5 Maintenance

5.1 Care and Maintenance

5.1.1 Overview

5.1.1.1 Description

In addition to cleaning and disinfecting the ultrasonic probe after each use, you need to regularly test or calibrate the ultrasonic system. This chapter describes only the recommended maintenance processes.

5.1.1.2 Tools, Measurement Devices and Consumables

Table 5–1 Tools and measuring devices

Tool or Measuring Device	Quantity	Description
Plastic or resin container	1	Used to store the saline, and can accommodate two ultrasound probes.
Soft brush	1	Its size is similar to that of a toothbrush, and it has a soft head.
Small plastic basin	1	Used to store the soapy water.
Safety tester	1	Refer to **9.3** Electrical Safety Maintenance.
Socket head wrench	2	M8 and M5 socket head wrenches

Table 5–2 Consumables list

Consumables	Quantity	Description
Aluminum foil	About 1 m	None
Normal saline solution	About 1000 mL	At least half of the container should be filled with the solution so that the probe can be submerged by the solution. (Refer to **9.3** Electrical Safety Maintenance.) (Concentration: 0.85%-0.95%)
Mild soapy water	About 400 mL	None
Dry soft cloth or cotton cloth	About 5 pcs	None

5.1.1.3 Routine Maintenance Items

Table 5–3 Maintenance items and maintenance frequency

No.	Item	Frequency	Method
1.	Cleaning the filter	Once per month	See **5.1.2.2** Cleaning the Filter
2.	Cleaning the display or touch screen	Once per month	Ditto
3.	Cleaning the trackball	Once per month	Ditto
4.	Cleaning Control_Panel_Board	Once per month	Ditto
5.	Cleaning the probe (acoustic head part)	After each use	Ditto
6.	Cleaning the probe cable and connector housing	Once per month	Ditto
7.	Cleaning the holders (including the probe holster and medical ultrasound gel holster)	Once per month	Ditto
8.	Cleaning the cover	Once per month	Ditto
9.	Cleaning peripherals	Once per month	See **5.1.3.1** Peripherals to Be Cleaned
10.	Checking the probe surface	1 time/day	See **5.1.4.1** General Inspections
11.	Checking the power cord, plug, and circuit break	Once per month	See **5.1.4.1** General Inspections
12.	Checking the functions of peripherals and optional accessories	Once per year	See **5.1.4.3** Inspection of Peripherals and Optional Functions
13.	Checking mechanical safety	Once per year	See **5.1.4.4** Mechanical Safety Inspection
14.	Checking electrical safety	Once per year	See **9.3** Electrical Safety Maintenance
15.	Checking the battery	Once per year	See **5.1.4.1** General Inspections

