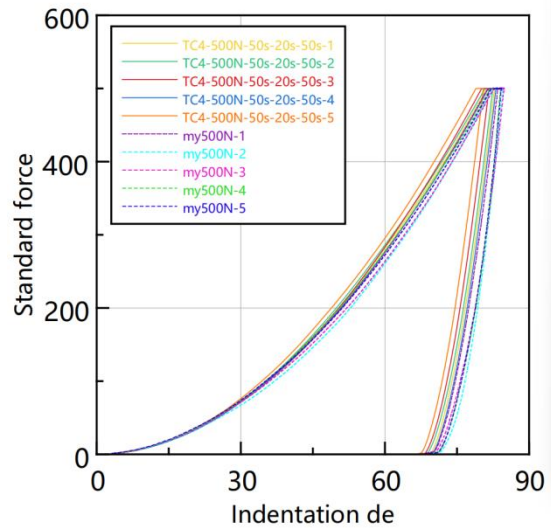


# KASON-CS Indentation Tester



## 1. Technical Principles:

### 1.1 Introduction to Instrumented Indentation Test:

The Instrumented Indentation Test (IIT) is a material property testing method based on the force-displacement curve during the contact between the indenter and the sample.

An indenter (such as a diamond Vickers indenter or a spherical indenter) is pressed into the material surface at a controlled rate using a loading system; simultaneously, the load ( $P$ ) and indentation depth ( $h$ ) data are recorded in real time; a complete  $P$ - $h$  curve is obtained throughout the loading-hold-unloading process; by analyzing the characteristic sections of the curve, a series of mechanical parameters of the material can be obtained.

Compared with traditional hardness testers, the instrumented indentation test can not only provide

a single indicator of "hardness," but also quantitatively evaluate various mechanical properties, such as tensile properties and fracture toughness.

## 1.2 Applied Standards:

International Standard ISO/TR 29381 Metallic materials - Measurement of mechanical properties by an instrumented indentation test - Indentation tensile properties

Korean Standard KSB 0950 Metallic materials - Instrumented indentation test - Indentation tensile properties

Chinese Standard GB/T 39635 Metallic materials - Instrumented indentation test - Determination of indentation tensile properties and residual stress

## 2. Structural Principle:

**2.1 Motion Loading Mechanism:** The loading system uses an electric actuator to drive a ball screw, converting rotational motion into highly linear displacement. The screw nut is fixed to the indenter and, through a connecting structure, drives the force sensor above to move synchronously, achieving synchronous transmission of force and displacement. To ensure the straightness and smoothness of the loading path, the entire mechanism is mounted on a high-precision linear guide system, and pre-tightening eliminates guide clearance, improving motion stiffness and repeatability.

**2.2 Measurement Feedback Mechanism:** The displacement of the indenter is precisely fed back to the displacement sensor through a patented structure independent of the loading mechanism, measuring only the actual displacement of the indenter into the sample. The displacement sensor is mounted in a rigid structure, avoiding interference from the elastic deformation of other components (such as the screw and force sensor) during loading. This structure effectively eliminates the influence of structural elastic deviations during loading on the measurement results, significantly improving the system's measurement stiffness and stability, thereby achieving higher consistency and repeatability.

### 2.3 Force-Displacement Decoupling Design

This system achieves decoupling of force transmission and displacement detection paths: force is transmitted from the actuator to the indenter via a lead screw and force sensor, while displacement is obtained through an independent measurement channel to measure the indentation depth of the indenter. This design significantly reduces the impact of structural coupling errors on measurement accuracy and is one of the key technologies for improving the reliability of results in macroscopic indentation testing.

## 3. Main Technical Parameters:

- Maximum Load: 200 kgf;
- Load Resolution: 2 gf;

- Indenter Stroke: 23 mm;
- Displacement Resolution: 0.1  $\mu\text{m}$ ;
- Loading Speed: 0.1  $\mu\text{m/s}$ ~2000  $\mu\text{m/s}$ ;
- Functions: Rockwell hardness, yield strength, tensile strength;
- Rockwell Indenter: 250  $\mu\text{m}$  radius tungsten carbide spherical indenter, 500  $\mu\text{m}$  radius tungsten carbide spherical indenter;
- Main Unit Dimensions: 350\*250\*160 mm.

## 4. Electrical Design

This system adopts a modular electrical architecture, integrating control, drive, and signal acquisition into one unit, possessing high anti-interference capability and measurement stability.

4.1 Control System: An embedded controller is used, integrating motion control and data acquisition functions. A real-time operating system enables precise control of processes such as loading, displacement acquisition, and data processing. It supports multiple USB communication interfaces for easy integration with host computers or external systems.

