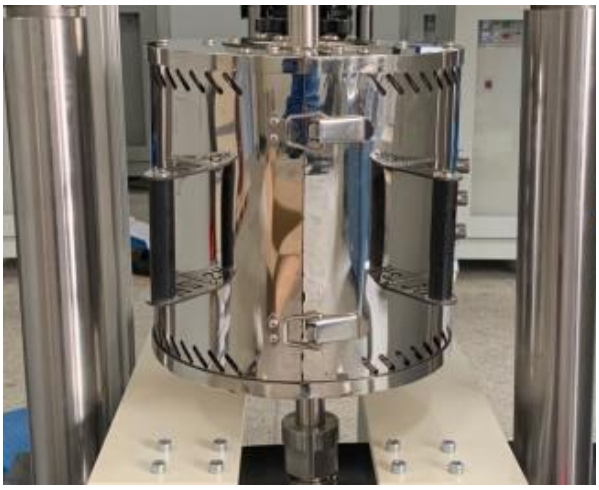
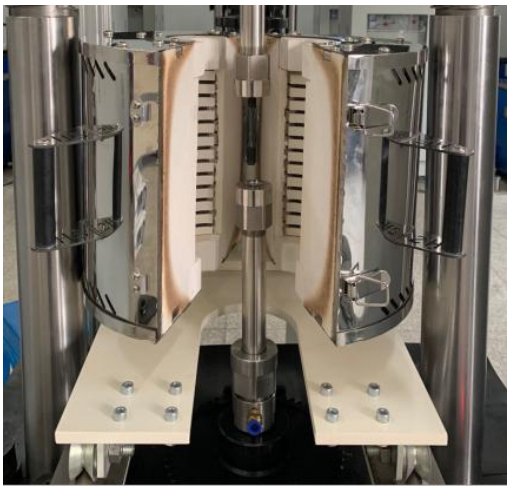
500KN high frequency fatigue testing machine

