The behaviour of the ONOS Charge Safe and associated equipment was also observed. It is important that in case of smoke development the fire damper closes and the power supply is cut off before the aerosol unit is activated. This process is observed during the test. Furthermore, the amount of smoke release during the test was observed, as was the temperature on the outside of the ONOS Charge Safe.

With regard to the batteries, the number of cells that exploded during the thermal runaway was examined. This makes it possible to make a statement about the extinguishing effect of the AF-X Fireblocker. It was also checked whether the batteries on the left and the right were irradiated by the battery in the middle (which came in thermal runaway).

4 Test results

The test was performed in the Laboratory for Fire Safety of Peutz in Molenhoek, the Netherlands. The ONOS Charge Safe was built up on 17 and 18 November 2020. The test was on 24 November 2020.

4.1 Visual observations

4.1.1 During the test

The test was started by overcharging the prepared battery. For this, the battery was connected to the Power Supply SM6020. The amperage was set at 10 A (the maximum the Power Supply could deliver). At the start of the test, the voltage was approx. 40 V. This voltage slowly increased towards approx. 50 V during the charging. After about half an hour, the voltage dropped to 0 V. This indicated that the internal protection interrupted the power circuit at that moment. After this, the battery was disconnected from the Power Supply and the first glow plug was connected to a voltage of approx. 6 V. A few minutes later the switch was made to the second glow plug at a voltage of approx. 5 V.

Approximately 49 minutes after the start of the test, a bang was heard from inside the ONOS Charge Safe. The video images from inside the ONOS Charge Safe showed the explosion of the first cell of the battery at that moment. This is shown in figure 4.1. Approximately 15 seconds after the first cell exploded, the smoke detector started beeping. About 30 seconds after the smoke detector detected smoke, several bangs could be heard in quick succession. At that moment, smoke came through the ventilation opening and the seams around the door. This is shown in figure 4.2. The fire damper in the ventilation opening closed around the same time. As a result, the smoke only left the ONOS Charge Safe when a cell exploded, because this caused an overpressure that opened the fire damper. When the pressure inside the ONOS Charge Safe was neutral again, the fire damper closed and almost no smoke was released any more. A total of 20 to 25 bangs were heard. The battery has a total of 50 cells. At the end of the test, therefore, were about 25 to 30 cells still intact.

f4.1 Battery comes in thermal runaway

f4.2 Smoke leaking from the ONOS Charge Safe

Two and a half minutes after the first noticeable bang, it was heard that the AF-X Fireblocker was activated. This was visible as white smoke slowly released through the seams around the door. Approximately four minutes after the smoke detector was triggered, the smoke detector stopped beeping. Five minutes after the first bang, only a minimal amount of smoke/aerosol was observed leaking from the ONOS Charge Safe at the height of the hole for the cylinder. This also stopped after a small period of time.

4.1.2 After the test

The door of the ONOS Charge Safe was opened more than an hour after the battery came in a thermal runaway. The temperature on the outside of the batteries had dropped to less than 70 °C and the temperature inside the ONOS Charge Safe was approximately 50 °C. The ONOS Charge Safe was black inside but still intact. The strips in the door frame were not foamed up (the temperature in the door frame has not been high enough). The battery in the middle was destroyed, but the adjacent batteries had not come in a thermal runaway. Photos of the situation inside the ONOS Charge Safe are shown in appendix 1.

The batteries were observed for several hours. They did not light up again after the test. It cannot be said with certainty whether the battery was extinguished by the AF-X Fireblocker during the thermal runaway or whether the thermal runaway stopped from itself. The thermal runaway was controlled and possibly extinguished by the AF-X Fireblocker. About 25 to 30 cells of the battery were still intact at the end of the test. It can be stated, however, that the battery did not bring any adjacent batteries in thermal runaway during the test.

f4.3 Situation inside the ONOS Charge Safe after the test

4.2 Temperature development

Some observations can be derived from the data from the thermocouples. The thermocouples on the batteries give no information about the temperatures inside the batteries. However, the measured temperatures on the batteries are related to the increase of the temperature inside the batteries. During the overcharging process, the temperature slowly increased to approximately 40 °C. The temperature rose further to approximately 55 °C after the activation of the glow plugs. When the thermal runaway started, the temperature increased to more than 500 °C within one second. This could also have been caused by a thermocouple that was hanging in a flame. Appendix 4 contains some graphs of the temperature inside and outside the ONOS Charge Safe during the test. The temperature inside the ONOS Charge Safe is an average of thermocouple 1, 2 and 7 and the temperature on the outside is an average of thermocouple 9 to 12. Is can be deduced from these graphs that the temperature inside the ONOS Charge Safe dropped fast after the activation of the aerosol unit. The maximum temperature in the ONOS Charge Safe was approximately 350 °C. About 20 minutes after the activation of the aerosol unit, the temperature inside the ONOS Charge Safe was below 100 °C. After an hour, the temperature had dropped to just over 50 °C. The graph shows a continuous downward line, the fire did not flare up again in the meantime. This indicated that the AF-X Fireblocker has controlled the fire for one hour. Also after the opening of the ONOS Charge Safe, the temperature continued to drop (no reaction from opening the door).

Thermocouple 5 (on the middle battery) showed a temperature over 500 °C for three minutes. This was also approximately the time until the aerosol unit was activated. Within an hour, the temperature dropped back to about 70 °C. The batteries on the left and right showed a maximum temperature of respectively 117 °C and 258 °C. Presumably the temperature inside the battery has been lower, as the flames from the middle battery could only affect the outside of the adjacent batteries.

