

KS-W600K4L Vertical Four-Station Thermo-Mechanical Tensile Testing Machine**1. Our Advantages**

1.1 Our company adopts an oil cylinder straight-pull structure: equipped with a special composite mandrel calibration tool (rated tensile strength 550kN), which is light in weight and easy to hang. The vertical type does not require climbing, and the horizontal type heat engine can complete the calibration work without a huge workload. .

1.2 The reason why the cylinder straight pull structure is used instead of the reaction frame structure is that the reaction frame structure has the following three disadvantages:

Firstly, calibration is inconvenient and it is necessary to carry a heavy calibration sensor and climb to a height of 4~5

meters for calibration itself. Even if there are maintenance platform protection arrangement, there are still certain safety risks; Secondly, the reaction frame structure is at the top of the equipment, making the equipment top heavy, which inevitably requires higher foundation production;

The last and most important point is that the product under test has physical properties of thermal expansion and contraction in the environmental chamber. These physical properties change extremely slowly, which requires the loading mechanism to be "sensitive" enough, especially when faced with sudden unloading requirements. : Frequent and timely correction of force changes caused by thermal expansion and contraction is required. The extra burden brought by the structural weight of the reaction frame structure allows the loading mechanism to pack lightly and focus more on the stability of load retention and the accuracy of sudden unloading. At present, most manufacturers are unable to overcome the difficulty of frequently and timely correcting the force value changes caused by thermal expansion and contraction, resulting in poor load holding accuracy and sudden unloading accuracy.

1.3 The unique servo control hydraulic technology patent makes it the most stable manufacturer in the industry in terms of load holding accuracy and sudden unloading accuracy in the field of thermal performance mechanical testing.

1.4 The hydraulic system uses servo motor control instead of hydraulic valve control, which can save 99% of energy when maintaining load. The hydraulic system does not start when the force value remains unchanged. The equipment operates without noise or heat, which greatly extends the use of each component of the hydraulic system. Precision time over lifetime.

1.5 The program perfectly solves the load-holding accuracy requirements for force value caused by thermal expansion and contraction, and completes the sudden unloading function through program control. This function has been promoted under the leadership of China Electric Power Research Institute, Wuhan High Voltage Research Institute and other institutions.

1.6 It has a power-off battery life function, and the test can be continued without restarting after a call is received.

1.7 Air-cooled binary cascade refrigeration method (taking into account the high operating temperature in hot areas, our company can configure a chiller unit to meet the operating temperature above 35°C without the need to arrange cooling water lines)

2. Main Parameter on Main Host

Model	KS-W600K4L
Load number of workstations	4 (number of stations can be customized such as single station, double station, three station, or four station)
Tensile test force of single cylinder	600kN
Force range and accuracy of each set of loading device	3-600kN, accuracy better than 0.5%
loading speed	No-load 0-120mm/min steplessly adjustable, automatic test control
Environmental chamber test space (length*width*height)	1700mm*800mm*3000mm
Displacement (deformation) range and measurement accuracy	300mm, accuracy better than ± 0.01 mm
Control mode	Constant test force fully automatic control
Test force holding point and holding time	Meet the pressure holding requirements of more than 200 hours
Energy consumption	Servo motor control, energy saving more than 95%, and no noise
Preload method	Cylinder preload
Connection Type	Mark 16-32 ball head ball socket
Frame form	welded steel structure
Protective function	Cylinder limit protection
	Hydraulic system overload overflow protection
	Test force overload protection
	Overcurrent and overvoltage protection
	Automatic shutdown protection at the end of test

3. Environmental System Parameter

3.1 Volume and size	
Single inner box size	1700mm*800mm*3000mm
Unit size	About W1000xH1200xD1000mm (single size)
Box structure	Test box (split) unit and box soft connection
Weight	About 1260kg
3.2 Function	
Test environment conditions	When the ambient temperature is +5℃~+35℃, the relative humidity is ≤85%, and there is no sample in the test chamber
Test Methods	GB/T 5170.2-2017 Temperature test equipment
★Control method	GB/T5170.5-2008 Damp heat test equipment (damp heat type only)
★Temperature range	-40℃~+140℃
★Temperature fluctuation	≤±0.5℃
★Temperature uniformity	≤1℃
★Temperature deviation	≤±1℃
★Heating and cooling rate	Maximum temperature change rate: (standard load, -70~+100℃≤110min, average over the whole process, measured at the air outlet control point) and the rate is controllable.
Standard load	80kg aluminum ingot
Meet test standards	GB/T 2423.1-2008 Test A: Low temperature test method GB/T 2423.2-2008 Test A: High temperature test method GJB 150.3A-2009 High temperature test GJB 150.4A-2009 Low temperature test IEC 60068-3-5:2001 Environmental testing of electrical and electronic products Temperature test chamber performance confirmation
★Working noise	A sound level ≤ 60dB (A) The noise value is the data measured at a distance of 1m from the front of the equipment and a height of 1.2m (in free space)
Energy saving and consumption reduction	It adopts cold-end PID adjustment technology, which can achieve the temperature control effect through the precise output of the compressor's cooling capacity. The cooling and temperature maintenance processes below normal temperature do not require the participation of heating, which is completely different from the hot and cold balance temperature control method. That is, heating without cooling, cooling without heating, saving more than 30% energy.

