

solid-state and pouch cell test setups

Next-generation battery cell testing

Pressure, temperature and thickness data from the first pressing step to the last cycle, for solid-state and pouch cells. Custom jigs and fixtures from our Engineering Hub.



30 to 45 days

standard lead time

24 months

warranty on every setup

24 hours

guaranteed response time

Which setup fits your research?

Reliable data starts with controlled conditions. Choose the setup that matches your research question.

format	your research question	setup	key spec
● solid-state	Airtight screening of new materials, with scarce or larger samples	ASC-X	0 to 400 MPa
● solid-state	Long-term cycling at constant pressure	ASC-AD	5 to 100 MPa, constant
● solid-state; liquid electrolyte	Low-pressure studies with pressure and swelling data	ASC-AD+	0 to 100 MPa
● solid-state	Conductivity versus temperature, with a reference electrode	ASC-T+	25 to 200 °C
● solid-state	Gas evolution during electrochemical cycling	ASC-G	4 gas channels
● pouch; prismatic	Pouch cells under controlled pressure	ASC-P	0 to 20 kN
● pouch; prismatic	Pouch and prismatic swelling, pressure and temperature mapping	ASC-P+	up to 56 mapping sensors
● pouch	Pouch cells under uniform (isostatic) pressure	ASC-IP	0 to 6 MPa, isostatic

● add-on

Pressure frame

Up to 20 kN ($\approx$ 400 MPa on an 8 mm pellet), fits a glove box antechamber.

● add-on

Control boxes

Pressure display, temperature control, analog output to your cycler.

● add-on

Swelling monitoring

Operando cell thickness, 1 μ m precision, 0.1 μ m resolution.

● add-on

Pressure & temperature mapping

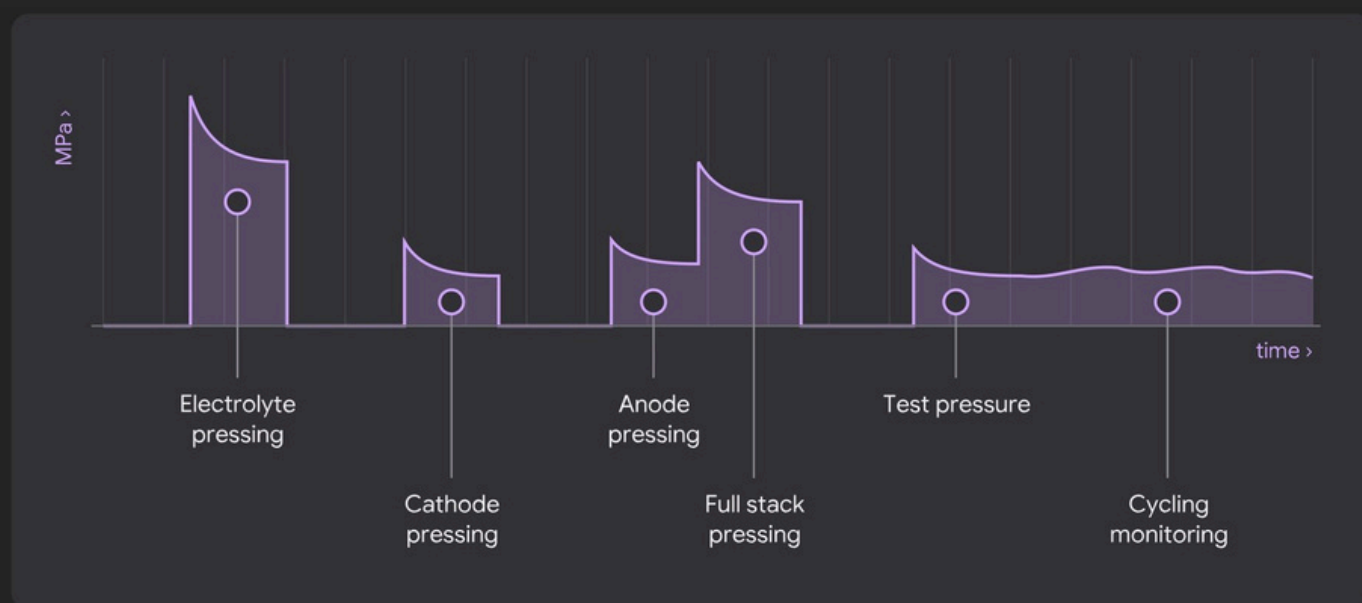
Up to 56 sensors across pouch and prismatic cells, on ASC-P and ASC-P+.

Describe your cell and your research question.
Our engineers will recommend the matching setup.