Finally, the temperature on the outside of the ONOS Charge Safe was also observed. This showed that the outside of the ONOS Charge Safe slowly heated up to approximately 40 °C., an increase of about 20 °C. This temperature was observed about 20 minutes after the thermal runaway started. At that moment the temperature inside the ONOS Charge Safe dropped again.

5 Conclusion

On behalf of Qivelo Europe BV Peutz performed a functionality test on the 'ONOS Charge Safe', which is a cabinet for storage and charging of batteries for electric bicycles. Storage and charging of batteries involves risks. The ONOS Charge Safe is designed to store batteries in a safe way. The ONOS Charge Safe is designed to control a thermal runaway (if it occurs) for a minimum of 60 minutes, so the necessary action can be taken. The purpose of the test was to investigate whether the system is functioning and to verify that all compounds are activated in the correct order. First of all, the smoke detector should detect the smoke and switches off the power. After this, the fire damper must close and the fire should be extinguished or controlled by the AF-X Fireblocker.

Fur this purpose, the ONOS Charge Safe has been built up within the Laboratory for Fire Safety of Peutz bv in Molenhoek, the Netherlands, and tested for functioning. Three batteries were placed in the ONOS Charge Safe and a thermal runaway was simulated with the battery in the middle. The functioning of the ONOS Charge Safe was observed with visual inspection, thermocouples and video cameras.

The test showed that the ONOS Charge Safe remained intact and closed during the fire with a thermal runaway inside the ONOS Charge Safe. The amount of smoke releasing from the ONOS Charge Safe was somewhat limited by the closure of the fire damper. The fire damper closed within a short period of time after the start of the thermal runaway (before the AF-X Fireblocker was activated). The overpressure caused by the thermal runaway was well controlled by the fire damper. Smoke did leak from the ONOS Charge Safe during the thermal runaway, due to the overpressure, but this was necessary to prevent the pressure for rising too high. Within a few minutes after the fire damper closed, the AF-X TEC Panel and thus the AF-X Fireblocker were activated by the linear heat detection. A decrease in temperature was visible immediately after the activation of the AF-X Fireblocker. After approximately 20 minutes, the temperature inside the ONOS Charge Safe was below 100 °C. The temperature had dropped further to about 50 °C after an hour.

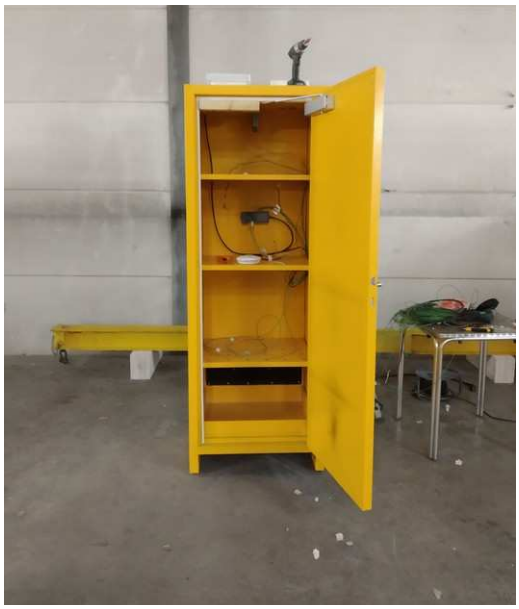
The ONOS Charge Safe offered sufficient protection to the surrounding during the thermal runaway. The goal to control the fire for 60 minutes was achieved during the test. The temperature on the outside of the ONOS Charge Safe did not exceed approximately 40 °C during the test. It cannot be said with certainty whether the battery was extinguished by the AF-X Fireblocker during the thermal runaway or whether the thermal runaway stopped from itself. The thermal runaway was controlled and possibly extinguished by the AF-X Fireblocker. About 25 to 30 cells of the battery were still intact at the end of the test. It can be stated, however, that the battery did not bring any adjacent batteries in thermal runaway during the test. These batteries did only have grime deposits from the fire on them.

This report contains 14 pages and 4 appendices

Mook,

Appendix 1 Pictures

Built-up of the ONOS Charge Safe

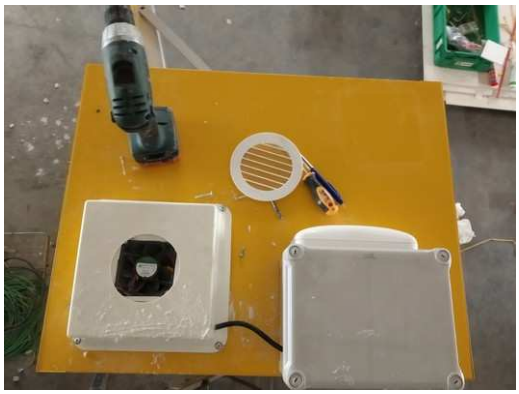


Opened ONOS Charge Safe

Closed ONOS Charge Safe

Hole for ventilator

Fire damper and ventilator seen from inside



Ventilator and DFI ProFireBox on ONOS Charge Safe (in final model in one part)

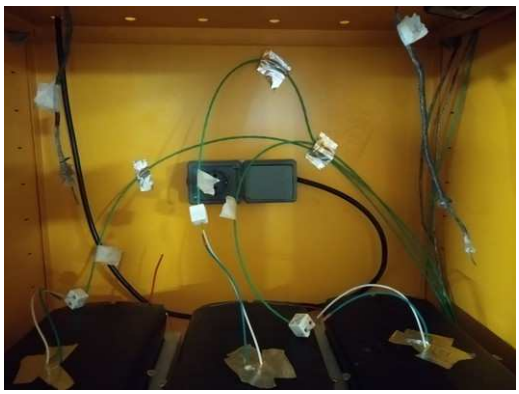
Smoke detector with around it the linear heat detection (red arrow)