Technical scheme

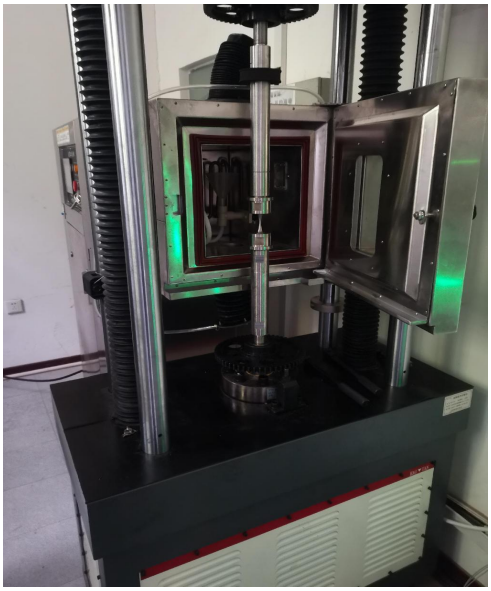
Equipment introduction

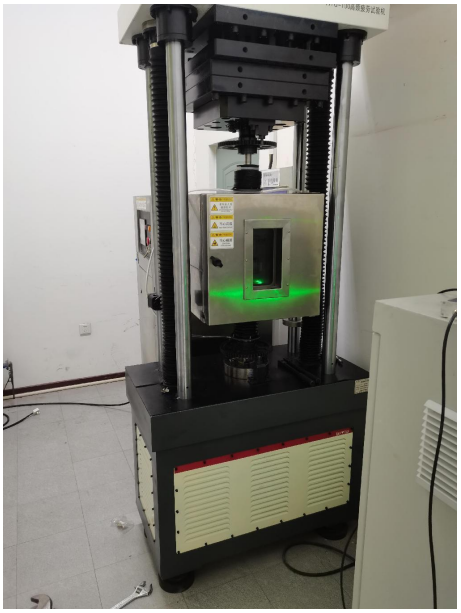
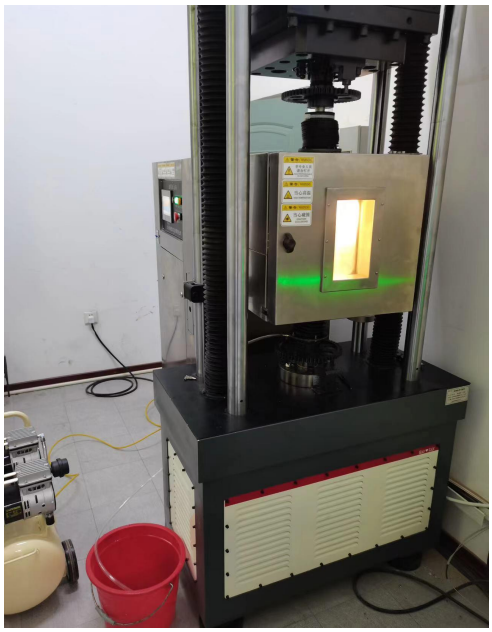
VFTest latest generation of high frequency fatigue testing machine, it is the first time in the country to electromagnetic excitation dynamic testing machine and fully functional static material testing machine together. The "two-in-one" function developed by Changchun Haoyuan makes this possible.In addition to static tensile and compression testing, the testing machine is especially used to determine fatigue strength and fatigue life and fatigue limits for effective fatigue testing. It is widely used to test the fatigue fracture resistance of various metal and non-metal materials and parts, test KIC value, S-N curve, fracture mechanics (such as fracture toughness, crack growth rate and threshold value) test functions.With a variety of fixtures, it can be used to test the fatigue life of various parts (such as plates,gears, crankshafts, bolts, chains, connecting rods, compact stretches, etc.). Can complete symmetric fatigue test, asymmetric fatigue test, unidirectional pulsation fatigue test, block spectrum fatigue test, modulation control fatigue test, high and low temperature fatigue test, three-point bending, four-point bending, torsion and other fatigue tests, as well as CT and SEB specimens fracture mechanics research.All tests can be controlled by force, deformation or strain, while the appropriate equipment is added, and can also be tested under a variety of environmental conditions (e.g., temperature, aggressive media), as well as torsion and deflection tests. It is widely used in national defense scientific research, colleges and universities and industrial production.

