

HTBZ-H Automatic Comprehensive Transformer Test Bench Solution



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I. Overview

1.1 This technical proposal specifies the design, manufacture, inspection, testing, technical data, acceptance, supply and transportation, on-site commissioning, after-sales service, etc. of the transformer integrated test bench. ◦

1.2 The products provided by Wuhan UHV Power Technology Co.,Ltd. are quality products that meet the requirements of the purchaser. ◦

1.3 The products provided by the supplier are products with stable performance and reliable detection data, which are widely used in the production and testing of transformers and power reactors and are well received by users.

II. Standards and requirement

2.1 Standards

The technical conditions of the Comprehensive Transformer Test Bench are in line with the national and power transformer industry standards and specifications. If there are differences between the standards, they are implemented at a higher standard.

No.

1.1	IEC60076-1 ~5	Power transformer
1.2	IEC60726	Dry-type power transformer
1.3	GB 1094.1—2013	Power Transformer Part 1: General Provisions
1.4	GB 1094.2—2013	Power Transformer Part 2: Temperature Rise
1.5	GB 1094.3—2013	Power transformers - Part 3: Insulation levels, insulation tests and external insulation gaps
1.6	GB/T 1094.10—2015	Power transformers Sound level determination
1.7	GB/T 6451—2015	Three-phase oil-immersed power transformer technical parameters and requirements
1.8	GB 1094.11—2013	Dry-type power transformer
1.9	GB/T 10228--2008	Technical parameters and requirements of dry-type power transformers
2.0	GB/T 15164—2013	Loading Guidelines for Oil-Immersed Power Transformers
2.1	GB/T 15164—2013	Insulating oil - Breakdown voltage determination method

2.2 Appearance inspection

Appearance measurements and measurements are made on the table style, shape size and technological structure size, on-screen equipment layout, alignment, installation process, surface coating, etc., and written records are made.

2.3 Electrical test project

The following tests are carried out in accordance with the relevant standards: IEC60076-1 ~ 5 <Power Transformer> and IEC60726 <Dry Power Transformer>. The test items are as follows:

No.	Test object	Factory test	Field test
1	Transformer no-load loss and no-load current percentage test	√	√
2	Transformer Load Loss and Short-Circuit Impedance Test	√	√
3	Transformer power frequency withstand voltage test	√	√
4	Transformer DC resistance test	√	√
5	Transformer induction withstand voltage test	√	√
6	Transformer temperature rise test	√	√

III. System Configuration

Party A's procurement of equipment produced by Party B must meet the following requirements:

■ 36kV 5000kVA or smaller power transformers

Party A's procurement of equipment produced by Party B must meet the following voltage rating requirements:

The tested transformer considers the impedance to be within 36kV/4-8%, the voltage level of the tested transformer is

■ High Voltage side: 36kV~11kV etc

■ Low Voltage side: 0.4kV~1.5kV

The equipment test objects purchased by Party A and produced by Party B must meet the following capacity requirements of the tested product:

Power transformers and distribution transformers with 36kV voltage level on the high-voltage side and 5000kVA or smaller capacity.

3.1 Product price

No	Product name	Specification model	Manufacturer	Unit	Qty	Price (USD)
1	Automatic transformer test bench	HTBZ-H	UHV	Set	1	
Total :						
Note: This quotation don't include export packaging fee, excluding shipping and installation and commissioning training costs.						

3.2 Scope of supply

No	Device name	Product model	Qty		Note
Part 1 : Main console body					
1-1	Fully Automatic Transformer Test Bench Main Console	HTBZ-H	1 unit		
1-2	Fully Automatic Testing Software System	HT-10C	1 set		
	Industrial Computer	Intergrated			
Part 2 : Transformer characteristic test					
2	Transformer Power Analyzer	HT-101	1 unit		
	Induction Electric Voltage Regulator	TSJA-100kVA	1 unit		10- 650V
Part 3: Induction withstand voltage test					
3	Intermediate Frequency Generator Set	HT-50kVA	1 set		150Hz
Part 4: power frequency withstand voltage test					