Appendix 1 Pictures

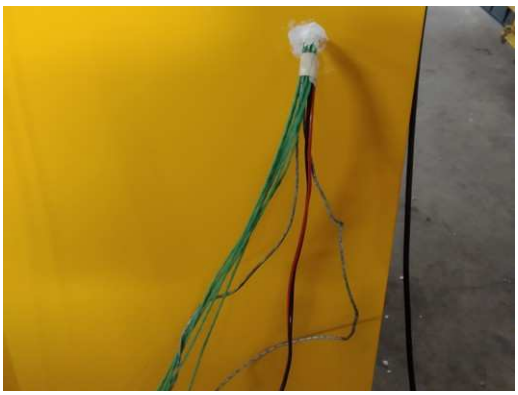
Built-up of the ONOS Charge Safe

Ceiling ONOS Charge Safe with smoke detector and AF-X Fireblocker with linear heat detection (red arrow)

AF-X TEC Panel with linear heat detection (red arrow)



Socket in ONOS Charge Safe



Hole in side with cables for the test

Prepared battery with glow plug

Batteries in ONOS Charge Safe

Appendix 1 Pictures

ONOS Charge Safe after the test

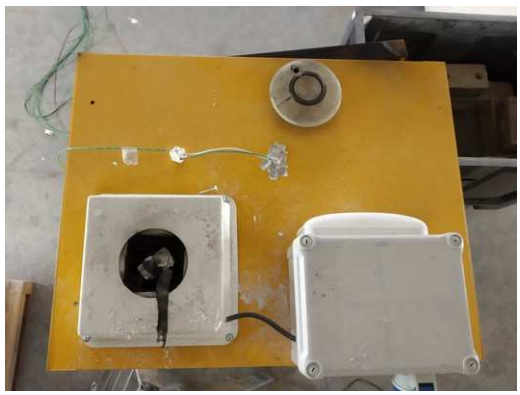
Batteries before the test

Batteries after the test

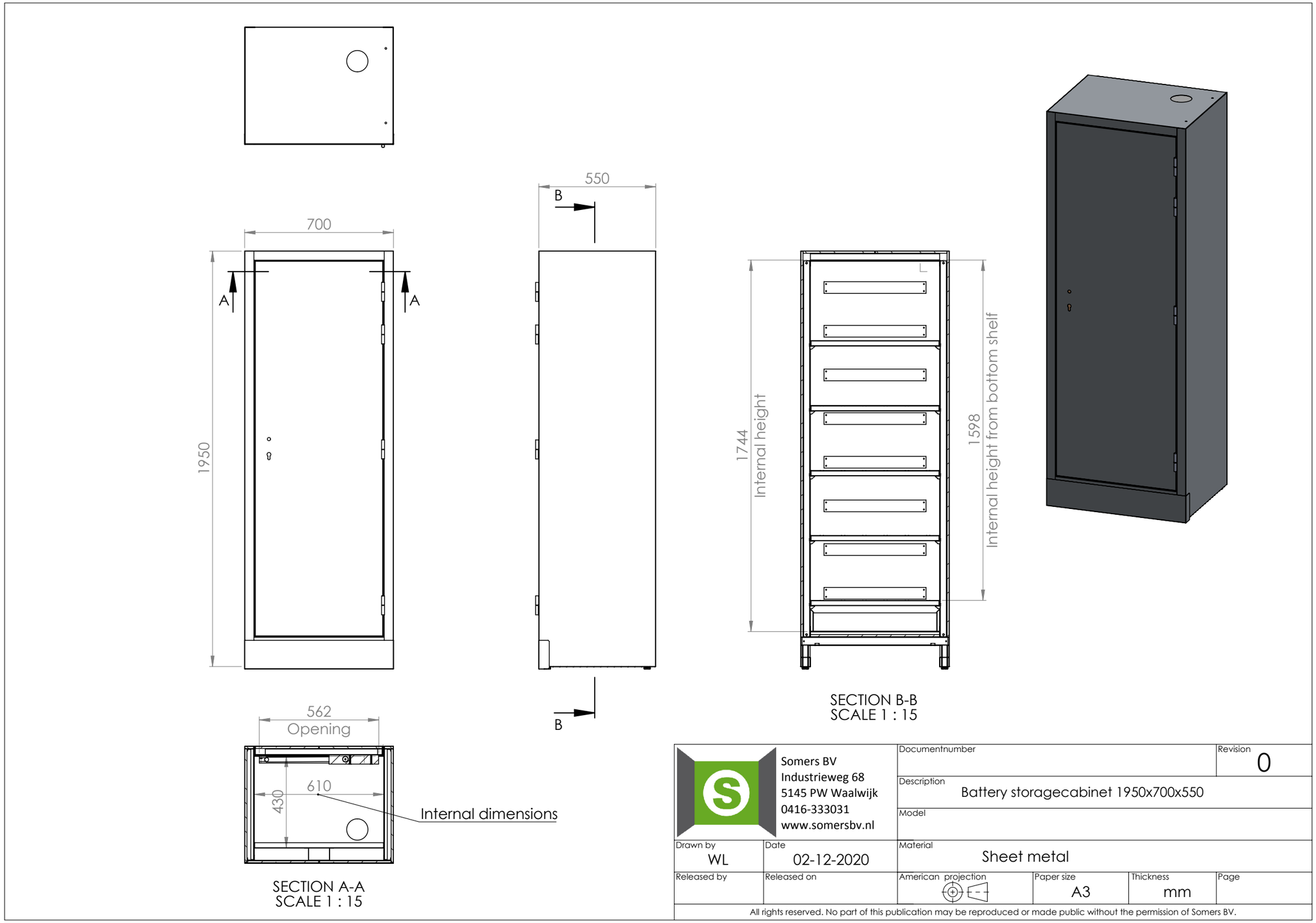