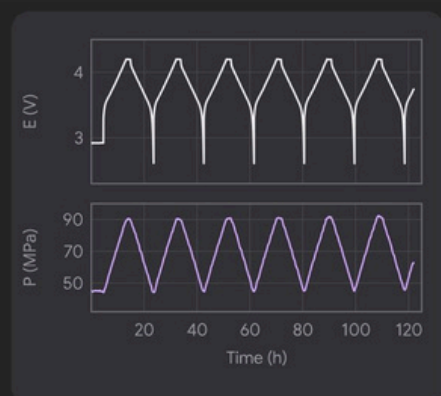
operations@sphere-energy.eu

Electro-chemo-mechanical data, start to finish

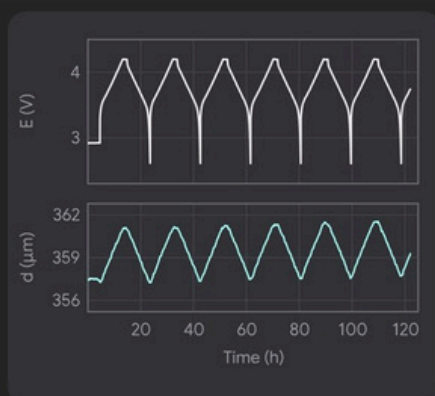
Depending on the setup, ASC cells record pressure from sample preparation through the entire electrochemical test, giving each measurement its mechanical context. Thickness and temperature data are available on selected setups.



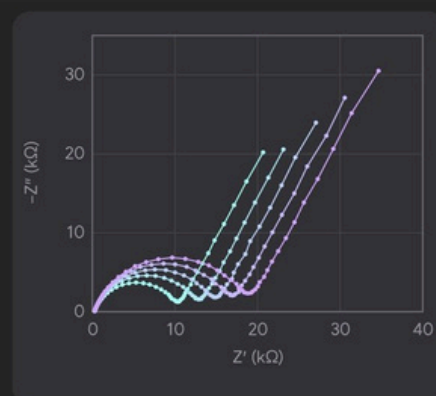
Pressure at every step. Electrolyte, cathode, anode and full-stack pressing, then test pressure and cycling.



Pressure monitoring. Cell voltage and stack pressure over 120 h of cycling.



Thickness monitoring. Cell voltage and sample thickness over the same test.



EIS. Impedance spectra of one sample at different temperatures.

Control boxes send pressure data by analog output to a potentiostat, cycler or computer, so mechanical and electrochemical data can be recorded side by side.

Six experiments, one platform

From pelletization to gas evolution: six ways to add mechanical context to your electrochemical data, and the setups built for each.

	ASC-T+	ASC-X	ASC-AD	ASC-AD+	ASC-G	ASC-P+	ASC-IP
01 Pressure behaviour of samples	●	●	●	●	●	●	●
02 Swelling under fixed pressure	●	●	●	●	●	●	●
03 Ionic conductivity	●	●	●	●	●	●	●
04 Anode and cathode contributions	●	●	●	●	●	●	●
05 Gas evolution	●	●	●	●	●	●	●
06 Isostatic pressure application	●	●	●	●	●	●	●

01 Pressure behaviour of samples

In-situ pelletization of complex material layers, with continuous pressure tracking during sample formation and throughout testing. Used with the ASC pressure frame.

02 Swelling under fixed pressure

Volume expansion and contraction during electrochemical tests. Springs apply a fixed pressure, and swelling monitoring records breathing and swelling behaviour.

03 Ionic conductivity

EIS under precise pressure control, with thickness monitoring. Sample dimensions under applied pressure are correlated with impedance values to support ionic conductivity estimates.

04 Anode and cathode contributions

A reference electrode embedded in the internal insulation sleeve, at the centre of the sample, helps separate anode and cathode voltage contributions.

05 Gas evolution

Built-in gas flow channels interface directly with external gas analysis equipment for real-time analysis of decomposition reactions during electrochemical tests.

06 Isostatic pressure application

Pouch cells under equal pressure from all directions, applied hydraulically up to 6 MPa. Isostatic compression minimises mechanical anisotropy, and built-in pressure monitoring sends data to your cycler.

Several of these experiments can run side by side in one ASC package. See page 15.

ASC-T+

Solid-state testing with temperature control and a reference electrode.

One cell for pressing, heating up to 200 °C and cycling, with pressure monitored from sample preparation to the end of the test.



Up to 400

pressure, MPa

Up to 200

controlled heating, °C

8 to 14.5

sample diameter, mm

5.5 kg

210 × 120 × 100 mm

best for

**Ionic conductivity
versus temperature**

EIS under controlled pressure with thickness monitoring, suited to Arrhenius analysis.

best for

**Separate electrode
contributions**

A reference electrode in the insulation sleeve, at the sample center, helps separate anode and cathode signals.

best for

**Swelling at fixed
pressure**

Spring-loaded fixed pressure mode with optional swelling monitoring.

main features

Multiple sample sizes

Pressure monitoring

Temperature control

Reference electrode

Fixed pressure mode

Compact dimensions

Exchangeable internal sleeves

in the box

ASC-T+ cell with built-in temperature control system

Pistons and sleeves for 8, 10, 12 and 14.5 mm

Ceramic sleeve for 8 mm samples

Internal sleeve with Cu-based reference electrode

Pressure frame with pressure sensor

Control box with temperature control, pressure display and analog output

Sample removing tool and loading holder

Glove box feedthrough adaptor, cables, tools

add-ons

Fixed thickness mode

Swelling monitoring

Multiple spring rates

4-point probe resistivity

ASC-X

Airtight solid-state screening cell with pressure control up to 400 MPa.