3.3 Structure

3.3.1 Box structure:

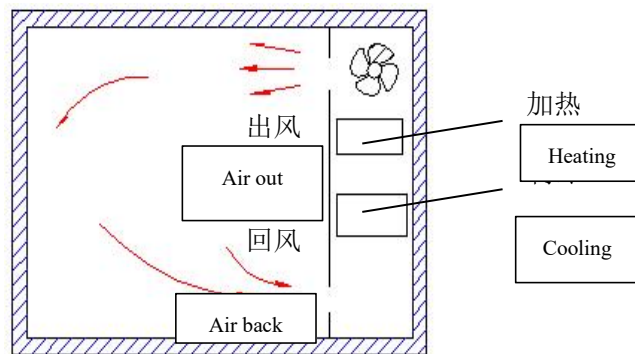
- Outer wall material: color steel plate, thickness 1.5mm, surface spray treatment, color: CSSC Taisho standard
- Inner wall material: stainless steel plate 1.5mmSUS304#
- Box insulation material: rigid polyurethane foam + glass fiber 100mm thick

- Door insulation material: rigid polyurethane foam + ultra-fine glass fiber
- Control system: located on the main door of the studio box
- Moving mechanism: The base of the box is equipped with 4 swivel casters

3.3.2 Box bottom plate load-bearing: $\geq 100\text{kg/m}^2$

3.3.3 The indoor circulation fan: adopts a soft horizontal air supply method to ensure that the average wind speed is less than 1.7m/s, and has an internal ventilation function. (Inverter implementation)

3.3.4 Air conditioning channel: Each independent box has 2 fans, heater, evaporator, temperature sensor, humidity sensor



3.3.5 Standard configuration:

- Lead hole: One lead hole with a diameter of 100 mm is opened on the left and right sides facing the box door, equipped with a soft rubber plug;
- Lighting: 1 explosion-proof LED 4W, located on the door of the test chamber
- Air pressure balance device: balances the air pressure difference inside and outside the test chamber to avoid box deformation

3.3.6 Door

- Opening method: hinged single door, right hinge, left handle (when facing the front of the door) to open the door to the right.
- Locking mechanism: hook with safety lock handle, made of SUS304 stainless steel plate
- Outer wall: cold-rolled steel plate 1.5mm carbon steel, surface electrostatically sprayed

- Inner wall: SUS304 mirror stainless steel plate, thickness 1.5mm
- Insulation material: 100mmPU rigid polyurethane foam + glass fiber insulation material
- Sealing strip: e-type silicone rubber sealing strip (Japanese Toshiba silicone raw material)
- Dimensions: Door opening height H2000mm, door opening width W800mm
- Observation window: There is an electric heating anti-condensation hollow glass observation window on the door, with a visual range of W300×H600mm. During the low-temperature test, the heating wire of the observation window automatically turns on to prevent condensation and frost and ensure that the equipment is in the open state. The test conditions inside the box can be observed through the observation window.
- Door frames and door edges are anti-condensation: The door frames and door edges are equipped with anti-condensation electric heating devices. The heating function is automatically turned on during low-temperature tests to ensure that the door does not frost or condensate.
- Water receiving tank under the door: There is a water collecting tank under the door to ensure that the condensation water on and around the inner panel of the door is effectively caught during the heat and humidity test. The drainage pipe of the water receiving tank merges with the drain outlet of the box and is discharged to the outside.

3.3.7 Noise measures: The refrigeration unit has anti-noise measures (using 20mm thick wavy sound-absorbing cotton)

3.3.8 Dehumidification function: Equipped with a control function to prevent condensation on the specimen to avoid condensation and frost on the surface and inside of the specimen during all testing processes.

