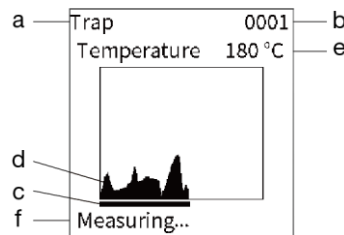


7.1.4 Display during and after measurement

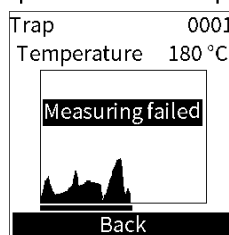
The measurement process takes 15 seconds.

1. Display during measurement (Pressing the probe against the valve)



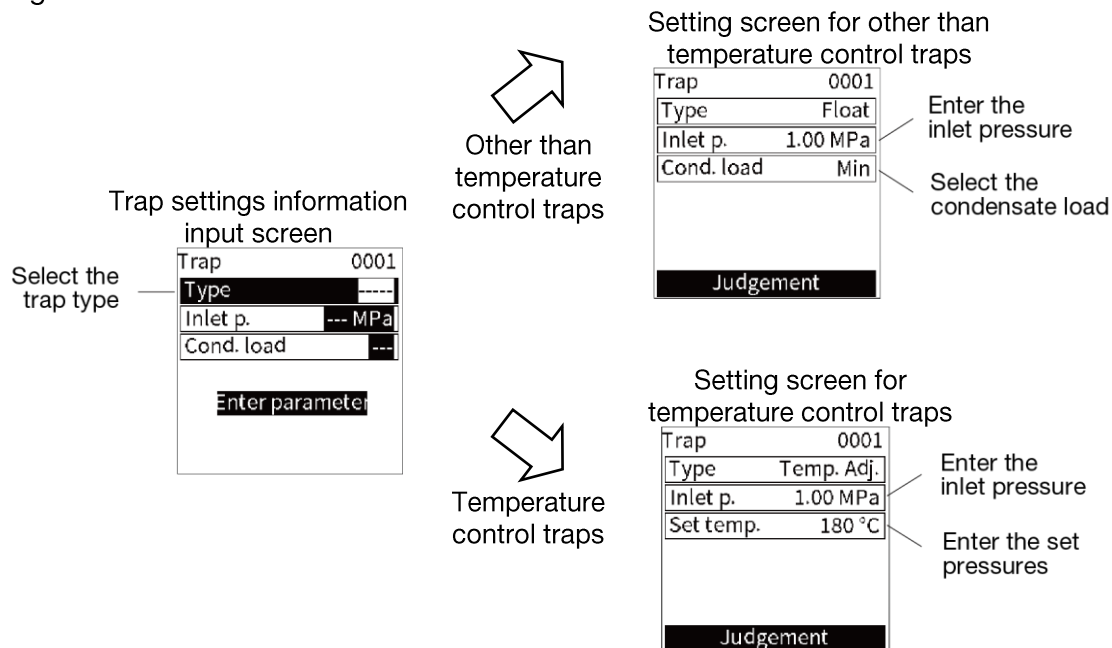
- Inspection mode**
Indicates that it is in trap inspection mode.
 - Record number**
Displays the record number.
The data currently being measured will be saved to this record number.
 - Progress bar**
Indicates the progress of the current measurement. When the bar reaches the end of the graph, measurement is complete.
 - Ultrasonic waveform graph**
Displays the ultrasonic waveform of the measurement in progress.
 - Measurement temperature**
Displays the trap surface temperature being measured
 - Comments**
Displays the current status.
2. The LED at the base of the device signals when a measurement is complete.
 3. If a probe is moved during measurement or is not held perpendicularly to the measurement surface, measurement will stop and an error is displayed on the screen. Hold the probe perpendicularly and steady while measuring. To interrupt the measurement, press the [ENT] button to return to the trap inspection mode screen.

Inspection error display



7.1.5 Entering the trap configuration information

After trap measurement is complete, the trap configuration input is displayed. Select the trap configuration information such as the trap type, pressure, condensate load or set temperature of the trap to be measured using the directional (left/right) button. If the given information is insufficient, “Enter parameter” will appear on the screen. After all information is input, [Judgement] is displayed. Press [Judgement] and perform the judgement.



7.1.6 Trap Type

Select appropriate trap type from the following:

Disc: Disc type

Float: Float type

Bucket: Bucket type

Thermo.: Thermostatic type

Temp. Adj.: Temperature control type

Other: Unknown

Search and display data stored for the device.

- If data was previously saved under this record number, “-,-” is displayed.
- If no data was previously saved under this record number, “-----” is displayed.

7.1.7 Entering the inlet pressure (for all trap types)

1. Enter the pressure information under which the trap to be inspected is operating. All displayed pressures are gauge pressures, not absolute pressures.
 - If data was previously saved under this record number, “-,-” is displayed.
 - If no data was previously saved under this record number, “-----” is displayed.

2. Enter the pressure with the left/right button.

- The input pressure will increase or decrease according to the table below.

Displayed unit	MPa	kg/cm ²	bar	psi
Pressure setting range 1	0.00 to 0.09	0.0 to 0.9	0.0 to 0.9	0 to 9
Increase/decrease value	0.01	0.1	0.1	1
Pressure setting range 2	0.10 to 0.95	1.0 to 9.5	1.0 to 9.5	10 to 95
Increase/decrease value	0.05	0.5	0.5	5
Pressure setting range 3	1.00 to 8.00	10.0 to 82.0	10.0 to 80.0	100 to 1160
Increase/decrease value	0.10	1.0	1	0

- Press the button for more than one second to increase/decrease the input value quickly.

7.1.8 Condensate load status (for other than temperature control traps)

Set the condensate load factor (MIN, ?, OTHER).