One cell for compressing and creating sample cells in situ, charge and discharge tests and ionic conductivity measurements, with pistons for samples of different sizes.



Up to 400

pressure, MPa

-20 to 120

operating temperature, °C

8, 10, 12

sample diameter, mm

750 g

65 × 65 × 57 mm

best for

High-throughput material screening

Rapid interchangeable pistons and simple assembly reduce setup time.

best for

Air-sensitive samples

The airtight design allows testing outside the glove box.

best for

Reproducible pressure

A torque wrench sets the pressure manually; optional pressure monitoring verifies it.

main features

Airtight precision design

Compact size: 65 × 65 × 57 mm

Fixed thickness mode

Exchangeable internal sleeves

Seal decoupled from sample pressure

in the box

ASC-X test cell
Pistons and sleeves for 8, 10 and 12 mm
Torque wrench for manual pressure setting
Sample removing tool and loading holder
Tools, sealing ferrules and cables

add-ons

Pressure monitoring
Swelling monitoring
Fixed pressure mode
Multiple spring rates

ASC-AD

Constant stacking pressure during cycling in an airtight cell.

A spring-based pressure compensation system holds the set stack pressure while the electrode materials expand and contract, so mechanical drift does not distort your results.



Up to 100

constant pressure test,
MPa

Up to 400

sample preparation,
MPa

-20 to 120

operating temperature,
°C

770 g

65 × 65 × 60.5 mm,
8 mm sample

best for

Long-term cycling at
constant pressure

Stack pressure stays
constant while the
electrodes expand and
contract, cycle after cycle.

best for

Adjustable pressure
levels

Plungers and springs with
different spring rates define
the operating pressure.

best for

Stand-alone operation

After pressing in the frame
and sealing, the cell operates
stand-alone, including outside
the glove box.

main features

Airtight precision design

Large pressure range

8 mm sample diameter

Exchangeable internal sleeves

in the box

ASC-AD test cell and compression tool
3 dynamic plungers of different lengths
2 PEEK internal sleeves for 8 mm samples
Sample removing tool and loading holder
Tools, springs, sealing ferrules and cables

add-ons

Pressure monitoring
Multiple spring rates

ASC-AD+

Low-pressure testing from a few kPa to 100 MPa with a built-in pressure sensor.

Designed for low-pressure tests with solid-state or liquid electrolytes and samples of different sizes, in fixed thickness or fixed pressure mode, with pressure and optional swelling monitoring.



Up to 100

pressure, MPa

-20 to 75

operating temperature, °C

8 to 14.5

sample diameter, mm

2.2 kg

90 × 90 × 145 mm

best for

Low-pressure studies

Block the pistons for fixed thickness, or add a spring for constant pressure.

best for

Pressure and swelling data

Live pressure signal to the cyclor, with optional swelling monitoring.

best for

Larger active area

Increase the active surface up to 3.3 times with interchangeable pistons and sleeves.

main features

Multiple sample sizes

Built-in pressure sensor

Exchangeable internal sleeves

Fixed thickness mode

Fixed pressure mode

Multiple spring rates

in the box

ASC-AD+ test cell

Control box with pressure display and analog output

Pistons and sleeves for 8, 10, 12 and 14.5 mm

Sample removing tool and loading holder

Glove box feedthrough adaptor

Loading tools, springs, o-rings, cables

add-ons

Swelling monitoring

ASC-G

Real-time analysis of gas evolution during cycling.

Four gas flow channels connect the cell to external gas analysis equipment, such as a mass spectrometer, during electrochemical tests.



Up to 400

pressure, MPa

-20 to 80

operating temperature, °C

4 channels

gas inlet and outlet

740 g

65 × 65 × 56 mm

best for

Decomposition reactions

Identify which gases evolve, and when, during electrochemical measurements.

best for

Electrode-resolved gas analysis

Channels can be configured to separate gases evolved at each electrode.

best for

Defined pressure at the sample

A calibrated torque wrench and a torque-to-pressure table set the applied pressure.

main features

Gas flow channels

Airtight

Large pressure range

8 mm sample diameter

Fixed thickness mode

in the box

ASC-G test cell

Calibrated torque wrench

4 PEEK inlet and outlet tubes, 50 µm inner diameter

Sample removing tool and loading holder

Tools, ferrules, channel stoppers, cables

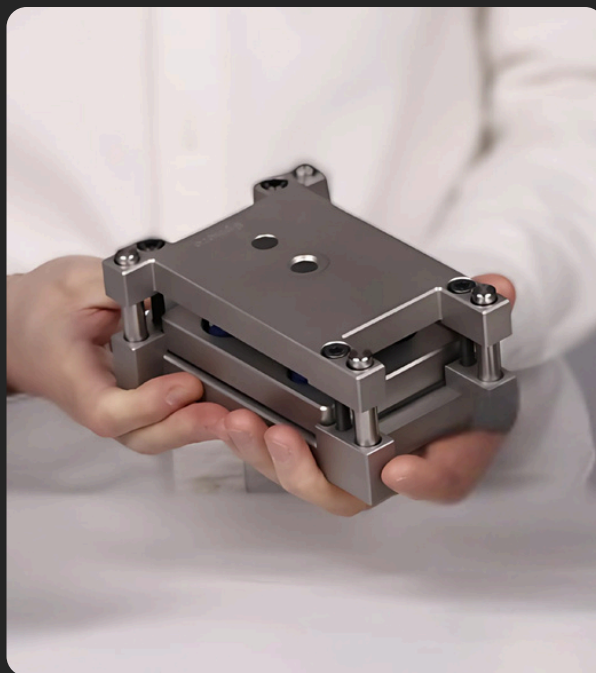
add-ons

Pressure monitoring

ASC-P

Pouch cell testing under defined pressure, up to 20 kN.