5.1.2 System Cleaning

5.1.2.1 Flow of Cleaning

Figure5–1

WARNING

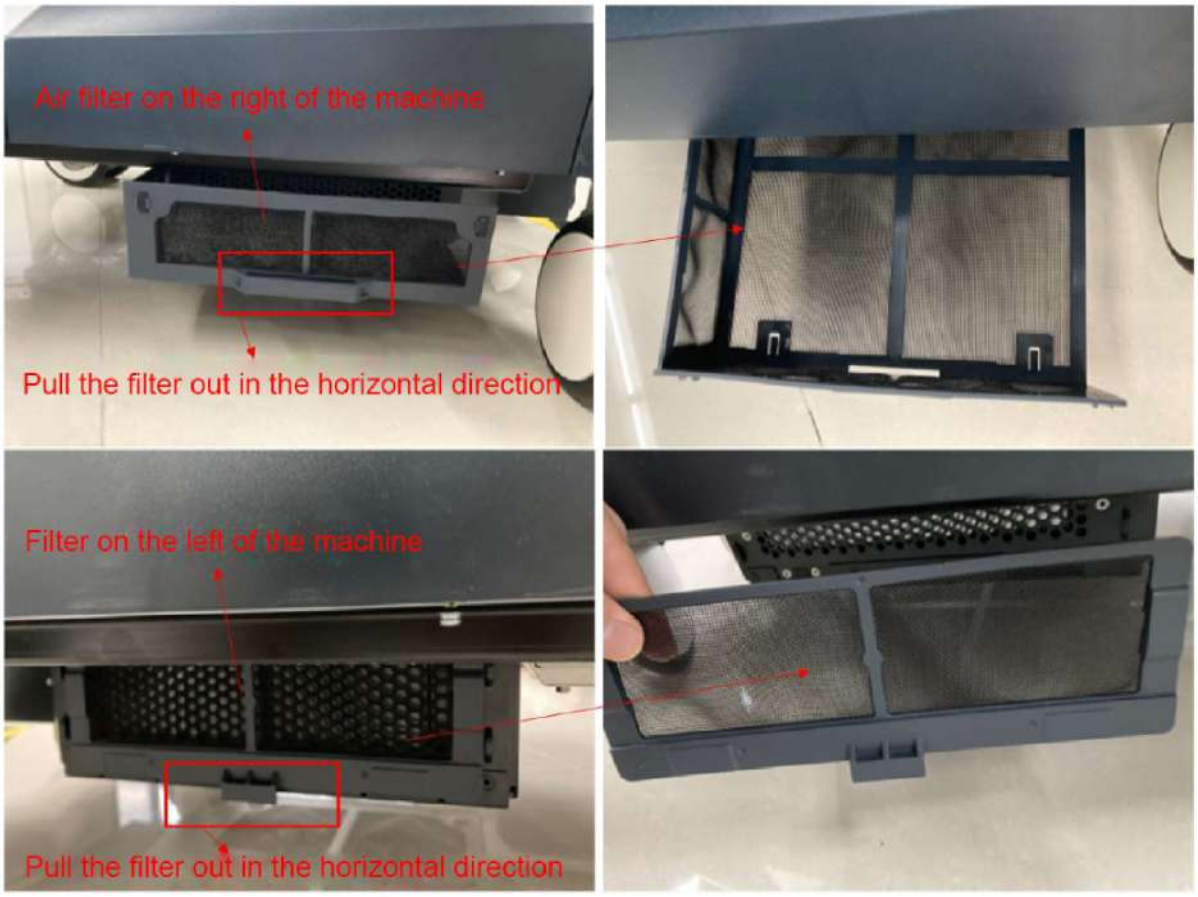
Before cleaning the machine, power off the machine and unplug the power cable. Cleaning the device in the power-on state may result in electric shock.

5.1.2.2 Cleaning the Filter

- Tool: soft brush
- Method:

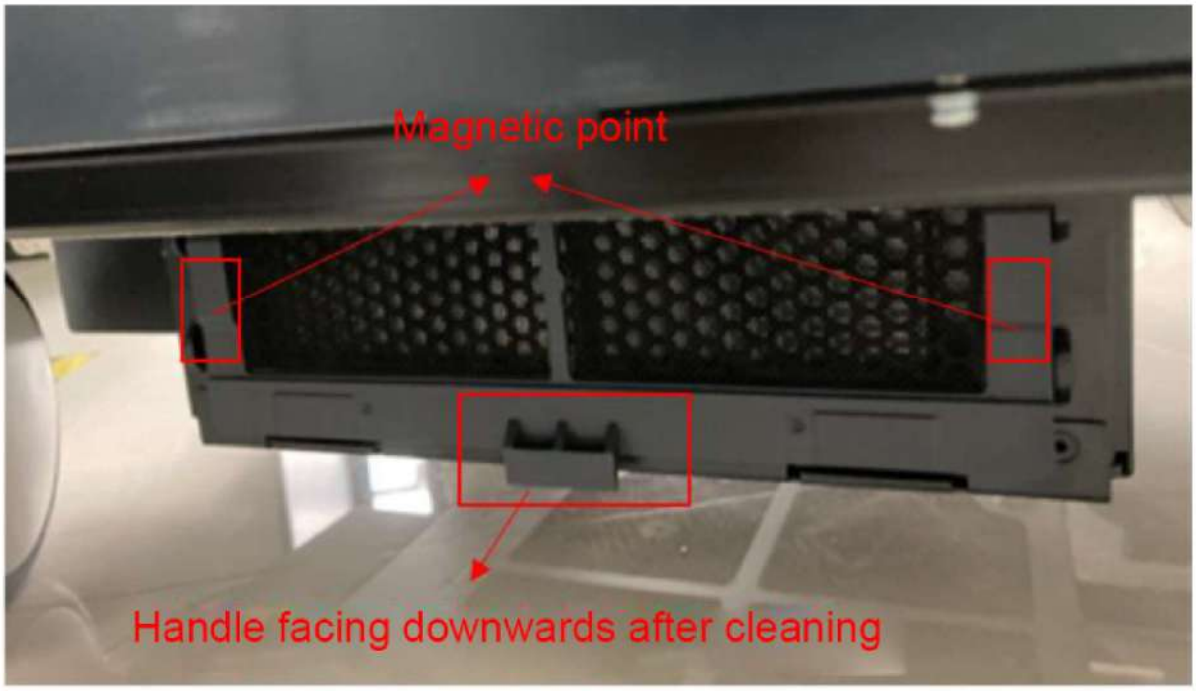
1. Remove the filter before cleaning.
   Pull out the base filter (There are dust filters on both sides of the machine. The air filter on the right of the machine is slidable, while the dust filter on the left side is magnetic).

Figure5–2



2. Clean the filter: Gently brush off the dust from the filter with a soft brush.
3. Install the filter.
   Air filter on the right of the machine: Insert the filter into the slot of the base power box (FRU), and push the filter inwards till the filter is buckled into the hole of the base power box.
   Filter on the left of the machine: The dust filter on the left side of the machine body is single-sided. After cleaning the dust, when