3.3.9 Control panel:

- Temperature control display
- Temperature over-temperature protection setting device
- Emergency stop switch
- Running indicator light, fault indicator light, buzzer, timer

3.3.10 Mechanical room The mechanical room contains: refrigeration unit, drainage device, power distribution control cabinet

3.3.11 Power distribution control cabinet

- cooling fan
- distribution board

- Sample test terminal
- RS-485 interface, Ethernet interface, USB data import and export
- Main power leakage circuit breaker

3.3.12 Heater: Nickel-chromium alloy electric wire heater

Heater control mode: contactless equal period pulse width modulation, SSR (Solid State Relay)

3.3.13 The power supply and drainage holes are located on the back of the box.

3.4 Cooling system

3.4.1 Working method: Air-cooled binary cascade refrigeration method (taking into account the higher working temperature in hot areas, our company can configure a chiller unit to meet the working temperature above 35°C without the need to arrange cooling water lines)

3.4.2 Working principle:

Refrigeration methods are divided into vapor compression refrigeration, absorption refrigeration, vapor injection refrigeration, gas expansion refrigeration, and thermoelectric refrigeration. Among the above refrigeration methods, vapor compression refrigeration is the most economical and widely used refrigeration method. It is also the most commonly used refrigeration method in environmental testing equipment. Its principle is to use the latent heat of evaporation of liquids such as Freon to absorb heat from the object being cooled. And achieve refrigeration. (Single-stage refrigeration cycle diagram) is a schematic diagram of the vapor compression refrigeration cycle process. The liquid entering the evaporator is throttled by the expansion valve and evaporates by absorbing the latent heat of evaporation from the surrounding objects. After evaporation, it turns into low-temperature and low-pressure gas and is sucked into the refrigeration compressor. After being compressed by the compressor, it turns into high-temperature and high-pressure gas and enters water-cooling or air-cooling for condensation. The evaporator is cooled into a high-pressure liquid, and then enters the evaporator through the expansion valve. In this reciprocating cycle, heat is absorbed from the low temperature to achieve cooling, and then the heat is released from the high temperature.

In the refrigeration cycle shown in (single-stage refrigeration cycle diagram), a change from one state to another is called a process. There are four processes in the refrigeration cycle. The four processes in the refrigeration cycle are briefly described below.

- Evaporation process: After passing through the expansion throttling, the low-pressure wet steam absorbs heat from the surrounding medium in the evaporator and is cooled, and gradually increases its dryness. In this way, the gas coming out of the evaporator has become dry saturated steam or slightly superheated steam. During the evaporation process, the refrigerant temperature and pressure remain constant.

- Compression process: After completing the refrigeration function, the vapor from the evaporator enters the refrigerator. After compression, the temperature and pressure increase sharply. Therefore, the gas discharged from the refrigerator becomes hot steam with a high degree of superheat. During the compression process, the entropy value of the refrigerant remains unchanged.
- Condensation process: The high-temperature and high-pressure superheated steam discharged from the refrigerator enters the condenser and undergoes heat exchange with cooling water or air, causing the superheated steam to gradually turn into saturated steam and then into a saturated liquid. When cooling with cooling water, the temperature of the saturated liquid will continue to decrease and subcooling will occur. The pressure remains constant during condensation.
- Throttling process: The liquid coming out of the condenser is throttled through a throttling device such as an expansion valve or capillary tube, and becomes low-temperature and low-pressure wet steam. The refrigerant enthalpy value remains unchanged during the throttling process.

The above four cycle processes are continuously circulated in order to achieve the purpose of refrigeration.

In order to complete each thermodynamic process of the refrigeration cycle, the compressor, heat exchanger, pipelines, pipeline accessories, etc. need to be composed into a system, which is called a refrigeration system.

Single-stage compression refrigeration means that the refrigerant vapor is compressed only once, and its lowest evaporation temperature can be controlled at $-30^{\circ}\text{C} \sim -40^{\circ}\text{C}$. When a lower test temperature is required, a cascade refrigeration system is usually used. Two single-stage compression refrigeration systems are stacked together. One of the systems is the high-temperature part and uses medium-temperature refrigerant; the other system is the low-temperature part and uses low-temperature refrigerant. The evaporator in the high-temperature part and the condenser in the low-temperature part are stacked to form a condensing evaporator.

