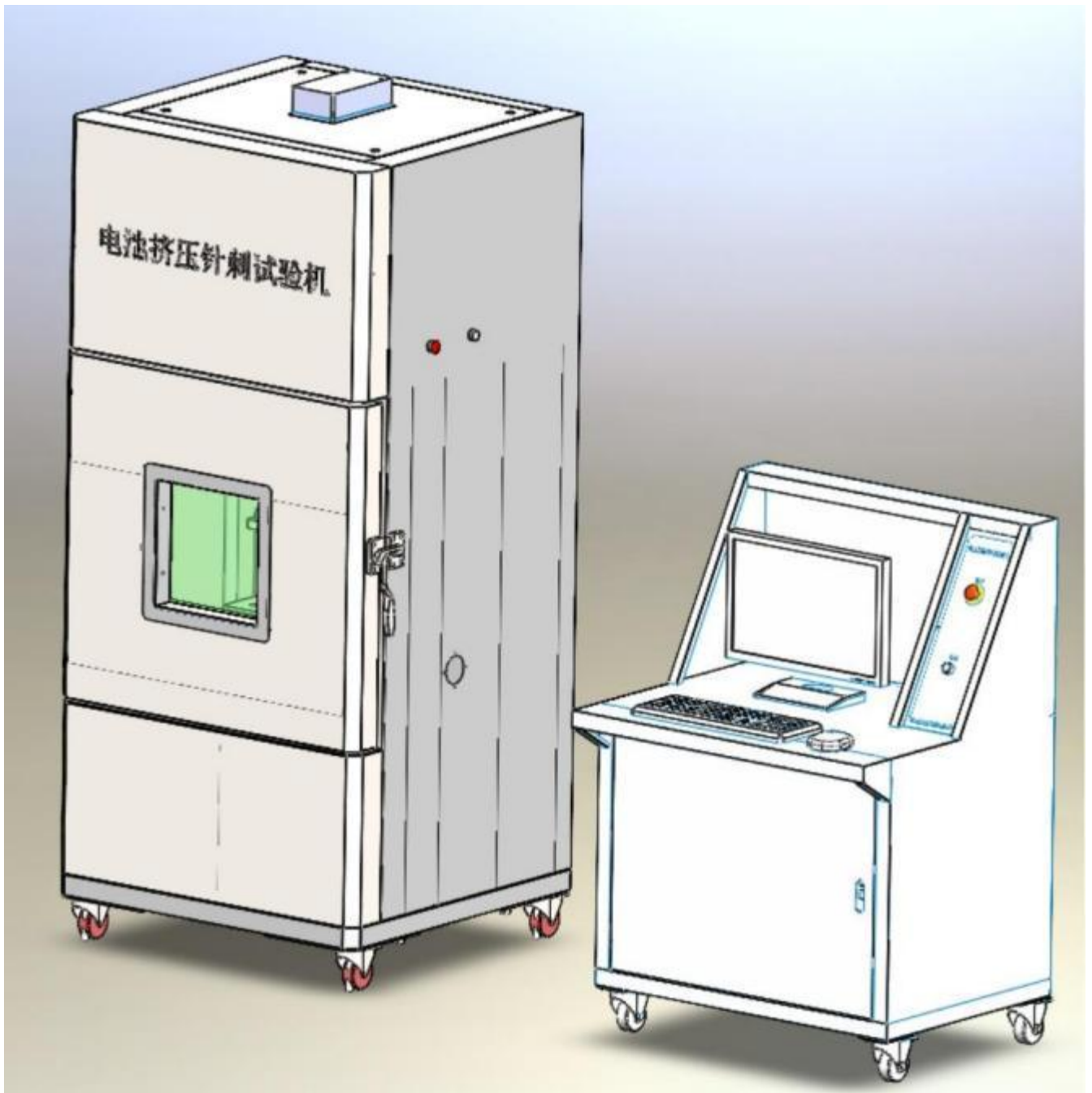


Battery Crush and Needle Penetration Tester

Technical Solution

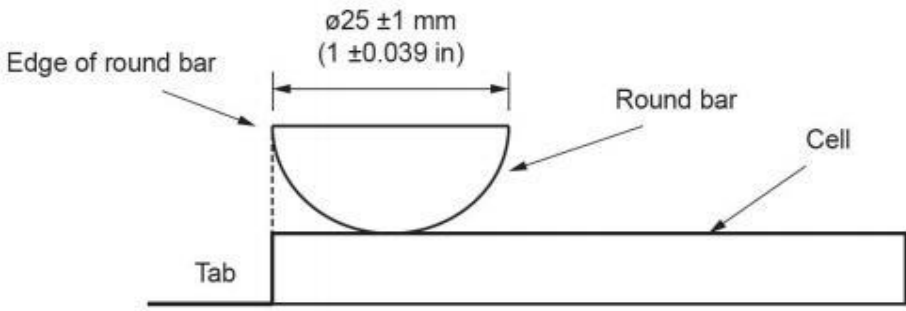


Appearance reference picture

| 1. Main Technical Parameters | | |
|--|--------------------------------|--|
| Serial Number | Project Name | Specifications |
| 1.01 | Product Name | Battery Crush and Needle Penetration Tester |
| 1.02 | Product Model | KP-8101C |
| 1.04 | Structural Method | Vertical: Servo electric cylinder transmission structure |
| <p>1.05 Test Battery GB31241-2022</p> <p>Cylindrical battery; square battery; button battery; soft pack battery; the test diagram is as follows</p> <div style="text-align: center;"> <p>a) 圆柱型电池 b) 方型电池(硬壳) c) 扣式电池 d) 方型软包装电池</p> </div> <p>图 4 挤压试验中电池放置示意图</p> | | |
| 1.06 | Control Method | Remote computer control |
| 1.07 | Test Space Size | Maximum extrusion test space size W300*D300*H300 mm Workbench height 770mm about |
| 1.08 | Explosion-Proof Test Inner Box | <ol style="list-style-type: none"> 1. Inner box size: W680*D620*H600mm (subject to design) 2. Inner box material: stainless steel SUS304 3. There is a smoking port on the top of the inner box: the aperture is $\phi 102\text{mm}$. Exhaust volume $300\text{m}^3/\text{h}$ 4. Rear of the inner box: Explosion-proof pressure relief vent with protective screen to prevent batteries from flying out during testing. 