4.2 Drive System: A stepper motor, in conjunction with a high-precision reducer, drives the lead screw to achieve pressure head loading. The driver supports microstepping control and closed-loop feedback to ensure displacement accuracy and motion smoothness. The motor drive signal and sensor acquisition channels use independent shielded wiring to reduce electromagnetic interference.

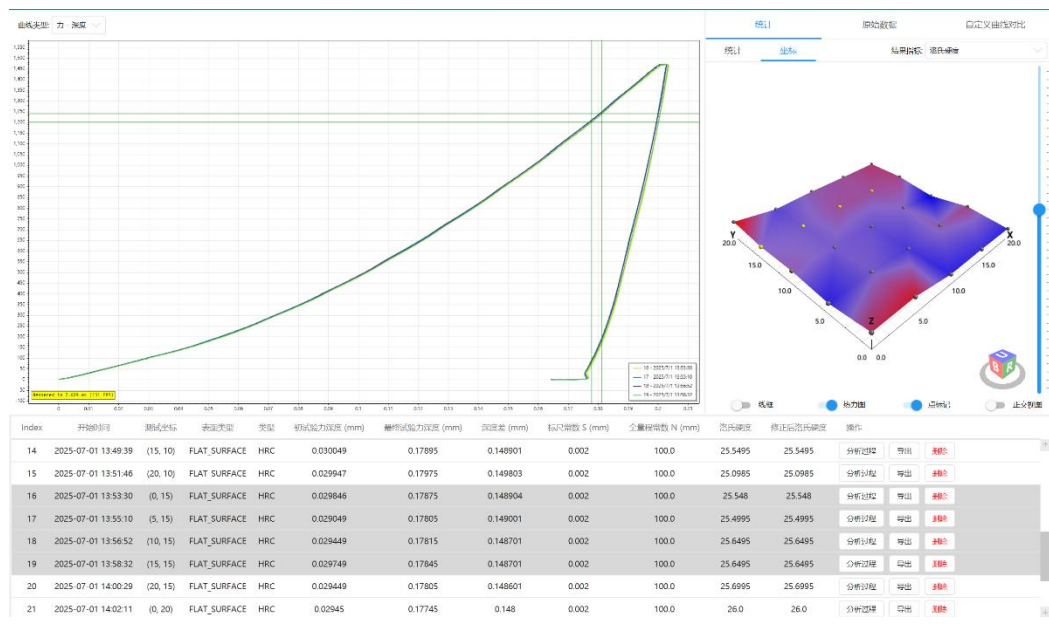
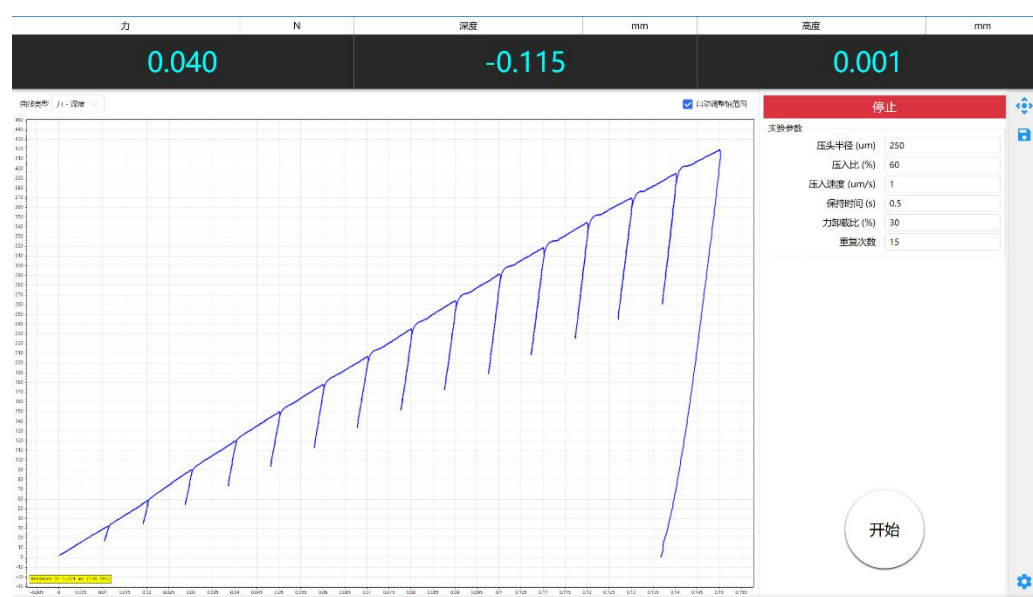
4.3 Signal Acquisition and Processing: Displacement and force values are acquired through high-precision analog sensors, using a 24-bit high-resolution ADC for data acquisition. The system has a built-in signal conditioning module with low-drift amplification, filtering, and temperature drift compensation functions to ensure stable and reliable measurement data.