3.4.3 Refrigeration compressor: French Ta MAKING MODERN LIVING POSSIBLE Danfoss on compressor



3.4.3



3.4.6

3.4.4 Evaporator: fin heat exchanger (also used as dehumidifier)

3.4.5 Air-cooled condenser: fin heat exchanger

3.4.6 Evaporative condenser: plate heat exchanger

3.4.7 Throttle device: thermal expansion valve, capillary tube

3.4.8 Refrigerator control method: The PLC (programmable logic controller) of the control system automatically adjusts the operating conditions of the refrigerator according to the test conditions (using cold balance technology, saving energy and reducing consumption by more than 30%)

Compressor return air cooling circuit, energy regulation circuit

3.4.9 Environmentally friendly refrigerant: R404A/R23 (ozone depletion index is 0) environmentally friendly refrigerant.

3.4.10 Refrigerator control method:

- The control system automatically adjusts the optimal energy-saving operating conditions of the refrigerator according to the test conditions.
- Compressor return air cooling circuit
- Energy regulation loop

3.4.11 Other: Air filters

3.5 Electric control system

3.5.1 Controller: model TH2000



3.5.2 Function introduction: The controller system mainly consists of 2 parts. That is, the LCD control panel and the input/output control board (I/O board).

The LCD controller displays the cause of the fault and the solution in Chinese characters according to the alarm signal transmitted from the I/O board through communication; the user can choose the English menu and the Chinese menu as needed; the LCD controller has a lithium battery and a calendar clock in the memory. It has the functions of power outage protection and scheduled power on/off. Color touch mode human-machine interface and high-performance programmable controller, the controller has three-level access rights to avoid shutdown due to human touch.

3.5.3 Display 10-inch TFT true color LCD display 16 million colors resolution 800*480

3.5.4 Operation mode: program mode, fixed value mode

3.5.5 Setting method: Chinese\English\Chinese menu, touch screen input

3.5.6 Program capacity Fixed value control can set the equipment running time. The amount of program control programs is more than 100 groups, and the number of program segments in each group is more than 900. It can perform repeated execution of commands and loop nesting (100) group functions. The program has segment skip and hold functions.

3.5.7 Setting range:

Input type	Temperature Range
Pt1 100	-90.00~200.00℃
Pt2 100	-100.00~300.00℃
DCV	-1.0~2.0V (-100.0~100.0℃)

3.5.8★Display resolution: Temperature 0.01℃; Time 0.1 minutes; Temperature 0.01RH%; Time 0.1 minutes

3.5.9 Input: Thermocouple (platinum resistance/voltage/current, etc., according to equipment needs)

3.5.10 Communication function:

(1) Equipped with a standard RS485 computer interface and a set of special communication software, which can realize remote communication management between the central control instrument and the computer. After the machine is connected, the operation, temperature, humidity and other parameters of the equipment can be set through the computer. and monitoring.

(2) Provide the communication protocol of the equipment to facilitate centralized monitoring and development in the later stage.

3.5.11 Control method: Anti-integral saturation PID (linear control, rate controllable)

3.5.12 Curve recording function: It has SRAM with battery protection, which can save the device's setting value, sampling value and sampling time. You can touch the screen with your finger to slide and observe the data in real time;

3.5.13 Test data collection:

- During the USB function test, insert the U disk into the controller interface. The test data can be customized and the export time or segment will be automatically recorded into the U card and saved as a data file. The sampling period can be set on the screen. If sampling If the cycle is 5 minutes, approximately 7500 days (20 years) of data can be collected. You can use EXCEL and other software

to open and process (display and print)

- Connect to printer (optional): --- Configure the printer to print the test date, set temperature, and measured temperature by setting the number of prints according to time.
- Connected to PC:----With networking function, it can test centralized monitoring. Through centralized monitoring software, it is possible to record
- The test data is automatically displayed as a curve in the PC and can be printed directly, with no limit on the recording time. File size depends on hard drive capacity. The PC can also be used as an operating terminal to achieve remote monitoring.

3.5.14 Input/output control board (I/O board) Input characteristics:

Input type: 16 switching input points 24V (used for external alarm signals, button command signals, coupling signal given and other functions) NPN type/PNP type universal

(2) Output characteristics:

Output type: 2 points/4 points DC24V response speed 50μs

2 points/4 points DC0-10V/DC4-20ma

14 RELAY output points, expandable to 256 DO points, each coarse point current capacity DC24V/5A, AC220V/5A, COM point maximum current 8A, custom output function

3.5.15 Auxiliary functions: fault alarm and cause, processing prompt function; upper and lower limit temperature protection function; timing function (automatic start and automatic stop), self-diagnosis function, cold start and hot start during power outage, temperature monitoring function, 20-year data storage function ;

3.5.16 Temperature sensor: T-type armored thermocouple or PT00 thermocouple. Place four sample sensors inside the test chamber. The sensors fit on the surface of the sample to be tested to detect the surface temperature of the sample. The sensors can be freely switched on the control instrument to view the temperature of each independent sensor. , the independent sensor can be set as the main temperature control sensor to control the temperature through the temperature of the sample surface.