5. Right side of inner box: open 1 Aperture $\phi 50\text{mm}$ Test port , convenient for collecting battery temperature and voltage. |
| 1.09 | Extrusion Force Range | 1~15KN (adjustable) |
| <p>1.10 Force Control Accuracy</p> <p>Up and down 1 A set of force sensors can be used at the same time without disassembly and replacement;</p> <p>1kN When squeezing force, force accuracy: $\leq \pm 0.01\text{kN}$ (steady state)</p> <p>15kN When squeezing force, force accuracy: $\leq \pm 0.7\text{kN}$ (steady state)</p> <p>Standard test pressure gauge is as follows</p> | | |

**Table 14A.1
Round Bar Crush Test Crush Force**

| Cell width | | Force | |
|------------|-----------------|-------|----------|
| mm | (in) | kN | (lbf) |
| 0 ≤ 25 | (0 ≤ 0.98) | 1 | (224.8) |
| > 25 ≤ 30 | (> 0.98 ≤ 1.18) | 3 | (674.4) |
| > 30 ≤ 40 | (> 1.18 ≤ 1.57) | 4 | (899.2) |
| > 40 ≤ 50 | (> 1.57 ≤ 1.97) | 5 | (1124.0) |
| > 50 ≤ 60 | (> 1.97 ≤ 2.36) | 6 | (1348.9) |
| > 60 ≤ 65 | (> 2.36 ≤ 2.56) | 7 | (1573.7) |
| > 65 ≤ 70 | (> 2.56 ≤ 2.76) | 8 | (1798.5) |
| > 70 ≤ 75 | (> 2.76 ≤ 2.95) | 10 | (2248.1) |
| > 75 | (> 2.95) | 13 | (2922.5) |