4.4 Power Management: This system adopts a dual-mode power supply architecture, compatible with both external control box power supply and internal lithium battery power supply. It features automatic switching and system stability assurance mechanisms, enhancing the equipment's portability and field adaptability. The system supports power supply via the control box's internal switching power supply or independent power supply from the device's built-in high-performance lithium battery. When an external power source is detected, the system will automatically switch to external power supply mode, prioritizing the switching power supply to extend battery life. Upon power failure, it automatically switches back to the lithium battery without manual intervention.

## 5. Unique Technologies:

5.1 Main Unit: A unique idle-travel contact indenter structure enables automatic deceleration of the indenter during approach, significantly shortening the approach time before contact.

5.2 Software: One-click testing software utilizes an innovative [sample-project] two-level data management structure, enabling quick management of experimental data through a database. Testers can pre-set parameters and start the test with a single click. The test automatically analyzes the data and saves the results upon completion. It features a convenient and quick results browsing interface, allowing for rapid comparison of multiple experimental data, including numerous statistical indicators, raw data curve comparison, a complete data analysis process and intermediate parameters, and multi-indicator 3D thermogram visualization, greatly facilitating the evaluation of the mechanical properties of the tested object.



5.3 Customizable Experimental Process: The testing platform software, based on innovative ATS scripts, enables fully customizable experimental processes. Users can freely combine various action types (such as open-loop, closed-loop, stop, etc.) and waveforms (dozens of waveforms, such as ramp arrival, sine, cosine, etc.) provided by the platform, and obtain their desired unique experimental process by setting parameters. During the experiment, users can monitor various custom operating parameters in real time, gaining a detailed understanding of every aspect of the experiment. The software includes pre-written ATS scripts based on various testing standards such as tensile properties and residual stress. Users can modify these scripts, such as fine-tuning parameters, to observe their impact on curves or experimental results, making it very convenient and fast.

1) Customizable Analysis Process and AI Assistance: The experimental platform software also features a fully customizable analysis script function. Users can write Python scripts for analyzing any data according to specifications, performing fully customized analysis. The software has built-in analysis schemes defined in several mainstream standards, which users can directly modify, such as fine-tuning parameters, for research. Considering the certain learning curve of Python, the software's custom analysis module has integrated the latest DeepSeek V3.1. Users do not need in-depth Python knowledge to have AI help write scripts or analyze or modify existing scripts through dialogue.

The screenshot displays the software's analysis interface. On the left, a file explorer shows several data files. The main window contains a Python script for finding extrema in a data array. The script defines a function `get_extremum_indices_last` that takes an array and a judgment ratio as input and returns the indices of the maximum and minimum values. The script is executed, and the results are displayed in a table and a graph.

```
13 # 常数参数
14 ratio = 0.005 # 极值识别比例系数
15 fit_point_count = 100 # 拟合数据点数量
16 zeta = 0.14 # 应变计算参数 (几何常数)
17 psi = 3.0 # 屈服力计算参数
18 vs = 0.3 # 试样材料泊松比
19 vi = 0.31 # 压头材料泊松比
20 E1 = 710000.0 # 压头弹性模量, 单位 MPa
21 c = 0.7 # 拟合函数常数项
22
23 def get_extremum_indices_last(extract_type, x_array, y_array, extremum_judgement_ratio):
24     extremum_search_flag = 0
25     extremum_judge_edge = max(y_array) * extremum_judgement_ratio
26     extremum_max = y_array[0]
27     extremum_max_index = 0
28     max_indices = []
29     extremum_min = y_array[0]
30     extremum_min_index = 0
31     min_indices = []
32     for i in range(len(y_array)):
33         y = y_array[i]
34         if extremum_search_flag == 0:
35             if extremum_min - y >= extremum_judge_edge:
36                 extremum_min = y
37                 extremum_min_index = i
38                 extremum_search_flag = 1
39             elif y - extremum_max >= extremum_judge_edge:
40                 extremum_max = y
41                 extremum_max_index = i
42                 extremum_search_flag = 1
43         elif extremum_search_flag == 1:
44             if y >= extremum_max:
45                 extremum_max = y
46                 extremum_max_index = i
47             if extremum_max - y >= extremum_judge_edge:
48                 max_indices.append(extremum_max_index)
49                 extremum_min = y
50                 extremum_min_index = i
51                 extremum_search_flag = 2
52         elif extremum_search_flag == 2:
53             if y <= extremum_min:
54                 extremum_min = y
55                 extremum_min_index = i
56             if - extremum_min >= extremum_judge_edge:
57                 min_indices.append(extremum_min_index)
58                 extremum_max = y
59                 extremum_max_index = i
60                 extremum_search_flag = 1
61     return max_indices if extract_type == "GET_EXTREMUM_MAX_LAST" else min_indices
62
63 def analyze(ch3Data, capturedvalue, extInfo):
```

