TM9000 Calibration Apparatus for Magnetometers

*The figure above is for reference, actual delivery may very slightly

1. Summary

TM9000 is a set of high precision, multi-function, intelligent magnetic parameter measurement standard device. It is composed of high-precision DC current standard source, standard electromagnet, standard Helmholtz coil, precision magnetometer, magnetic shielding cavity, automatic calibration software, etc. It is suitable for provincial and municipal metrology laboratories to set up magnetic field measurement testing standards and carry out digital or pointer type DC magnetometer calibration.

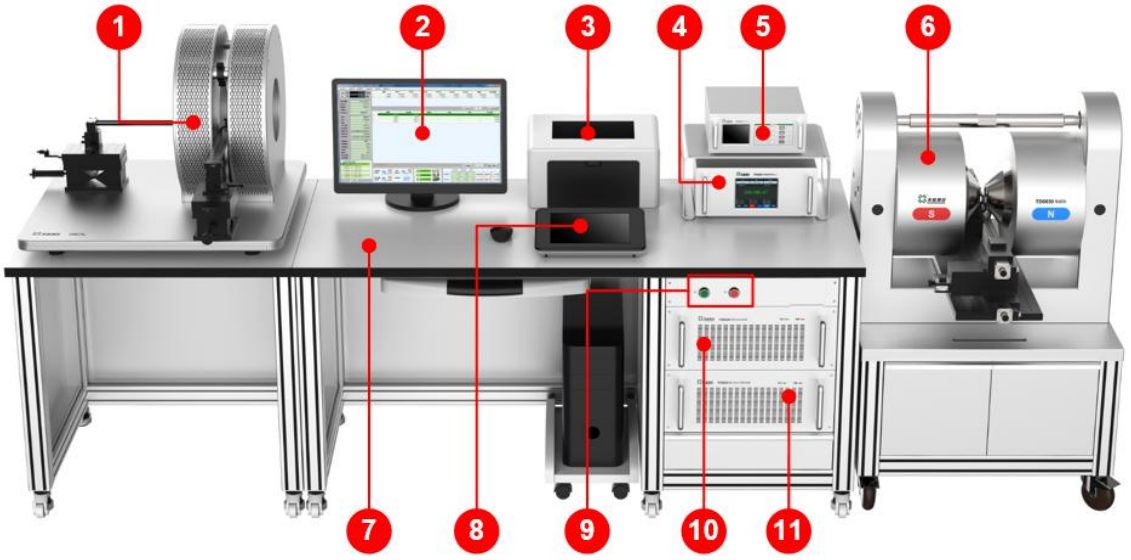
2. Features

- A standard source of bipolar excitation current equipped with dual channels.
- The stability of the current source reaches 30 ppm /min.
- Accuracy class 0.01, the annual error variation is better than 50 ppm.
- Adjustment fineness is a minimum of 5ppm.
- Magnetic field coil generates a standard magnetic field of ± (0.1 mT to 100 mT).
- Electromagnets generate a highly stable magnetic field of ± (10 mT ~ 2.5 T).
- A custom-developed precision magnetometer of Tunkia acts as a standard meter for electromagnets.
- Both the magnetic field coil and the electromagnet are equipped with intelligent probe position adjustment devices.

- Equipped with a magnetically shielded cavity that is used to calibrate the zero drift of the magnetometer.
- Equipped with a portable measurement and control console for easy manual control of the magnetic field output.
- The system uses a modular integrated design.
- Comes with dedicated calibration software.

3. Instrument Appearance

☆ Overall Introduction



NO.	Name	Description
1	**Helmholtz coils**	The magnetic field of ±(0.1MT ~ 100mT) can be generated by DC standard current source excitation.
2	**Computer and Software**	Realize semi-automatic or fully automatic calibration, data recording, report generation.
3	**Printer**	Print the resulting calibration report.
4	**Precision magnetometer**	Can be used as a standard meter to calibrate the magnetic field of an electromagnet.
5	**Calibrated magnetometer**	The position of the DUT.
6	**Electromagnet**	The magnetic field of ±(10mT ~ 2.5T) can be generated by DC standard current source excitation.
7	**Workbench**	Placing equipment, proofread table, computer, printer, etc.
8	**Measurement and control platform**	Manual control of excitation current or magnetic field output.

9	**Power switch**	The green button is on, and the red button is off.
10	**DCI standard source**	Produces high precision DC current for electromagnet or Helmholtz coil excitation.
11	**Probe position controller**	Each stepper motor with 13 RS232 interfaces is connected to the probe positioning device.

4. Equipment Composition

☆ High Precision DC Current Standard Source

- High-precision bipolar current standard source, which can output dual DC current to excite the magnetic field coil and the electromagnet respectively. Accuracy is up to Class 0.01.
- Output stability is better than 30 ppm/min, annual error variation is better than 50 ppm.
- The current source can be continuously tunable by program control and has a small adjustment fineness, which facilitates the calibration of pointer magnetometer.
- Large power output and it can drive a magnetic field coil or electromagnet for a long time at full load.