Battery after thermal runaway

Inside of the ONOS Charge Safe after test

Ceiling of the ONOS Charge Safe after test



Top of the ONOS Charge Safe after test

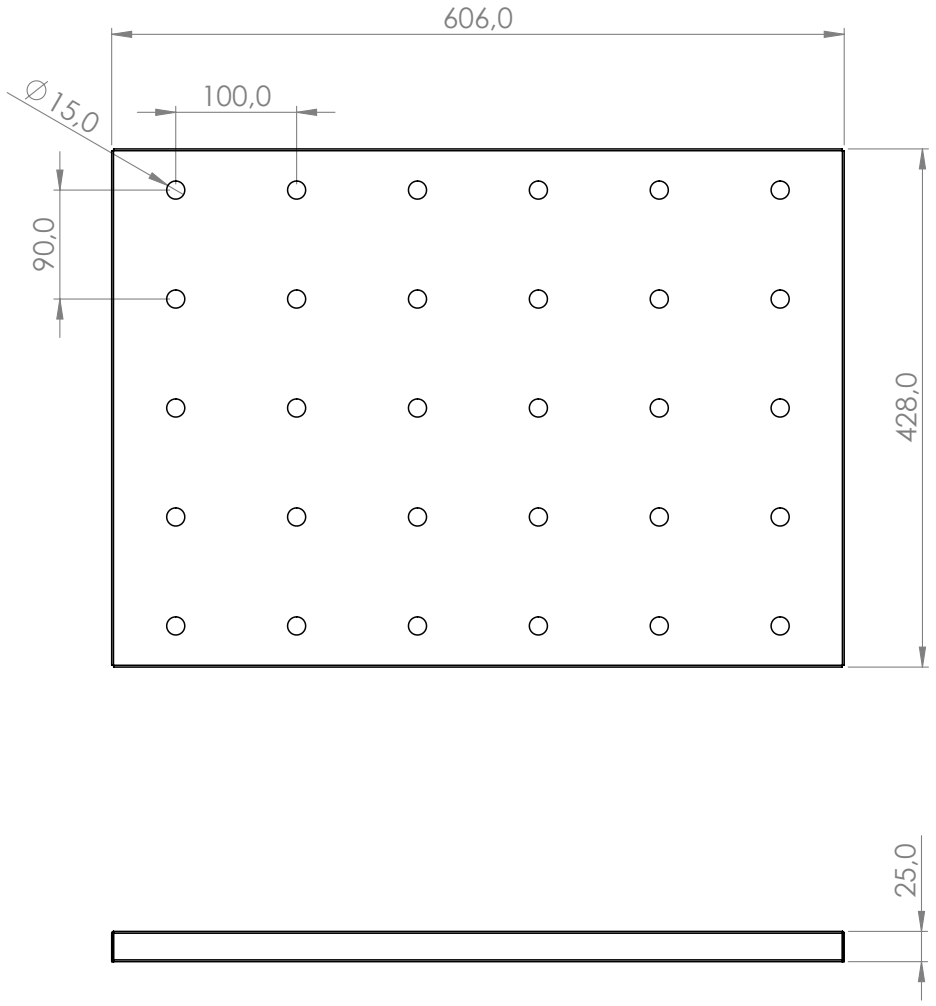


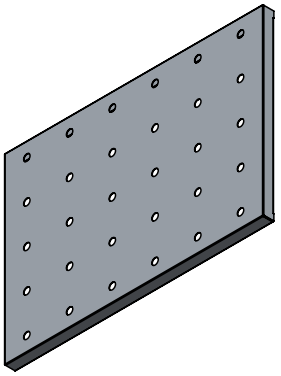
SECTION A-A
SCALE 1 : 15

SECTION B-B
SCALE 1 : 15

Somers BV
Industrieweg 68
5145 PW Waalwijk
0416-333031
www.somersbv.nl

Documentnumber					Revision 0
Description: Battery storagecabinet 1950x700x550					
Model					
Drawn by: WL	Date: 02-12-2020	Material: Sheet metal			
Released by	Released on	American projection	Paper size: A3	Thickness: mm	Page





