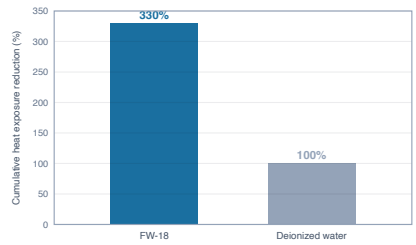
FW-18 — base data

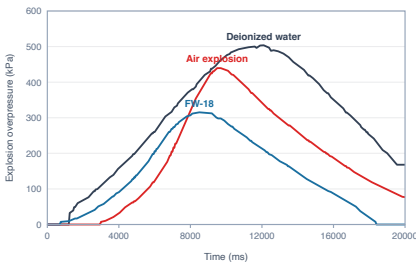
Water-based, fluorine-free fire extinguishing agent developed for lithium-ion battery fires. Figures and test records in this sheet are taken from “R&D and Application of FW-18 Dedicated Fire Extinguishing Agent for Lithium-ion Batteries” (2026-01-27).

1 · Key technical specifications compared with deionized water

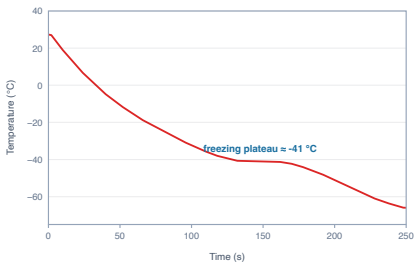
Property	Deionized water	FW-18	Note
Cooling capacity (%)	100%	**330%**	Cumulative heat exposure reduction relative to deionized water (= 100%).
Electrical conductivity (µS/cm)	2.28 µS/cm	**6.7 µS/cm**	
PFAS & PFOS content	None	**0% PFAS**	Fluorine-free. PFAS test report by TÜV Rheinland (report no. 178209196b 001, testing period 2024-11-18 to 2024-11-22).
Freezing point (°C)	0 °C	**−40 °C**	The measured cooling curve shows the freezing plateau at about −41 °C.
Explosion overpressure vs. air explosion (%)	+11.8%	**−30.8%**	Change in peak explosion overpressure compared with the explosion in air.
Voltage withstand	–	**No breakdown at 1500 V**	1500 V withstand test: no breakdown. Test report dated 2025-08-14.



Cooling capacity. FW-18 330% against deionized water 100%.



Explosion overpressure. Peak against the explosion in air: FW-18 −30.8%, deionized water +11.8%.



Low temperature. Cooling curve of FW-18; freezing point −40 °C.

2 · Technology and scope

Microemulsion: a thermodynamically stable system formed by the micellar reaction of an oil phase, a water phase, a surfactant and a co-surfactant.

- Dispersed oil phase of 1–100 nm, uniform in size and spherical.
- Low electrical conductivity.
- Can decompose and absorb combustible gases such as H_2 and CO.
- Chemical inhibition interrupts the combustion chain reaction; physical cooling removes heat from the cell surface.

Five core functions

- Rapid fire suppression
- High-efficiency cooling
- Effective explosion suppression
- Termination of thermal runaway
- Insulating and non-conductive

Applies to

Cell chemistries: LCO (lithium cobalt oxide), NCM (lithium nickel cobalt manganese oxide), LFP (lithium iron phosphate)
Equipment: Portable extinguishers, Fixed fire protection

systems
Fires: Lithium-ion battery fires, Class A
Ambient temperature: −40 °C to 60 °C

3 · Effectiveness tests

3.1 Fixed fire extinguishing system test: LFP pack

In-house comparison test, three agents under the same procedure. Method reference: General technical requirements for fire prevention and control devices for lithium-ion power battery boxes of electric buses.

Set-up	
Cells	CATL lithium iron phosphate ($LiFePO_4$ / graphite), 173 × 46 × 133 mm
Test pack	3P4S: three cells in parallel per module, four modules in series
Preconditioning	Fully charged 48 h before the test; 3.6–3.65 V per cell verified
Instrumentation	12 thermocouple channels (CH01–CH12)
Suppression	Water-mist system, constant 4 MPa, 240 s spray

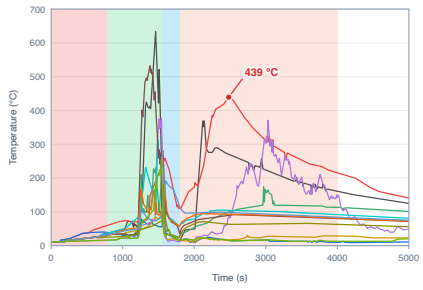
Procedure

1. Keep the fully charged battery in an overcharged state.
2. After 180 s, heat the battery with a heating plate for 780 s, then stop heating and overcharging and let thermal runaway develop.
3. Activate the water-mist system: constant 4 MPa for 240 s.
4. Observe the pack after extinguishing.