No	Device name	Product model	Qty		Note
4	AC Test Transformer	HT-30kVA/100kV	1 set		all bronze
Part 6: Transformer temperature rise test test					
1	Temperature test equipment	HT-16	1 unit		16 channel
	Temperature Sensor	PT100	10pc		
2	Dual Channel Temperature Rise DC Resistance Tester	HT-R-20AW	1 unit		Communicate with computer
Configuration required for 36kV test					
1	High Voltage Auxiliary Control Cabinet	HT-36	1 unit		Automatic control with 600kvar capacitor compensation
2	Intermediate Step-up Transformer	450kVA 0.6/3kV	1 unit		
3	High Voltage Standard Current Transformer	HL-200A	3 units		Accuracy class 0.05
	High Voltage Standard Voltage Transformer	HJ-4kV	3 units		Accuracy class 0.05

3.3 spare parts

No.	Product name	Specification	Manufacturer	Unit	Qty	Explain	Price
2	High Voltage Test Test Cable	35 square		M	50M	Test cable	Self-provided
3	Field commissioning cables	35 square		M			Self-provided
4	High current test clamp	300A		pcs	3	Free	Free

5	Electric Voltage Regulator Control Wiring	10 cores		pcs	1	Free	Free
6	Digital Thermo-Hygrometer			pcs	1	Free	Free

IV. Product performance

HTBZ-H Comprehensive Transformer Test Bench manufactured by our company, has the following functions (test items):

- Transformer no-load characteristic test (no-load loss, no-load current as a percentage of rated current);
- Transformer load characteristic test (load loss, impedance voltage percentage; temperature conversion and load loss test under full current of 30% and above can be automatically performed);
- Ambient temperature and humidity test function;

V. Product performance

5.1 Appearance of Transformer Comprehensive Test Bench: Specification and Dimension: Table Color: Table Picture (Reference only):

Transformer Comprehensive Test Bench reference picture:



5.2 Transformer power analyzer, to meet single-phase, three-phase measurement, its performance requirements are as follows:



- Voltage measurement range 0V—100V, current measurement range 0.2A—1A, accuracy 0.2;
- Power $U \cdot I$, accuracy 0.5;
- Power factor 0.050--1.000, accuracy 0.3;
- Frequency 40-70Hz, accuracy 0.1;
- Three-phase total power P;
- No-load current I_0 %;
- No-load loss P_0 ;
- Load loss P_K ;
- Impedance voltage U_K ;
- Three-phase power value $P_a(P_{ab})$ 、 P_b 、 $P_c(P_{bc})$;
- Three-phase average line voltage U_n ;
- Three-phase average current I_n .

5.4 Dual-channel temperature rise resistance test device



Features:

- It can measure the resistance value of the high voltage side and low voltage side coils of the transformer at the same time. Continuous measurement according to interval time.
- The test process is controlled by a microcomputer, which automatically completes self-calibration, constant current judgment, data processing, and resistance value display;
- Have perfect back EMF protection function;
- It has functions such as charging and power display, and adopts large-capacity lithium battery to meet the needs of field tests;
- The longitudinal test of the DC resistance of the on-load voltage regulating transformer can be completed by one power supply;
- Fast measurement speed, accurate and stable measurement data;
- It has the characteristics of easy operation, high precision, anti-interference, shock resistance, easy to carry, etc;

Technical parameter

- Output current 20A、10A、2A、500mA、100mA、
- Test range 500 $\mu\Omega$ ~200 Ω
- Resolution 0.1 $\mu\Omega$
- Measurement accuracy $\pm(0.2\%$ reading+2digits)

5.4 The intermediate frequency generator set

- Test range:40V~800V;
- Rated capacity:50kVA;
- Input voltage:380V;
- Output frequency: 150Hz \pm 2%
- Main technical performance indicators: After the generator is successfully started, the no-load residual magnetic voltage of the intermediate frequency generator does not exceed 40V. By adjusting the excitation, the output voltage can be continuously adjusted within the range of not more than 20V to 800V.