User use site

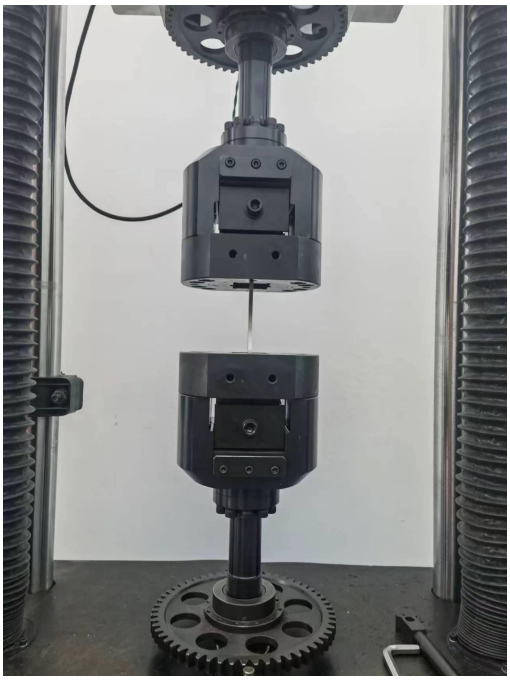



High temperature atmosphere furnace and high temperature fixture

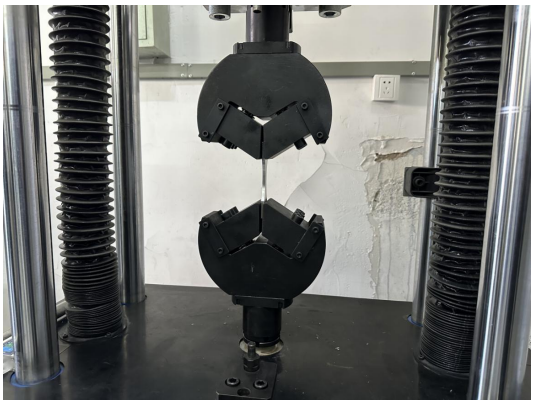


Salt spray test system and fixture



Patented new automatic centring fatigue fixture

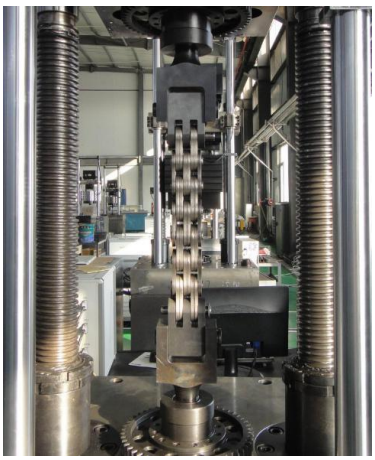


New plate fixture

3000kn large tonnage engine connecting rod fixture

Special plate tension clamp

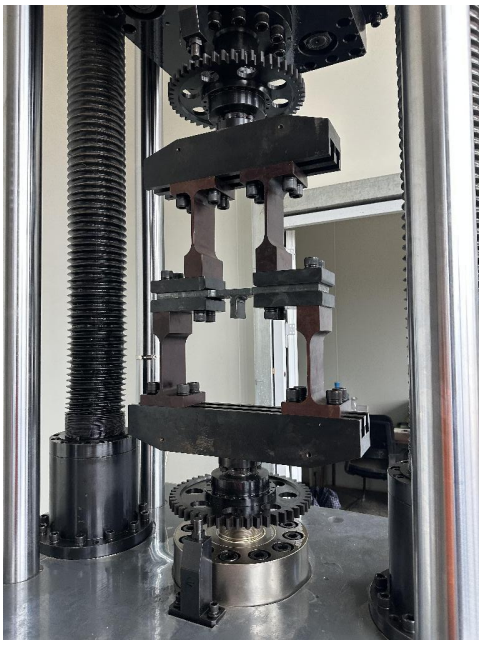
Compact drawing fixture

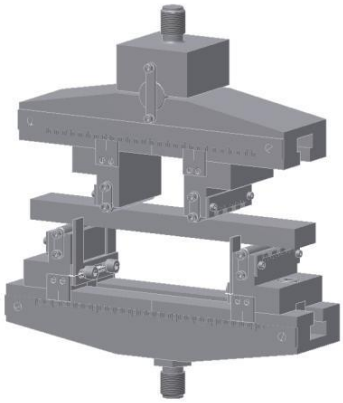


Chain clamp

Bolt clamp

Special fixture for thin wall pipe





Basic conditions for the use of equipment

1, indoor, ambient temperature range: (-10 ~ +45).
2, environmental relative humidity: not more than 80%.
3, altitude: not more than 1000m.
4, the laboratory should have a three-phase five-wire 380V AC power supply and the necessary plugboard (seat), the power supply voltage fluctuation range is not more than ±10%, the power distribution power is not less than 1.5 times the power required by the equipment. The laboratory should have a reliable grounding wire.
5, the laboratory floor should be able to bear the equipment of solid flat ground, such as flat cement ground, do not need special foundation.
6, the main power is about 5kw, the computer printer is about 1kw, the jig oil source is 2kw.

Main technical features

1. Powerful static and dynamic testing machine, double ball screw, four guide column. The transmission efficiency of the ball screw is more than 90%, which is more than 10 times the efficiency of the trapezoidal screw (because the high-frequency screw needs to be locked, so the transmission efficiency of the trapezoidal screw becomes extremely low), the stiffness is large, and the test space is large. It can ensure the coaxiality well, ensure the accuracy and stability of the test data. The beam speed can reach more than 250mm/min, and the beam speed of the small-size high-frequency machine can reach 500mm/min. With the trapezoidal screw, a large motor is required to achieve this speed, and the high-speed capability provides a solution for the operator to quickly load and unload samples. Ball screw transmission precision, drive motor is small, it is easy to achieve static force real-time control, my company's products have done the test force peak and valley value control has reached 1% accuracy, has been the same level as the German ZwickRoell control accuracy.
2.50 ~ 400Hz high test frequency, UHF can reach 1000Hz, shorten the test time, improve the sample flux. The energy consumption of the testing machine is very low (only about 2% of the energy consumption of the same specification electro-hydraulic servo fatigue testing machine).
3. Easy to install - no auxiliary equipment or systems (e.g. hydraulic system, cooling system) required.
4. The workbench is highly customized, easy to operate, and easy for the operator to test.
5. The device is equipped with a color display controller, which can display the measurement channel, machine and test status; Can also be used for host setting, manual lifting beam, operation test, set test parameters, etc., directly display the load and loading speed, very convenient loading and unloading samples and observation of cracks in time to stop.
6.HYG full digital measurement control system, with 10kHz control frequency and 24-bit resolution, 24-bit resolution pulse width modulation, high control stability, low failure rate. The electrical part and the previous improvement is mainly manifested in the use of distributed system, the controller adopts DSP series embedded monolithic system, which can independently control the equipment to ensure the stability of the system work, even if the WINDOWS system fails, it can still control the equipment normally. A new digital controller, using DSP+FPGA architecture, FPGA parallel capability, data acquisition, filtering, logic timing control into the FPGA, multi-task parallel operation, each task does not occupy the resources of other tasks. DSP has a