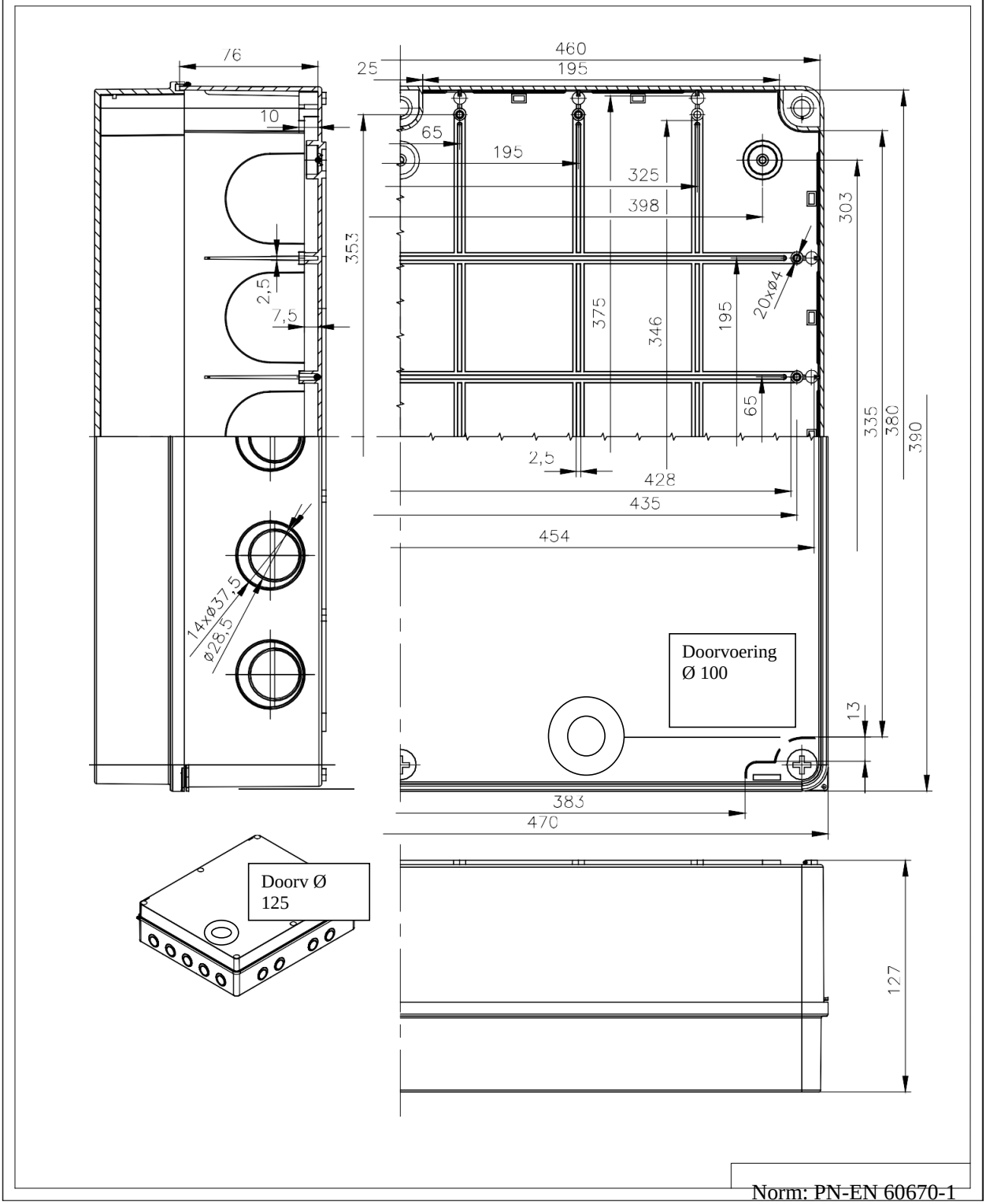
Legbord

PAWBOL

PRODUCT DATA SHEET
DFI PRO-FIREBOX460x380x120

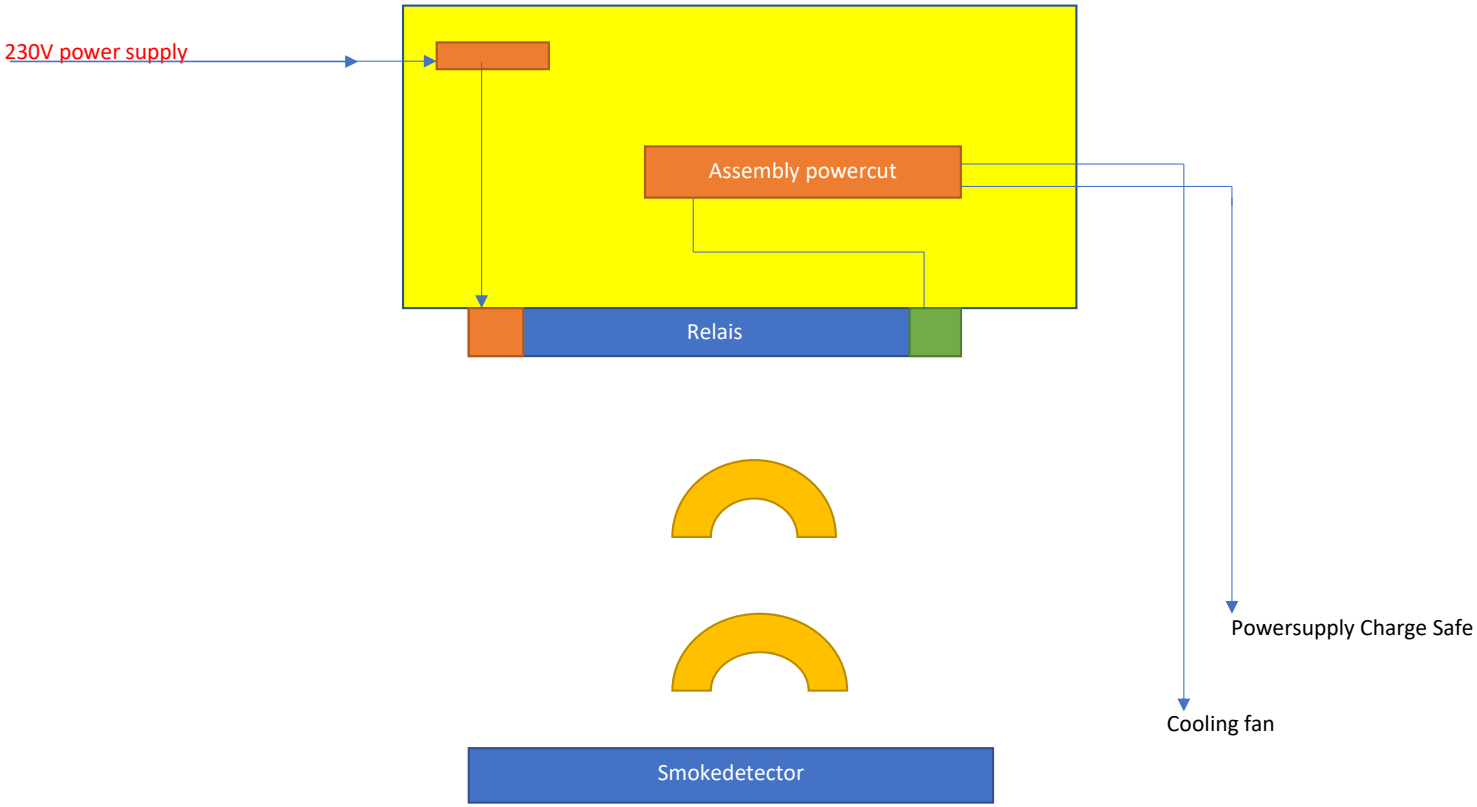
INSTALUJ Z NAJLEPSZYMI
www.pawbol.pl

Cat. No.	IP	Material	Working temperature [°C]	Internal dimension [mm]	Depth	Hole diameter for choke	Packaging [pcs]	Notes
PRO-FIRE	65	PS/ABS	-25 do +60	460x380	120	-	1	RAL 7035



Norm: PN-EN 60670-1

DFI PRO-FIREBOX ®



af·x fireblocker

Model: AF-X Fireblocker n-CS
Article: 10-15-130-03-02

GENERAL TECHNICAL INFORMATION

fire classes	A & B
activation mechanism	heating element 1.3 - 3.2 Ohm resistance
activation current	electric (6-36V D/C 1.0 A for 1-2 sec)
test recording current	max 40 mA (0.04 A) within 5 min

SPECIFICATIONS

gross weight	2.5 kg
weight extinguishing agent	150 g
discharge time	<30 sec
discharge openings	1
max. installation hight	1.5 M
discharge length	1.5 M
dimensions (h x diameter)	31 x 9.4 cm
outflow temperature 75°C	<50 cm
outflow temperature 200°C	0 cm

PROTECTIVE REACH CONFORM ISO, EN & UL NORM

EN 2 Class of fire	**net m³**
A	2.6

Please note; In the design of the system one should always add a safety factor of 30%.

EXAMPLES OF APPLICATION AREAS

technical spaces	computer boxes electrical cabinets switch boxes
engine compartments	car bus train boat
machinery	CNC machines industrial machinery generators

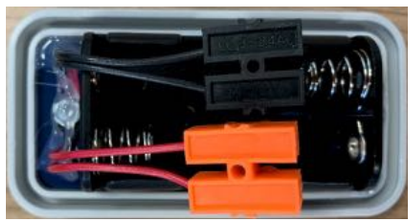
af-x fireblocker

AF-X TEC
article: 21-10-598-00-00

TECHNICAL INFORMATION

AF-X TEC	thermal detection and activation unit
main power	2x 1.5 VDC battery AA