5.5 The AC test transformer:

- 1.Rated capacity:30kVA;
- 2.Rated output voltage:0~100kV;
- 3.Rated output current:0~0.3A;
- 4.Rated input voltage: 0~600V;



- 5. Rated input current: 0~50A

5.6 Capacitance compensation meets the following indicators:

Electric switching

1. The supplier must implement the current national standards and industry standards, and the main current standards that should be followed are as follows:

GB/T11024.1-2001<Shunt capacitors for AC power systems with standard voltages above 10kV>

GB8287.1-1983<Technical characteristics of high-voltage pillar insulators>

GB8287.2-1989<Dimensions and characteristics of high voltage post insulators>

GB50227-1995<Specification for Design of Shunt Capacitor Devices>

JB/T7111-1993<High Voltage Shunt Capacitor Device>

ZBK48003-1987<Specification for Electrical Test of Shunt Capacitors>

2. Use environmental conditions:

2.1 Outdoor use

2.2 Altitude <1000m

2.3 Ambient temperature: -25~+40°C

2.4 The creepage distance of the outer insulation of the capacitor should not be less than 2.5cm/kV;

2.5 Anti-seismic requirements: capacitors should be able to withstand the action of earthquake intensity of 8 degrees without damage

3. Technical conditions

3.1 Product Model: Parallel Capacitor

3.2 Rated capacity: 600kvar, the capacity deviation should not exceed 0~+5% of its rated value;

3.3 Rated voltage: $0.69/\sqrt{3}$ kV

3.4 Rated frequency: 50Hz

3.5 Under the power frequency rated voltage, the tangent value of the dielectric loss angle measured when

the ambient temperature is 20 °C should be less than 2/10,000;

3.7 Insulation level: LI75/36;

36kV required equipment technical parameters

1 High-voltage precision current transformers

- Rated working voltage: $4\text{kV}\sqrt{3}$
- Withstand voltage: 8kV
- Capacity: 1VA
- Measuring range: 0.1A~200A;
- The accuracy is 0.05 level;
- The ratio 200, 100, 50, 20, 10, 5/1A, A total of seven gears



2. High-voltage precision voltage transformers should meet the following indicators:

- Rated working voltage: $4\text{kV}\sqrt{3}$
- Withstand voltage: 8kV
- Capacity: 1VA
- Measuring range: 0.1kV~4kV
- The accuracy: 0.05 level
- The ratio 4kV, 2kV, 1kV, 0.5kV /100V $\sqrt{3}$ A , six gears in total.



3. The intermediate booster transformer should meet the following indicators:

- Rated working voltage: 100kVA
- Rated input voltage and current: 0.6kV/96A
- Rated output voltage and current: 3kV/19A
- Withstand voltage rating: 25kV, time 60S
- Impedance voltage : 4%
- Meet the requirements of the 24-hour temperature rise test
- Frequency doubling voltage withstand test: It needs to be considered for long-term operation under the condition of 2 times the voltage and load .



VI .Design working principle

6.1 Transformer laboratory comprehensive test system design specification:

6.1.1 System operation is simple, safe and reliable

- ◆ The whole test system takes into account the safety of the test personnel and the reliability of the operation of the equipment.
- ◆ Various overvoltage and current protection functions are complete
- ◆ Reasonable layout, clear and neat wiring

6.1.2 System work efficiency

Make full use of the microcomputer data processing technology, and directly record the measurement results into the microcomputer for calculation. The trouble of manually substituting formula calculations is eliminated. The external wiring is arranged uniformly, and manual wiring is avoided as much as possible. When the line is changed, only the control button is used for automatic switching on the test bench.

6.1.3 Systematic human operation

Make full use of the mechanical and electrical interlocking function, and skillfully combined with computer software programs to effectively prevent the occurrence of malfunctions, that is, if you do not follow the safety procedures, the system will refuse to start, thus effectively protecting the human body and equipment safety.

6.1.4 System reliable operation

The system has two operation modes: manual and automatic. The automatic operation mode uses manual operation mode when abnormal time occurs, which does not affect the normal test task.

6.1.5 System measurement accuracy is high

The measuring instruments and meters of this system are higher than the national standard requirements.

6.2 The main components of the project (see the sub-test table for detailed configuration)

- Comprehensive Transformer characteristic test system
- AC and induction withstand voltage test system
- Common instrumentation in the laboratory.

6.3 Brief description of the main test system

6.3.1 Transformer characteristic test:

A. Manual function

- Use the buttons on the front panel to control the test program.
- Manually record the test data and save it in the database.
- The test process can be completed by PC-side software and loss meter on the PC.
- Tested items can be selected by buttons, and only one test task can be run at a time.
- All test functions and test procedures are selected and controlled by the front panel buttons of the test bench.