3.6 Protection Device

3.6.1 Refrigeration system:

- Compressor overpressure
- Compressor motor overheated
- Compressor motor overcurrent

3.6.2 Test room:

- Adjustable temperature fuse over-temperature protection --- over-temperature protection mode 1
- Air conditioning channel limit over-temperature --- over-temperature protection mode 2
- The controller sets an over-temperature shutdown alarm --- over-temperature protection mode 3
- Fan motor overheated
- When the cabinet door is opened (during operation), an alarm is prompted.
- Air pressure balance device inside and outside the box
- Indoor anti-lock door handle device

3.6.3 Others:

- Total power supply phase sequence and phase loss protection
- Leakage Protection
- Load short circuit protection
- Test box grounding protection

3.7 Other Configurations

3.7.1 Sample power terminal: Relay contact control, DC 24V within 4A (when operating normally, the contact is closed; when the equipment is shut down or malfunctioning, the contact is open)

3.7.2 Main power leakage circuit breaker: Main power leakage circuit breaker

AC380V, 50Hz, three-phase four-wire + protective ground wire

3.7.3 Power cable: 1 five-core (four-core cable + protective ground wire) cable (standard length: 5m)

3.7.4 Lead holes: The lead holes are available in diameters of $\phi 50$ and $\phi 150$. Their positions and quantities can be customized according to user requirements if the chamber structure allows it.

3.8 Working Environment

3.8.1 Site:

- The ground is flat, well ventilated, and does not contain flammable, explosive, corrosive gases and dust.
- There are no strong electromagnetic radiation sources nearby
- A drainage floor drain is provided near the equipment (within 1 meter from the refrigeration unit)

- Site ground load-bearing capacity: not less than 800kg/m²
- Leave 1 meter of maintenance space around the equipment

3.8.2 Environmental conditions

Temperature: 5°C ~ 35°C

Relative humidity: ≤85%RH

Air pressure: 86 ~ 106kpa

3.8.3 Power supply: AC380V three-phase four-wire + protective ground wire;

Allowable voltage fluctuation range: AC (1±10%) 380V

Allowable frequency fluctuation range: (1±1%) 50Hz

The grounding resistance of the protective ground wire is less than 4Ω; TN-S mode power supply or TT mode power supply

The user is required to configure an air or power switch of corresponding capacity for the equipment at the installation site, and this switch must be independent and dedicated to the use of this equipment.

3.8.4 Power supply capacity: 13kVA (heating 4KW, cooling 8KW, other 1KW)

3.8.5 Configuration switch capacity: 25A (single unit)

3.8.6 Total power supply: 100A

3.8.7 Requirements for storage environment: When the equipment is not working, the temperature of the environment should be kept within 0~45°C.

When the ambient temperature is below 0°C, the water remaining in the equipment should be drained cleanly to prevent the water in the pipes from freezing and causing damage to the pipes.

4. Stress analysis of each stressed component

In order to examine the stress of the equipment during the test and determine whether the equipment structure is reasonable, the thermal engine frame is now subjected to finite element analysis. The finite element analysis here is static analysis, which is divided into meshing, defining boundary conditions, and applying Several steps of constraint and solution analysis.

1. Divide the grid

Divide each part of the thermal engine frame into meshes and define the material as steel.

2. Define boundary conditions

The various parts of the thermal engine frame are connected by bolts, and the contact surface at the

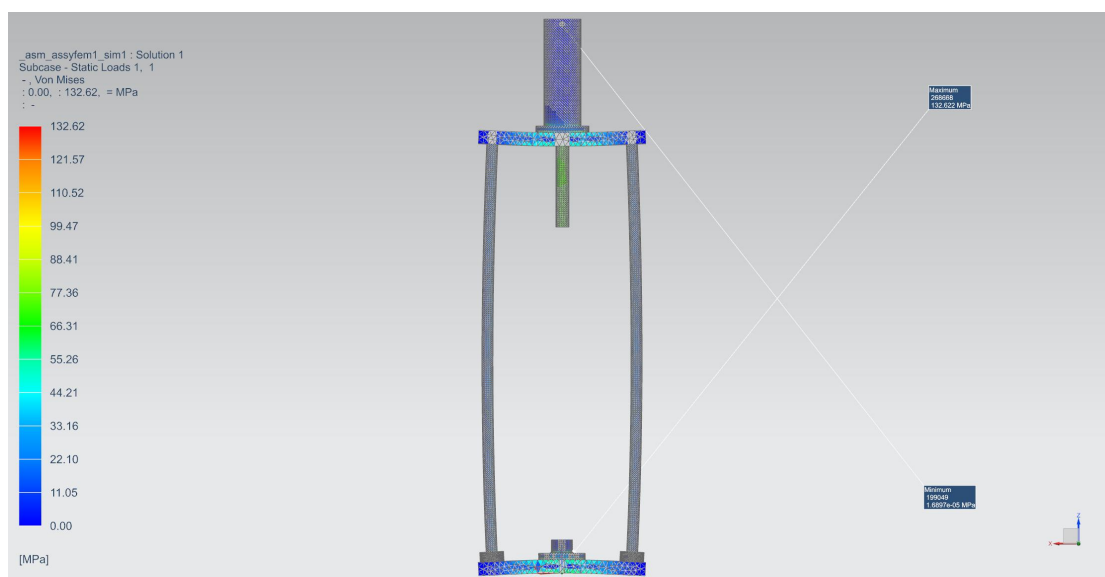
bolted joints is defined as bonding.