reinstalling it, hold the handle downward and directly attach it to the source position so that it will be automatically attached due to the magnetic attraction.

Figure5–3



CAUTION

Clean all the filters of the machine regularly (once a month). Otherwise, it is easy to cause damage to the machine. When the machine is used outdoors or in other dusty places, increase the cleaning frequency.

5.1.2.3 Cleaning the Display

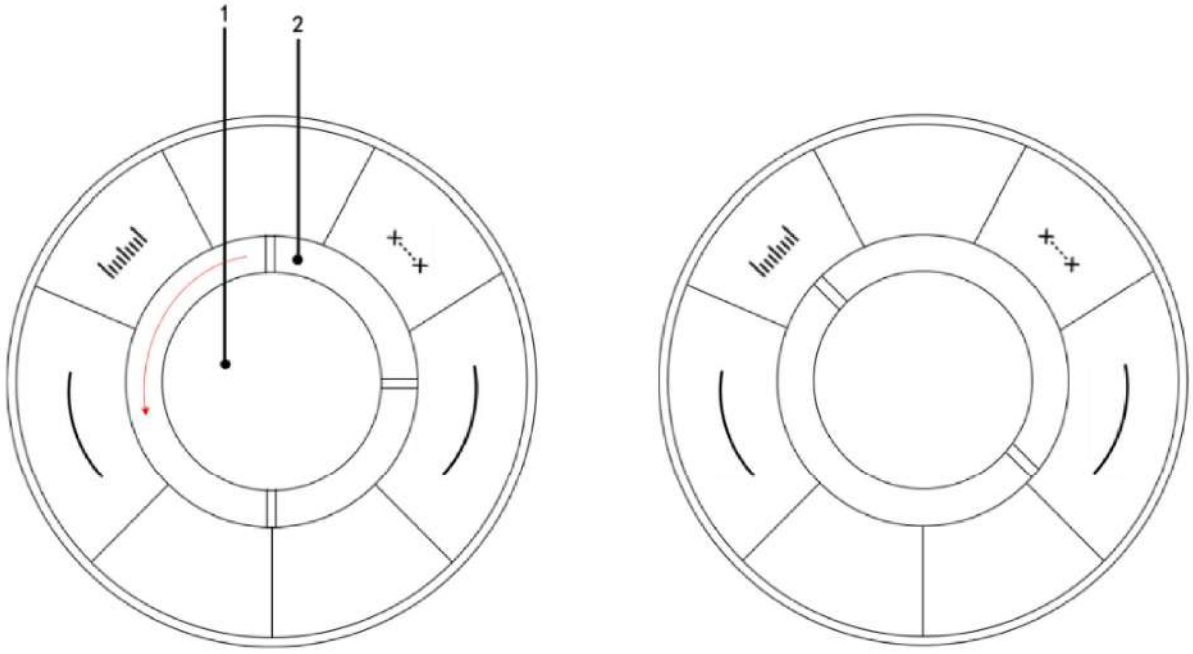
- Tools: dry soft cloth, water or mild soapsuds
- Method:
  Directly use a dry soft cloth to clean the surface of the display and touch screen. If there is still a stain, dip a dry soft cloth with a little water or mild soapsuds to wipe and then air dry the display.