Table 4: 幂律拟合参数

K (MPa)	n_IT
707.194	0.20847
710.791	0.23851
722.125	0.27254
727.513	0.32183
744.127	0.38417
751.753	0.49249

Table 5: 力学强度特征点

项目	应变 $\epsilon_{IT}$	应力 $\sigma_{IT}$ (MPa)
屈服强度	0.00758	453.92
抗拉强度	0.09075	626.25

Table 6: 材料性能指标汇总

应变硬化指数	弹性模量 (MPa)	屈服强度 (MPa)	抗拉强度 (MPa)
0.1296	81341.09	453.92	626.25

## 19 YEARS

Professional focused on testing equipment

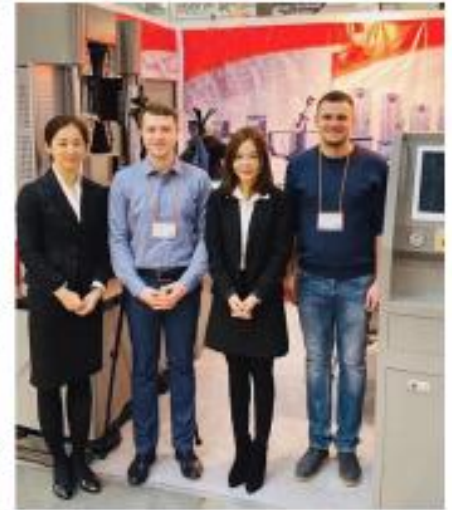
KASON is established in 2003, owns more than 8000 square meters factory. has a professional sales teams, modern enter prise technology center, scientific and technological research and development team.

Machines passed the European CE authentication, American FDA certificate and and ISO 9001.

Products sold to USA, Canada, Australia, Europe, Africa etc, more than 130 countries and supply OEM service for many customers

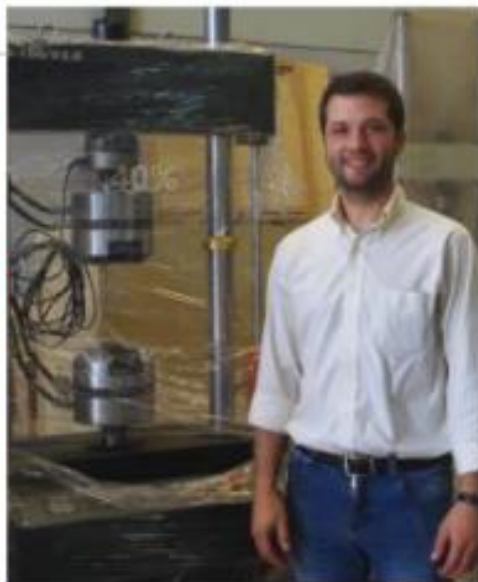
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KASON has a professional sales teams, modern enter prise technology center, scientific and technological research and development team.




## OUR CUSTOMERS (more than 130 countries)





## OUR CERTIFICATE (CE / ISO / SGS)



### MACHINERY DIRECTIVE ATTESTATION OF CONFORMITY

Technical file of the company mentioned below has been inspected and audit has been completed successfully.

2006/42/EC Machinery Directive Annex VIII has been taken as references for these processes.