- If no data was previously saved under this record number, "---" is displayed by default.
- If the data was already saved with the same record number in the past, the condensate load status saved in the past is displayed.

The selection criteria of the condensate load factor are as follows:

- Condensate load factor:

$$\text{Condensate load} = \frac{\text{Amount of condensate currently being discharged}}{\text{Discharge capacity under operating conditions}} \times 100(\%)$$

Use the following standards to select the condensate load status:

Condensate load rate	Less than 10%	10 to 90% or unknown
Condensate load status	MIN	OTHER

- Press the left/right button to select the condensate load status.

7.1.9 Enter the temperature setting (for temperature control traps)

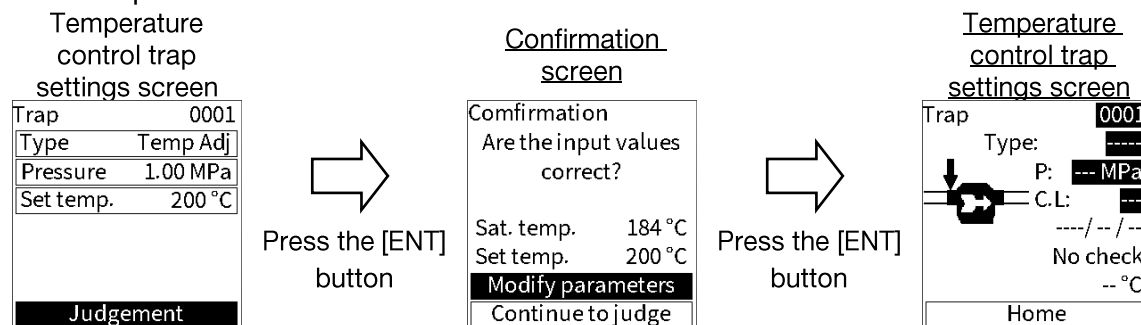
Enter the temperature setting for the temperature control type. The set temperature range is 1 to 350 °C.

7.1.10 Judgement

After the settings are completed, select [Judgement] on the measurement screen and press the [ENT] button.

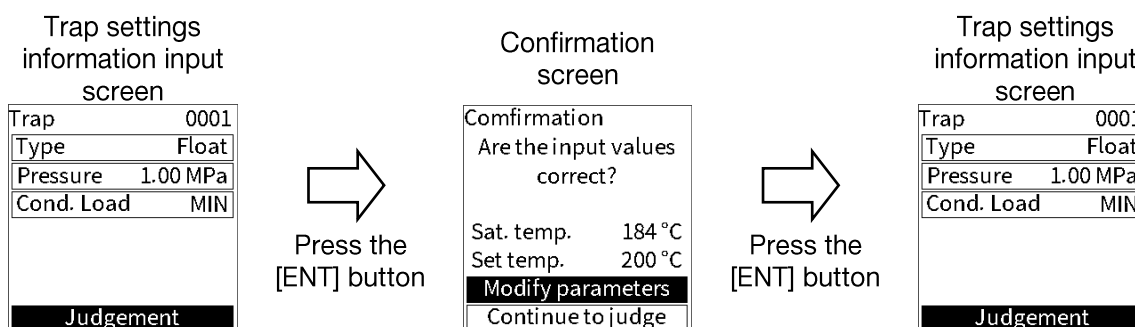
Note: If the set temperature is higher than the saturated temperature obtained from the previously entered pressure when selecting the temperature control type, a discrepancy confirmation screen is displayed. To change the set temperature or input pressure, select [Modify parameters] on the temperature control trap setting screen and press the [ENT] button to reset the setting.

When [Continue to judge] is selected, the judgement will be performed by using the current input value.



Note: For all trap types, if the measured temperature is higher than the saturated temperature

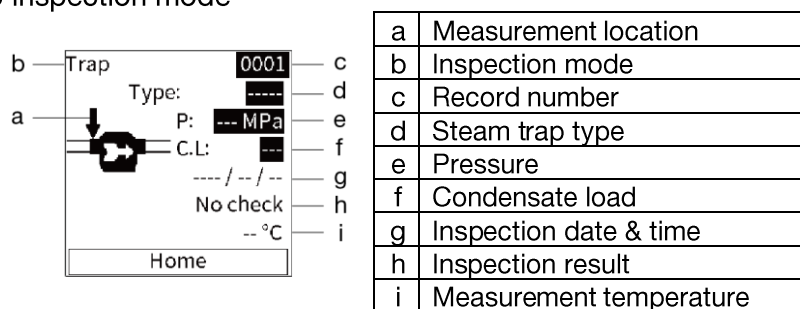
calculated from the previously calculated inlet pressure value input (for all trap types), a confirmation screen is displayed. To change the input pressure, select [Modify parameters], press the [ENT] button, and repeat 7.1.7, Entering the inlet pressure (for all trap types). When [Continue to judge] is selected, the judgement will be performed with the current input values.



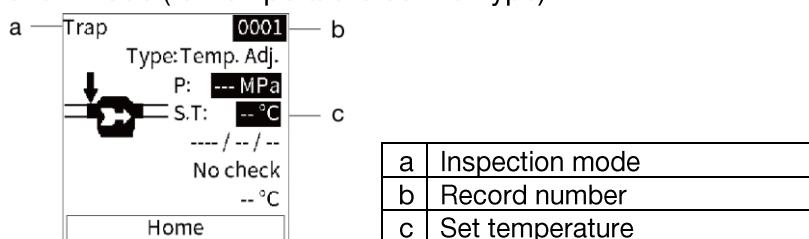
7.1.11 Inspection results

Inspection results are displayed and data is automatically saved.

Steam trap inspection mode



Trap inspection mode (for temperature control type)



Inspection results are as follows:

Good

The surface temperature is as expected, and there is no detected ultrasonic sound. The steam trap is likely to be in proper operational condition.