5.1.2.4 Cleaning the Trackball

- Tools: paper tissue, dry soft cloth, and mild soapsuds
- Method:

1. Remove the trackball:
   Press the bulges on the clamping ring by both hands and turn the ring about 45° counterclockwise until it lifts. Take out the clamping ring and the trackball. Be careful not to drop the ball. See the figure below:

Figure5–4



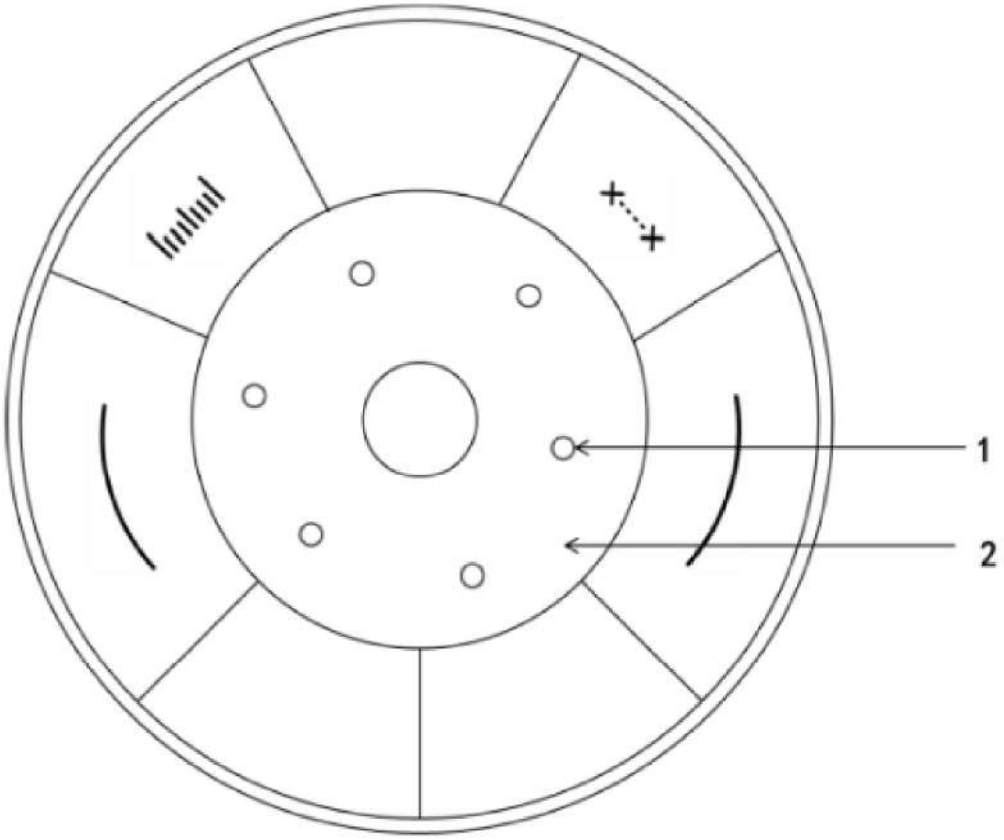
1 Trackball

2 Clamping ring

2. Cleaning:

Use a clean soft cloth or dry paper tissue to clean the bearings, plastic housing, and inner part of the clamping ring inside the trackball, as shown below. Meanwhile, clean the ball.

Figure5–5

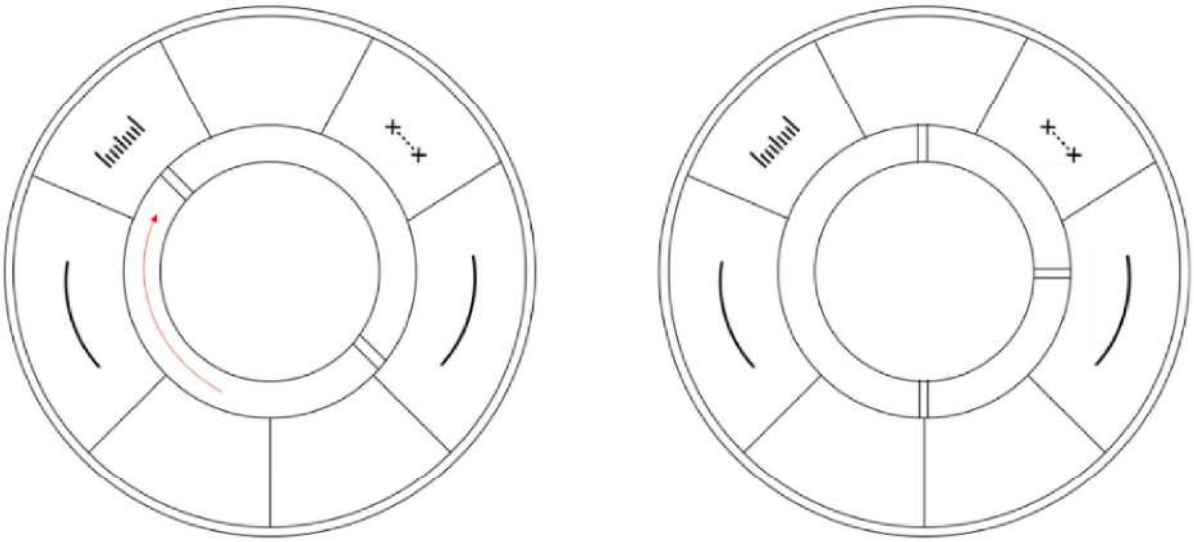


1 Bearing

2 Plastic housing

3. Re-installing:
   Put the ball in. Then, put the pressure ring in (the convex strip on the pressure ring is about 15 degrees from the horizontal), and rotate clockwise until the convex strip on the pressure ring is horizontal. Then, the buckle is locked. At this time, the pressure ring can no longer be rotated, indicating that the pressure ring has been installed in place. See the figure below.

Figure5–6



5.1.2.5 Cleaning Control_Panel_Board

- Tools: mild soapsuds, and dry soft cloth
- Method:
  Use a dry soft cloth to wipe the dust from the surface of Control_Panel_Board (including keys and the encoder). Or, dip a soft cloth with a small amount of mild soapsuds to scrub away stubborn stains, and then use another soft cloth to dry or air dry Control_Panel_Board. If it is difficult to clean Control_Panel_Board, remove the encoder cap and clean Control_Panel_Board with mild soapsuds.

