test report

test report

number*/Number***8123007288-30 v1**

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client *Customer*	Fisacon GmbH Augsburger Str. 2-6 33378 Rheda-Wiedenbrück Germany */ Germany*	Proceedings *Method*	**Real fire test with lithium-ion batteries**after test principle for awarding the certificate**"TÜV NORD type tested"**
clerk *case worker*	Feldmann	sample receipt *Specimen receipt*	August 27, 2024
test date *Date of test*	August 28, 2024	Valid until *Valid until*	unlimited *unlimited*

Product name**/Product designation****
RACLAN SQUARE

Results*/Results*			
thermal insulation *Insulation*	room closure *Integrity*	smoke extraction *Exhaust management*	HF concentration *HF concentration*
fulfilled*/fulfilled*	fulfilled*/fulfilled*	fulfilled*/fulfilled*	fulfilled*/fulfilled*

Dortmund, December 16, 2024

Niederberghaus Digital signed by Nadine Niederberghaus

Release*/approval*

Prüflaboratorium für Brandschutz DMT

Feldmann Digital signed by Sebastian Feldmann

Responsible*/responsible*

This report includes *10* Pages and more *15* Page attachments.

This test report consists of 10 pages and further 15 pages appendices.

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Appendix

1 test basis/specification

The real fire test with lithium-ion batteries was carried out in accordance with the test principle “M 02-2022 Storage media for lithium-ion batteries”, version 1.0, as of May 12, 2022.

The client provided the tested container as well as the four battery packs used (lithium-ion batteries).

2 documentation of the test setup

2.1 Framework conditions of the examination

place of the exam		:	Tremoniastrasse 13, 44137 Dortmund
air temperature	[°C]	:	23.3
air pressure	[hPa]	:	- /-
relative humidity	[% RH]	:	58.6
horizontal air speed	[m/s]	:	< 0.5

2.2 Sample description

feature	Unit	Value
Manufacturer and place of manufacture*		see client
Brand name / type designation*		RACLAN SQUARE
specimen structure*		RACLAN SQUARE - Box with a flap at the front, consisting of loading/ storage space and functional space - Equipped with a pressure-free extinguishing system within the functional room Corpus: - Housing made of synthetic resin pressed wood (Panzerholz®, (material thickness 8 mm, according to DIN 7707) - framed in aluminum groove profiles (profile 8 30 x 30 type B and profile 23-229 (groove 8) - Profiles connected with 3D cube connectors (cube connectors 8 30 x 30 3D) - In addition, a vermiculite plate was used in the floor area (material thickness 9.6 mm) - Mat to prevent the fire load/battery from slipping (material: NR/SBR 70°; fine grooves on the underside with a fabric pattern; material thickness: 3.0 mm)

feature	Unit	Value
		- There are handles on the sides in the upper area, the openings of the exhaust management system are also located on the sides - There are adjustable feet on the floor flap/door: - Plate of the flap made of synthetic resin pressed wood (Panzerholz®, (material thickness 8 mm, reinforced to 15 mm, according to DIN - 7707) Flap equipped with opening handle - for closing two spring-loaded locking units, each consisting of a compression rotary latch (7-086 flush compression rotary latch made of stainless steel) and a spring unit (pressure spring VD-288Z-08) two hinges (7-202 hinge Pr01 - 270 ° made of stainless steel) are attached to the bottom of the flap - silicone seal 4.5 x 6.5 mm (50°±5° Shore A, translucent, tolerance according to DIN ISO 3302-1 E2) applied all around the inside of the flap exhaust gas management system: - Exhaust pipe with ventilation openings through the interior (loading/storage space), ventilation slots (long hole) on the rear - Gill plates on the outside to divert the exhaust gas flow - Filter sections consisting of stainless steel wool, stainless steel flame retardant screen 500 micron 2 layers and Sorbacal® SP extrudate are inserted inside the exhaust pipe extinguishing system: - Components in the functional space: ■ Extinguishing agent bag filled with approx. 10 liters of extinguishing agent TRIDENT ■ pump ■ solenoid valve ■ Thermal switch with a trigger temperature of approx. 90 °C (sensor in the storage room) - Components in the loading/storage area: ■ extinguishing agent nozzles (full cone nozzles R1/8 S120 3.2) External electrical components: - key switch - Two indicator lights - Voltage display for the internal power supply Button for - the voltage display - buzzer - connection to external power supply - For the fire tests, only the buzzer and the connection for the external power supply were attached to the test specimen.
Color		brown / silver

feature	Unit	Value	
number of specimens		1	
		nominally*	determined
specimen size (L x W x H)	[mm]	580 x 580 x 380	- /-
Weight	[kg]	42	42.63
free storage volume	[l]	60	- /-

All information is provided by the client unless otherwise indicated. Overview and detailed photographs of the test specimen can be found in Appendices A 8 to A 10.

2.3 Fire load

feature	Unit	Value
Manufacturer and place of manufacture*		Fisacon GmbH Augsburger Str. 2-6 33378 Rheda-Wiedenbrück
Brand name / Type designation*		- /-
Electrical capacity*	[Wh]	4x 877 Wh => 3508 Wh
cell chemistry/geometry*		NMC18650 round cells
module composition*		70 cells 18650, 14 cells in parallel, each with 5 blocks
Color		blue cells
Number		1 battery consisting of 4 modules
Nominal voltage*		Module 1: 41.8 V Module 2: 40.8 V Module 3: 40.7 V Module 4: 41.7 V
Weight	[kg]	20.24
heating device		6 heating elements with 350 W each,
remark		The rear wall of the battery housing was removed to prevent the extinguishing agent from pooling.