Screws and springs set the mechanical stress. Tab contacts protection, connecting the cell to the cycler through the jig. Playground for testing different spring rates and performing swelling measurements.



Up to 20

force, kN

-20 to 80

operating temperature, °C

108 × 75 × 8

max cell size, mm

3.8 kg

157 × 112 × 70.5 mm

best for

Pouch cell prototyping

Test durability and performance under defined pressure.

best for

Pressure stabilization

Three spring rates (216, 98 and 32 N/mm) accommodate cell swelling. More available on demand.

best for

Swelling tracking

Optional swelling monitoring follows volume expansion.

main features

Fixed thickness mode

Fixed pressure mode

Multiple spring options

Protected tab connection

High force, up to 20 kN

Compatible with ASC pressure frame

in the box

ASC-P testing setup

Torque wrench for manual pressure

Spring sets: 216, 98 and 32 N/mm (medium, low and extra low force)

Pressure pads (automotive)

Tools, screws and accessories

add-ons

Pressure monitoring

Built-in pressure sensor

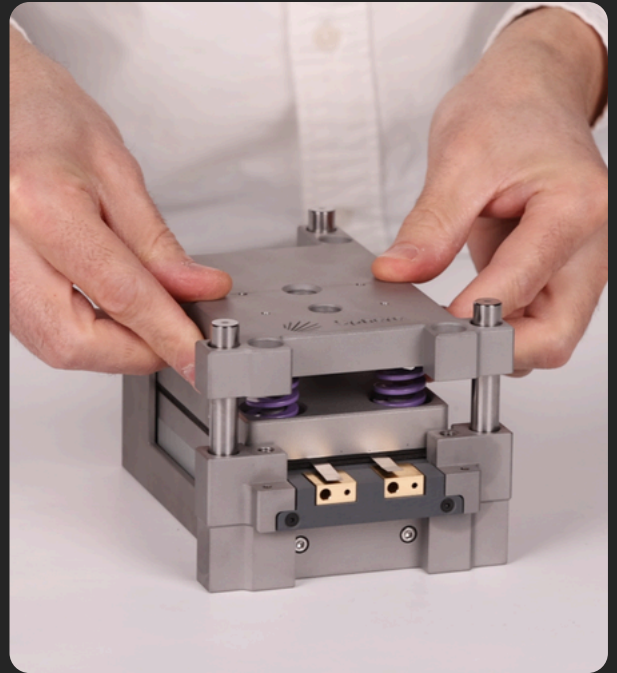
Swelling monitoring

Pressure and temperature mapping

ASC-P+

Pouch testing with real-time pressure and swelling data.

Protected tab contacts connect the cell to the cycler through the jig. A playground for testing different spring rates and performing swelling measurements.



Up to 20

force, kN

-20 to 80

operating temperature, °C

0.1 μm

thickness resolution
(add-on)

4.8 kg

157 × 112 × 100 mm,
cell up to 108 × 75 × 8

best for

Swelling and reversible expansion

Track thickness over long cycling and see reversible expansion in each cycle.

best for

Spatial pressure and temperature maps

Up to 56 sensors map pressure and temperature across the cell surface.

best for

Fixed-force testing

Three spring rates keep pressure stable while the cell swells. More options available on demand.

main features

Built-in pressure monitoring

Fixed thickness mode

Fixed pressure mode

Hybrid mode

Multiple spring options

Protected tab connection

High force, up to 20 kN

in the box

ASC-P+ testing setup with built-in pressure sensor

Analog data output

Spring sets: 216, 98 and 32 N/mm (medium, low and extra low force)

Pressure pads (automotive)