NOTE

The sound level is very low, so it is difficult to determine if the valve seals properly or if there is a very small leak. Continue to observe the valve closely.

Leak

A large amount of high-intensity ultrasonic sound is detected. There is a high possibility that the trap is leaking steam, and immediate repair or replacement is recommended.

Blocked

The surface temperature is less than 40 °C. The trap is most likely blocked making condensate discharge impossible. Immediate cleaning, repair or replacement is recommended.

Low temp. (for other than temperature control traps)

There is a high possibility that the surface temperature has dropped due to condensate

accumulation, inlet pressure drop, closed inlet valve, or blocked inlet piping.

Fail adj.-H (for temperature control traps)

The surface temperature is excessively high against the set temperature.

Fail adj.-L (for temperature control traps)

The surface temperature is excessively low against the set temperature.

- When taking measurement again

Press the sensor part on the trap inlet side to take a measurement again.

Note: If data is already recorded at the selected data number, taking a measurement will overwrite the data.

- Inspecting the next trap

Select the record number and press the left/right button to set the record number. After the record number is assigned, repeat procedures in 7.1.2 Set record number in 7.1 Steam trap inspection.

- Switching the inspection mode to the valve inspection mode

Pressing the up and down buttons simultaneously in the trap inspection mode switches the valve inspection mode in the same record number.

Follow the instructions under 7.2. Valves inspection.

Trap inspection mode screen

Trap	0001
Type:	----
P:	--- MPa
C.L:	---
	---/---/---
No check	-- °C
Home	



Press the up and down buttons simultaneously

Valve inspection mode screen

Valve	0001
	---/---/---
No check	-- °C
Measure valve outlet	
Home	

- Erasing data

Select [Home] and press the left/right buttons simultaneously to move to the data erase screen.

Note: Even the left/right buttons are pressed simultaneously while the record number is selected, the screen will not move on to the data erase screen.

Select [Erase data] and press the [ENT] button to return to the trap inspection mode screen and the data in the current record number will be erased.

Select [Cancel] and press the [ENT] button to return to the trap inspection mode screen without erasing the data in the current record number.

Steam trap inspection

Trap	0001
Type	Float
Pressure	1.00 MPa
Cond. Load	MIN
Judgement	



Directional buttons

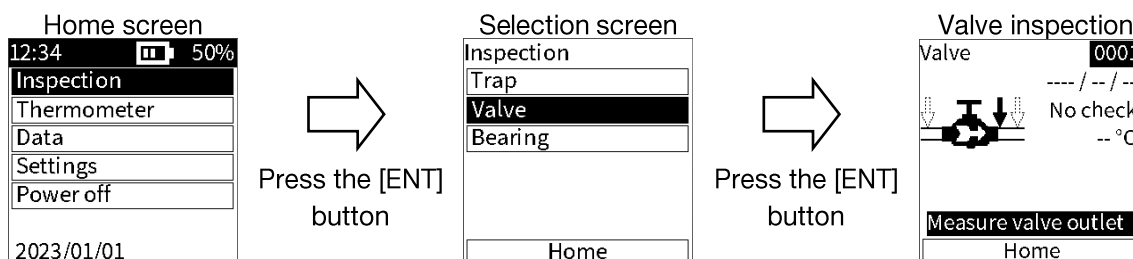
Data erase screen

Trap	0001
Type	Float
Inlet p.	1.00 MPa
Insp. date	2023/01/01
Result	Good
Temperature	180 °C
Erase data	
Cancel	

7.2 Valve inspection

The PT3 is equipped with a simple automatic diagnosis function for valves installed on steam or air piping. This section explains how to operate the device for valve inspections properly.

7.2.1 Setting the valve inspection mode

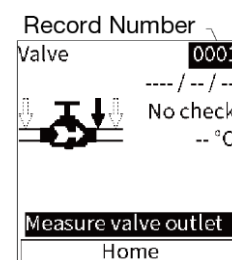


1. Select [Inspection] on the home screen and press the [ENT] button.
2. Select [Valve] on the selection screen and press the [ENT] button.

7.2.2 Setting the record number

Select the record number and use the left/right button to set the memory number.

Note: The record number cannot be changed after the measurement is taken. Set the record number in the same procedures as for the trap inspection. (Refer to 7.1.2 Set record number.)

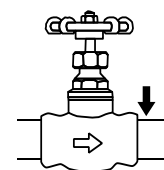


7.2.3 Measurement location

To check for internal valve seat leaks when the valve is closed, make sure the valve is completely closed. If a valve is open, it should only be closed when it is safe to close it for inspection.

A maximum of three measurements are required for valve inspection. First, the piping nearest the valve outlet (hereafter referred to as the valve outlet) is measured.

Note: The piping nearest the outlet should be about 3 cm in length. Do not press the probe against the threaded portion of the pipe as accurate measurement may not be possible. Measurement begins automatically once the probe is pressed against the measurement location.

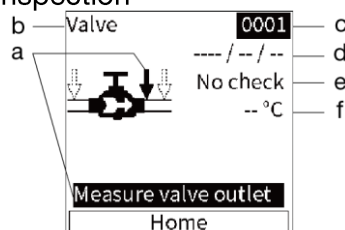


7.2.4 Display during and after measurement

For valves, it takes 10 seconds after placing the probe against the measurement surface for the measurement to be complete.

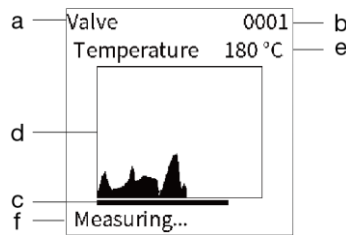
Hold the probe perpendicularly and steady for this entire period.