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| 1.11 | Force Sensor | <p>The above force sensor can be used for small force 0 Point judgment; thickness detection, effectively improving the force deformation detection accuracy of small batteries</p> <p>The following high-force sensors are used for high-force experimental tests, such as 13kN</p> <p>The upper and lower force sensors can be used together without disassembly, which does not affect the test</p> |
| 1.12 | Maximum Stroke | 0~300mm |
| 1.13 | Displacement Accuracy | ±0.1mm |
| 1.14 | Displacement Resolution | 0.01mm |
| 1.15 | Test Speed | <p>Extrusion test speed 0.1mm/S~15mm/S (adjustable)</p> <p>Acupuncture test speed 0.1mm/s~40mm/s (adjustable)</p> |
| 1.16 | Speed Accuracy | ±0.1mm/s |
| 1.17 | Velocity Resolution | 0.01mm/s |
| 1.18 | Time Range | 0~9999S (adjustable) |
| 1.19 | Extrusion Head | <p>(1) Diameter of flat extrusion head: φ 150mm;</p> <p>(2) Cylindrical extrusion head: φ25mm long 200mm;</p> <p>(3) Soft pack, semi-cylindrical extrusion test diagram is as follows</p>  |
| 1.20 | Pressure Relief Port | <p>There is a pressure relief door at the rear of the inner box W300mm * H300mm; Automatically open in case of battery explosion, explosion-proof and pressure relief</p> |

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| 1.21 | Explosion-Proof Chain | The door is equipped with 2 Explosion-proof chains prevent the door from being blown away and injuring people. It plays a role of safety protection. |
| 1.22 | Smoke Exhaust Function | The top of the test inner box is equipped with a smoke exhaust boiler induced draft fan: it discharges smoke from the test inner box, explosion-proof and fire-proof. The stainless steel smoke exhaust pipe extends from the rear: outer diameter DN102mm. Exhaust volume 450m ³ /h |
| 1.23 | Lighting Function | Windows internal installation 2 strip led Light: Illuminates the entire test chamber, making it easy to see the test status inside the chamber. It is also explosion-proof and fire-proof. |
| 1.24 | Explosion-Proof Glass Windows | The test chamber door is equipped with a 300*300mm Explosion-proof glass window allows clear observation of the test conditions in the test chamber |
| 1.25 | Access Control Security Design | There is an access switch above the door. The vacuum pump cannot be started when the door is not closed, making the operation safer and more reliable. |
| 1.26 | Control Panel Safety Design | The control panel is built-in with an inclined surface. The buttons are placed inside so that they cannot be accidentally pressed or hit by external objects or the body. It is safer. |
| 1.27 | Equipment Operation Safety Reminder Design | The equipment is equipped with a three-color alarm light to remind personnel of the current test operation status of the equipment to avoid misoperation during operation. |
| 1.28 | Voltage Acquisition Channel | 2 aisle |
| 1.29 | Voltage Acquisition Range | 0~10V |
| 1.30 | Voltage Acquisition Accuracy | ±0.2%FS |
| 1.31 | Voltage Acquisition Rate | 1-50Hz Adjustable |
| 1.32 | Temperature Acquisition Channel | 2 aisle |
| 1.33 | Temperature Collection Range | 0~800°C |
| 1.34 | Temperature Acquisition Accuracy | ± 1.5°C |
| 1.35 | Temperature Acquisition Rate | 1-10Hz Adjustable |
| 1.36 | Computer Configuration | Lenovo host: WIN7, CPU:i5, running memory: 16G, Hard Drive: 2t Lenovo monitor:19 inch Keyboard and mouse: 1 set |
| 1.37 | Test Shutdown Conditions | Can be set: force, displacement, temperature, voltage as shutdown conditions |
| 1.38 | Data Saving and Export | Force, displacement, voltage, temperature, time, monitoring and control, and data can be saved and exported Excel format. All parameters can be displayed on the same interface through the software interface curve icon, and can also be screenshot and saved PDF Image format.. |
| 1.39 | Steel Needle | Material: SKD11; Needle tip angle 45 ° |