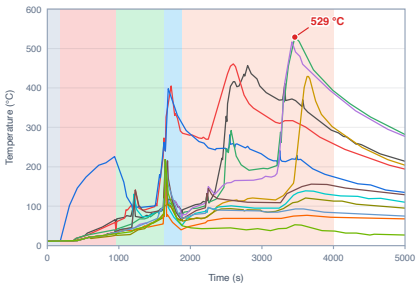
Acceptance criteria

1. The flame is completely extinguished and there is no re-ignition within 1 hour.
2. After 1 hour, at least one unburned battery cell remains.

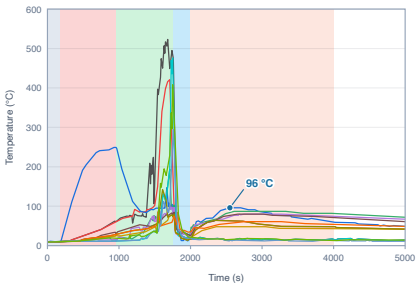
Agent	**Flame extinguished after**	**Re-ignition**	**Max. temperature after extinguishing**
Deionized water	`2 min`	`Yes`	`> 400 °C`
A mainstream Li-ion extinguishing agent	`1 min 20 s`	`Yes`	`> 500 °C`
FW-18	`2 s`	`No`	`< 100 °C`



Deionized water. Highest reading after the spray: 439 °C (CH02).



A mainstream Li-ion extinguishing agent. Highest reading after the spray: 529 °C (CH04).



FW-18. Highest reading after the spray: 96 °C (CH03).

Heating / Overcharging: Fully charged pack held in overcharge (180 s), heating plate on (780 s)
Runaway: Heating and overcharge off; runaway develops
Spray: Water-mist system, 4 MPa, 240 s
After Extinguishing: Pack left under observation

CH01 CH02 CH03 CH04 CH05 CH06 CH07 CH08 CH09 CH10 CH11 CH12

- Cooling effect: FW-18 > a mainstream Li-ion extinguishing agent > deionized water.
- FW-18 terminated thermal runaway; with the other two agents the pack re-ignited.

3.2 Portable extinguisher test: LCO pack

In-house test. Method reference: KFI certification criteria for the extinguishing performance of extinguishers on small lithium-ion battery fires, No. 630, 2024-12-18.

Set-up	
Cells	New LiPo pouch cells, LCO ($LiCoO_2$), 8000 mAh, 3.7 V
Test pack	6 groups of 4 cells in series (14.8 V per group), 710.4 Wh
Preconditioning	Fully charged 48 h before the test; ≥ 4.1 V verified; enclosures removed
Extinguisher	6 L, FW-18

Procedure

1. Overcharge group #3 to induce thermal runaway by electrical abuse.
2. When the first battery enters thermal runaway, discharge the extinguisher.
3. Observe for 20 minutes, then measure the battery voltages.

Acceptance criteria

1. All flames are extinguished and all batteries remain inside the test apparatus.
2. No re-ignition during the 20-minute observation; at least one group of 4 cells in series has not caught fire and holds a cell voltage of ≥ 3.7 V.
3. Agent consumption ≤ 9 L for a 600 Wh battery module.

Result. One 6 L FW-18 extinguisher put out the 710.4 Wh pack fire; three groups kept their voltage.

Result	
Flame extinguished	Yes
Thermal runaway again within 20 min	No
Groups with qualified voltage	3 of 6
Group voltages #1–#6 (V)	16.36 / 0 / 0 / 0 / 16.65 / 16.83
Meets acceptance criteria	Yes

3.3 Portable extinguisher test: NCM pack

In-house test. Method reference: NTA 8133+A1.

Set-up	
Cells	LG E61 NCM pouch cells, 11.5 × 98 × 350 mm
Test pack	5 cells, 1128.5 Wh
Preconditioning	Fully charged 48 h before the test; ≥ 4.05 V verified
Extinguisher	6 L, FW-18, pre-heated to 40 °C

Procedure

1. Pre-heat the whole extinguisher to 40 °C.
2. Place a 300 W heating device between cells #1 and #2 and raise the temperature at 5–10 °C/min.
3. When the first cell goes into thermal runaway, discharge the extinguisher immediately.
4. Observe for 1 hour, then measure the cell voltages.