B. Automatic function

- The test process can be controlled by the PC and software on the PC.
- Test data can be automatically recorded and saved in the database.
- The keys on the front panel can be invalid during automatic operation.
- The test project can be selected through the buttons in the dialog box, and only one test task can be run at a time.
- The ambient temperature is automatically recorded during no-load or load test.
- In the temperature rise test, automatic control functions supporting constant power and constant current are supported, and temperature test data (or optional interval time) is automatically recorded every 15 seconds.
- Test results such as insulation resistance and oil withstand voltage can be manually entered into the document to complete the test report.
- Correct all test results according to the requirements of the latest standard of GB1094, IEC 60076 or ANSI C57 sequence.
- After the test is completed, the database is automatically completed and the test report can be printed out immediately.
- Automatic calculation of test data can be accurately performed during temperature rise test.
- The data of the no-load test can be automatically corrected for waveform, rated voltage correction, and frequency correction (50 Hz, 60 Hz).
- Automatic temperature correction (75°C, 100°C, 120°C, 145°C), rated current correction, frequency correction for load test data.
- During the no-load test, the high-voltage side voltage can be monitored, recorded, and analyzed.
- During the load test, the low-voltage side current can be monitored, recorded, and analyzed.

6.3.2 Performance characteristics meet the following requirements:

- ◆ Direct loop and indirect loop are automatically switched.
- ◆ High-voltage current and voltage transformers use the principle of secondary switching。
- ◆ CT\PT range automatic switching
- ◆ Transformer test bench for complete control and measurement monitoring of the entire circuit
- ◆ The measured data is automatically processed by the microcomputer and can be stored and

printed as needed.

- ◆ Microcomputer automatic control measurement system test bench and manual operation electric control voltage regulation digital display two mutual standby systems
- ◆ Zero protection, over current protection, over voltage protection
- ◆ High-voltage leakage current display and protection, using 1:1 transformer safety ground
- ◆ The test transformer adopts a new oil-immersed test transformer, which has stronger insulation performance and greatly reduced volume capacity.

Test station auxiliary facility

- ◆ Security alarm system
- ◆ System error alarm system
- ◆ Stainless steel isolation barrier. (Self-made by Party A)
- ◆ Sound and light hazard warning system

VII. User testing software

The user testing software provides encryption functionality and data sharing based on permission levels. The results of inter turn, withstand voltage, and resistance tests can be manually input into the test report.

7.1 Software interface

7.1.1 English interface

7.1.2 The test software interface is exclusive, and the tester cannot access other application software interfaces

7.1.3 Friendly interface, simple and convenient operation, clear and concise steps

7.1.4 Relevant prompt areas (operation guidance, error prompt, etc.)

7.1.5 Relevant curve display area

7.1.6 Real-time information display area including current operator name, time, model and number of tested motor

7.2 Software functions

7.2.1 Standard parameter settings and input functions (corresponding authority is required)

Motors with the same model, different voltage, or different number of poles are treated as different models in the parameter database and stored separately. This interface provides functions such as creating, deleting, editing, and searching parameters.

7.2.2 The testing process and working conditions control function

supports automatic test under user-defined working conditions (if No abnormality occurs during the test, and a complete test is completed automatically without manual intervention)

7.2.3 System setting and hardware proportion setting function (must have corresponding authority)

7.2.4 Operation prompt function

(it can display the operation in progress in real time during automatic test, and it can display the operation in manual test, be able to prompt the next operation instructions; Error prompt in case of misoperation)

7.2.5 Automatic control function

Can control the test process Automatically

7.2.6 Number management function

You can save the corresponding motor number according to the model type and choose to automatically add it.

7.2.7 The test process recording function (recording the completed items)

7.2.8 Can display the size of each test quantity in real time and automatically generating some curves.

7.2.9 Can converse the test results and judging whether the test result is qualified automatically.

7.2.10 Saving function of test results

Establish a product qualification database and choose whether the test data is qualified or not by computer or manual judgment. The test software automatically saves the test data (the test data can be manually corrected), the historical test record can be queried and also can choose whether to save the data of unqualified motors.

7.2.11 Native database function

It has database interface and can connect to server database

7.2.12 Test result retrieval function

There is a corresponding data management interface that allows for data retrieval through methods such as time and model. It also allows for statistical analysis of test data by year, month, and day, and allows for calculation of pass rates based on test items.

7.2.13 Test report printing function

7.2.13.1 The certificate of conformity and/or factory inspection report can be printed according to the requirements of Party A, and statistical reports can be automatically issued.