strong digital operation ability. It can analyze the signal, solve the spectrum characteristics, amplitude-frequency characteristics, phase-frequency characteristics, damping ratio and other parameters of the system, solve the resonant frequency of the system, and control the system loading. Because of the digital processing method, the excitation frequency is obtained by the system crystal frequency division, so the vibration frequency is a single frequency equal to the resonant frequency, and has a strong carrier suppression effect, so it fundamentally solves the other (non-main resonant frequency) vibration interference, and completely solves the phenomenon such as vibration of the exciter. Real-time acquisition of vibration waveform is adopted, and peak and valley values are determined from the waveform data, which truly reflects the stress situation of the sample, and will not lead to inaccurate measurement due to waveform distortion. For example, in the bolt test, when the force value is close to zero, the connection stiffness will decrease, that is, the connection stiffness, that is, the stiffness of the sample, is inconsistent within a vibration cycle, that is, a nonlinear system. Then using the old circuit conversion method to measure the dynamic load, there will be errors, using the waveform measurement method can solve this problem. Now foreign equipment (such as Germany ZwickRoell) are using this measurement method, while the measurement and control system also retains the old measurement method, only need to change the system parameter Settings.

7. Electromagnetic excitation power amplifier adopts new low-voltage excitation system. The power amplifier module adopts the high power IGBT module of Fairchild, which can withstand the short circuit time of 10 μ s. The current overcurrent protection circuit can turn off the current output within 4 μ s. Generally, the power amplifier can be safely protected when the load resistance value is very small.

8. Japan Panasonic AC servo motor and speed control system, speed ratio up to 100,000 times, can achieve fast and accurate average force control.

9. The weight can be directly connected to the lower end of the beam with bolts. When using, you only need to remove the bolt of the connecting beam and connect the weight to the weight tray, which does not need to be removed, making the replacement of the weight convenient and fast.

10. Modular, standardized, efficient heat dissipation performance and easy maintenance of the drive unit.

11. Digital frequency selection, there is no analog frequency selection circuit of other frequencies (that is, non-main resonant frequency) interference problem, that is, only allow the main resonant frequency through, do not allow other frequencies to interfere with the working system. Digital frequency selection makes the frequency domain of the equipment wider, and the controller's operating frequency domain is 20 ~ 1200Hz. It will not produce phenomena such as transverse vibration of exciter, equipment flutter, frequency instability, etc. In theory, it solves the phenomenon that the power amplifier tube burns out of control. Even if the equipment is not connected to the sample, it can also vibrate, the electromagnet will not impact, and the power amplifier system will not be damaged.

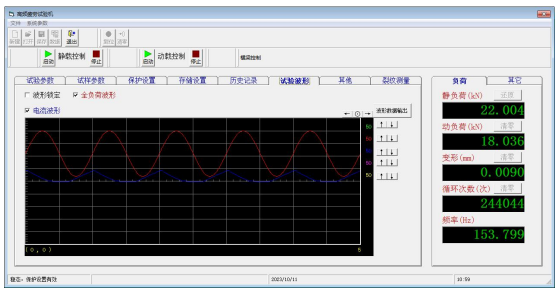
12. In the fatigue test, even when the waveform is deformed, the peak and valley values can be accurately measured with the test waveform, to ensure the authenticity of the test data, and to meet the accuracy required by the ASTE E 467 and the national standard JJG-556 dynamic force.