Tools, screws and accessories

add-ons

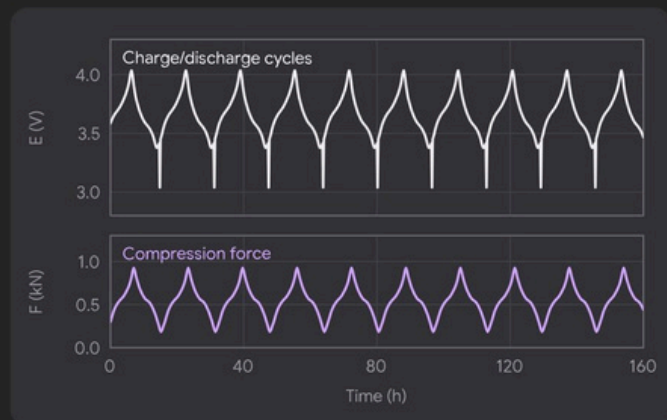
Swelling monitoring

Pressure mapping

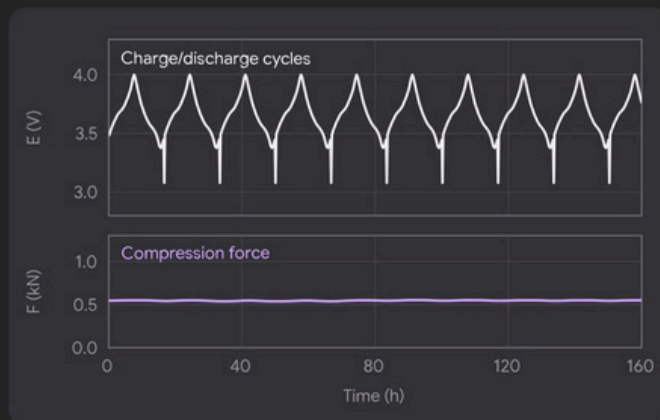
Temperature mapping

Watch your pouch cell breathe

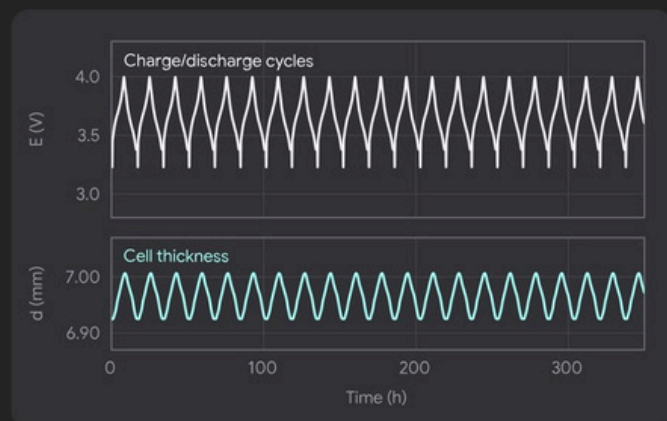
Data recorded with the ASC-P+ on a Li-ion pouch cell. Choose how pressure is applied, then follow force and thickness through every cycle.



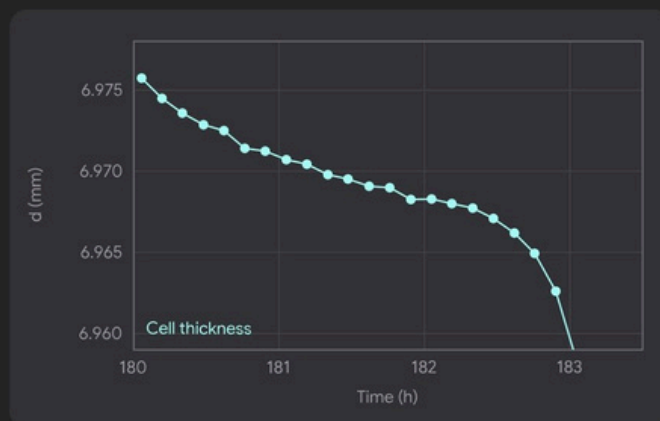
Fixed thickness. The plates are locked, so the force rises and falls with every charge and discharge.



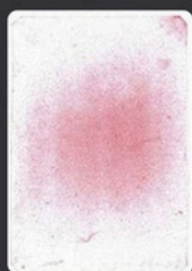
Fixed force. Springs absorb the swelling, so the force stays almost constant.



Breathing. Cell thickness over time at fixed force; the reversible expansion of each cycle is resolved.



Micrometer scale. Zoom into thickness data, showing that even changes below 1 μm can be tracked.



bare plates



with pressure pads



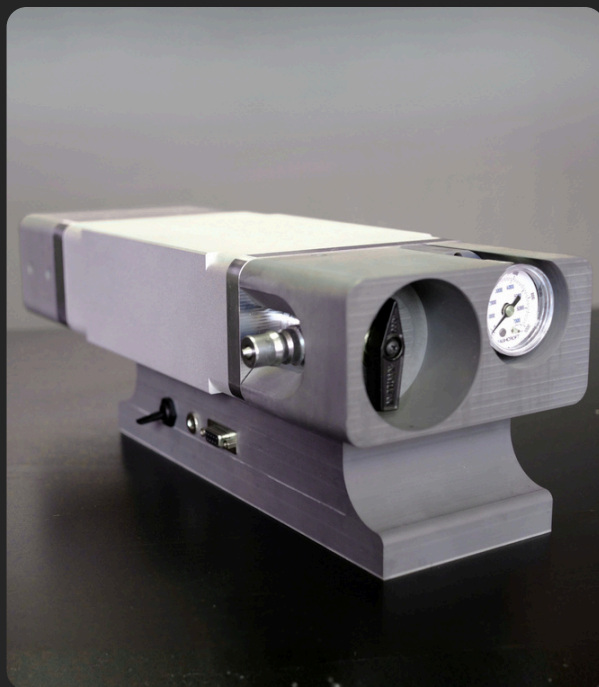
on a pouch cell

Uniform pressure, verified. Fujifilm Prescale films on bare plates, with pressure pads, and on a pouch cell.