automatic control and alarm	when wire breakage, fire detection and low battery
alarm visual	LED on panel
alarm acoustic	buzzer on panel 3KHz / 80dB
detection zones	1
extinguishing output	suited for 1x AF-X Fireblocker
dimensions mm (h x w x d)	85 x 44 x 38
detection	maximum length LHD without EOL = 2.5 metre maximum length LHD with EOL (10K ohm) = 10 metre

- 2x AA
- Orange connection for AF-X Fireblocker
- Black connection for LHD



FireAngel®

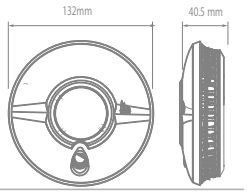
ST-630-INT Thermoptek rookmelder, 10 JAAR lithiumbatterij, Smarthome ready
Optioneel: Z-Wave-Plus, Zigbee 3.0 en Wi-Safe-2 module

Sensor type	Thermoptek Multi-Sensor
Batterij type	10 jaar, niet vervangbare lithium batterij

- Thermoptek maakt gebruik van technologie die bestaat uit een ultramoderne optische sensor gecombineerd met thermische intensivering.
- De melder reageert niet alleen op een langzaam ontwikkelende brand, maar door de constante controle op temperatuurstijging reageert de melder ook op een snel ontwikkelende- en uitslaande brand. De rookmelder gaat aanzienlijk sneller in alarm dan een rookmelder zonder Thermoptek technologie.
- Centrale test-/pauzeknop en unieke vergrendelingsoptie.
- Smart Silence & Pauze verminderd de gevoeligheid gedurende maximaal 10 minuten.
- De rookmelder is voorzien van een niet vervangbare 3V DC Panasonic lithiumbatterij met een levensduur van minimaal 10 jaar.
- De ST-630- INT is voorbereid voor draadloze communicatie met domotica & smarthome oplossingen.