1. "Valve" displayed on the top left on the screen indicates it is in the valve inspection mode.
2. Valve inspection



a	Measurement location
b	Inspection mode
c	Record number
d	Inspection date & time
e	Inspection result
f	Measurement temperature

3. Display during measurement



a) **Inspection mode**

Displays the current inspection mode.

b) **Record number**

Displays the record number.

Data from the measurement in progress is automatically saved in the record number.

c) **Progress bar**

Indicates the progress of the current measurement. When the bar reaches the end of the graph, measurement is complete.

d) **Ultrasonic waveform graph**

Displays the ultrasonic waveform of the measurement in progress.

e) **Measurement temperature**

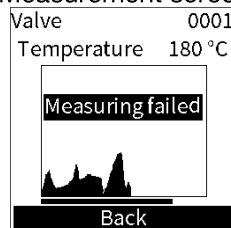
The surface temperature of the measured valve is displayed.

f) **Comments**

The current status is displayed.

4. The LED indicator lights green during measurement and turns off when measurement is completed.
5. If the sensor moves away from the measurement surface or is extremely tilted, a measurement error is displayed, and the LED will blink red. In this case, perform the measurement again. To return to the Valve inspection mode screen, select [CANCEL] and press the [ENT] button.
6. If an ultrasonic waveform could not be detected after measurement is complete, further measurements will not be performed and the judgement result of “Good” is displayed.

Measurement screen



7.2.5 Measuring valve upstream

If an ultrasonic waveform is detected after a measurement, an instruction to measure downstream of the valve is displayed. After the upstream measurement, a third measurement is required about 50 cm (2 ft) downstream of the valve. After the upstream measurement, a measurement instruction for the valve downstream is displayed.

7.2.6 Measuring valve downstream

After the upstream measurement, a third measurement is required about 50 cm (2 ft) downstream of the valve. After measurement is complete, the TM displays the inspection results automatically.

7.2.7 Inspection Results

Inspections results are as follows.

Good

No ultrasonic sound originating from the valve was detected. The valve seems to seal properly without leakage.

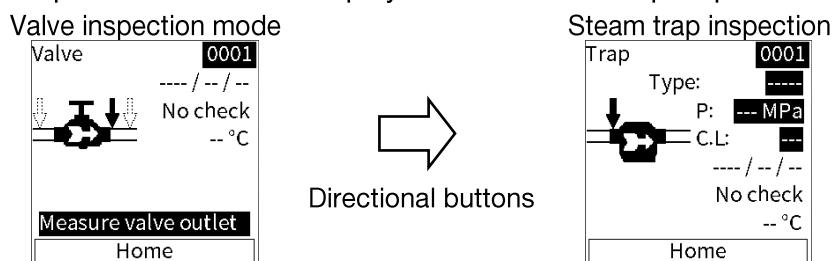
Caution

The sound level is very low, so it is difficult to determine if the valve seals properly or if there is a very small leak. Continue to observe the valve closely.

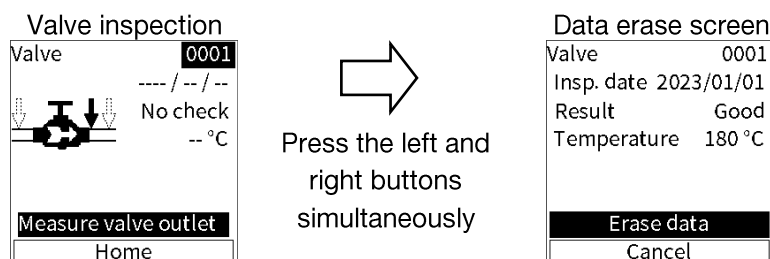
Leak

A large amount of high-intensity ultrasonic sound is detected. There is a high possibility that the trap is leaking steam, and immediate repair or replacement is recommended.

- Repeat inspection
Repeat sections 7.2.3. to 7.2.6.
Note: If data is already recorded at the selected data number, taking a measurement will overwrite the data.
- When the valve was closed for the inspection
Open the valve again.
- Inspecting the next valve
Select the record number and use the left/right button to set the memory number.
For subsequent operations, repeat 7.2.2. to 7.2.6.
- Steam trap inspection
Pressing the up and down buttons simultaneously in valve inspection mode switches to the trap inspection mode. The display switches to the trap inspection mode screen.



- Erasing data
 1. Select [Home] and press the left and right buttons simultaneously to move to the data erase screen.
Note: Even the left and right buttons are pressed simultaneously while the record number is selected, the screen will not move on to the data erase screen.
 2. Select [Erase data] and press the [ENT] button, the data saved in the current record number will be erased and returns to the valve inspection mode screen.
Select [Cancel] and press the [ENT] button to return to the valve inspection mode screen without erasing the data of the current record number.



7.3 Bearing deterioration inspection

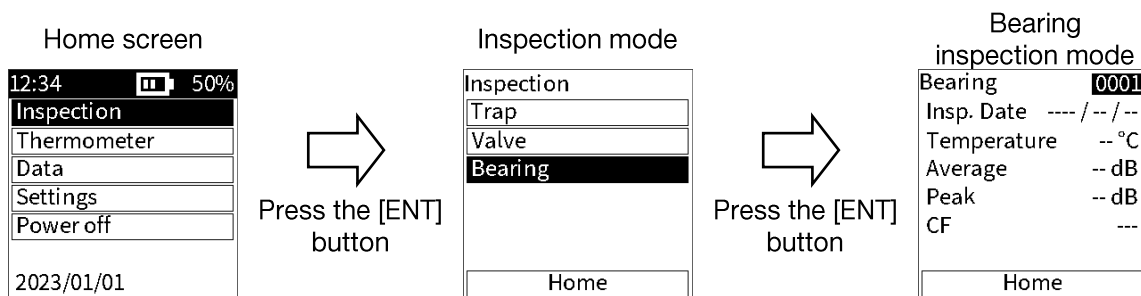
This chapter describes the features of PT3, and how to operate and measure the device when inspecting bearings.