ASC-IP

Isostatic pressure on pouch cells: equal force from all directions.

Isostatic compression minimises mechanical anisotropy, so with the ASC-IP you can see the true performance potential of your battery cell without manufacturing bottlenecks.



Up to 6

pressure, MPa (60 bar)

0 to 80

operating temperature, °C

Hydraulic

manual pump, pressure
data to your cycler

4 kg

352 × 120 × 132 mm

best for

Uniform pressure
studies

Test pouch cells under perfect
pressure distribution.

best for

Flexible pouch formats

Spacious cavity and
repositionable clamp or screw
tab connectors fit many sizes.

best for

Synchronized data

Built-in pressure monitoring
sends data to your cycler or
potentiostat.

main features

Isostatic pressure

Hydraulic pump and manometer

Thermocouple for sample temperature

Pressure monitoring and data transfer

Clamp or screw tab connectors

in the box

ASC-IP isostatic test cell
Hydraulic pump for manual pressurization
Hydraulic pressure monitoring with automatic data transfer
Pouch cell connectors and thermocouple
Cables, connection leads and user guide with test protocols

add-ons

Further upgrades on request

Add-ons that grow with your experiments

Most ASC setups share the same pressure frame, control boxes and monitoring options. When your research question changes, you extend your setup instead of replacing it.

● for all ASC cells

Pressure frame

Applies and monitors up to 20 kN, about 400 MPa on an 8 mm pellet. Small enough for a glove box antechamber. Works with all ASC cells and ASC-P.

● control box

For temperature and pressure

Shows the pressure on the sample in real time, controls the ASC-T+ temperature and sends pressure data to your cyclor by analog output. Optional programmable PID for temperature protocols available.

● control box

For pressure

A simpler box that displays the pressure on the sample across ASC cell types, with analog output to your cyclor.

swelling monitoring

Operando

Displacement sensor on the pressure frame. 1 μ m precision, 100 nm resolution, recorded by analog output.

In situ

Micrometer on the pressure frame with built-in display. 3 μ m precision, 1 μ m resolution.

Wireless

Press a button on the micrometer and the reading lands in an Excel table. Transmitter, receiver and cables included.

pressure & temperature mapping for ASC-P and ASC-P+

Thin sensor pads sit in direct contact with the cell and show where pressure and heat concentrate. Developed with Flexoo (Germany).

- Up to 56 detection points
- Pressure 1 kPa to 5 MPa, <3 % accuracy
- Temperature 20 to 100 °C, <1 °C accuracy
- Up to 9 maps recorded at the same time



Pressure map of a pouch cell.
High- and low-force zones, followed through cycling.

Complete test packages

Each package combines cells, pressure frame, control box and accessories, ready for your first test.



ASC package

Three solid-state cells in parallel for screening, long-term and advanced tests.

ASC-T+ · ASC-X · ASC-AD

Pressure frame · ASC control box

Calibrated torque wrench



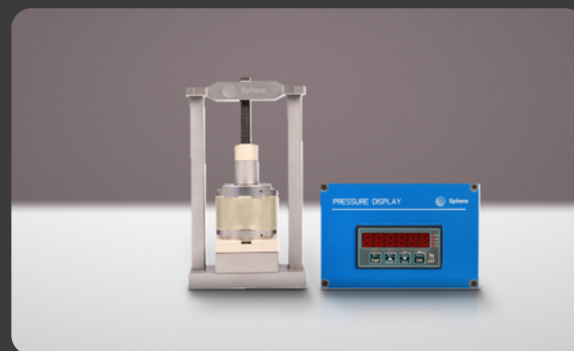
ASC+ package

Extended pressure range with real-time pressure data.

ASC-T+ · ASC-AD+

Pressure frame · control boxes

Pistons and sleeves up to 14.5 mm



ASC-X package

Air-sensitive materials, tested outside the glove box under monitored pressure.

ASC-X airtight cell

Pressure frame · control box for pressure

Calibrated torque wrench



ASC-P package

Pouch cell prototyping at fixed thickness or fixed pressure.

ASC-P jig · pressure frame · control box

Three spring sets (216, 98, 32 N/mm)