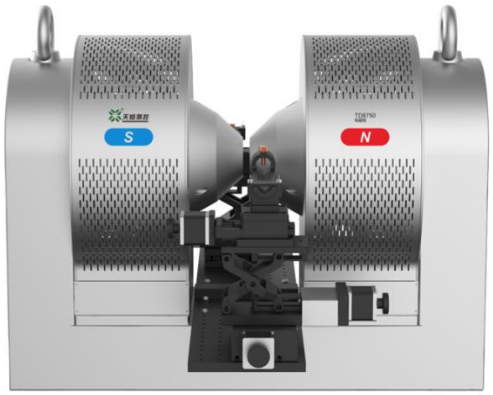
Specifications	
Dual current range	50 mA, 200 mA, 1 A, 5 A, 20 A
Output range	± 5 mA～± 24 A
Adjustment fineness	5 ppm*RG
Short term stability	30 ppm/min
Accuracy	0.006%+ 0.004% ±(ppm of reading + ppm of range) [1]
Full scale linearity	< 10 pp
Annual error variation	< 50 ppm
Maximum load voltage	80 V
Protection function	Open circuit protection, overload protection function
Power supply	AC (220 ± 22)V, (50 ± 2)Hz, Max. power comsumption: < 2 kVA
Note [1] : (ppm = parts per million) (e.g., 10ppm = 0.001%).	

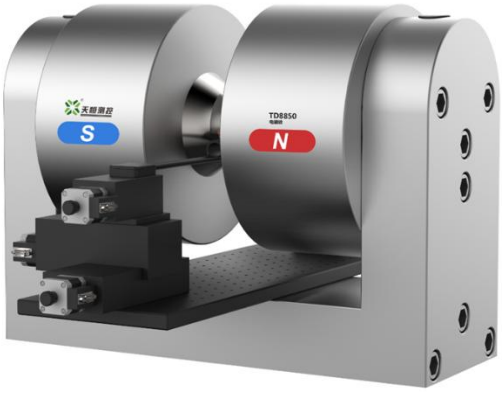
☆ TM9000-HC Standard Magnetic Field with Helmholtz Coil

- A standard magnetic field of ± (0.1 mT ~ 100 mT) can be generated by excitation with a high-precision DC standard current source.
- Calibration of a DC magnetometer with a radial or axial probe.
- The stability and accuracy of a magnetic field depends entirely on the excitation current, and can be directly regarded as a standard magnetic field.
- Two sets of probe position intelligent adjustment devices are installed on the coil, which drive the probe to move and rotate in the Y/Z axis by a precision stepper motor, and determine the best test point by intelligent adjustment and positioning by software.
- The coil is not only suitable for DC magnetometer calibration, but also suitable for various research institutes, colleges, enterprises to conduct electromagnetic interference simulation experiments, material magnetic detection experiments, etc., which is widely used.

Specifications	
Field current	± (5 mA～20 A)
Scope	± (0.1 mT～100 mT)
Uniformity	The uniform field within 20 mm is better than 300 ppm
Linearity	The magnetic field is proportional to the excitation current
The temperature influence	The coil constant K changes little with temperature
Inner hole diameter	200 mm
Size	680 mm × 700 mm × 450 mm (W x D x H)
Weight	About 120 kg

☆ TM9000-EM Standard Magnetic Field Electromagnet





- The electromagnet can be excited by a high-precision DC standard current source to generate a stable magnetic field of ± (10 mT ~ 2.5T).
- The reference value is measured by a standard table.
- There is a good linear relationship between the magnetic field and the current, and the stability of the magnetic field depends on the excitation current.
- The TM6140B precision magnetometer (Class 0.05) is used as the standard meter.
- Equipped with two sets of probe position intelligent adjustment device, the probe is driven to move and rotate in the Y/Z axis by a precision stepper motor, and the optimal test point is determined by intelligent adjustment and positioning of software.
- The electromagnet base is equipped with rollers on each of its four legs.
- The electromagnet has a small input power/magnetic field ratio and can work stably for a long time without water cooling and heat dissipation.

Specifications	
Field current	± (5 mA～24 A)
Scope	± (10 mT～2.5 T)
Uniformity	The uniform field within 5 mm is better than 300 ppm
A column diameter	180 mm
Polar surface diameter	60 mm
Air gap	10 mm
Size	710 mm × 885 mm × 560 mm (W x D x H)
Weight	About 500 kg

☆ TM6140B Precision Magnetometer

- Equipped with high-sensitivity, low-drift Hall sensors and applied advanced digital signal processing techniques.
- DC magnetic field is measured from 0 to 3000 mT, accuracy Class 0.05.
- As a standard meter for a magnetometer calibration device, calibrating DC magnetometer.