NOTICE

Clean Control_Panel_Board and keyboard regularly; otherwise the dirt in the gaps between keys will jam the keys, causing long beeping of the buzzer and malfunction of keys.

5.1.2.6 Cleaning the Probe

- Tools: mild soapsuds, and dry soft cloth
- Method:

1. Use a dry soft cloth to wipe off the dust on the head of the probe, connector housing, and cable.
2. Use a soft brash to generally remove the dust on the probe connector terminal.
3. If there are still stubborn stains, dip a dry soft cloth with a little mild soapsuds to wipe off dust or stains on the surface of the probe cable or connector housing, and then air dry them.

NOTICE

Do not wipe the probe connector using a wet soft cloth.

5.1.2.7 Cleaning the Probe Holster

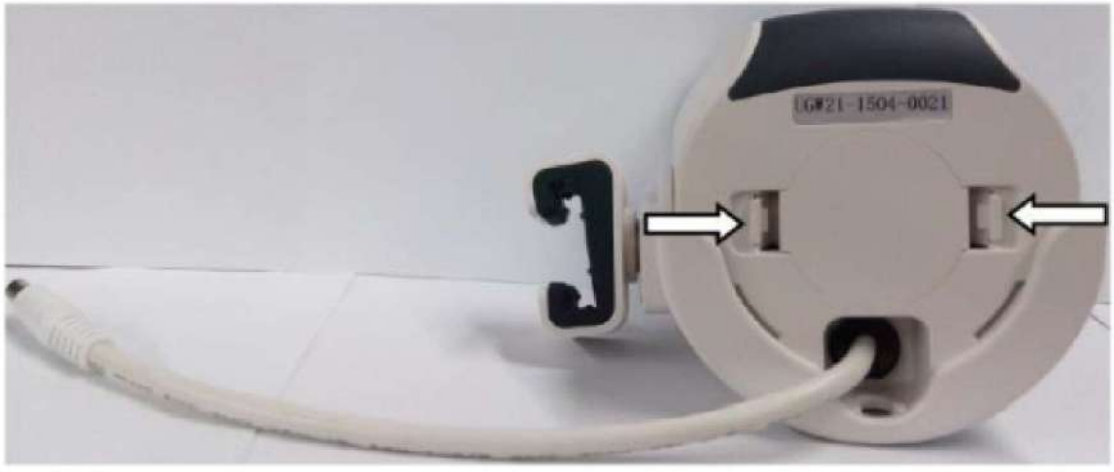
- Tools: mild soapsuds, dry soft cloth, and soft brush
- Method:

1. Use a dry soft cloth to wipe the dust inside and outside the probe/medical ultrasonic gel holder and the gap of the holder. For the small intracavitary probe holster or gap, use a soft brush to gently brush off the dust and stains from the inner layer.
2. If there are still stubborn stains, you can remove the holder, dip a dry soft cloth with a small amount of mild soapsuds to wipe off the stains attached to the external or internal layer of the holder, air dry the holder, and the install the holder.
3. Medical ultrasonic couplant heating cup: Disconnect the power cord of medical ultrasonic couplant heating cup, remove the heating cup, dip a dry soft cloth with a small amount of soapy water to clean the inside and outside of the heating cup, use a soft brush to clean the dust in the holes at the bottom, dip a dry soft cloth with a small amount of soapy water to remove the residual stains, air dry the heating cup, and then install it.

5.1.2.8 Cleaning the Ultrasonic Gel Warmer

1. Disconnect the power supply of the gel warmer and remove it from the cup rack.
2. Press the snap-fits of the bottom arm in the directions indicated by the arrows to remove the bottom cover.