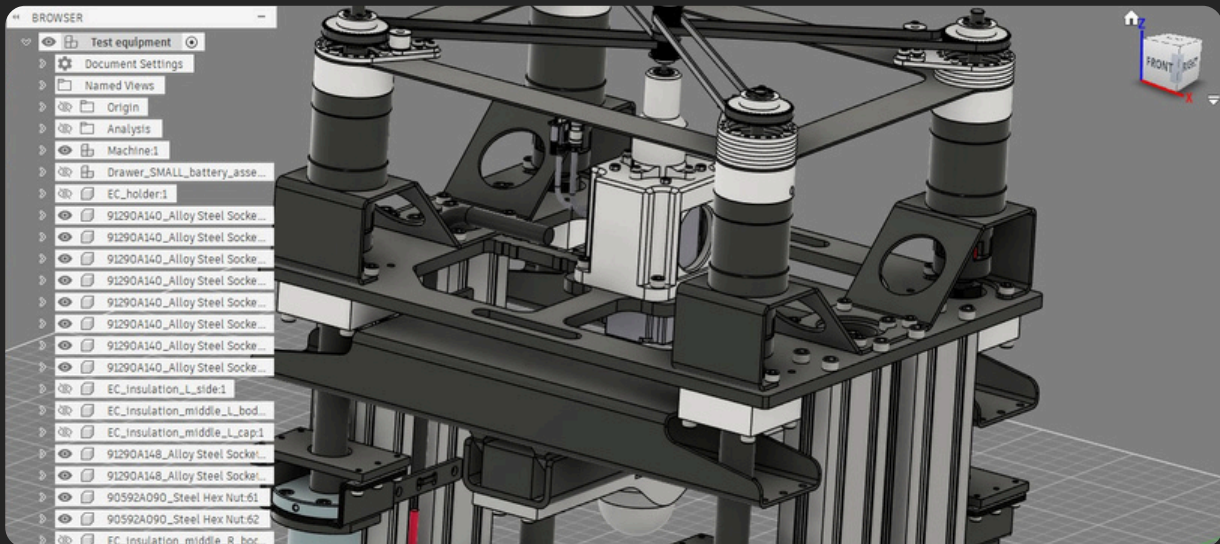
Torque wrench · feedthrough adaptor

Need pressure mapping, ASC-IP or another combination? Tell us about your experiment and we will put the package together with you.

operations@sphere-energy.eu

Custom test setups for any cell format

Jigs, fixtures and complete test setups, from a single prototype to series production. Designed and built in-house on the ASC platform. If your cell does not fit our standard line, this is where we start.



how it works

01

Brief

Send a drawing, cell specification or test protocol.

02

Design

Our engineers propose a concept and a quote.

03

Prototype

One unit built and validated with you.

04

Series

Repeat orders at the volume you need.

what we build

Compression jigs and cell holders
Fixtures with pressure and temperature sensing
Complete test setups for cycler integration
Series production of proven designs

any cell format

pellet

coin

pouch

cylindrical

prismatic

Informed by the design rules of the ASC line. Your drawings stay confidential; we can work under NDA.

Send us a drawing or a cell spec. First feedback within 24 hours.
operations@sphere-energy.eu

35+

Peer-reviewed publications

Studies by research groups using ASC setups.

6+ years

2020-2026

Six years of results published by the research community with ASC cells.

four research clusters

cluster #1

Sulfides & Argyrodites

Reactivity, thermal limits and scalable processing of thiophosphate electrolytes.

cluster #2

Silicon & Advanced Mechanics

Managing silicon's volume change under controlled external cell pressure.

cluster #3

Halide, Oxide & Polymer Electrolytes

Chloride, bromide, oxide and polymer matrices that widen the stability window.

cluster #4

Interfaces & Diagnostics

Sub-micron solid-solid contact, three-electrode cells and operando pressure monitoring.

what researchers say

"One of the challenges of solid state battery research is the use of different cell designs which are often manufactured in university workshops. Sphere Energy solves this issue by providing high-quality, precision-machined test cells to enable standardised and reproducible electrochemical testing."

Dr. David McNulty
University of Limerick

"Using the testing equipment from Sphere Energy, we have been able to access the mechanical properties of solid-state batteries during electrochemical characterizations. This has allowed us to practically explore new materials and concepts."

Dr. Florian Strauß
KIT / BASF Joint Laboratory BELLA

"Sphere Energy's setups provide quick access to characterizing new materials and concepts for solid-state batteries, helping advance research in this challenging field."

Dr. Abhik Banerjee
TCG CREST

Let's build your next result

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Selected publications

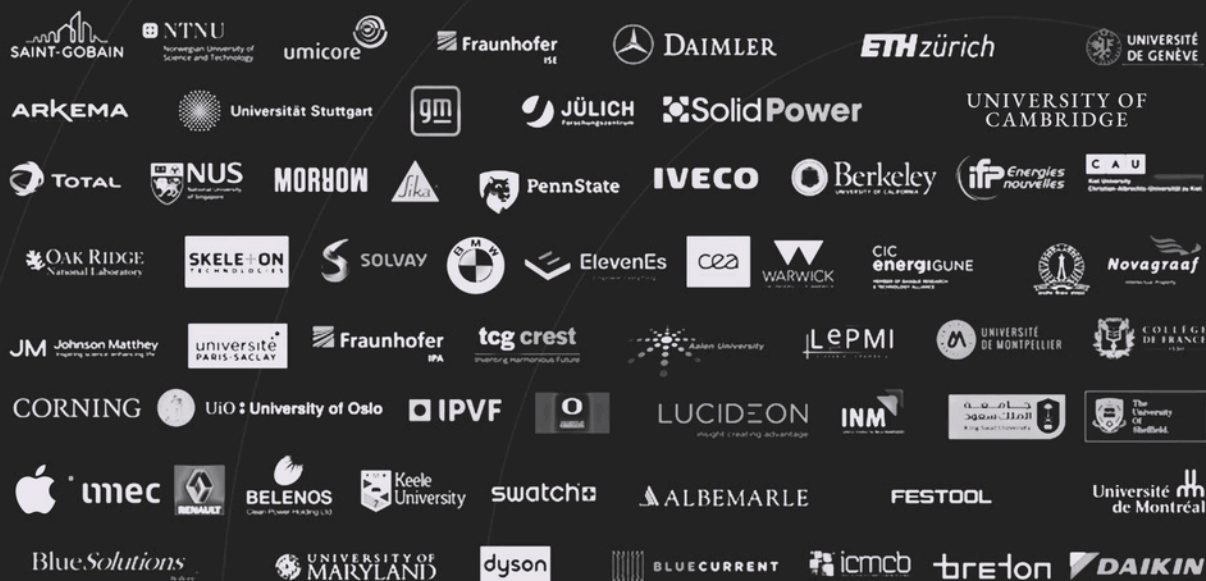
A selection of the 35+ peer-reviewed publications highlighting ASC equipment. Full list on request.