- Optioneel: Wi-Safe 2, Z-Wave PLus en Zigbee 3.0 modules
- Voorbereid op LTE Cat NB1 en LTE Cat M1

Afmeting Rookmelder	132mm (diameter) x 28mm
Specificatie	ST-630-INT Optische Rookmelder
Technologie	Thermoptek
Montage	Plafond/muur
Bedrijfstemperatuurbereik	+4° C tot +38° C
Luchtvochtigheidsbereik	tot 90% zonder condensatie
Bedrijfstemperatuurbereik -opslag	-20 C tot +60° C
Luchtvochtigheidsbereik -opslag	tot 93% RV zonder condesatie
Kunststof materiaal	UL94 V0 brandvertragend
Garantie	10 jaar.
Gecertificeerd	EN14604:2005+AC:2008
Voeding/batterij	3V DC niet vervangbare lithium batterij
EAN	0816317004491



Neem contact op voor meer informatie: www: FireAngel.nl

LPCB
651d

CE
0832
EN14604:2005+AC:2008
Smoke Alarm Devices
DoP:FSTDOP19002

FireAngel

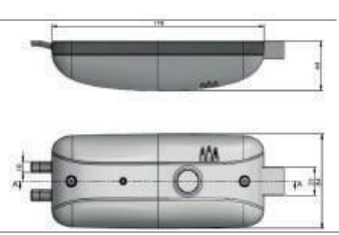
Wi-Safe 2

WRLYB-1EU 12VDC/230 VAC Relais en nevensignalering

230VAC Relais Wi-Safe 2

- Unieke optie als draadloze nevensignalering. Batterij gevoed. 4 x AAA. De sounder en LED's reageren als de rook-, hitte- of koolmonoxidemelder in alarm gaat.
- Toepassingen: koppeling met domotica, in/uitschakelen van bijv: CV ketel en WTW ventilatie, aansturen van nevenindicatoren, doormelding naar een alarmcentrale, thuiszorg, brandmeldsysteem. Aansturen van deuropeners, vrijloopdrangers.
- 12VDC en 230 VAC Voedingsspanning.12VDC adapter niet bijgeleverd.
- 2 x Potentiaalvrije wisselcontacten max. 5A.
- Maximale spanning aan te sluiten over de contacten is 30VDC tot 250 VAC.
- Triggeringang: input 12-24 VDC.
- Testfunctie voor de relais contacten.
- LED indicatie: Stand-by, Back-up en Alarmmelding.
- Onopvallende, moderne vormgeving.
- Eenvoudige te monteren en in te stellen d.m.v. dipswitches.
- 2 jaar garantie.
- Voorzien van Wi-Safe 2 draadloze technologie - maximaal 50 Wi-Safe 2-apparaten op één netwerk. Incl relais.

Technische specificaties

AFMETINGEN	84mm (breedte) x 198mm (lengte) x 44mm (hoogte) 
Voedingsspanning	230VAC / 50-60 Hz of 12VDC adapter
Stand-by/power	Continue groene led – 230VAC netvoeding aangesloten Knipperende groene led- 1 x per 60 sec – werkt op back-up batterij
Alarmsignalen	Knipperende rode led voor brand Minimaal 75 dB pulserend signaal
Lege back-up batterij en einde levensduur	Knipperende rode led 1 x 60 seconden. Zoemer klinkt elke 60 seconden
Montage	Muur, plafond. Als nevensignalering bijv. boven een deur, in de gang, of bij een zusterpost
Garantie	2 jaar
Relais contacten	2 x potentiaalvrije wisselcontacten elk voor max. 5A Ohmse last Max. aan te sluiten spanning 30VDC / 250VAC
EAN	0816317004910
Normale bedrijfs- en opslagtemperatuur	0 – 40° C
Normale bedrijfs- en opslagvochtigheid	15% to 95% Relative luchtvochtigheid – niet condenserend
Materiaal, behuizing	ABS, UL94, V-0 classificatie
Gewicht	300 gram
Onafhankelijk getest	CE
Compatibiliteit	Werkt met: WSM-F-1EU, WHM-F-1EU, WST-630, WHT-630, W2-CO-10X en alle overige FireAngel producten met Wi-Safe 2 technologie. Unieke oplossing voor extra meldingen naar alarmcentrale, thuiszorg, inbraaksysteem
Max. aantal deelnemers in een netwerk	Maximaal 50 stuk, incl relais