Figure5–7



3. Use a soft cloth dipped in soapy water or water to gently wipe the heater surface and the connection cable.

Avoid liquid flowing into the gap of the heater. Do not use organic solvent to scrub the heater. Turn on and use the heater only after its surface is fully dried.
Do not use strong solvent such as acetone. It is prohibited to use rough materials (such as steel velvet) to clean the surface of the heater.
Clean the bottom bucket of the heater regularly. Remove the bottom bucket during cleaning. After cleaning, re-install the bucket at the bottom of the heater after its surface is dried.

4. Remove the bottom cover for cleaning.

5.1.2.9 Cleaning the Machine Shell

- Tools: mild soapsuds, and dry soft cloth
- Method:
  Use a dry soft cloth to wipe off the dust on the equipment enclosure (exposed part). Or, use with a dry soft cloth dipped in a small amount of mild soapsuds to remove stains, and air dry the shell.

NOTICE

Use a soft brush to gently remove the dust from naked interfaces or sockets (such as the probe socket, and ports and sockets on the I/O board and power board). Do not use a wet soft cloth.

5.1.3 Cleaning Peripherals

5.1.3.1 Peripherals to Be Cleaned

Clean peripherals according to the actual conditions of the optional peripherals, and omit items that are not configured.

Table 5–4 Peripherals to Be Cleaned

Item	Description	Method
1.	Color or black and white video printer	Use a dry soft cloth to wipe off the dust or stains on the outer shell of the printer, and then open the outer shell to clean the inside of the printer. Make sure to follow instructions of the printer for cleaning and maintenance.
2.	Graph/text printer	Use a dry soft cloth to wipe off the dust or stains on the shell of the printer, and then open the shell to clean the inside of the printer. Make sure to follow instructions of the printer for cleaning and maintenance.

Table 5–4 Peripherals to Be Cleaned(continued)

Item	Description	Method
3.	Footswitch	Use a dry soft cloth dipped with an appropriate amount of mild soapsuds to wipe off the dust and stains on the keys and cables of the footswitch.
4.	Barcode scanner	Use a dry soft cloth to wipe the glass plate of the scanning window, and then wipe of the dust or stains on the cable and bracket. For special cleaning, make sure to follow the instructions of the scanner.

5.1.4 Inspection

5.1.4.1 General Inspections

Table 5–5 Common checklist

No.	Description	Method
1.	Probes	1. Visually check the head of the probe for cracks or expansion. 2. Visually check the probe cable for aging or peeling. 3. Visually check the probe connector for foreign objects and smudges.
2.	Power cord and plug	1. Visually check the power cord for wrinkles, cracks or aging. 2. Manually check whether the connection of the power plug is reliable, check whether the power cord or plug is loosened or broken, and whether the anti-drop device of the power cord is effective.
3.	Circuit breaker	1. Manually check whether the circuit breaker can be properly turned on or off.
4.	Battery	Check battery performance regularly. 1. Check whether the battery can be normally charged in startup state: If the current battery is 100% or the battery rises after a certain period of time, it indicates that the battery can be normally charged. When the general battery is less than 90%, the time needed to increase the battery power by 1% should be < 5 min; when the battery is greater than 90%, it takes more time to increase the battery power by 1%. 2. In the standby state, after disconnecting the AC power supply, check whether the battery can maintain normal standby status based on the battery status indicator.

5.1.4.2 System Function Inspection

This inspection is an effective method to ensure product quality. When necessary, perform this inspection. Regular maintenance is not required.

Table 5–6 System function checklist

No.	Description	Method
1.	B mode	Check the basic operations of the B mode. Check the basic software and hardware controls that affect operations in B mode.
2.	Color mode	Check the basic operations of the color mode. Check the basic software and hardware controls that affect operations in the color mode.
3.	Doppler mode (PW/CW)	Check the basic operations of the Doppler mode. Check the basic software and hardware controls that affect operations in the Doppler mode.
4.	M mode	Check the basic operations of the M mode. Check the basic software and hardware controls that affect operations in the M mode.
5.	Measure (2D, M, Doppler routine measurement; application measurement is optional)	Perform gray scale image scanning on the phantom, use the measurement control to verify the accuracy of distance and area calculation, and verify the measurement accuracy based on the performance test results.
6.	Keyboard test	Perform keyboard tests to verify that all control keys are working properly.
7.	LCD	Verify that the LCD display function and parameter adjustment are normal. For details, see the LCD inspection method.
8.	Software menu check	Check the software menu display function, and verify that users can access various operation menus and screens normally.
For details, refer to the performance test in function check **4.4.1.1** Check Process. **4.5.1.1** Test Process		