3. Impose constraints

The bottom tooling connection is set as a fixed constraint, and a tensile force of 600kN is applied to the end face of the cylinder rod and solved.

4. Analysis results (taking 600kN single cylinder as an example)

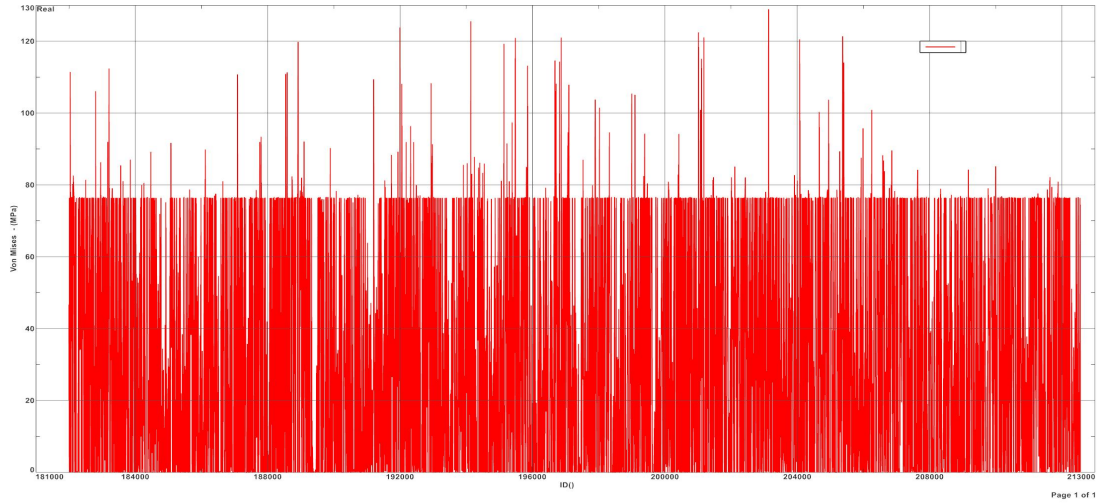
The tensile strength of 45 steel is not less than 600MPa, and the yield strength is not less than 360MPa. The finite element analysis results of the frame are shown in the figure below.



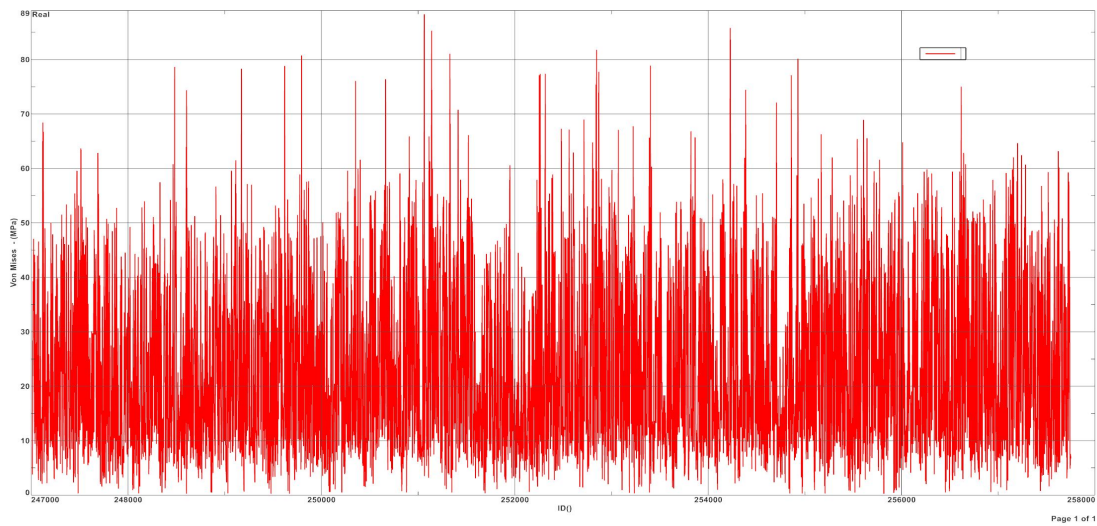
At this time, the maximum stress of the frame is 132MPa at the bottom connection tooling (at this time, the yield strength safety factor of the weakest point reaches 2.72, and the tensile strength safety factor reaches 4.55). Within the required range, the frame structure meets the test requirements.