7.3.1 Bearing deterioration inspection

PT3 has functions specific to the bearing inspection mode.

1. The PT3 can measure and display vibration acceleration levels (dB).
The crest factor can be also calculated automatically and displayed.
For the use of CF value, refer to 7.3.5. Display during and after measurements.
Surface temperature is displayed simultaneously.
2. The average values of up to 9 sets of inspection data can be saved for each record number.
Refer to 7.3.6 Inspection results for operations.
3. One of two different calculation methods can be selected. Refer to 6.6.7 Calculating displayed value (for bearing inspections mode) for settings.
4. The progress of measurement can be checked by setting the LED flashing condition.
Refer to 6.6.8 LED flashing conditions (for bearing inspection mode) for settings.

7.3.2 Setting the bearing inspection mode



1. Select [Inspection] on the home screen and press the [ENT] button.
2. Select [Bearing] in the inspection mode selection screen and press the [ENT] button.

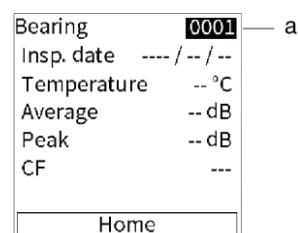
7.3.3 Setting a record number

Use the left/right button to set the record number (a).

Note: The record number cannot be changed after the measurement is taken.

Pressing left/right button once increments/decrements the record number by one.

1. Holding left/right button for more than one second increments/decrements record numbers rapidly.
2. If any data is recorded at the selected record number, the details is displayed.
3. Record numbers from 0001 to 3000 are available.



7.3.4 Measurement location

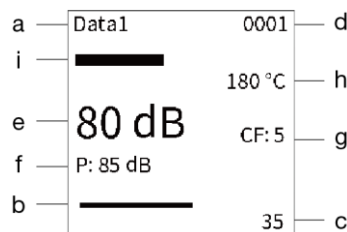
When determining the measurement position, the housing should be as close to the bearing as possible since the bearing itself cannot be measured.

Note: Avoid taking measurements at dangerous locations or from places that require dangerous body positioning.

One bearing can be inspected by trend control through measurement at one location. Measurement begin automatically once the probe is pressed against the measurement location.

7.3.5 Display during and after measurement

- Display during measurement



a) **Data number**

Displays the current data No.

b) **Progress bar**

Indicates the progress of the current measurement. When the bar reaches the end of the graph, measurement is complete.

c) **Timer**

The cumulative number of measurements made to-date.

d) **Record number**

Displays record number that is currently assigned (to a result).

e) **Average value**

The cumulative of measurements made to-date.

f) **Peak value**

The cumulative of measurements made to-date.

g) **CF value**

The cumulative of measurements made to-date.

CF is the ratio of the peak value to the average value; a large CF value indicates possible damage due to scratches, while a small CF value indicates possible lubrication failure.

h) **Surface temperature**

Displays surface temperature.

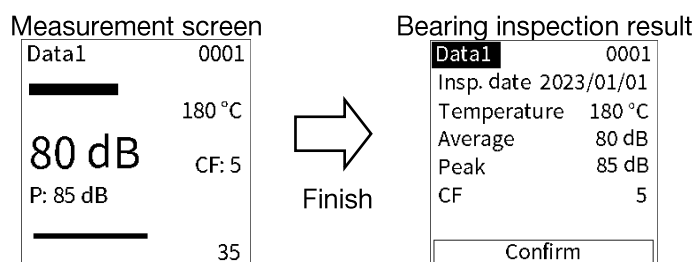
i) **Vibration level indicator**

The measured values are displayed in a bar graph.

- When the measured surface temperature and the acceleration level are higher than their respective measurable ranges, "OVER" is displayed. If they are lower than their respective measurable ranges, "UNDER" is displayed.
- The maximum measurement time for bearing inspection is one minute. Finish automatically once the probe is applied to the measurement location.

7.3.6 Inspection Results

After measurement is complete, the bearing inspection result screen is displayed automatically.



(1) Remeasurement

Press the probe against the measurement surface without changing the data no.
Repeat procedures in 7.3.5. Display during and after measurement.

(2) When measurements are taken multiple times

1. Press the directional buttons (left/right) to set the data number.
2. The data number is a single digit number from 1 to 9.
If any data is recorded at the selected record number, detailed information is displayed.

Note: If data is already recorded at the selected record number, the data will be overwritten by taking a measurement.

3. Once the data number is selected, press the probe against the measurement location.
4. When multiple measurements (with multiple data numbers) are taken, the average value will be saved as results.

(3) Saving measurement results

To save the result, select [Confirm] and press the [ENT] button.

When multiple measurements (with multiple data numbers) are taken, only the average value will be saved.

(4) Inspecting the next bearing

Repeat steps from 7.3.3. Setting a record number.

(5) Erasing data

1. Select [Home] and press the left/right buttons simultaneously to move to the data erase screen.

Note: Even if the left/right buttons are pressed simultaneously while the record number is selected, the screen will not move on to the data erase screen.

2. Select "Erase data" and press the [ENT] button, data in the current record number will be erased and returns to the bearing inspection mode screen.

Select [Cancel] and press the [ENT] button to return to the bearing inspection mode screen without erasing the data in the current record number.