5.1.4.3 Inspection of Peripherals and Optional Functions

If there are no modules or optional accessories in the system configuration, skip the relevant inspections.

Table 5–7 Inspection of optional functions and peripherals

Item	Description	Method
1.	Color or black and white video printer	Check whether the output of the video printer is normal.
2.	Graph/text printer	Check whether the output of the graphic printer is normal.
3.	Footswitch	Check whether the footswitch implements the configured functions according to the program.
4.	DVD-R/W	Check whether DVD-R/W is working properly (burning, reading and ejecting).
5.	Barcode scanner	Check whether the scanner works normally and the output is correct.
6.	DICOM	Check whether DICOM works normally. Send pictures and other data to DICOM server for verification.
7.	ECG module	Check the user's basic operations and verify the implementation of functions of the ECG module.
For details, refer to routine checks. **4.3.1.1** Check Process		

5.1.4.4 Mechanical Safety Inspection

Mechanical safety inspection mainly focuses on the mechanical strength and mechanical function of key components of the ultrasound system. The main inspection and evaluation methods include visual inspection and operation inspection. If the inspection result fails to pass and proves that the system is in an abnormal state, stop the system and take appropriate measures. The inspection process is as follows:

Figure5–8 Mechanical safety inspection flowchart

Table 5–8 Mechanical safety checklist

Item	Description	Method	Tool
1.	Wheel	Visually check that the casters are not broken.	None
2.	Caster connection	1. Visual inspection: Check that the casters do not skew, and that the screws do not crack or fall off. 2. Use a wrench to check that the casters and the base connection screws are not loose.	Socket head wrench
3.	Central braking system	1. Step on the brake pedal and confirm that the machine cannot move. 2. Step on the straight-line pedal, and ensure that the machine can move straightly, without turning at any angle.	None
4.	Handle	1. Visually check that there are no cracks in the front and rear handles of the machine. 2. Hold the rear handle with both hands, push the machine, and gently pull it to confirm that the rear handle is not loose.	None

Table 5–8 Mechanical safety checklist(continued)

Item	Description	Method	Tool
5.	Control_Panel_ Board and support structure	Move Control_Panel_Board by hand to check that the support structure of Control_Panel_Board is normal and Control_Panel_Board is not tilted or loose.	None
6.	Display fixing and motion structure	a) Visually check that the display is not tilting left or right.	None
		b) Manually check that the display can be bent, lifted, rotated to the left and right normally, and no abnormal sound indicating that the display is loose can be heard during this process.	None
7.	Lifting and rotating mechanism	1. Press the up button on Control_Panel_Board of the handle. Control_Panel_Board will rise steadily without any abnormal sound. After reaching the upper limit, the up button will become invalid. 2. Press the down button on Control_Panel_ Board of the handle. Control_Panel_Board will fall steadily without any abnormal sound. After reaching the lower limit, the down button will become invalid. 3. Press the rotating and locking button on Control_Panel_Board. Control_Panel_Board will flexibly rotate at an angle within ±90°, without any abnormal sound.	None
8.	Other mechanical structures	Check that no other structural parts are loose, the shell does not crack, and no conductive parts are exposed.	None

5.1.4.5 Electrical Safety Inspection

Electrical safety inspection must be carried out by maintenance engineers with specialized knowledge or skills or by engineers trained to have such skills. For details, refer to **9.3** Electrical Safety Maintenance: Electrical Safety Inspection.