The following is the stress analysis chart of each part (maximum stress/MPa)

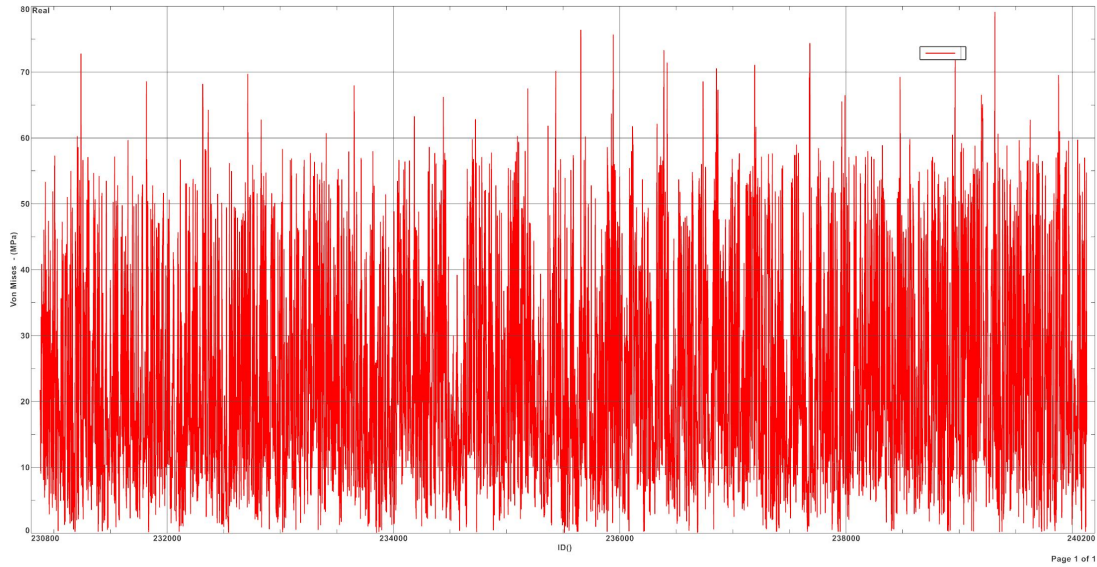
The oil cylinder is as shown in the table below



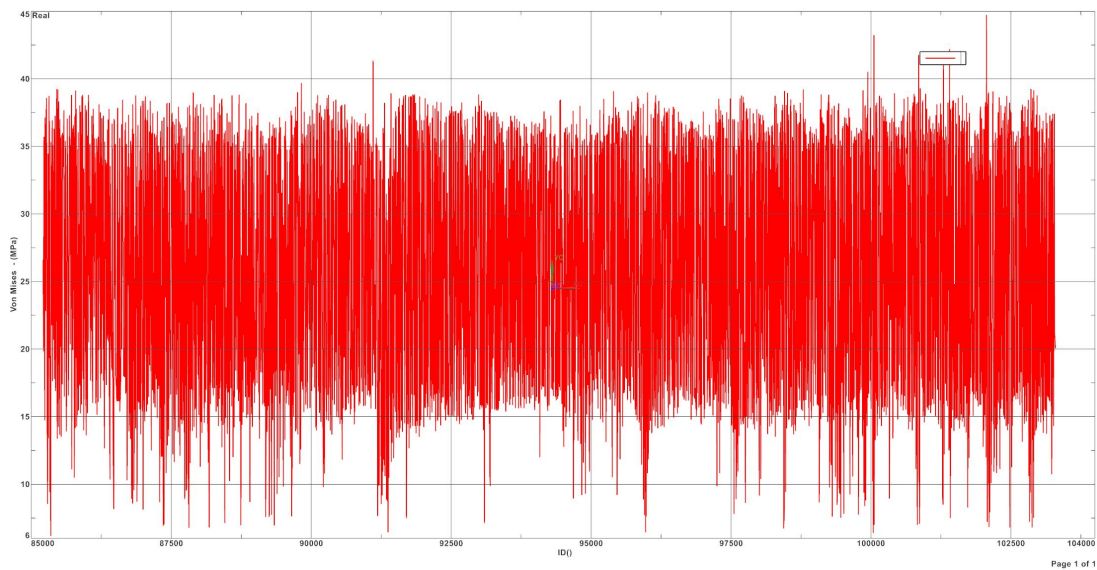
The top fixing plate is as shown in the table below