Bearing inspection mode

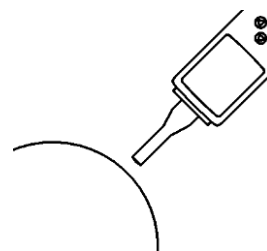
Bearing	0001
Insp. date	--- / -- / --
Temperature	-- °C
Average	-- dB
Peak	-- dB
CF	---
Home	



Press left and right
buttons simultaneously

Erase data screen

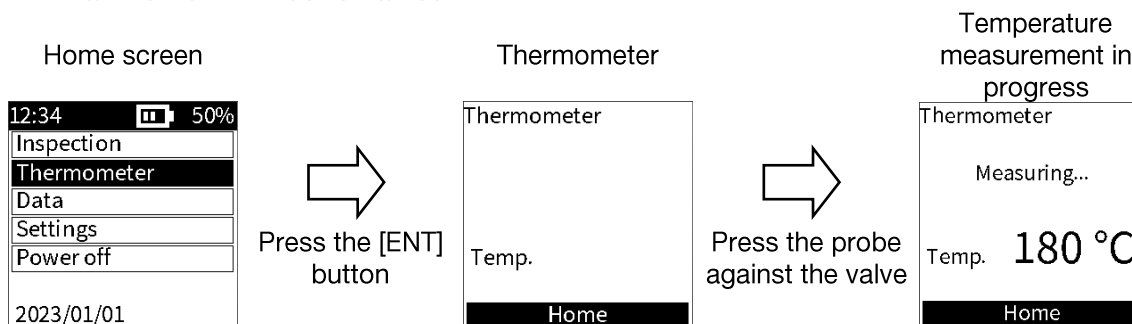
Bearing	0001
Insp. date	2023/01/01
Temperature	180 °C
Average	80 dB
Peak	85 dB
CF	5
Erase data	
Cancel	



8. Thermometer (temperature measurement)

This function measures the surface temperature of the steam trap.

1. Select the [Thermometer] icon on the home screen and press the [ENT] button.
2. The measurement of the surface temperature will begin once the probe is placed on the measurement surface while the temperature measurement screen is displayed.
3. When the probe is moved away from the measuring location, the measured value at that moment will be remained.



4. Press the [ENT] button to return to the home screen.

9. Browsing data

Search and display data stored on the device.

1. Select [Data] on the home screen and press the [ENT] button.
2. Select the item you wish to view on the data menu screen.

Home screen

12:34	50%
Inspection	
Thermometer	
Data	
Settings	
Power off	
2023/01/01	



Press the [ENT] button

Data menu screen

Data	
Trap	
Valve	
Bearing	
Home	

3. Select [Trap] and press the [ENT] button to view the stored trap inspection data. Select the record number and use the left/right button to change the record number. Record number that has no inspection data stored will be skipped.
4. If the data does not exist, "No data" is displayed on the screen.

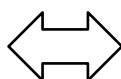
No data

Trap	0001
No data	
Back	

5. Press the up and down buttons simultaneously to review the valve inspection data saved in the same record number. If valve inspection data with the applicable record number does not exist, "No data" is displayed on the screen.

Trap data 1 Screen 1

Trap	0001
Type	Float
Inlet p.	1.00 MPa
Cond. load	Other
Insp. date	2023/01/01
Result	Good
Temperature	180 °C
Back	



Press the up and down buttons simultaneously

Valve data 1 Screen

Valve	0001
Insp. date	2023/01/01
Result	Good
Temperature	180 °C
Back	

6. When the inspection data exists, select [Back] and press the left/right buttons simultaneously to move to the data erase screen.
Note: Even the left/right buttons are pressed simultaneously while the record number is selected, the screen will not move on to the data erase screen.
Select [Erase data] and press the [ENT] button to erase the inspection data for the current record number.

To return to the home screen, select [Cancel] and press the [ENT] button.

Trap data screen

Trap	0001
Type	Float
Inlet p.	1.00 MPa
Cond. load	Other
Insp. date	2023/01/01
Result	Good
Temperature	180 °C
Back	



Press the left and right buttons simultaneously

Erase data screen

Trap	0001
Type	Float
Inlet p.	1.00 MPa
Insp. date	2023/01/01
Result	Good
Temperature	180 °C
Erase data	
Cancel	

7. Data can be browsed in the same way for [Valve] or [Bearing] inspection modes.
Note: In bearing data browsing mode, even when pressing the up and down buttons simultaneously, there will be no screen transition.
8. Select [Back] and press the [ENT] button to return to the data menu screen.

10. Troubleshooting

10.1 Error codes

E0000, E0001, E0002, E0003, E0006

Symptom: A program error has occurred.

Action: Press the [ENT] button to cancel the error and return to the home screen. If the measurement was performed immediately before the error code was displayed, perform the measurement again.

F0004, F0005

Symptom: A program error has occurred.

Action: If the error is displayed on the screen, contact TLV.

E0007

Symptom: A battery abnormality has occurred.

Action: The device will be turned off 10 seconds after the error code is displayed on the screen. If the error is not resolved, contact TLV. When a device is used outside the allowable range of the ambient temperature, wait for a while.

E0008

Symptom: The device temperature is out of the allowable range.

Action: Press the [ENT] button to cancel the error and turn off the device. Make sure to use the device within the ambient temperature range of -10 to 50 °C.

E0009

Symptom: The battery temperature during charging is out of acceptable range.

Action: After an error message is displayed, charging stops automatically. Remove the USB cable, wait for a little while and then charge within the ambient temperature range of 0 to 40 °C.

F0010

Symptom: The temperature sensor is disconnected.

Action: If the error is not resolved even after the device is rebooted, contact TLV.

E0013

Symptom: A battery control error has occurred.

Action: The device will be turned off 10 seconds after the error code is displayed on the screen. Insert or remove the battery pack in non-hazardous areas. If the error is not resolved even after the device is rebooted, contact TLV.

E0014

Symptom: Bluetooth communication error has occurred.

Action: The device automatically restarts 10 seconds after the error code is displayed on the screen. If the error is not resolved, contact TLV.

F0015, E0019, F0021

Symptom: A memory error has occurred.

Action: If the error is not resolved, contact TLV.

E0016

Symptom: A memory error has occurred.