2.4 Measurement technology

2.4.1 Temperature measurement technology for the outer specimen surface

- 11 pieces of thermocouples according to EN 1363-1, section 4.5.1.2, with a silicate fibre-based cover attached to the test specimen
- Measuring transducer HBM MX1609-P (manufacturer: Hottinger Baldwin Messtechnik) Output
- signal is recorded at 1 Hz without further processing steps with catman.

The arrangement of the temperature measuring points can be found in the measuring point plan and the photo documentation in Annexes A 1 and A 2.

2.4.2 temperature measurement technology inside the test specimen

- 4 pieces of sheathed thermocouples of type K according to EN 60584-1 with an outer diameter of 1.5 mm, freely positioned in space by bending or fixed to the test specimen with aluminum adhesive tape. HBM MX1609-P
- measuring transducer (manufacturer: Hottinger Baldwin Messtechnik)
- Output signal is recorded at 1 Hz without further processing steps with catman.

The arrangement of the temperature measuring points can be found in the measuring point plan and the photo documentation in Appendix A 3.

2.4.3 Gas measurement for detecting hydrogen fluoride content (HF measurement)

The measurement was carried out 300 mm from the center of the outlet opening using an electrochemical gas detection system (“4ECM-SMART Module PCBA”) for the detection of 10 ppm x hr to 100 ppm x hr HF.

2.4.4 camera technology

The test was recorded with two cameras with min. 25 fps and 1920x1080 px.

2.4.5 Measurement of deformations and spatial closure

To measure the deformation and gap formation, 6 mm and 25 mm gap gauges according to DIN EN 1363-1, section 4.5.5.2 and a calibrated caliper were kept ready.

2.4.6 overall structure

The arrangement of the fire load in the test specimen as well as the arrangement of the test specimen relative to the test room and the camera or RF measuring technology can be found in Appendix A 4.

The fire load was placed centrally within the loading/storage area.

3 test procedures

3.1 Sampling

The test specimen, the fire load used and the heating element used for initiation were selected and provided by the client without the involvement of the testing laboratory.

3.2 Sample preparation

For the fire test, cable ducts were installed in the test specimen to allow the temperature sensors and the power supply for the heating elements inside.

Employees of the testing laboratory installed temperature measuring points on the test specimen, the fire load and in the interior.

The charge state of the fire loads was checked by a voltage measurement.

3.3 Air conditioning

The test specimens and fire loads were stored for >24 h at room temperature in the test laboratory premises and only transported to the test room immediately before the start of the test.

3.4 Test procedures

According to the underlying test specification, the heater was started one minute after the measurement technology was started to initiate a thermal runaway of the fire loads (batteries). The time until the thermal runaway occurred and the time at which the heater was switched off and the extinguishing device was manually activated can be found in Table 1. The observation of the test and the temperature recording were maintained for 2 hours.

3.5 Observations

The following description is based on remote observation carried out during the experiment and on subsequent video analysis by the author of the document.

Table 1: Observations during the test

Time [mm:ss]	observations
00:00	Start of test, start of measurement data recording, air temperature 23.3 °C, horizontal air velocity < 0.5 m/s
01:00	Start of the heating phase (230 V, 9 A)
03:32	Light smoke development
04:17	First Venting
04:32	Second Venting
04:45	Third Venting
05:02	Fourth venting, short outgassing via flap (< 1 second)
05:06	alarm signal active
05:18	Further venting, short outgassing via flap (< 1 second), heater switched off
05:24	Further venting, short outgassing via flap (< 1 second), further venting with short outgassing via the flap (< 1 second)
06:00	extinguishing system activated, heavy smoke emission
06:30	No further reaction
08:06	Alarm signal deactivated, start of the follow-up period
130:00	No further reaction, END OF OBSERVATION

3.6 Deviations from the test specification

no

4 Results

Table 2: Test results

criterion	observation	assessment
Temperature rise at all measuring points <180 K	ΔT_{MAX}= 26.27 K	fulfilled
Temperature rise in mean value of the partial areas <140 K	$\Delta \langle T \rangle_{MAX}$= 18.58 K	fulfilled
continuation of the room closure	Gap gauges could not penetrate test specimens	fulfilled
Predominant compliance with the designated routes of flue gas discharge (<30 s)	Smoke escape through door gap <30 s per event	fulfilled
Maximum recorded HF concentration in the exhaust stream <95 ppm	4.41 ppm	fulfilled
middle Hydrogen fluoride concentration per 15 min interval <34 ppm	0.12 ppm	fulfilled

5 notes

The results only reflect the behavior of the tested specimens under the specific test conditions. They do not represent the only criteria that can cause possible fire hazards. In case of doubt, the German version of this report is valid. This test report may only be distributed in its entirety and unchanged. Extracts or abbreviations require the written permission of DMT GmbH & Co. KG.

If a statement of conformity has been made in this test report, the following decision rule has been applied: "The measurement uncertainty is not taken into account in the statement of conformity".

This document does not constitute a type approval or certification of the product

Information marked with an asterisk (*) is data provided by the customer.

The test specimens are used up.