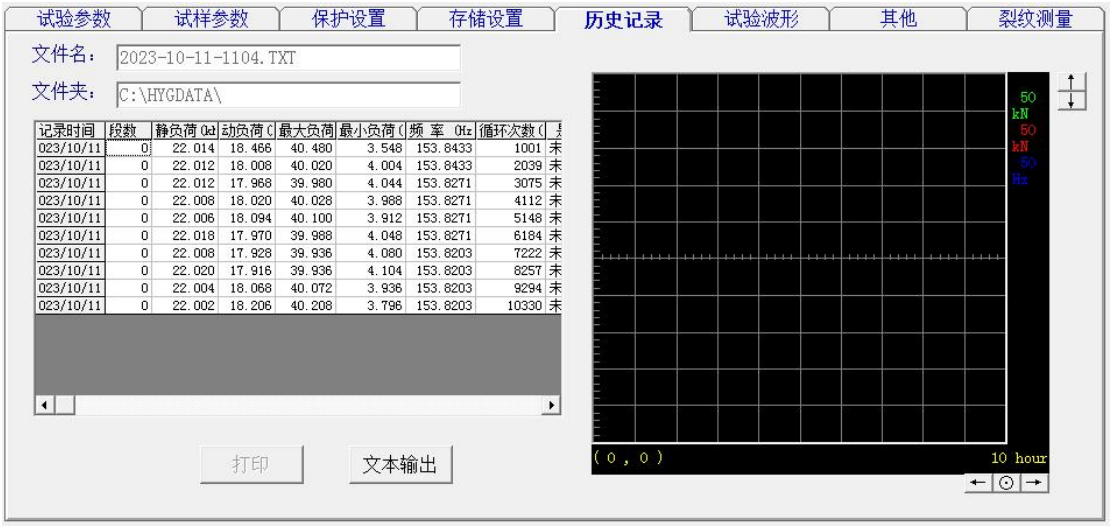
13. Due to the use of digital control, the resonant frequency selection is more accurate, according to the mechanical vibration theory, can get a larger resonance amplification, do fatigue test

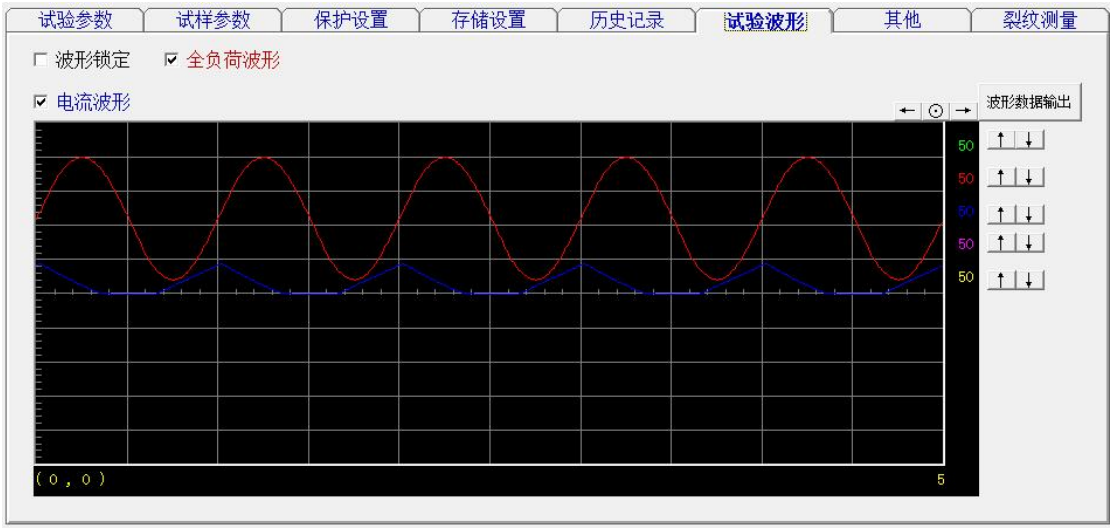
dynamic load can be used to the full scale of the equipment.

14. The equipment has the dual functions of dynamic testing machine and static testing machine. Due to the precision transmission of ball, it can be used as a static tensile testing machine. Static testing machine load GB/T228 standard, support load, displacement, deformation, stress, strain control mode.