Action: Press the [ENT] button and the device will be turned off. Insert or remove the battery pack in non-hazardous areas. If the error is not resolved even after the device is rebooted, contact TLV.

E0018

Symptom: An error has occurred during battery charging.

Action: When the USB cable is unplugged, an error is displayed, and the display reverts to the home screen. Please check the USB cable.

E0022

Symptom: The battery voltage is low.

Action: Use the cable included with the device and change the charging source. The device will restart when the battery is charged to its minimum level.

E0022_USB

Symptom: The battery voltage is low.

Action: The device will restart when the battery is charged to its minimum level.

Other

Action: If the error is not resolved even after the device is rebooted, contact TLV.

10.2 Causes and corrective measures

Cause	Remedy
The display is blank, even if the [ENT] key is pressed	Charge the battery. When the problem is not resolved after the battery is charged, replace with a new battery.
After pressing and holding the [ENT] button, there is a delay before the device goes on	This is normal. Press and hold the [ENT] button for three 3 seconds to display the start screen.
The temperature displayed is abnormal	<ul style="list-style-type: none"> The probe may not be correctly placed against the measurement location. Hold the device so that the probe is perpendicular to the measurement surface. Foreign matter may be adhered to the probe. Remove any foreign matter from the tip of the probe. Be careful not to damage or deform the sensor. Continuing measurement under conditions that exceed maximum allowable surface temperature (350 °C, 662 °F) could result in temperature sensor damage. If deformation or damage is confirmed in the sensor unit, repairs will be necessary. Contact TLV.
Measurements do not begin automatically even when the probe is placed against the measurement location	Foreign matter may be adhered to the tip of the probe. Remove any foreign matter from the tip of the probe. Be careful not to damage or deform the sensor.
Nothing can be heard from the earphones	<ul style="list-style-type: none"> The Bluetooth function may be disabled. Enable the Bluetooth function in settings. The earphones may not be connected to the device. Try connecting the earphones again. The earphones volume may be low. Please adjust the volume with your earphones. There is no output from the earphones in bearing inspection mode.
Despite having the automatic power off function enabled, power does not turn off even when left unattended for the set period of time. (The LED does not go out.)	<ul style="list-style-type: none"> The automatic power-off function does not operate while the battery is being charged. The device may have frozen. When nothing appears on the screen by pressing buttons, force shut down the device and restart.
Incorrect remaining battery level display	The remaining battery amount is correctly displayed after a learning period. Note that approximately 3 or 4 charges are necessary for the device to learn after delivery or battery removal.
The screen is frozen and the device cannot be operated	Press and hold the up and down buttons simultaneously for seven seconds to force restart.
The device does not start even when the USB is plugged in	<p>Power may not be supplied to the USB. Make sure that power is being supplied.</p> <p>If power is being supplied, there is a possibility that the USB maybe damaged. Try with a different USB.</p>

If the problems listed above are not resolved after attempting the respective remedy, contact TLV with detailed information.

11. Specifications

Product Name Pocket TrapMan

Model PT3

Measurement

Items Measured: Ultrasonic sound/vibration acceleration level (shock pulse: 32 kHz), surface temperature

Temperature measurement

Allowable measurement temperature range: -40 to 350 °C

Response: 97% within 15 seconds (ideal conditions)

Measurement accuracy: $\pm 3\%$ of RD (after one minute/ideal conditions)

Trap measurement

Maximum primary pressure: 0.0 to 8.0 MPa

Maximum condensate flow rate: 0 to 3000 kg/h

Valve measurement

Applicable fluids: Steam, air

Automatic judgement

Steam traps: Good/Caution/Leak/Blocked/Low temp./Fail Ajd-H/Fail Ajd-L

Valves: Good/Caution/Leak

Power source

Battery: Secondary lithium-ion battery pack

Suitable battery type: SEnergy Corporation: model P11-22050

Continuous operation time: Approx. 24 hours (with no front light on), approx. 16 hours (with front light on)

Charging time: Approximately 2.5 hours

Allowable temperature range

When in use or stored: -10 to 50 °C

Note: When device is not used, make sure to charge the battery every month.

When charging: 0 to 40 °C

Appearance

Dimensions: 150 mm (L) × 40 mm (W) × 30 mm (T)

Weight: Approximately 310 g

12. Calibration

Pocket TrapMan PT3's temperature and ultrasound sensor is a crucial component of the device. The probe sensitivity deteriorates over time, not only if the unit is dropped or knocked, but also as a result of regular wear and use. Therefore, periodic calibration is required.

- Calibration should be performed every two years or when deformation or damage is observed at the tip of the sensor.
- The device will be calibrated using special adjustment equipment at TLV. Contact TLV for details.

13. TLV EXPRESS LIMITED WARRANTY

Subject to the limitations set forth below, TLV CO., LTD., a Japanese corporation ("**TLV**"), warrants that products which are sold by it, TLV International Inc. ("**TII**") or one of its group companies excluding TLV Corporation (a corporation of the United States of America), (hereinafter the "**Products**") are designed and manufactured by TLV, conform to the specifications published by TLV for the corresponding part numbers (the "**Specifications**") and are free from defective workmanship and materials. The party from whom the Products were purchased shall be known hereinafter as the "**Seller**". With regard to products or components manufactured by unrelated third parties (the "**Components**"), TLV provides no warranty other than the warranty from the third party manufacturer(s), if any.