**Company Name** : Jinan Kason Testing Equipment Co., Ltd.

**Company Address** : No.4715, Jingshi West Road, Huaiyin District, Jinan, Shandong, China

**Related Directives and Annex** : 2006/42/EC Machinery Directive/Annex VIII

**Related Standards** : EN ISO 12100:2010; EN 60204-1:2018

**Product Name** : Testing Machine

**Report No and Date** : TCF-JKTE230605-MD

**Product Brand/Model/Type** : WDS-1, WDS-2, WDS-3, WDS-5, WDS-10, WDS-20, WDS-50, WDS-100, WDS-200, WDS-300, WDW-1E, WDW-2E, WDW-3E, WDW-5E, WDW-10E, WDW-20E, WDW-30E, WDW-50E, WDW-100E, WDW-200E, WDW-300E, WDW-500E, WDW-600E, WDW-1000E, EM103, EM203, EM303, EM403, EM104, EM204, EM304, EM404, EM105, WE-3000D, WE-600D, WE-1000D, WE-2000D, HUT305S, HUT605S, HUT105S, HUT126S, WEW-300D, WEW-600D, WEW-1000D, WEW-2000D, WEW-3000D, HUT305E, HUT605E, HUT105E, HUT126E, HUTAS06E, HUTAS08E, WAW-300D, WAW-600D, WAW-1000D, WAW-1200E, WAW-2000E, WAW-3000, WAW-2000A, WAW-3000A, WAW-4000A, HUTAS06W, HUTAS08W, HUTAS06V, HUTAS08V, HUT105W, HUT126W, WAL, YAW, HUT-L, JB-300, JB-300B, JB-500B, JBS-300, JBS-500, JBW-300, JBW-500, JEM-300, JEM-500, CST-50, VL-2T, VL-1S, DMC-40, DMC-60, DMC-80, DMC-100, DMC-150, YES-1000, YES-2000, YES-3000, YAW-1000, YAW-2000, YAW-3000, YAW-5000, NDS-200, NDS-500, NDS-1000, NDS-2000, NDW-200, NDW-500, NDW-1000, NDW-2000, NDW-3000, NDW-5000, NDW-10000, EZ-1, EZ-2, EZ-10, JWI-10, TJS, TLW, HNS, PLS-20, PLS-50, PLS-100, PLS-300, PLS-500, PLS-1000, KASON-1, RDJ-10, RDJ-20, RDJ-50, RDJ-100, DWIT-20000, DWIT-30000, DWIT-40000, DWIT-50000, DWIT-80000, DWIT-100000, PIT-302, PIT-302M, PIT-502, PIT-502M, PIT-302T, PIT-502T, PIT-302W, PIT-302TW, PIT-502W, PIT502CW, PIT502CW, PIT502CW, PIT302CT, PIT302CT, PIT602CT, PIT752CT, PIT302W, PIT502W, PIT302T, PIT502T, PIT502CW, PIT302CT, PIT452CW, PIT452CT, PIT752CW, PIT752CT, PIT302CT, HCT106, HCT206, HCT306, KSC1M, HVJ, HEZ-3, HEZ-5, HEZ-10, HEZ-20, KSET-10, KASON 370.02, KASON 370.05, KASON 370.10, KASON-370.25, KASON 370.50, MMV, CBW-60B, CB5-60B, HUT, ETM, XNB, CW-40, CW-50, MBS, MMU, MBL, CBW, CW, ISW, HBT, GLY, GCG-1000, GCG-1000, GCG-1000, GCG-1000, GCG-1000, GCG-1000, GCG-1000, GCG-5, GCG-5, GCG-100, HR-150A, HRD-150, HRS-150, XHR, HR, HVS, HV, HBRV, W-20, HBA-1, HBT, Q-2A, MP-2, XQ-2R, XD-30M, 4KCE, 4XB, JSZ, MOPAO, MPT, P, MP, BG, LBG-32, MPJ-35, Q-Z, Q-100R, SQ, Q-3A, QCE-4, ISQ, LQJ, GTQ-5000A, GTQ-5000B, DTQ, ZQJ, 4XC, HST, KASON, KS, KSCUT, HTR, HTRP, HTR, HSTR-455, HTV, HVMV, HTRV, METPRESS, MPJ


**Certificate Number** : M.2023.206.C86313

**Initial Assessment Date** : 07.06.2023


**Registration Date** : 08.06.2023

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**Expiry Date** : 07.06.2028



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### Authentication Certificate of Quality Management System

Registration No.19922Q01072R0S

This is to certify that

#### Jinan Kason Testing Equipment Co., Ltd.

Unified Social Credit Code: 9137010458994939X0  
 Registered/Production Address: No. 4715, Jingshi West Road,  
 Huaiyin District, Jinan City, Shandong Province  
 Office Address: Room 2-1108, Harmony Square, Huaiyin District, Jinan City

In conformity with :

### GB/T 19001-2016/ISO 9001:2015

The certificate is valid for the following scope :  
 Assembly and sales of testing machines

This certificate should be used effectively with the legal requirements of the administrative license, qualification license, compulsory certification, which the certification scope involved.

In the case that the organization regularly receives surveillance assessments, the certificate shall be valid when used together with the Quick Response Code.

Date of Issue: 2022-07-19  
 Date of Expiry: 2025-07-18  
 Date of Initial Certification: 2022-07-19



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