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| | | Outer diameter: Ø3 length 100mm--5 strip Outer diameter: Ø5 length 100mm--5 strip |
| 1.40 | Dimensions | Extrusion Needle Punching Host Machine: W850 X D800 X H1970mm Computer control cabinet: W830 X D750 X H1200mm |
| 1.41 | Equipment Weight | Approx. 350kg |
| 1.45 | Power Supply | AC 220V 50HZ |
| 1.43 | Total Power | 1.5 KW |
| 1.44 | Provide belt CNAS A qualified measurement certificate issued by a third-party testing agency with the mark . | |
| 1.45 | Provide a performance certificate of providing relevant specification testing equipment to a third-party provincial or above testing agency and attach a copy of the contract. | |
| 2. Product Overview | | |
| 2.01 | Advanced Design | <p>1. Explosion-proof and fire-proof transmission structure: The servo cylinder, force sensor, and control components of the transmission structure are isolated from the test inner box. If the battery explodes or ignites outside the test inner box, it will not be damaged by explosion or fire, and its transmission and control accuracy will not be affected.</p> <p>2. Overload : The test force can be overloaded 150%F*S The force sensor can be used normally in high and low temperature environments ranging from -20°C to +80°C.</p> <p>3. Refractory exhaust fan: The exhaust fan in the smoke exhaust system utilizes a boiler induced draft fan, featuring the following structural characteristics: The negative pressure centrifugal exhaust impeller employs an isolated drive design from the motor. An aluminum alloy heat dissipation flywheel is mounted on the isolation shaft to shield against high temperatures.</p> <p>4. The overall size is small , does not take up space, and saves the cost of the buyer.</p> <p>5. Beautiful and user-friendly: The overall appearance is beautiful and generous, and the installation of the test battery is simple and convenient. The height of the test platform is suitable for people to squat down and operate.</p> <p>6. Safe control panel design: The control panel is built-in and inclined, so the buttons are not accidentally pressed or hit by external objects or the body. It is safer.</p> <p>7. Independent control electrical box: The control circuit is designed in an independent distribution box on the right, separated from the control area and test area; reduce interference, avoid oil and dust, open the electrical box door on the right, the control electrical appliances are clear at a glance , and inspection is convenient</p> <p>8. Remote computer control: The computer is connected to extrusion needle punching host machine via a network cable to achieve remote control</p> |
| 2.02 | Basic Performance | <p>1. Simple operation and control: human-machine interface, computer editing and control ;Place the battery between the upper and lower extrusion plates. Press the test button to automatically complete the test.</p> <p>2. The test inner box is designed with: safety explosion-proof pressure relief; smoke exhaust; lighting; and safety access control design.</p> <p>3. The whole equipment is beautiful and energy-saving.</p> |

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| 2.03 | Main Components | <p>1. Control System + Acquisition System Computer control + multi-channel battery data acquisition</p> <p>2. Vertical transmission structure Servo motor + screw transmission structure</p> <p>3. Other auxiliary functions With visual explosion-proof glass window ;illumination ;Smoke exhaust ;Pressure relief and explosion proof ;Threshold protection ;Emergency stop protection function.</p> |
| 2.04 | Basic Uses | <p>This testing apparatus simulates scenarios where batteries are subjected to compression by objects or puncture by sharp instruments during use. The device demonstrates the various states exhibited by batteries when subjected to compression or needle penetration.</p> |
| 2.05 | Equipment Installation Conditions | <p>1. Installation and Positioning: The equipment may be unloaded using a 3-tonne forklift. Once moved into the laboratory, ensure the rear and both sides of the unit are positioned at least 600mm from the walls. Maintain a minimum clearance of 1500mm at the front for operational access, facilitating battery loading and testing. Secure the equipment in place.</p> <p>2. Connect the power cable to the earth terminal and exhaust duct: Internal diameter DN100mm. The laboratory must be equipped with a dedicated fume extraction duct. This unit's exhaust capacity: 720m³/h.</p> <p>3. The installation distance between the computer control cabinet and the extrusion acupuncture host is ≥ 5 If possible, the computer should be placed in an independent control room.</p> <p>4. Ground load-bearing capacity $\geq 500\text{kg/m}^2$.</p> <p>5. Laboratory: The entire laboratory must have a ventilation system to discharge smoke leaked during testing; the lighting must be good to facilitate viewing of operating equipment.</p> <p>6. The laboratory passages should be convenient for transporting batteries and related transportation vehicles, and personnel can be evacuated in time in the event of special emergencies.</p> <p>7. The laboratory should be equipped with appropriate fire-fighting facilities to facilitate the use of fire-fighting tools.</p> |