Exceptions to Warranty

This warranty does not cover defects or failures caused by:

1. improper shipping, installation, use, handling, etc., by persons other than TLV, TII or TLV group company personnel, or service representatives authorized by TLV; or
2. dirt, scale or rust, etc.; or
3. improper disassembly and reassembly, or inadequate inspection and maintenance by persons other than TLV or TLV group company personnel, or service representatives authorized by TLV; or
4. disasters or forces of nature or Acts of God; or
5. abuse, abnormal use, accidents or any other cause beyond the control of TLV, TII or TLV group companies; or
6. improper storage, maintenance or repair; or
7. operation of the Products not in accordance with instructions issued with the Products or with accepted industry practices; or
8. use for a purpose or in a manner for which the Products were not intended; or
9. use of the Products in a manner inconsistent with the Specifications; or
10. use of the Products with Hazardous Fluids (fluids other than steam, air, water, nitrogen, carbon dioxide and inert gases (helium, neon, argon, krypton, xenon and radon)); or
11. failure to follow the instructions contained in the TLV Instruction Manual for the Product.

Duration of Warranty

This warranty is effective for a period of one (1) year after delivery of Products to the first end user. Notwithstanding the foregoing, asserting a claim under this warranty must be brought within three (3) years after the date of delivery to the initial buyer if not sold initially to the first end user.

ANY IMPLIED WARRANTIES NOT NEGATED HEREBY WHICH MAY ARISE BY OPERATION OF LAW, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND ANY EXPRESS WARRANTIES NOT NEGATED HEREBY, ARE GIVEN SOLELY TO THE INITIAL BUYER AND ARE LIMITED IN DURATION TO ONE (1) YEAR FROM THE DATE OF SHIPMENT BY THE SELLER.

Exclusive Remedy

THE EXCLUSIVE REMEDY UNDER THIS WARRANTY, UNDER ANY EXPRESS WARRANTY OR UNDER ANY IMPLIED WARRANTIES NOT NEGATED HEREBY (INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE), IS **REPLACEMENT**; PROVIDED: (a) THE CLAIMED DEFECT IS REPORTED TO THE SELLER IN WRITING WITHIN THE WARRANTY PERIOD, INCLUDING A DETAILED WRITTEN DESCRIPTION OF THE CLAIMED DEFECT AND HOW AND WHEN THE CLAIMED DEFECTIVE PRODUCT WAS USED; AND (b) THE

CLAIMED DEFECTIVE PRODUCT AND A COPY OF THE PURCHASE INVOICE IS RETURNED TO THE SELLER, FREIGHT AND TRANSPORTATION COSTS PREPAID, UNDER A RETURN MATERIAL AUTHORIZATION AND TRACKING NUMBER ISSUED BY THE SELLER. ALL LABOR COSTS, SHIPPING COSTS, AND TRANSPORTATION COSTS ASSOCIATED WITH THE RETURN OR REPLACEMENT OF THE CLAIMED DEFECTIVE PRODUCT ARE SOLELY THE RESPONSIBILITY OF BUYER OR THE FIRST END USER. THE SELLER RESERVES THE RIGHT TO INSPECT ON THE FIRST END USER'S SITE ANY PRODUCTS CLAIMED TO BE DEFECTIVE BEFORE ISSUING A RETURN MATERIAL AUTHORIZATION. SHOULD SUCH INSPECTION REVEAL, IN THE SELLER'S REASONABLE DISCRETION, THAT THE CLAIMED DEFECT IS NOT COVERED BY THIS WARRANTY, THE PARTY ASSERTING THIS WARRANTY SHALL PAY THE SELLER FOR THE TIME AND EXPENSES RELATED TO SUCH ON-SITE INSPECTION.

Exclusion of Consequential and Incidental Damages

IT IS SPECIFICALLY ACKNOWLEDGED THAT THIS WARRANTY, ANY OTHER EXPRESS WARRANTY NOT NEGATED HEREBY, AND ANY IMPLIED WARRANTY NOT NEGATED HEREBY, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, DO NOT COVER, AND NEITHER TLV, TII NOR ITS TLV GROUP COMPANIES WILL IN ANY EVENT BE LIABLE FOR, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO LOST PROFITS, THE COST OF DISASSEMBLY AND SHIPMENT OF THE DEFECTIVE PRODUCT, INJURY TO OTHER PROPERTY, DAMAGE TO BUYER'S OR THE FIRST END USER'S PRODUCT, DAMAGE TO BUYER'S OR THE FIRST END USER'S PROCESSES, LOSS OF USE, OR OTHER COMMERCIAL LOSSES. WHERE, DUE TO OPERATION OF LAW, CONSEQUENTIAL AND INCIDENTAL DAMAGES UNDER THIS WARRANTY, UNDER ANY OTHER EXPRESS WARRANTY NOT NEGATED HEREBY OR UNDER ANY IMPLIED WARRANTY NOT NEGATED HEREBY (INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE) CANNOT BE EXCLUDED, SUCH DAMAGES ARE EXPRESSLY LIMITED IN AMOUNT TO THE PURCHASE PRICE OF THE DEFECTIVE PRODUCT. THIS EXCLUSION OF CONSEQUENTIAL AND INCIDENTAL DAMAGES, AND THE PROVISION OF THIS WARRANTY LIMITING REMEDIES HEREUNDER TO REPLACEMENT, ARE INDEPENDENT PROVISIONS, AND ANY DETERMINATION THAT THE LIMITATION OF REMEDIES FAILS OF ITS ESSENTIAL PURPOSE OR ANY OTHER DETERMINATION THAT EITHER OF THE ABOVE REMEDIES IS UNENFORCEABLE, SHALL NOT BE CONSTRUED TO MAKE THE OTHER PROVISIONS UNENFORCEABLE.

Exclusion of Other Warranties

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY DISCLAIMED.

Severability

Any provision of this warranty which is invalid, prohibited or unenforceable in any jurisdiction shall, as to such jurisdiction, be ineffective to the extent of such invalidity, prohibition or unenforceability without invalidating the remaining provisions hereof, and any such invalidity, prohibition or unenforceability in any such jurisdiction shall not invalidate or render unenforceable such provision in any other jurisdiction.

14. Service

For Service or Technical Assistance: Contact your TLV representative or your TLV office.

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