Software Introduction







The company's series of measurement and control management software is integrated with the comprehensive opinions of various user manufacturers, designed and developed from the user's point of view, its main characteristics are as follows:

1.WINDOWS7/10 Chinese interface, easy to operate, using virtual panel operation mode, clear interface, convenient operation, standard and robust program, complete the management and control of the entire equipment, test data collection and processing, storage and printing. And it is equipped with data processing software, waveform display software and other software packages. The core of HYG series control system adopts DSP series embedded monolithic system, which can control the equipment independently and ensure the stability of the system. Even if the WINDOWS system fails, the equipment can still be controlled normally. It has the function of real-time acquisition of test data, and can display the dynamic carrier shape, current waveform and excitation waveform in real time during dynamic test. The computer and the controller are connected through the network port, and the control and dynamic force are strictly synchronized, so that the system can always work on the resonance point, the waveform distortion is small, the work is more stable, and the vibration will not stop during the test process of high temperature fatigue test and crack growth rate.

2. Provide a software package for measuring crack depth with frequency method. This method is suitable for batch crack growth test. According to the frequency characteristics of the completed crack growth specimens, the method can approximate the crack growth.

3. With constant static load, constant load control. During the test, the load setting can be freely changed, and the system automatically adjusts and stabilizes to the new load value. All parameters can be automatically zeroed by software. Can be preset fatigue number, fatigue number to automatic stop.

4. Real-time display of load waveform, current waveform, excitation waveform, with locking waveform function. Used to test whether the test is normal and the test process analysis. Real-time display current value, pulse width value.

5. With conventional fatigue test (symmetric, asymmetric, unidirectional pulsation), block spectrum fatigue test, dynamic load amplitude given modulation control fatigue test (sine wave, triangle wave, trapezoid wave, square wave), etc. With load, strain control mode.

6. With safe and reliable hardware and software protection functions. Complete protection functions, such as: overload (110%) protection, overcurrent protection, limit protection, sample fracture protection, power failure protection, but also with arbitrary set of dynamic load protection, static load protection, frequency protection.

7. The computer completes the whole process of control and data collection, and can display dynamic load, static load, frequency, fatigue times, equipment working time and single test time and other parameters in real time. Test data automatic storage, data processing, S-N curve fitting, printing reports and other functions, its format can also be converted into commonly used software document formats, such as Word, Excel and so on.

8. The test state and data are automatically stored at regular intervals, and the data is not lost after power failure. The results of each trial are stored separately in a file, and previous data can be opened to continue the trial. It is also possible to temporarily stop the test in the test, and continue the test after adjusting the sample, without affecting the continuity of the data. It can automatically record the number of test cycles, and the number of cycles can be set at any time. After reaching the specified number of cycles, it has the automatic stop function, and it can prevent the automatic start again after the unexpected shutdown such as power failure. The whole process test data, test state and the time when each test state occurs can be automatically stored on the computer hard disk to prevent loss of power failure. For intermittent fatigue tests,

the test process data can be automatically renewed to maintain the integrity of the test process data.

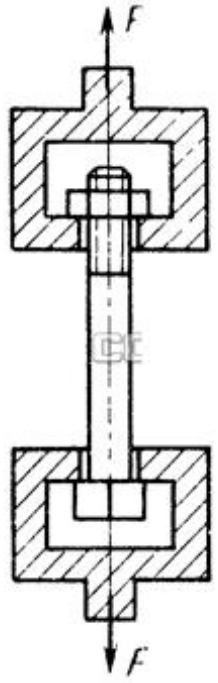
9. The test process can be unattended, perfect protection function, high stability and reliability.