voor meer informatie of verkoop: www.FireAngel.nl

CA0065R1

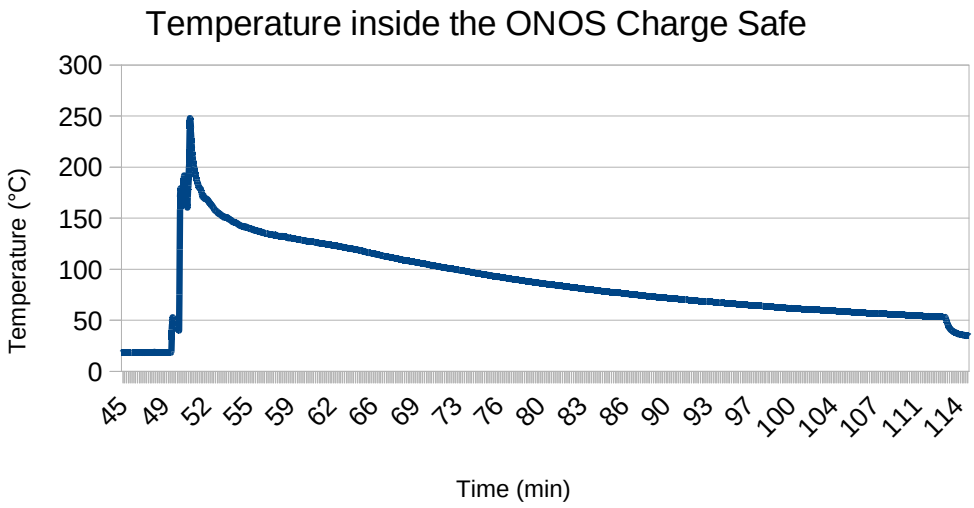
af-x fireblocker

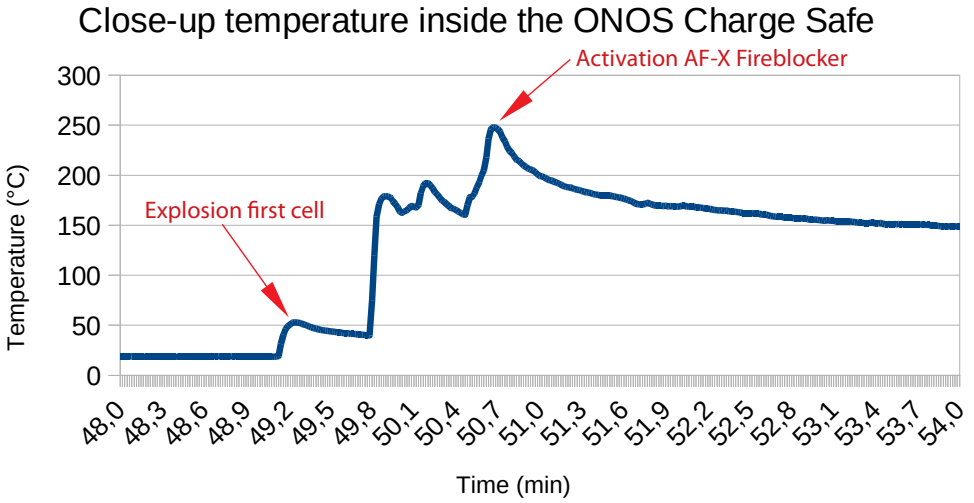
Calculation method in conformity to UL, ISO, EN, BRL certification	
This calculation method is for net space	
Name project:	ONOS Charge Safe
Safety factor af-x	30%

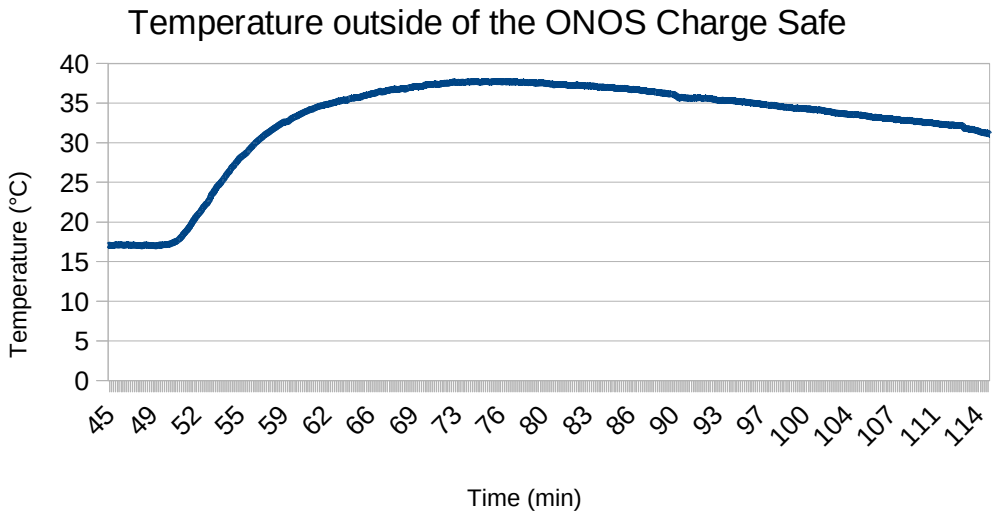
Room 1	**Room name:**	Lithium Storage						
Room m³		**Length**	1,95	**Width**	0,7	**Height**	0,55	m³	0,75
M³ total of items that are deducted								m³	0,00
To protect m³								**m³**	**0,75**

Room 1				
Number of units, Class A	0,6	0,2	0,0	0,0
Number of units, Class B	0,7	0,2	0,0	0,0
Number of units, Lithium	0,2	0,1	0,0	0,0
Type unit	**AF-X Fireblocker n-CS**	**AF-X Fireblocker n-CM**	**AF-X Fireblocker n-BM**	**AF-X Fireblocker n-BL**
Total of units	1	0	0	0

Type unit	**AF-X Fireblocker n-CS**	**AF-X Fireblocker n-CM**	**AF-X Fireblocker n-BM**	**AF-X Fireblocker n-BL**
Total of units	**1**	**0**	**0**	**0**


Temperature inside the ONOS Charge Safe
Temperature (°C)
300
250
200
150
100
50
0
45 49 52 55 59 62 66 69 73 76 80 83 86 90 93 97 100 104 107 111 114
Time (min)


Close-up temperature inside the ONOS Charge Safe
Activation AF-X Fireblocker
Explosion first cell
Temperature (°C)
300
250
200
150
100
50
0
48,0 48,3 48,6 48,9 49,2 49,5 49,8 50,1 50,4 50,7 51,0 51,3 51,6 51,9 52,2 52,5 52,8 53,1 53,4 53,7 54,0
Time (min)


Temperature outside of the ONOS Charge Safe
Temperature (°C)
40
35
30
25
20
15
10
5
0
45
49
52
55
59
62
66
69
73
76
80
83
86
90
93
97
100
104
107
111
114
Time (min)