Range	Resolution	Accuracy ±(A ppm of reading + B)	The temperature coefficient ± ppm/℃	Zero drift ± μT/h
3 mT	1 nT	0.1% + 100 μT	50	15
30 mT	10 nT	0.05% + 100 μT	50	20
300 mT	100 nT	0.05% + 100 μT	50	50
3000 mT	1 μT	0.05% + 150 μT	50	75

☆ TM2800 Magnetic Shielded Cavity

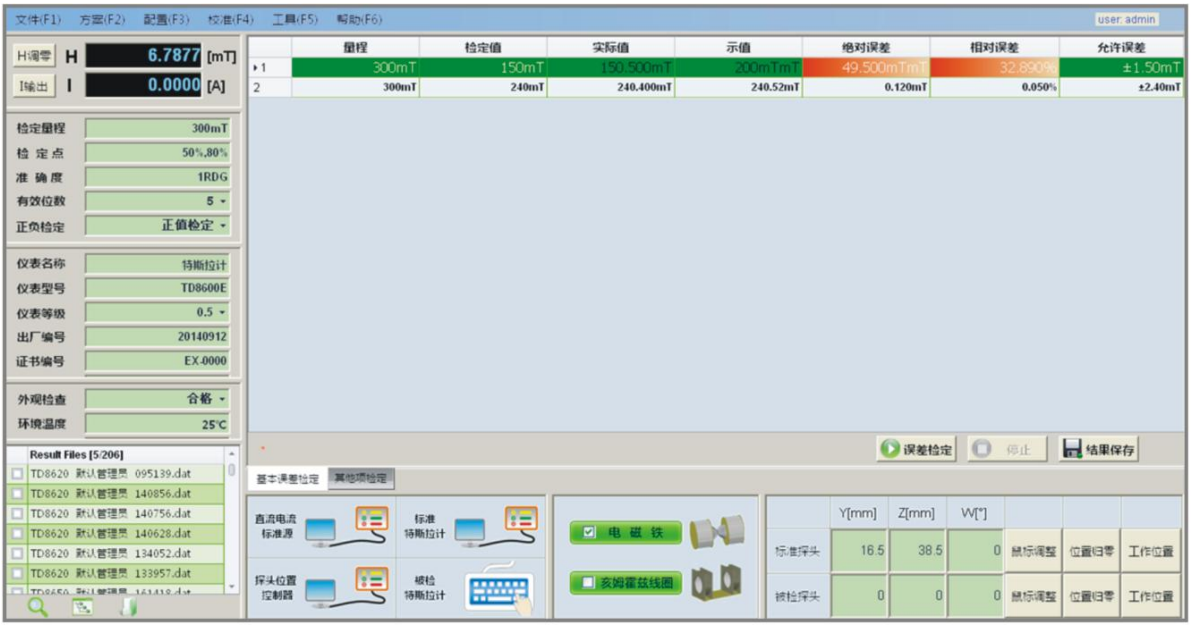
- The shielding frame is made of a shielding material with high magnetic conductivity, which removes the effects of the geomagnetic field.
- The internal magnetic field <10^{-6} T, which can be directly regarded as zero magnetism when calibrated.
- Small, lightweight (about 1kg), compact and easy to carry.
- The device is suitable for calibrating the zero point of a standard or calibrated magnetometer.

☆ Magnetic Field Probe Position Controller

- The device has 13 RS232 interfaces, 12 of which are used to control a total of 12 precision stepper motors on four probe positioning systems (two for each field coil and two for the electromagnet).
- The other RS232 is used for computer communication, controlling the stepper motor by software or wireless mouse remote control, driving the Hall probe to move or rotate at Y/Z axis and W Angle to determine the best magnetic field test point.
- The four sets of probe position intelligent adjustment devices are made of non-magnetic materials.

Axis	Range of stroke/Angle	Adjustment fineness
Y	50 mm	0.1 mm
Z	60 mm	0.1 mm
W	± 12°	0.1°

☆ Special Calibration Software



- The software automatically recognizes whether an accessory is communicating properly with the PC, and visually displays in the configuration interface.
- The selected excitation mechanism is visually displayed in the interface of the software and can be freely switched.
- The calibration parameter units: mT, G, kG, Oe, kOe, A/m, kA/m.
- The software controls the Y axis, Z axis, and W axis of the standard probe and the probe to adjust the best test point of the probe, or enter the wireless mouse control mode.
- Automatically prompts you to switch between the range and the calibrated value of the input, and automatically enters the standby state if no input is entered within 2 minutes.
- Automatically calculates zero drift, which exceeds the permissible zero drift and is marked in red.
- An error is automatically calculated and compared to the permissible error, warning you with a red light for an excess value.
- Test data can be generated and exported as a calibration report.

5. General Specifications

Power supply	AC (220 ± 22) V, (50 ± 2) Hz
Temperature performance	Working temperature: 0°C～50°C； Storage temperature: -20°C～70°C
Humidity performance	Working humidity: 40% ~ 80% R·H no condensation； Storage humidity: < 80% R·H, no condensation