Main technical indicators

1. Maximum load test force: ± 500kN
2. Maximum average test force: ± 500kN
3. Maximum unidirectional pulsating load: ± 500kN
4. Maximum dynamic load: 500 kN, maximum alternating load (amplitude) : 250 kN
5. Frequency range: 40 ~ 280Hz, frequency resolution: 0.001Hz, multi-level frequency adjustment
6. Maximum amplitude: ±2mm
7. Maximum count: 9×109
8. Static force accuracy (static load indication accuracy) : ±0.5%
9. Dynamic test force accuracy (dynamic load indication accuracy) : ±2%
10. Stress coaxiality: 5%
11. Test space: Height: 850mm, operating height: ≤1200mm
12. Number of columns: 6 (4 guide posts, 2 lead screws)
13. Test force measurement range: 1% ~ 100%
14. Dynamic test force fluctuation: ±0.5%
15. Static test force fluctuation: ±0.5%
16. Beam speed: 0.001 ~ 250 mm/min
17. Maximum beam return speed: 250 mm/min
18. Control mode: full digital microcomputer control, with conventional fatigue test (symmetric and asymmetric), block spectrum (programmed) fatigue test, modulation fatigue test (sine wave, triangular wave, trapezoid wave, custom wave) and so on.
19. With remote manual operation function to facilitate remote operation, including load, speed display and speed adjustment.
20. The computer takes WINDOWS as the working platform, adopts the virtual panel operation mode, the interface is clear, the operation is convenient, the program is standardized and robust, completes the management control of the entire equipment, the collection and processing of the test data and the storage and printing, and has the real-time display function of the dynamic carrier shape, the current waveform and the excitation waveform. The test method conforms to ASTM, ISO, GB and other standards. The whole process test data, test status and the time when each test status occurs can be automatically stored on the computer hard disk to prevent loss of power failure; For intermittent fatigue test, the test process data can be automatically renewed to maintain the integrity of the test process data. The test data can be printed, and its format can also be converted into common software document formats, such as Word, Excel, etc.
21. Applicable standards: JJG556-2011 "Verification Regulations for Axial Extension Fatigue Testing Machine", GB/T2611, GB/T3075, HB5287, ASTM E647, ASTM E399 standards, etc. The equipment indicators and functions fully meet the requirements of ASTM, ISO, GB and other standards or test methods, and fully meet the requirements of domestic and foreign certification systems for laboratories at all levels that have been carried out in China.
22. With the function of static testing machine, with tensile, compression, bending and other test functions. The software meets GB/T228 standard.

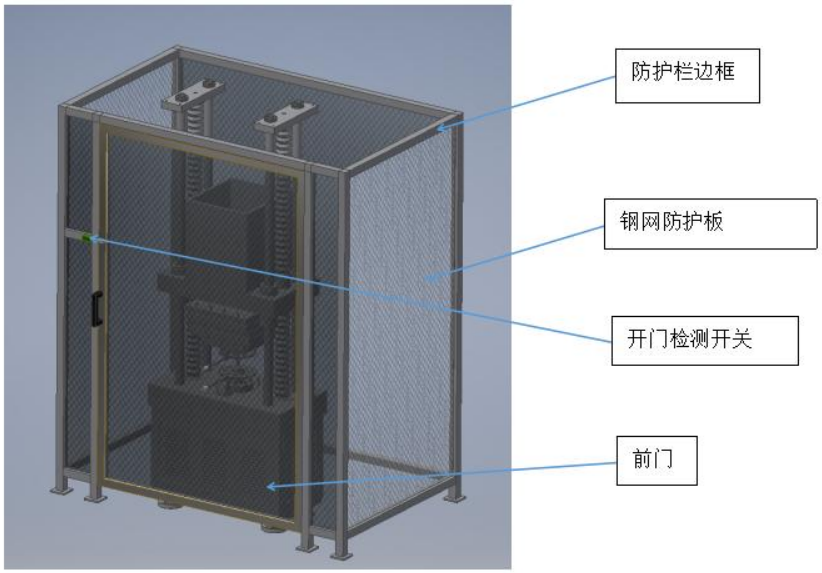
23. Host size: length 1000mm* width 1460mm* height 3300mm
24. Size of control cabinet: length 630mm* width 900mm* height 1680mm
25. Host weight: 8000Kg