3. Product Meets Standards

- GB 31241-2022 Safety Requirements for Lithium-ion Batteries and Battery Packs for Portable Electronic Products
- IEC 62133-1-2017 Safety Requirements for Secondary Batteries or Battery Packs Containing Alkaline or Other Non-acid Electrolytes - Portable Sealed Secondary Batteries and Batteries (Packs) Manufactured from Them for Use in Portable Equipment
- UL 1642-2022 Safety Standard for Lithium Batteries
- UN 38.3 United Nations Manual of Tests and Criteria for the Transport of Dangerous Goods

4. Product Structure and Performance

4.01 Chinese and English Host Computer Control Software

1. The software is installed on a standard Windows The system is easy to learn and operate, meeting the test requirements, and the software can be freely selected in Chinese and English.
The reference diagram of the control interface is as follows



2. Real-time recording of force, displacement, temperature, voltage parameters, time, and can be displayed as a curve on a computer interface, making observation and analysis simple and convenient. Data can be exported to EXCEL sheet.

The reference picture of the acquisition interface is as follows



3. Equipped with multi-channel data acquisition to meet the test requirements, making the analysis of battery performance more convenient.

4.02 Transmission Structure

1. Vertical servo electric cylinder transmission structure.
2. The servo electric cylinder has high transmission precision, is easy to control, simple to maintain, and is energy-saving and environmentally friendly.

4.03 Explosion-Proof Test Chamber and Explosion-Proof Door Design

1. Explosion-proof inner box: Stainless steel inner box explosion-proof design.
2. Pressure relief port: There is a safety explosion-proof pressure relief port at the rear of the test chamber: size W300*H300 mm.

| | | |
|--|--|--|
| | | <p>When the shock pressure generated by the explosion of the inner compartment battery reaches 0.104 Mpa, the pressure relief door will automatically open to vent pressure and prevent explosions. This protects the inner compartment from being destroyed by the blast.</p> <p>3. Smoke exhaust system: There is a smoke exhaust port designed on the top, which discharges high-temperature smoke gas to the outside through the high-temperature resistant boiler wind blower and pipeline.</p> <p>4. Lighting system : The outside of the test chamber is equipped with high-brightness LED. The lights illuminate the entire test chamber, making it easy to observe and monitor.</p> <p>5. Observation window: There is one on the door 300*300 mm The transparent explosion-proof glass window allows people to observe the test conditions in the test chamber.</p> <p>6. Access control system: There is an access control switch installed on the door. The test cannot be started if the door is not closed to prevent accidents.</p> <p>7. Explosion-proof chain: There are two on each side of the door 2 An explosion-proof chain. When the battery explosion force exceeds the force range of the door, the door may be blown open by the explosion shock wave. The chain will pull the door and open it at a small angle to release the explosion force, playing a safety protection role.</p> |
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| 4.04 | Accessibility | <p>(1) Emergency stop protection function: The device's control panel is equipped with 1 An emergency stop switch. When an emergency occurs or you want to stop the test , you can press this switch and the PLC The controller stops outputting and all test actions.</p> <p>(2) Three-color sound and light alarm system: The equipment is equipped with a three-color alarm light to remind personnel of the current test operation status of the equipment to avoid misoperation during operation.</p> <p>(3) Mobile and fixed functions of the equipment The bottom of the device is equipped with 4 Mobile universal wheels and 4 Leveling feet: convenient for moving and positioning the equipment .</p> |
|------|---------------|--|

5. Standard Configuration

| Configuration Name | Quantity | Configuration Name | Quantity |
|--------------------------|----------|---------------------------|----------|
| Host | 1 | Operating Instructions | 1 |
| Computer Control Cabinet | 1 | Factory Inspection Report | 1 |
| | | | |

6. Equipment Accessories List

| Accessory Name | Brand | Accessory Name | Brand |
|----------------|-------|----------------|-------|
|----------------|-------|----------------|-------|

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|--------------------------|--------------------------|------------------------|-----------|
| Servo Motor | Nissin or similar brands | Force Sensor | Dayang |
| Electric Cylinder | Kingpo | Intermediate Relay | Schneider |
| Bearings | NSK | Contactactor | Chint |
| Boiler Induced Draft Fan | Chengyi | Computer Host | Lenovo |
| Steel Needle | Kingpo | Switching Power Supply | MEAN WELL |