Acceptance criteria

1. The flame is completely extinguished and there is no re-ignition within 1 hour.
2. After 1 hour, at least one unburned cell remains, with a voltage above 3.7 V.
3. Agent consumption ≤ 9 L for a 1000 Wh battery module.

Result. One 6 L FW-18 extinguisher put out the 1128.5 Wh pack fire; four of five cells kept their voltage.

Result	
Flame extinguished	Yes
Thermal runaway again	No
Cells with qualified voltage	4 of 5
Cell voltages #1–#5 (V)	thermal runaway / 4.06 / 4.09 / 4.07 / 4.10

Result	
Meets acceptance criteria	Yes

3.4 Class A fire test: wood cribs

In-house test. Method reference: GB 4351 portable fire extinguishers.

Set-up	
Wood crib	On a support of two angle irons, top (400 ± 10) mm above ground; sticks of (39 ± 1) mm square cross-section
Extinguishers	950 mL, 3 L and 30 L, FW-18

Procedure

1. Place the ignition pan under the crib and add water to a depth of 30 mm.
2. Weigh the crib; the target mass is (55 ± 2)% of the initial mass.
3. Pour fuel into the pan and ignite it.
4. When the crib has burned down to the target mass, discharge the extinguisher continuously at full opening: first from 1.8 m in front of the crib, then closer, onto the top, bottom, front and sides, not the back.
5. Observe for 10 minutes.

Acceptance criteria

1. The fire is completely extinguished and there is no visible flame within 10 minutes after the extinguisher is fully discharged.
2. If the crib collapses during the test, the test is invalid and is repeated.

Result. All three sizes put out their crib with no re-ignition within 10 minutes.

Class	Sticks	Stick length (mm)	Arrangement	Ignition pan (mm)	Ignition fuel
0.5A	45	400	9 layers × 5 sticks	300 × 300 × 100	0.63
2A	112	635	16 layers × 7 sticks	535 × 535 × 100	2.0
6A	230	925	23 layers × 10 sticks	825 × 825 × 100	4.8

Extinguisher	Flame extinguished	Re-ignition within 10 min	Rating	Meets criteria
950 mL FW-18	Yes	No	0.5A	Yes
3 L FW-18	Yes	No	2A	Yes
30 L FW-18	Yes	No	6A	Yes

4 · Conventional extinguishing agents on lithium-ion battery fires

Agent type	Common agents	Mechanism	Effect on Li-ion battery fires
Gaseous	Halon 1301, Halon 1211	Chemical inhibition	Fast, but the fire easily rekindles
Gaseous	CO_2, IG-541, IG-100	Smothering	Limited effect, poor cooling, prone to re-ignition
Gaseous	HFC-227ea, 2-BTP	Cooling, smothering, chemical inhibition	Poor in large spaces, limited cooling, prone to re-ignition
Dry powder	ABC dry powder	Isolation, cooling, smothering, chemical inhibition	Almost no effect, prone to re-ignition
Aerosol	K-type, S-type	Smothering, chemical inhibition	Fast, but prone to re-ignition
Liquid	Water, AF-31, A-B-D	Cooling	Unremarkable cooling, high water consumption, conductive, risk of re-ignition
Liquid	Foam	Cooling, separation	Unremarkable cooling, conductive, risk of re-ignition
Liquid	Ordinary water-based agent	Cooling	Good cooling; conductive, no explosion suppression
Liquid	FW-18	Cooling and chemical inhibition	Rapid fire suppression, efficient cooling, explosion suppression, termination of thermal runaway, insulating and non-conductive

5 · Reports and intellectual property

Item	Count / status
Type test report	1
Commissioned test reports	3
1500 V voltage breakdown test report	1
Technical appraisal certificate for a lithium-ion battery dedicated extinguishing agent (China)	Obtained
Patent applications	32
Authorized invention patents	4
Authorized utility model patents	3
Registered software copyrights	6
Academic papers	26

Notes on this sheet

Tests. The tests in section 3 are in-house tests carried out with the methods named there. They are not certifications. Approval status by market is published separately.

Charts. Curves are digitized from the published chart images of the FW-18 technical presentation (2026-01-27). Approximate: about +/-9 s and +/-1.5 °C on the thermal-runaway charts; where lines overlap, the hidden line is taken to follow the line covering it. Not the raw logger data. The full tables are in the CSV files of the test data kit.

Comparison agent. “A mainstream Li-ion extinguishing agent” is a commercially available agent tested under the same procedure; it is not named.