500kN high frequency special bolt fixture



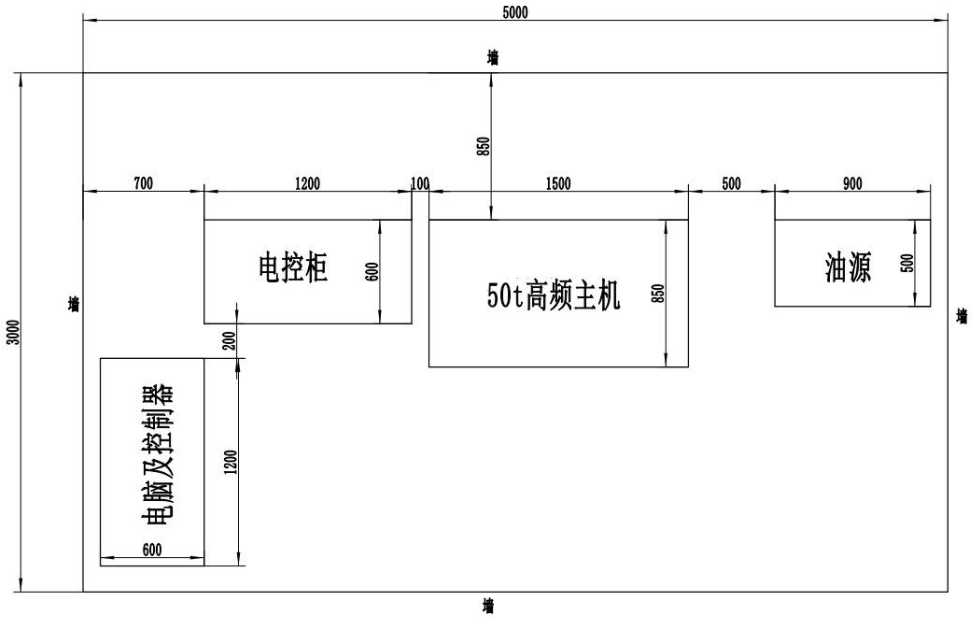
The actual design and production shall prevailBolt fixture: the specific size of both parties to negotiate, the use of temperature: room temperature

high-frequencyfatigue testing machine protection device



The perimeter of the main machine is equipped with guardrail to protect the safety of the operator. The guardrail is composed of a border and a steel mesh protective plate. The guardrail is provided with a front door and a door opening detection switch. When the door is opened, the control system can detect the door opening signal, and the control system can immediately shut down the equipment.

Layout diagram



high-frequency fatigue testing machine configuration

No	Name Model	Specification	Quantity	Note
1	500kN 高频疲劳试验机主机 500kN high frequency fatigue testing machine host	HYG-500	A set	
2	全数字测控电箱 Full digital measurement and control electrical box	HYG-DCS6	A set	Embedded deformation measurement channel. It mainly includes load amplifier, dynamic load amplifier, static load amplifier, counter: maximum number 9 × 109, frequency meter, strain measurement channel (can connect COD gauge, strain gauge, etc.)
3	高频疲劳试验机电气控制柜 High frequency fatigue testing machine electrical control cabinet	HYG-ECS6-500	A set	Mainly including Japan Panasonic AC servo motor drive controller and dynamic load drive, full digital control, including feedback interface, control parameter input
4	高频疲劳机专用负荷传感器 High frequency fatigue machine special load sensor	HYG-Z500	A set	Meet the ISO7500 standard
5	品牌一体计算机 Brand integrated computer	associate	A set	Mainstream configuration, 22-inch LCD display, i5 CPU, 8GB memory, 1T hard disk
6	惠普激光打印机 HP Laser printer	Hewlett Packard	A set	A4
7	手持式遥控数显操作盒 Handheld remote control digital display operation box	HYG-HB6	A set	Remote wired manual operation function
8	中文版试验控制软件 test control software	HYG-SW6	A set	Combined with fracture mechanics related test function.
9	校验工装 Check fixture	Including static force (tension and compression direction), dynamic	A set	Used for device verification.

		force (tension and compression direction), coaxial calibration equipment		
10	螺纹圆试件夹具 Clamp for threaded round specimen	M40 × 2, M48 × 2, M56 × 2, M64 × 2, M16×2	A set	Use temperature: room temperature.
11	500KN 专用螺栓夹具 500KN special bolt fixture	Bolt specifications both parties to negotiate	A set	Use temperature: room temperature.
12	高频疲劳试验机防护装置 High frequency fatigue testing machine protection device		A set	Prevent specimen breakage and protect the operator
13	Random tool		A set	Gear disc locking wrench, hex wrench kit, etc
14	Random data		A set	Specification, certificate, packing list, etc
15	Quality documentation		A set	Quality documentation