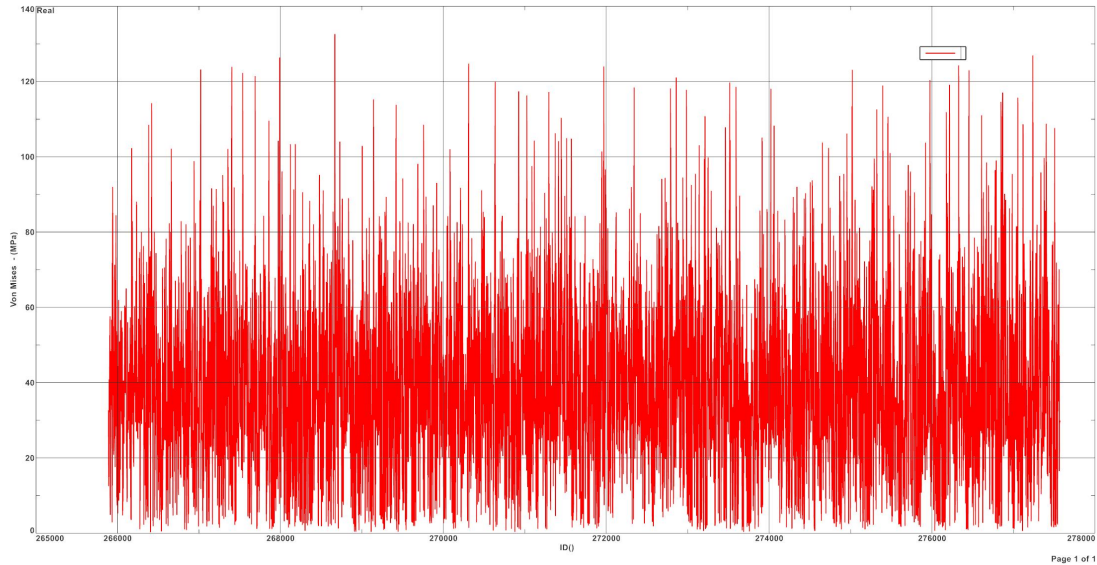
The bottom fixing plate is as shown in the table below



The columns are as shown below



The bottom tooling is as shown in the table below



Page 1 of 1

5. Main configuration

Items	Description	QTY.
Testing machine host	Precision servo hydraulic cylinder (originally imported NOK seals)	4Sets
	Special imported load cell for testing machine	4Sets
	Special displacement encoder for testing machine 1000mm	4Sets
	steel structural frame	1set
Servo loading Hydraulic system	Original imported Italian Mazzucchi high pressure gear pump	1set
	Original imported Taiwan TECO servo motor	1set
	Italian Atos pilot relief valve	1set
	Italian Atos solenoid directional valve	4Sets
	Independently developed and designed integrated hydraulic valve block	1Set
	High pressure pipeline oil filter	1set
	Hydraulic accessories such as air filters and oil tanks	1set
Environmental chamber system	environmental chamber	1set
Testing Machine Control System	Testing machine Siemens PLC control system	1set
	Strong and weak current systems (Schneider, Siemens)	2set
	dedicated computer	1set
	Completely independently developed special control and processing software for testing machines: the test report form can be customized according to user requirements	1set
Appendix	Various specifications of O-rings and combination pads	10set for each
	Mark 16, 20, 24, 28, 32 ball head and socket	4Set for each
	Insulated tie rod for calibration	1pc
	toolbox	1pc
Documents	user's Guide	1pc

	Certificate	1pc
	Load cell calibration certificate	1pc
	Packing List	11pc

Customer use site

FOCUS IN MATERIAL TEST

KASONTTEST®

**JINAN KASON TESTING
EQUIPMENT Co, LTD.**

DuandianIndustrial Park , Jingshi Road, Jinan City,China.

P: +86 159 1008 1986

E: admin@jnkason.com | **W:** www.syjlab.com