7.2.13.2 Data backup function.

7.2.13.3 Search function by number.

7.2.13.4 Test data can be exported as a file and can be easily copied through a USB port.

7.3 Software copyright description

The test software is a product independently developed by our company. Our company sells it to users only on behalf of users who have the right to use it, and the final copyright belongs to our company. Our company promises that the test software developed can fully meet the use needs agreed with the user. Our company will not provide the installation version of the operating system platform, test software development platform, office software, network database (if involved), etc. related to the test software.

7.4 Inspection and acceptance

1. This clause is used to inspect and accept the testing equipment provided by Party B(Seller) during the execution of the contract, ensuring that the equipment provided by Party B(Seller) meets the technical requirements of this agreement.

2. Within one week after debugging, Party A(Buyer) shall organize on-site testing and acceptance to inspect whether the testing device meets the requirements of the agreement. After acceptance, Party A(Buyer) shall provide written acceptance documents.

7.4. Technical Information

1. The party B(Seller) shall provide the electrical schematic diagram and manual of the testing device.

2. Provide testing software for the testing device and ensure that the software meets the valid version of the current standard. Party B(Seller) promises to provide preferential assistance for future software upgrade services. Party B(Seller) shall provide the factory certification of the main purchased device components.

7.6 Technical Services and Collaboration

1. Warranty: Warranty is 1 year, during the period, B(Seller) will provide the free charge repairment and reasonable charge replacement (customer take the shipment cost) & lifelong after sale-service (reasonable charge) when using time exceed 1 year.

2. According to the negotiation, after the arrival of the testing device, Party A (Buyer) shall be responsible for unloading, receiving, and preliminary acceptance.

3. Party A (Buyer) shall specify the contact person for the implementation of the system project, in order to facilitate timely communication during the project implementation process.

4. The Party A (Buyer) shall provide the tested motor for the performance and functional inspection of the equipment. If it cannot be provided temporarily no performance and functional inspection shall be conducted during pre-acceptance;

5. The party B (Seller) is responsible for equipment debugging, and the party B (Seller) provides necessary work space and assistance; The testing power supply and motor testing wire shall be provided by Party A (Buyer) and installed under the guidance of Party B (Seller).

6. Party B (Seller) is responsible for training Party A (Buyer)'s staff to familiarize them with the performance,

operation, daily maintenance, and simple repairs of the testing device.

The main console of the comprehensive transformer test bench adopts the following distributed design scheme

■ The advantage of using a distributed design is that it is convenient for the tester to operate and easy to install and debug, which can improve the reliability of the platform. that is, DC resistance test, variable ratio test, no-load characteristic and load characteristic of transformer, and high and low voltage power frequency withstand voltage and induction withstand voltage test of transformer on one platform, each function part is independent of each other Can be freely combined. Both implement automatic testing.

The distributed design can make other units work normally even when one unit or several are damaged.

Therefore, various methods should be adopted to improve the reliability of the platform.

The upper part of the test bench has a built-in low power factor power analyzer test unit. The lower part has built-in current (voltage) transformers, output relays, various working indicator lights, buttons, and various contactors. Voltage regulators and oil-immersed test transformers need to be externally installed due to their large size or high voltage.

The main console of the power transformer comprehensive test bench adopts the following distributed design scheme