- Artal, R., et al. (2025). Cation disorder and lithium conductivity in mechanochemically synthesized chloride solid electrolytes. *Solid State Ionics*, 428, 116952.
- Brighi, M., et al. (2022). Mechanical behavior and dendrite resistance of closo-hydroborate solid electrolyte. *Advanced Materials Interfaces*, 9(3), 2101254.
- Dugas, R., et al. (2021). Engineered three-electrode cells for improving solid state batteries. *Journal of The Electrochemical Society*, 168(9), 090508.
- Karkera, G., et al. (2023). A structurally flexible halide solid electrolyte with high ionic conductivity and air processability. *Advanced Energy Materials*, 13(30), 2300982.
- Kissel, M., et al. (2026). Toward efficient development and reliable benchmarking of novel CAM coatings for solid state batteries. *Journal of The Electrochemical Society*.
- Klimpel, M., et al. (2025). Dual-layer Li metal all-solid-state battery based on an argyrodite-type $\text{Li}_6\text{PS}_5\text{Cl}$ catholyte and a garnet-type $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ separator. *ACS Applied Energy Materials*.
- Malik, Y. T., et al. (2026). Correlating (chemo-)mechanical coupling in TiS_2 during Li^+ intercalation across liquid and solid electrolytes via operando analysis. *ACS Energy Letters*.
- Mandal, L., et al. (2024). Evolution of interfacial electro-chemo-mechanics between lithium metal and halide solid electrolyte. *Chemistry of Materials*, 36(20), 10336–10350.
- Mandal, L., et al. (2026). Tuning the electrochemical stability window of Li_3YCl_6 by fluorine doping to enable 4.8 V solid-state battery. *Journal of The Electrochemical Society*.
- Marchini, F., et al. (2020). Li-rich layered sulfide as cathode active materials in all-solid-state Li-metal batteries. *ACS Applied Materials & Interfaces*, 12(13), 15145–15154.
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- Neumann, T., et al. (2025). Chemical prelithiation of silicon powder and its role as anode material for all-solid-state batteries. *Batteries & Supercaps*, 2500332.
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- Samanta, S., et al. (2024). Ionocovalency of the central metal halide bond-dependent chemical compatibility of halide solid electrolytes with $\text{Li}_6\text{PS}_5\text{Cl}$. *ACS Energy Letters*, 9(8), 3683–3693.
- Sánchez-Ahijón, E., et al. (2024). Paper-like 100% Si nanowires electrodes integrated with argyrodite $\text{Li}_6\text{PS}_5\text{Cl}$ solid electrolyte. *Batteries & Supercaps*, 7(12), e202400292.
- Shen, F., et al. (2023). Tape casting of thin electrolyte and thick cathode for halide-based all-solid-state batteries. *Journal of The Electrochemical Society*, 170(10), 100505.
- Shen, F., et al. (2025). Optimization of catholyte for halide-based all-solid-state batteries. *Journal of Power Sources*, 640, 236709.
- Šivavec, J., et al. (2025). On the feasibility of pairing pyrochlore iron(III) hydroxy fluoride cathode with argyrodite $\text{Li}_6\text{PS}_5\text{Cl}$ solid-state electrolyte for low-cost all-solid-state batteries. *Batteries & Supercaps*, e202400731.
- Šivavec, J., et al. (2026). Low-pressure cycling of lithium metal anodes with argyrodite solid-state electrolytes enabled by an Sb-based interfacial layer. *Energy Storage Materials*.
- Springl, E. B., et al. (2025). Performance optimization of electrospun lithium-ion conducting PAN/PEO solid polymer electrolyte. *Inorganic Chemistry*.
- Yadav, P., et al. (2025). Solid-state lithium metal batteries with improved performance via polymer electrolyte interface modification. *ACS Applied Materials & Interfaces*.
- Yang, J., et al. (2025). Glass-ceramic lithium thiophosphate electrolytes with enhanced conductivity and (chemo)mechanical properties for all-solid-state batteries. *Chemistry of Materials*.

next-generation battery cell testing



our customers



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www.sphere-energy.eu
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