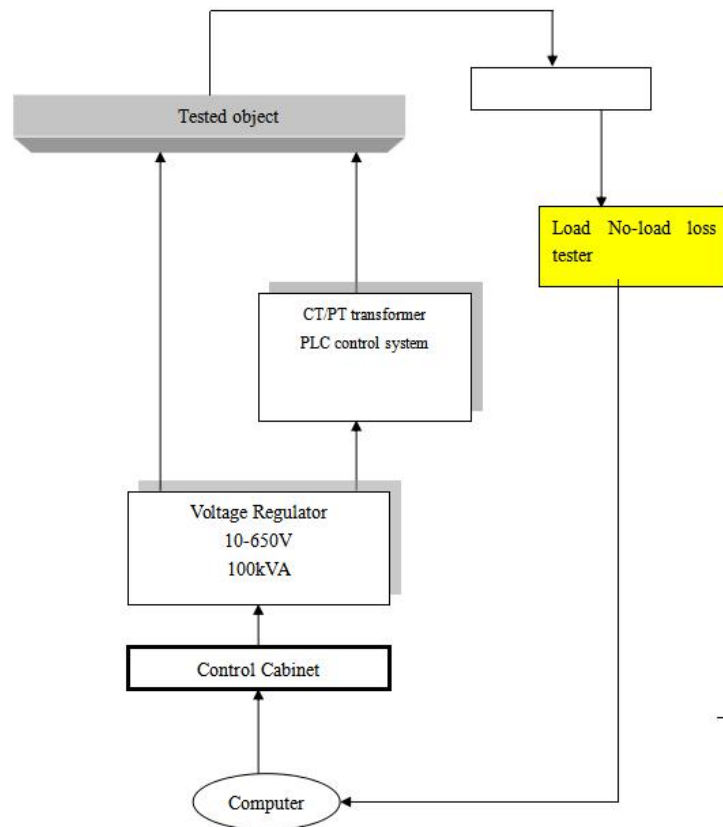
The distributed design can make other units work normally even if one unit or several are damaged. Because the table body is a production line inspection equipment, it is used very frequently, so various methods should be adopted to improve the reliability of the table body.

The upper part of the test bench has a built-in power factor power analyzer test unit. The lower part has built-in current (voltage) transformers, output relays, various working indicator lights, buttons, and various contactors. Voltage regulators and oil-immersed test transformers need to be externally installed due to their large size or high voltage.

The transformer characteristic test system adopts computer program control operation. The computer sends out instructions, and all kinds of gears of the control panel automatically switch in place and boost automatically. When the voltage reaches the set test voltage or current, the test data is locked and the test system is closed.

The system is equipped with a voltage regulator 100kVA and compensation device. Use a transformer power analyzer produced by our company.

The frame diagram of the test system is as follows:



The system can be automatically completed by computer program control. The test procedure is as follows:

- a. The computer issues an instruction to the console.
- b. After receiving the command, the console splits the corresponding contactor to enable the test circuit.
- c. The computer issues a command to the inverter to adjust the boost frequency, then activates the inductive regulator to start boosting.
- d. The computer monitors the boosting process by the voltage and current signals fed back by the empty load tester.
- e. When the single test voltage reaches the set value, the boost is stopped.
- f. Record the test data and then step down.
- g. When stepping down to the zero point of the regulator, the system closes the contactor and the test is completed.

VII. Technical Information

When we supply the equipment, the information provided is as follows

No.	Item name	Electronic Version	Paper version	QTY	Remark
1.	Test bench wiring diagram/schematic diagram	√	√	1set	Ship together with system
2.	Wiring diagram/schematic diagram of power part of test system	√	√	1set	Delivery after completion
3.	Operation and operation instructions of test system	√	√	1set	Ship together with system
4.	Certificate	√	√	1set	Ship together with system
5.	Calibration Certificates for measurement equipment (Factory provided)	√	√	1set	Ship together with system

Note: "√" in the table means to provide the corresponding category of data, and "\" means not to provide the corresponding category of data

VIII. Quality assurance and after-sales service

8.1 quality assurance

The design, manufacture and commissioning of the products provided by the supplier shall be in strict accordance with ISO9001 quality assurance system standard.

8.2 warranty period

The warranty period of products supplied by the supplier shall be 12 months from the date of acceptance of the products . Within the warranty period, the supplier shall provide free services to the demander; after the warranty period, the supplier shall only charge the cost for the maintenance of the equipment.

All products are provided with lifetime maintenance service.

8.3 after sales service

After the arrival of the equipment, if receiving the notice from the demander, the supplier shall send

representatives to the site to guide the installation, commissioning and trial operation, and be responsible for solving the manufacturing quality and performance problems found in the installation, commissioning and trial operation of the contract equipment. For the equipment spare parts damage not caused by the supplier, the supplier shall give priority to providing spare parts and repairing. The supplier is responsible for long-term provision of vulnerable parts of equipment or supplier list of vulnerable parts.

We send special personnel to the site for installation and debugging until delivery, and provide on-site technical training for the demander.(Note:relevant travel expenses are borne by the buyer)

In the field debugging, the Demander shall provide the following test environment: three phase 380V \pm 10%, frequency 50 Hz \pm 0.1, and capacity not less than 100 KVA power supply and installation site; the power supply and test wire required for field installation and debugging shall be provided by the demander.

Automatic Transformer Test Bench reference picture:







